

AniBalloons: Animated Chat Balloons as Affective Augmentation for Social Messaging and Chatbot Interaction

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Abstract

Despite being prominent and ubiquitous, message-based communication is limited in nonverbally conveying emotions. Besides emoticons or stickers, messaging users continue seeking richer options for affective communication. Recent research explored using chat-balloons' shape and color to communicate emotional states. However, little work explored whether and how chat-balloon animations could be designed to convey emotions. We present the design of AniBalloons, 30 chat-balloon animations conveying Joy, Anger, Sadness, Surprise, Fear, and Calmness. Using AniBalloons as a research means, we conducted three studies to assess the animations' affect recognizability and emotional properties ($N = 40$), and probe how animated chat-balloons would influence communication experience in typical scenarios including instant messaging ($N = 72$) and chatbot service ($N = 70$). Our exploration contributes a set of chat-balloon animations to complement nonverbal affective communication for a range of text-message interfaces, and empirical insights into how animated chat-balloons might mediate particular conversation experiences (e.g., perceived interpersonal closeness, or chatbot personality).

Keywords:

Emotion, Chat Balloon, Messaging, Chatbot, Animation

1. Introduction

Messages are one of the most prominent means of communication in today's society. It is estimated that Short Message Services (SMS) are being used by five billion people around the world². Message-based interaction has been evolving and adapting to multiple mobile and wearable devices, such as mobile phones, smartwatches, smart glasses, etc. The user population of mobile and wearable messaging apps had surpassed three billion³, with the majority from WhatsApp, Facebook Messenger, and WeChat, which also allow for cross-device communications. The growing usage of messages has been further propelled after the COVID period (Nguyen et al., 2021), revealing its importance in various use contexts, such as connecting distant friends

and family (Kluck et al., 2021), facilitating patient-doctor communication (Campbell et al., 2021), supporting telecommuting (Zhang et al., 2024), and enabling chatbot-supported businesses⁴.

Despite its ubiquity and prominence, text chats are by nature, rather limited in nonverbal aspects of communication, especially when it comes to nonverbally conveying affective information (Aoki et al., 2022; An et al., 2022). In face-to-face communication, people could discern rich and nuanced feelings from each other based on numerous nonverbal social signals, including facial expressions, vocal features, bodily motions, etc. (Vinciarelli et al., 2009). Most of these nonverbal aspects are sacrificed in message-based communication (Hancock et al., 2007), resulting in less sense of connectedness and presence (Nguyen et al., 2022), and increased likelihood of miscommunication of emotional states (Byron, 2008; Aoki et al., 2022). As suggested by Social Information Processing Theory originally de-

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²<https://www.vodafone.com/business/news-and-insights/blog/gigabit-thinking/the-evolution-of-the-text-message>

³<https://www.businessofapps.com/data/messaging-app-market>

⁴<https://www.uschamber.com/co/good-company/launch-pad/text-based-commerce-surges-during-pandemic>

veloped by Salancik and Pfeffer (1978) and later revisited by Walther (1992), Computer-Mediated Communication (CMC) may require more time to foster social relationships compared to face-to-face communication due to the limited channels and absence of non-verbal cues (Walther, 2015); therefore, the inclusion of non-verbal elements may enhance the richness and expressiveness of communication, benefiting the development of interpersonal relationships.

Similarly, according to Social Presence Theory (Short et al., 1976), social presense, or the “sense of being with another”, is crucial for affording warm and sociable interpersonal interactions. Different communication media offer varying levels of social presence, corresponding to their richness of social cues. For instance, face-to-face communication is considered the richest medium, followed by video conferencing, phone calls, and then text-based communication, which is less rich due to fewer social cues (Yen and Tu, 2008). As a compensation in practice, message senders commonly use pictographic elements such as emojis/emoticons, in parallel with messages, as an added nonverbal channel to express emotions (Walther and D’Addario, 2001). While emoticons predominantly represent facial expressions, there remain a lot more design opportunities for visually communicating emotions by integrating other forms of social signals (Vinciarelli et al., 2009). For instance, HCI research has explored depicting affects expressed in vocal features using typefaces (Choi and Aizawa, 2019) or animated texts (Wang et al., 2004a). Prior research also suggested the promise of incorporating vibrations (An et al., 2022) or bio-signals (Liu et al., 2017).

Beyond augmenting typeface or emoticons, recently, a few studies started exploring *chat balloons* as a novel medium for visually conveying emotions (Aoki et al., 2022; Chen et al., 2021a). Namely, Aoki et al. (2022) presented EmoBalloon which visualizes the emotional arousal of a message through the “explosion” shape of its encasing chat balloon generated by an ACGAN model. Chen et al. (2021a) explored utilizing colors of chat balloons to indicate affects of voice messages (e.g., excitement, anger, sadness and serenity). These two studies suggested a great potential for further probing and designing the affordance of chat balloons in affective communication.

However, to date, little has been known about whether and how chat balloon *animations* could be designed to convey intended emotions. This under-addressed opportunity has become the primary motivation of our design-driven research. In other design areas, animation has been long utilized for conveying

affective cues (Lasseter, 1987; de la Torre-Arenas and Cruz, 2017; Chevalier et al., 2016): for instance, enhancing audience’s affective resonance to data storytelling designs (Lan et al., 2022). Prior work in multi-modal emoticons found that simple animations could already be interpreted by users as dynamic affective cues such as body language, and such dynamic affective cues could add a new level of nuance in messages in addition to static affective cues (An et al., 2022). It is thereby suggested that exploring the animations of chat balloons may result in a unique and complementary affective channel for messages, and more design research is hence needed.

In this research, following a structured affective animation design process (introduced by Lan et al. (2022)), and a set of design requirements specifically formulated for chat balloons, we have designed AniBalloons. AniBalloons is a set of chat balloon animations that could communicate six types of emotions: Joy, Anger, Sadness, Surprise, Fear and Calmness. The first five are from the so-called basic emotions that commonly manifested and universally understood (Ekman, 1992b). Calmness is for users to express the state of being free from strong emotions. we analyzed 230 affective animation examples to extract design patterns for each emotion category, and iteratively designed five animations for each category.

We utilized AniBalloons as a means of inquiry to answer the following two research questions:

- **RQ1:** *How could chat balloon animations be designed to convey emotions?*
- **RQ2:** *How would people perceive the emotional properties of the chat balloon animations?*
- **RQ3:** *How might animated chat balloons influence user experience in message-based interaction?*

A formative, design-driven research (**Study 1**) was conducted with design professionals to address **RQ1**. To answer **RQ2**, **Study 2** assessed the affect recognizability of the designed animations, and their perceived emotional properties according to the valence-arousal emotion model ($N = 40$). To answer **RQ3**, we created high-fidelity design mockups to explore two typical yet distinct scenarios of message-based interaction: mobile messaging in **Study 3-a** ($N = 72$), and chatbot interaction in **Study 3-b** ($N = 70$). In both studies, we took a between-group setup to compare the relevant aspects of participants’ experience in a pre-scripted conversation under two conditions: one with animated chat balloons implemented for the message interface, and the other with only static chat balloons.

Our studies results showed that 80% of the designed animations were effective in communicating the intended emotions, and the animation designs together covered a variety of valence-arousal parameters, which suggested the great potential of chat-balloon animations in serving as a unique affective channel for messages. Moreover, we found that animated chat balloons could enhance perceived emotional communication quality, nonverbal information conveyance, and the sense of closeness in the context of mobile messaging. And they could also increase the chatbot’s likeability, make it funner to interact with, and affect its perceived personality trait. These findings indicated that animated chat balloons could be leveraged to mediate particular aspects of conversation experience in message-based interaction, which opens up a broad range of opportunities for future design and research.

Our contribution in this paper is thereby two-fold: (1) a set of chat balloon animations that could support nonverbal affective communication for a range of message-based interfaces; (2) empirical insights into how animated chat balloons would influence user experience in instant messaging and chatbot interaction.

2. Related Work

2.1. Affective Enhancement for Messages

Due to the inherent limitation of text messages in nonverbally conveying emotions, HCI systems have implemented different approaches to enhance the affective channels in text message-based communication. Emoticons, or emojis, have been the focus of the majority of research in this area. Emoticons have a long history of augmenting messages with affective information (Fahlman, Retrieved 2021; Brian, 2012). Studies have also set out to understand the emotional states of users based on their usage of emoticons in various contexts such as education (Zhang et al., 2017), software development (Chen et al., 2021b), and public discussions (Hagen et al., 2019). Studies have also revealed user-led creative use of emoticons emerging in real-world scenarios, such as repurposing emojis (Wiseman and Gould, 2018; Kelly and Watts, 2015) and replacing text with emojis (Zhou et al., 2017). Alongside HCI research, the industry has been continuously introducing new designs of emoticons (Burge, 2020; Facebook, 2021; Telegram, 2021) and new user customization capabilities (Apple, 2021; Google, 2021).

While emoticons have been the primary means of enhancing affective expression in text-based communication, other techniques have also been explored by

HCI research. Studies have examined the use of images such as static or animated memes as a medium for emotional communication. For example, Kim et al. (2020) proposed a system that recommends images to match the context of a message. Jiang et al. (2017) found that animated GIFs can trigger nuanced interpretations and enrich the nonverbal communication experience. DearBoard by Griggio et al. (2021) supported the co-customization of image stickers across messaging apps for nonverbal expressions between intimate partners. Beyond images, the visual features of texts, such as typefaces (Choi and Aizawa, 2019), or text animations, have also been explored (Ohene-Djan et al., 2007). Emotype (Choi and Aizawa, 2019) presented emotional typefaces that mean to match a selected emoticon, to enhance the message’s emotionality. Animated texts were also explored to convey nonverbal cues to television viewers with hearing impairment (Ohene-Djan et al., 2007). A recent work by Hautasaari et al. leveraged emotional text captions to enhance attendees’ communication experience of online conferencing Hautasaari et al. (2024). Wakey-Wakey (Xie et al., 2023) proposed an automatic framework that could transfer existing GIFs’ animation schemes to text. Liu et al. depicted heart rate data to enhance affective communication in social messaging (Liu et al., 2017), and they also developed Animo (Liu et al., 2019), a smartwatch-based animated agent that enables users’ affective connection. Similarly, Wang et al. (2004b) developed a generative technique to translate bio-signals into text animations. Buschek et al. (2018) utilized physiological data and contextual factors to customize fonts to augment chats.

In summary, various methods, such as emoticons, images, and visual elements of text, have been examined to enhance emotional communication for messages. While these elements can all be considered as part of the message’s “content”, less exploration has been done on the universal “container” of messages, which is the chat balloons, leaving ample opportunities for design and research.

2.2. Chat Balloon Related Affective Design

Chat balloons or text bubbles are common in text-based communication interfaces. Before digital media, speech balloons had played a crucial role in comics and manga, serving not only as carriers for speech, but also as emotional indicators (Aoki et al., 2022). Studies by Yamanishi et al. on manga have shown the connection between the type of speech balloon used and the linguistic properties of the speech, as well as the relationship

between the shape of the speech balloon and the emotional arousal level of the message (Yamanishi et al., 2017).

Built further upon, Aoki et al. (2022) presented the EmoBalloon system, which used explosion-shaped chat balloons to communicate arousal level of the message sender. These explosion shapes were generated by an Auxiliary Classifier GAN (ACGAN). The evaluation results of EmoBalloon suggested that the shape of the chat balloons could accurately convey emotional arousal in text messaging. Besides emotional states, speech balloon shapes were also used to indicate other nonverbal information (Peng et al., 2018; Kurlander et al., 1996). Chen et al. (2021a) explored using colors of voice message bubbles to represent senders' affects such as excitement, anger, or serenity: e.g., a red bubble to indicate an angry message, and an orange bubble to indicate a happy message.

Besides shape and color, the animation of chat balloons also seems to be a potential affective channel for text-based communication. However, there is limited research on how to design chat balloon animations to convey emotions. The only related exploration was from Shi et al. (2018), which used facial expressions, text box movements, and voice waveforms to convey different emotional states of a voice assistant (idle, bored, curious, etc.). However, it is unclear if the text box animations alone could convey the intended emotions or if they can be used across various message contexts. Our work aimed to address this gap by formally assessing the designed 30 affective animations in terms of affect recognizability and emotional properties and exploring their use in two distinct contexts. Overall, while prior studies show the potential of chat balloons to complement nonverbal affective cues for messages, the use of chat balloon animations as an affective medium remains under-explored and requires more design and research.

2.3. Affective Animation Design for HCI Systems

The use of animation to convey emotional aspects has a long history in animation theory (Thomas et al., 1995; Tieryas et al., 2017; Lasseter, 1987). In the field of User Interface design (Chevalier et al., 2016) and Data Visualization (de la Torre-Arenas and Cruz, 2017), animations are also used as a means of depicting and evoking emotional feelings. The additional temporal dimension of animations allows for the depiction of more nuanced or richer affective states that cannot be conveyed through static media. For example, Sonderegger et al. presented AniSAM and AniAvatar (Sonderegger et al., 2016), a set of animated feedback tools for measuring

affective states. The study found that animated forms led to higher accuracy than static forms in measuring participants' arousal, highlighting the value of animations as nonverbal representations of emotions. Animo by Liu et al. (2019) demonstrated how animations of simple geometries could depict the physiological data of smartwatch users and enhance their affective bonding. Another smartwatch application, Significant Otter (Liu et al., 2021) used diverse animations of two otters, influenced by shared biosignals, to express intimacy and affect between partners, despite its primary focus being on biosignal sharing rather than animation design.

HCI research has been continually exploring the design of animations or kinetic motions for GUI components. One of the most renowned works is Kineticons by Harrison et al. (2011). Kineticons proposed a large set of animation designs, or a "kineticon vocabulary", that could be applied to a wide range of GUI elements. Although Kineticons were not initially designed or assessed for affective communication, there are several motion designs that could be associated with emotional expression (e.g., "jump wave", "jump reach", "heart beat", or "shake no"). In the study of VibEmoji (An et al., 2022), a subset of Kineticons was used to create an animation library for multi-modal emoticons to enrich emotional communication in mobile messaging. Our research, inspired by Kineticons, aims to provide a collection of chat balloon animations that can support affective expression in a wide range of message-based interaction scenarios. Similarly, in the field of data visualization, Lan et al. recently presented Kineticharts (Lan et al., 2022), which designed a collection of animation effects for bar charts, pie charts, and line charts to enhance the affective expressiveness of data stories. Despite its focus on charts, Kineticharts demonstrates a structured way of designing affective animations that could potentially be applied to other design areas, such as chat balloons.

Research and design related to affective communication often rely on two main types of emotion theories: discrete emotion models and dimensional emotion models. Dimensional emotion models view emotional states as a continuous distribution over an emotional space, whereas discrete emotion models categorize emotions into distinct, generalized categories. For example, Russell and Barrett's valence-arousal model (Russell and Barrett, 1999) describes each emotional state in terms of its valence (positive or negative) and arousal (arousing or calm), whereas Ekman's work (1992b; 1992a) identifies basic emotions that are commonly experienced and universally understood across cultures. While previous affective designs have been assessed based on ei-

ther discrete (Lan et al., 2022; Chen et al., 2021a; Foo et al., 2021), or dimensional (Aoki et al., 2022; An et al., 2022) views of emotion, in this research, we evaluated our designed affective animations by assessing both affect category recognizability (discrete) and valence-arousal properties (dimensional) to have a comprehensive understanding of the affective affordance of the animated chat balloons.

3. Study 1: Creating AniBalloons through an Iterative Design-driven Research

In this section, adopting a Research-through-Design (RtD) approach (Zimmerman et al., 2007), we present our process and outcomes of addressing RQ1, including the formulation of design requirements, a structured, iterative design process, and finally, the 30 affective animations of AniBalloons (An et al., 2023).

3.1. Design Requirements

While affective animation design has been widely practiced in HCI sub-domains such as GUI (Chevalier et al., 2016) or Data Visualization (de la Torre-Arenas and Cruz, 2017; Lan et al., 2022), few studies have explored its practical implication for chat balloons. We thereby formulated the following design requirements to explicate the specificity of our design target and guide our design practice:

D1: The designed chat balloon animations could be applied on various message-based interfaces. This is to make sure the designed animation schemes could be easily implemented in practice, for instance, when integrated into an existing keyboard interface for users to select and combine with their message on the spot—as similar to Vibemoji (An et al., 2022) or DearBoard (Griggio et al., 2021). Hence, to make the animations compatible with various message interfaces and scenarios, the design should be based on a generic chat balloon shape (e.g., rounded rectangles), be compatible with different base colors, and be tested on different types of interfaces (e.g., mobile messaging and chatbot interaction).

D2: The chat balloon animations are able to be used together with emojis in a complementary way. Emojis and emoticons have been commonly added to messages to convey emotional cues through facial expressions. Our design aims to expand the emotional bandwidth for messages without replacing existing cues. Therefore, it is important that the created chat balloon animations and emojis can work together, completing instead of competing with each other. To achieve this, our design focuses on the motion patterns of chat balloons and

the dynamic effects of their abstract decoration, while avoiding any concrete facial features on the balloons, to ensure that the animations will enhance rather than simply repeat the emotional cues provided by emojis when used together.

D3: The designed chat balloon animations should not demand prolonged engagement from users. Our goal in designing chat balloon animations is to enhance the emotional expressiveness of messages without demanding users' prolonged engagement. To achieve this, we have kept the repetition cycle of each animation to under four seconds and used simple, abstract shapes in the animation sequences. This allows for a quick understanding of the animation's pattern, which allows for short engagement. Additionally, we have avoided the use of detailed graphic elements and confined each animation to its surrounding area to avoid being intrusive during a conversation. Additionally, we confined each animation to its surrounding area and avoided having "whole-screen" animations (e.g., screen effects in Apple iMessage) which might be distracting in a conversation.

D4: The chat balloon animations should not hinder users from reading the message. Chat balloon animations meant to convey emotional cues should not sacrifice the readability of the message. This consideration has guided many of our design choices. For example, in animations that feature fast motion, we have chosen to keep the message content static or moving at a slower pace and smaller range (as a design metaphor, we see the chat balloons as containers holding viscous liquid with the message content floating within). Additionally, in animations that include perspective distortion or transition effects, we have extended the interval duration between animation cycles to maintain appropriate readability.

3.2. Design Process

Our design process of AniBalloons consists of five stages by following the design requirements:

Identifying Initial Categories: To guide our design, we conducted a design inspiration analysis to identify common patterns used by animation designers to convey emotions. We used a structured workflow introduced in Kineticharts (Lan et al., 2022), which is meant to elicit affective animation patterns from design inspirations. The first step was to choose which emotions to design for, and we narrowed it down to the six "basic emotions" identified by Ekman in the 1970s: *joy, anger, fear, surprise, sadness, and disgust* (Ekman, 1992a). These emotions are universally recognized and commonly experienced in everyday life, regardless of cultural or language differences (Ekman,

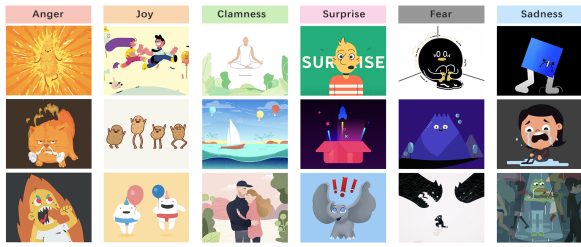


Figure 1: Samples of collected design inspirations.

1992a,b). These basic emotions are also widely referenced by HCI research, e.g., (Lan et al., 2022; Foo et al., 2021). Additionally, we included an extra category of emotional state, calmness, to give users the option to express feelings of being free from strong emotions.

Collecting Initial Inspirations: With the initial emotion categories formed, we began collecting design inspirations. We used a process similar to that outlined in Kineticharts (Lan et al., 2022) and first took an inclusive approach to build an archive of existing animation design examples. We searched popular design platforms such as Dribbble, Behance, and Pinterest, where animation designers post and exchange their motion graphic designs. Keywords (synonyms) related to the seven emotion categories were used. Animations deemed capable of effectively communicating the designated emotions were included. This process involved a review by two researchers; an animation was included if either researcher found it adequate. In the subsequent *Refining Inspirations* phase, a more selective approach was applied to further refine and filter the samples. Regarding the emotion of disgust, we found a significant lack of design references. Given our adopted affective design approach (Lan et al., 2022) primarily relies on extracting design patterns from rich examples, we chose to prioritize the six categories that seemed best suited for this approach, while leaving out disgust for future development. In total, we collected 336 motion graphic designs in the GIF or MOV format.

Refining Inspirations: An exclusive approach was then taken to refine the design inspirations for the finalized emotion categories: **joy**, **anger**, **fear**, **sadness**, **surprise**, and **calmness**. Two designers from our research team carried out this refinement for each category. Our design emphasized the role of motion and nonverbal dynamic effects in conveying emotions, as a complement to facial expression-based emojis (D2). Therefore, we excluded examples in which the emotion was mainly communicated by texts or static facial expressions, and the kinetic motions or dynamic effects

contributed little. Some typical examples included a word “JOY” with each letter animated but their motion did not evoke a sense of joy; or, a slowly moving angry-face emoji in which anger cannot be discerned from its movement. The two designers examined each category separately and marked designs potentially for exclusion, then discussed and reached final decisions for exclusion. In the end, 230 design examples remained after the refinement, including 52 inspirations for joy, 50 for anger, 39 for fear, 39 for sadness, 50 for surprise, and 38 for calmness. Examples of these design inspirations can be seen in Figure 1.

Analyzing Inspirations: An open coding method (Moghaddam, 2006) was adopted to extract affective animation design patterns from our collected inspirations. Following prior studies (Shi et al., 2021; Thompson et al., 2020) while guided by our design requirements, we coded the inspirations based on three aspects: (i) the main object’s motion; (ii) the decorative dynamic effects; and (iii) timing. We first annotated around 40% of the inspirations, from which the initial codes emerged. Then, each category was coded by two designers separately, and new codes could still be added during the process. The two designers then worked together to finalize the coding results and cluster the codes into design patterns in these three aspects. (i-iii). For example, in terms of the main object’s motion (i), we found that “trembling”, “huddling” and “jumping” were often used to animate a character’s fear. Decorative elements’ dynamic effects (ii), such as shaking dashed lines (or “yure-sen” in Japanese) or fluctuating silhouettes were often used to convey fear. Timing (iii) was especially helpful in distinguishing subtle differences in motion designs. For example, “jumping” was a common motion for expressing both joy and fear but joyous jumping often repeated multiple times and had longer “slow-in”, while fearful jumping often happened only once and rather suddenly. These extracted patterns helped us to effectively characterize how the emotions can be depicted by design elements.

Iterative Design and Expert Involvement: Using the extracted design patterns, three designers from the research team designed chat balloon animations for the six emotion categories iteratively. They first carried out divergent design experimentation on whether or how the animation patterns (e.g., main character/object’s kinetic motion and decorative dynamic effects) could be translated into motions of a “generic” chat balloon in a rounded rectangular shape (D1). They found that sometimes a single pattern was enough to convey the desired emotion, while other times a combination of patterns was needed. The outcomes included designs inspired

by both single patterns and pattern combinations, deliberately balancing expressiveness with unobtrusiveness, to avoid demanding prolonged engagement (D3).

After generating a variety of design ideas in the divergent stage, a convergent approach was taken. The design team selected a set of promising design samples that effectively conveyed the intended emotions, while also representing a diversity of design patterns. In this stage, the team paid more attention to the patterns of timing to fine-tune the temporal features of each design sample and optimize its emotional communicability.

To further develop the designs, we carried out three expert review sessions with three professional animation designers. We chose two from technology companies in North America and one running her own animation design agency in Asia. All experts were women and had more than five years of industry experience. The sessions were conducted via video call, where we introduced the background of our project and presented the design samples category by category. The experts were encouraged to freely provide feedback at any time, either after seeing a single sample or the whole category. All experts were interested in the concept of using chat balloon animations to convey emotions and offered valuable feedback.

The experts' suggestions for improving the designs covered a wide range of aspects, such as the metaphor of motion (e.g., animating the body language of "arms" and "legs" via the corners of the balloon), specific choices for the decorative dynamic effects (e.g., conveying anger via spitting "fire" instead of "steam"), and the fine-tuning of temporal patterns (e.g., adjusting the speed of "shaking" to more vividly express fear). Moreover, the experts also helped with optimizing the readability of the textual message for each animation design, discarding a few design ideas that employed graphical effects in the background of the textual message (D4). As a result, six to seven selected design samples in each category were further detailed and polished. The team then conducted another round of divergence-convergence design iteration, creating variations of the designs based on the expert's suggestions, comparing and selecting the most effective designs for further fine-tuning. Finally, five representative animations for each emotion category were carefully polished to create the final design collection.

3.3. AniBalloons

As illustrated in [Figure 2](#) (also see the demo video [ClickHere](#)), the final designs of AniBalloons consist of 30 unique animations. It is important to note that the names given to the designs are solely for referencing

purposes in this paper and do not limit the potential use contexts of each animation. The following is a brief overview of the AniBalloons designs for each emotion category:

Anger. The five animations in this category are *Fire-spitting*, *Erupting*, *Clenching*, *Shouting*, and *Exploding*. We found that a common animation pattern for expressing anger is squeezing a certain part of the body with tension (e.g. shrinking shoulders, tucking chin, or balling hands into fists). Both *Fire-spitting* and *Clenching* use this pattern and include dynamic effects such as spitting fire or displaying "cross-popping veins." *Erupting* uses the motion of expanding the body (e.g., puffing out chest), along with a volcano eruption effect. *Shouting* features the motion of angry shouting and mumbling, paired with the effect of shark teeth biting. In *Exploding*, the chat balloon expands and then "explodes."

Calmness. This category includes *Rippling*, *Breathing*, *Bubbling*, *Drifting*, and *Floating*. The motion patterns for calmness often involve metaphors related to water, air, and the state of being floating or weightless. For example, *Rippling* was inspired by the motion of gentle waves. Similarly, *Drifting* depicts the motion of floating on water. *Bubbling* gives the impression of bubbles in soda or other carbonated drinks. *Breathing* combines the metaphor of a cloud with the motion of slow deep breathing. *Floating* illustrates the motion of (a meditating character) floating in the air and moving slightly and slowly up and down.

Fear. This category includes *Quivering*, *Shuddering*, *Shaking*, *Huddling*, and *Recoiling*. Different types of "trembling" motions were predominantly seen in the inspirations. However, through detailed analysis, subtle variations were identified and incorporated into the designs. For example, *Quivering* is solely based on a trembling motion, while *Shuddering* and *Shaking* also integrate dynamic effects such as "fluctuating silhouette" and "shaking dashed lines" respectively. *Huddling* combines trembling with body shrinking, a common pattern in fear-evoking animations. Lastly, *Recoiling* combines a sudden jump with trembling, similar to the "jump scare" moment commonly seen in inspirations.

Joy. The five animations are *Celebrating*, *Cheering*, *Shining*, *Hailing*, and *Swinging*. *Celebrating* features the motion of stretching both arms upward and incorporates a firework effect. *Cheering* and *Hailing* both employ the typical joyous motion of jumping repetitively, with the confetti effect added in *Cheering* and a different motion pace in *Hailing*. *Shining* uses the motion of stretching one side of the body and arm alternately, accompanied by a star-shining effect. Lastly, *Swinging* shows the motion of jumping and swinging left and

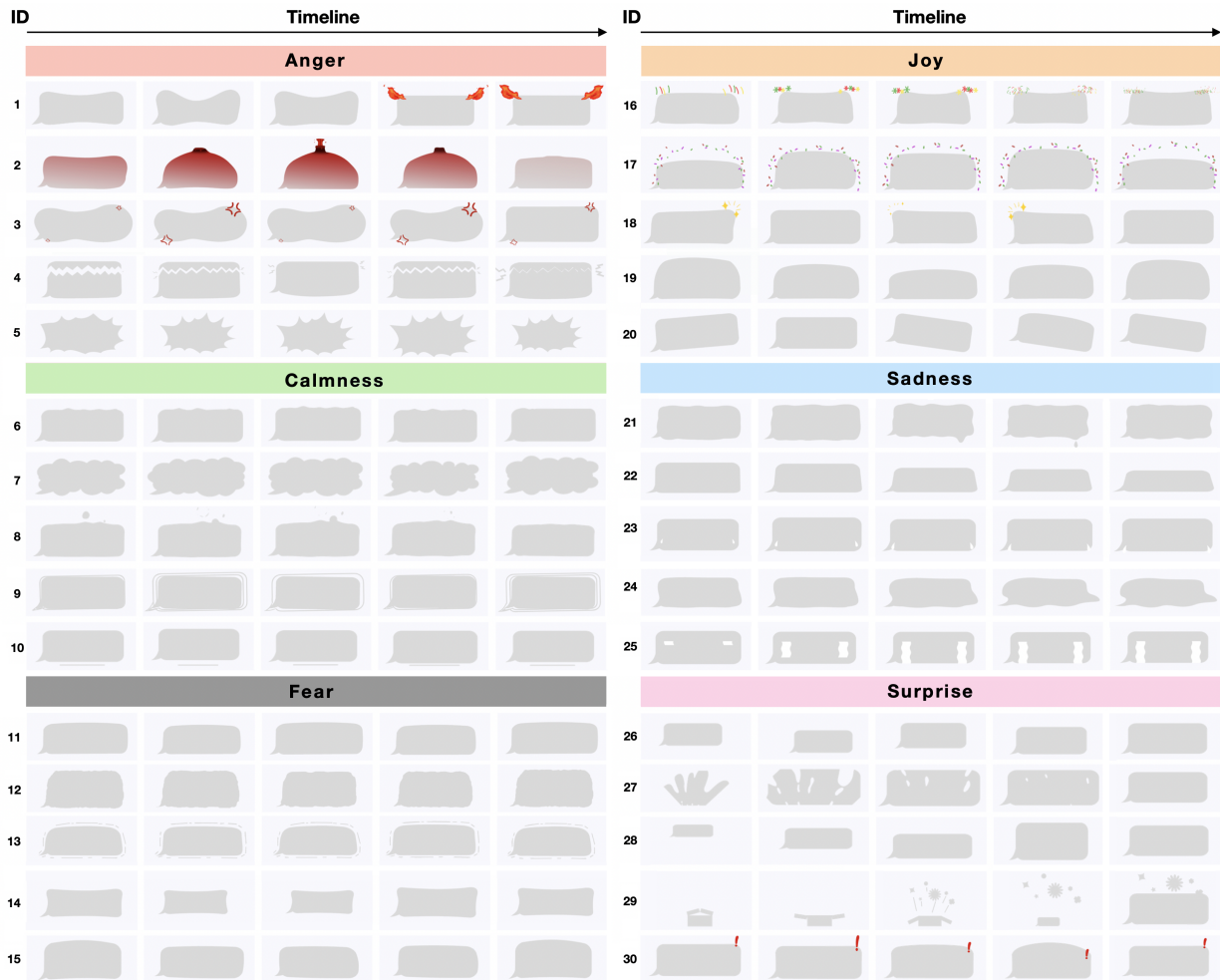


Figure 2: The 30 designed AniBalloons:

Anger:	1-Fire-spitting	2-Erupting	3-Clenching	4-Shouting	5-Exploding
Calmness:	6-Rippling	7-Breathing	8-Bubbling	9-Drifting	10-Floating
Fear:	11-Quivering	12-Shuddering	13-Shaking	14-Huddling	15-Recoiling
Joy:	16-Celebrating	17-Cheering	18-Shining	19-Hailing	20-Swinging
Sadness:	21-Tear-shedding	22-Lying-down	23-Weeping	24-Melting	25-Whining
Surprise:	26-Zooming	27-Splashing	28-Popping	29-Unboxing	30-Springing

See an anonymized video demonstration via: [ClickHere](#)

right, a pattern commonly seen in inspiration examples.

Sadness. The five designs in this category are *Tear-shedding*, *Lying-down*, *Weeping*, *Melting*, and *Whining*. Our analysis revealed that motions related to crying are often used to convey sadness in animations. The design of *Tear-shedding* captures the abstract impression of tears welling up in the eyes. *Weeping* combines the motion of sobbing with the dynamic effect of tears drops. *Whining* illustrates the impression of breaking down in tears with an abstract tear-streaming-down effect. In contrast, *Lying-down* represents the motion of

characters laying back or lying down in sadness. Lastly, *Melting* captures the unique motion of anthropomorphic objects sadly collapsing or melting.

Surprise. The designs for surprise are *Zooming*, *Splashing*, *Popping*, *Unboxing*, and *Springing*. The patterns extracted for surprise often involved sudden appearance or proximity. *Zooming* is designed to convey the feeling of something quickly approaching, represented by the balloon rapidly expanding. *Splashing* evokes the sensation of liquid being splashed on a surface. *Popping* features the motion of jumping out and

bouncing on the ground. *Unboxing* uses the metaphor of a message coming out of a gift box. Lastly, *Springing* combines an exclamation mark effect with the motion of jumping in surprise.

4. Study 2: Emotion Recognizability and Emotional Properties of AniBalloons

Utilizing AniBalloons as a research means, we aim to address the question of whether or how the designed chat balloon animations could convey emotions, and how people would perceive their emotional properties (RQ2). To do so, we conducted a study with 40 participants to evaluate the 30 designed animations with two-fold objectives:

Objective 1: Assessing the emotion recognizability of the designed motion effects of AniBalloons. This involved assessing whether or to what extent participants could identify the intended emotion conveyed by each chat balloon animation without any hint from the textual content of a message. As per prior research, an affective design is considered effective when recognition accuracy exceeds 50% (Lan et al., 2022; Ma et al., 2012) (i.e., most respondents could recognize the intended emotion without any hint from the texts).

Objective 2: Gathering the perceived emotional properties of the designed motion effects of AniBalloons. This objective aimed to understand how the designs of AniBalloons are perceived in terms of valence and arousal. By collecting data on the perceived emotional properties of each design, we can identify the range of emotions that AniBalloons can effectively convey and how they can complement other emotional cues (e.g., emoticons) and identify potential areas for future design developments.

4.1. Methods

Stimuli: The 30 designed motion effects of AniBalloons have been used as stimuli. To ensure that the evaluation was not influenced by the base color of the chat balloons, which can vary in actual usage cases (D1), each design was rendered on a grey chat balloon. However, the color of the dynamic decorative effects (e.g., see the confetti or question mark in Figure 3) were not changed, as these would remain in the same color in actual usage cases. Additionally, to prevent the content of the message from influencing participants' perception, while still providing a sense of a complete chat balloon, we used Lorem ipsum, a type of pseudo-Latin text, as the placeholder message in the balloon.

Procedure: The 40 participants were recruited by the research team via word of mouth, aged from 18-44

(95% aged from 18-34), with 42.5% women and 57.5% men. A web-based survey interface was created for the evaluation. After a participant completed consent and demographic information, the survey interface demonstrated each of the 30 designs one by one to the participant (rendered on an identical grey balloon with the same placeholder text), and meanwhile, ask the participant to fill in a few evaluation questions. The designs were shown to each participant in a randomized order to avoid the order effect biasing their evaluation. For each design, a participant was first asked to choose which emotion the sender of the rendered message seemed to convey, with seven options provided: Joy, Surprise, Sadness, Anger, Calmness, Fear, and Other. When Other was opted for, as an optional request, they could input a better-suited answer in a text field. Secondly, the participant was asked to rate their perception of valence (the extent of being pleasant-unpleasant) and arousal (the extent of being calm-exciting) expressed by the rendered message in two seven-point scales. Afterwards, 8 participants were randomly invited for a 15-min follow-up remote interview to talk about their responses to the survey. The interviews were transcribed verbatim and subjected to a thematic analysis (Braun and Clarke, 2006) where two researchers engaged in collaborative inductive coding. Initially, they annotated transcripts to highlight pertinent quotes, essential concepts, and initial patterns. Through recurrent discussions, they formulated a coding scheme, under which quotes were organized and grouped into emerging themes, forming a hierarchical structure. These themes were reviewed and finalized collaboratively with the research team.

4.2. Emotion Recognizability of AniBalloons

As Figure 4 shows, 24 out of 30 animations (80%) have achieved a recognition accuracy of greater than 50%, which are considered effective in affective design according to prior works (Lan et al., 2022; Ma et al., 2012). Among them, 20 designs reached an accuracy of 65% or higher. In the categories of Joy and Surprise, all the designed affective animations could be successfully recognized by the majority of the participants. And in the category of Fear or Anger, four out of five animations could be correctly recognized by the majority. And in the category of Sadness or Calmness, three out of five animations could be correctly recognized by the majority.

We further conducted a subsequent analysis through a binomial test, which showed that for 93% of the designs (28 out of 30), the intended emotion was identified significantly more often than would be expected by chance alone ($p < .001$). Moreover, for these 93% designs, the



Figure 3: AniBalloons used for evaluation: rendered on chat balloons with grey base color and pseudo Latin texts

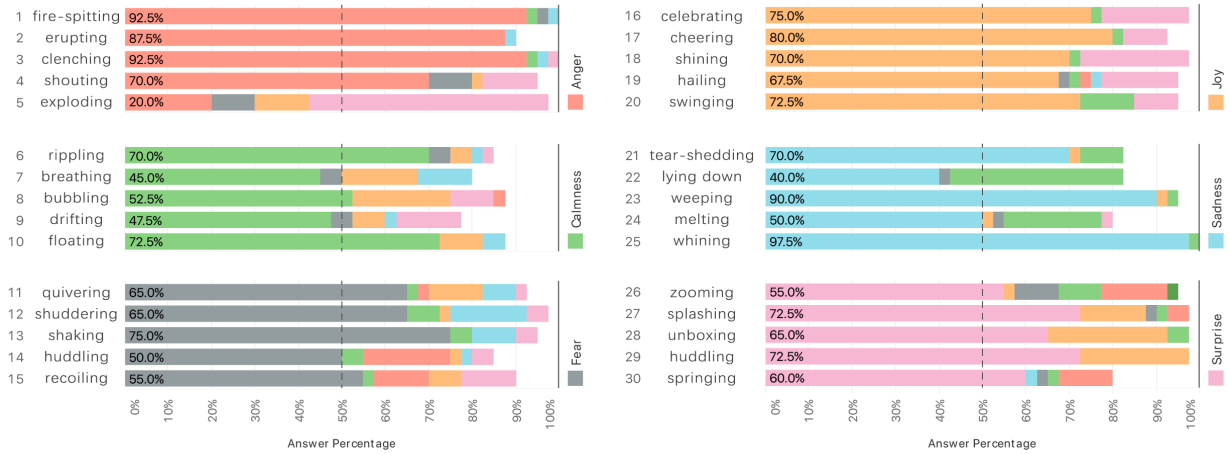


Figure 4: Emotion recognizability of AniBalloons

selection rates for alternative emotions did not significantly differ from chance. This underscores a consensus among participants regarding the conveyed emotion.

Six animations’ accuracy did not exceed 50%, including *Exploding* (20%) from Anger, *Breathing* (45%) and *Drifting* (47.5%) from Calmness, *Huddling* (50%) from Fear, *Lying-down* (40%), and *Melting* (50%) from Sadness. However, when looking at the responses from participants who chose “Other,” some interpretations were closely related to the intended emotion. For example, for *Drifting* (Calm), 7.5% of participants interpreted it as meditation, no emotion, or sleepiness. 5% of participants thought *Huddling* (Fear) conveyed anxiety. And 7.5% of participants saw *Melting* (Sadness) as expressing disappointment, frustration, upset, and feeling down. If these related interpretations are considered correct answers, 27 (90%) animations could be considered effective in conveying the intended emotion. The participants’ interpretations also included alternative meanings to the conveyed emotions. For instance, *Exploding* was identified by a participant to convey “importance”, and *Breathing* was identified by two participants as “thinking”. These alternative interpretations could serve as inputs for refining or expanding the designs of AniBalloons.

Qualitative Results: While most of the designs’ affective expressions were commonly agreed upon by the

participants, there were a few animations that elicited diverged interpretations. For instance, *Exploding* (designed for Anger), was interpreted as Surprise by 50% of participants, and *Lying-down* (designed for Sadness) was perceived as Calmness by 40% of participants. Several participants provided explained how they would apply *Exploding* to a message to express surprise: e.g., “like ‘I will be home tomorrow!’” Another participant stated that she would use it to express “emphasis”, such as “[reminding people:] don’t forget to do it”. “Lying-down” was associated with tiredness by multiple participants: e.g., “I’m so tired! So many things to do next week.” Interestingly, several participants stated that they would use *Bubbling* and *Drifting* to express relaxation or leisure. Notably, the designs with lower agreement were not viewed as “bad”. Instead, the participants gave their individual interpretations and envisaged when and how they would like to use them to express feelings beyond the original design intent (echoing findings in (Wiseman and Gould, 2018; Kelly and Watts, 2015; An et al., 2022)).

4.3. Perceived Emotional Properties of AniBalloons

This subsection unveils the nuanced emotional properties of the designed animations and how they relate to one another on the valence-arousal plane.

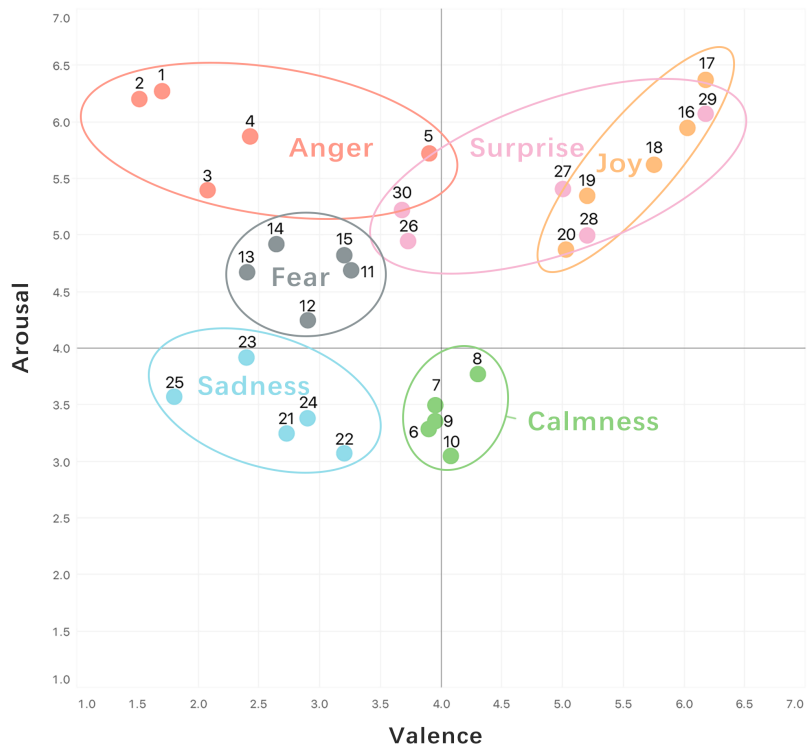


Figure 5: Emotional properties of AniBalloons. TOP: AniBalloons' distribution on valence-arousal plane. BOTTOM: AniBalloons's distribution in reference with frequently used emojis and VibEmoji (An et al., 2022) motions.

The distribution of the designs on this plane is illustrated in Figure 5. Each emotion category occupies a specific range on the plane (marked by the ellipses on Figure 5), providing users with nuanced options for expressing a certain emotion. The Joy designs are broadly distributed in the positive-arousing section of the plane, with the most positive and arousing design being *Cheering* and the least being *Swinging*. The Anger and Fear designs are located in the negative-arousing section, with *Erupting* and *Shaking* perceived as expressing the strongest negative feelings from the two categories. The Sadness designs are in the negative-calm section, with *Whining* perceived as the most negative. The Surprise designs are primarily located in the arousing section and span across the neutral and positive regions on the valence axis (as Surprise can evoke a wide range of valence), with *Unboxing* conveying the highest positivity and *Zooming* and *Springing* conveying valence-neutral surprise. The Calmness designs are located in the calm section of the plane and around the neutral region on the valence axis, which aligns with the intended design of conveying a feeling of being free from strong emotions. The distribution of the designs also aligns with the results of the emotion recognizability evaluation, as some participants identified Joy in some Surprise designs and vice versa. This may be due to the overlap between the two clusters in real-life, as expressing happy surprise often involves both the emotions of surprise and joy. Similarly, The designs that evoked different interpretations (such as *Exploding* and *Lying-down*) were located near the border regions of other clusters. By utilizing such proximity-based associations evident in the distribution data, animations can be recommended based on their nuanced emotional properties, rather than solely relying on predefined emotion labels.

To further understand the affective affordance of AniBalloons, in Figure 5, we visualize the distribution of AniBalloons in reference to frequently used emojis (Rodrigues et al., 2018), as well as a prior set of animations used for multimodal emoticons (An et al., 2022).

In the figure, 50 frequently used (facial) emojis from the Apple IOS platform were plotted based on a survey by the Unicode Consortium⁵, with their valence-arousal properties taken from the Lisbon Emoji and Emoticon Dataset, i.e., LEED (Rodrigues et al., 2018). Additionally, a prior set of animations from the VibEmoji system, consisting of 15 motion designs selected from Kineticons and with valence-arousal data gathered in (An et al., 2022), were plotted in the figure.

To be noted, the LEED dataset serves merely as a contextual backdrop in Figure 5 to illustrate the distribution of commonly used emojis within the valence-arousal space. Our goal was to furnish the audience with a referenced overview to better understand the positioning of AniBalloons in the emotional landscape. As can be seen in Figure 5, the distribution of the 30 AniBalloons designs covers a relatively wide range of emotional parameters, which is on par with the range covered by frequently used emojis and include the range covered by the VibEmoji animations. To be noted, the VibEmoji animations were designed to enhance multimodal emoticons, rather than communicating emotions alone, thus we use their data as a reference point rather than making a direct comparison. The 50 frequently used emojis, on the other hand, cover a range of emotions commonly used in everyday communication, and the large overlap between the two suggests that AniBalloons can also support a wide range of affective expression in daily contexts. However, as can be seen in the figure, there may be a need for more designs in the positive-calm phase of the emotional space in the future to support affective expression in this area.

Qualitative Results: The interviews with participants provided additional insights into how AniBalloons can complement existing methods of emotional expression, such as emojis and stickers. As echoing our design purpose, a few participants mentioned that AniBalloons could complement emojis because emojis were static while AniBalloons convey feelings through motions and dynamic effects. A participant pinpointed that the meaning of emojis tends to be context-dependent, whereas “*the chat balloon animations are more straightforward, thus less likely to be misinterpreted*”. Additionally, participants pointed out that AniBalloons can be integrated seamlessly into any message that has a chat balloon, whereas “*stickers require an extra message. So sometimes I hesitate whether to send a sticker [...] but this [chat balloon] is part of your message.*” Another interesting difference mentioned was “*the chat balloon animations are more universal, their usage are not restricted to gender, personality, age [...]*” Whereas when using emojis or stickers, people tend to select the appropriate ones (e.g., to match their skin color, gender, or culture). This is likely due to that emojis and stickers are designed with specific facial features or figures, while AniBalloons were designed based on extracted motion patterns and relatively abstract effects.

⁵<https://home.unicode.org/emoji/emoji-frequency/>

5. Study 3-a: Potential Effects of Animated Chat Balloons on Messaging Experience

This study explores the potential use of animated chat balloons in mobile instant messaging, a common context for text-based communication. The research question is how animated chat balloons would impact the conversation experience in this context (RQ3). A between-group study was thereby conducted with 72 participants to examine the influence on participants' experience when applying animated chat balloons in an instant messaging scenario.

5.1. Methods

Hypotheses: Based on our research questions, four hypotheses were formulated. Among them, H1 has been based on our results of Study 2, and H2 and H4 were inspired by prior related work. We now address these hypotheses and rationales behind each:

H1: Applying animated chat balloons can influence perceived affective communication quality. Findings from Study 2 suggest that AniBalloons could effectively convey emotional feelings. Therefore, we hypothesize that applying these designs in a mobile messaging scenario can influence the perceived quality of affective communication, such as increasing the perceived emotional expressiveness and liveliness of the conversation.

H2: Applying animated chat balloons can influence perceived conveyance of nonverbal information. Non-verbal interactions play an important role in enhancing the sense of social presence in computer-mediated communication (De Greef and Ijsselstein, 2001; Yen and Tu, 2008), and have been greatly sacrificed in messaging due to the lack of nonverbal cues (Aoki et al., 2022). Since AniBalloons are based largely on embodied motions, we hypothesize that they enhance the conveyance of nonverbal information and make the conversation feel more like face-to-face interaction.

H3: Applying animated chat balloons would not influence perceived message comprehensibility. Animated chat balloons are designed to nonverbally convey emotional feelings, while the comprehensibility of messages depends more on verbal features. Therefore, we expect that the use of AniBalloons will not have a significant impact on the perceived comprehensibility of messages.

H4: Applying animated chat balloons could influence perceived closeness to the conversation partner. Sharing emotions can strengthen the relationship and sense of connectedness between people (Rimé et al., 2020). We will explore whether the use of animated chat

balloons in messaging can mediate participants' perception of interpersonal closeness to the conversation partner.

Stimuli: In order to evaluate the potential impact of using AniBalloons in mobile instant messaging, two versions of high-fidelity mockups, called **IM1** and **IM2**, were created (see Figure 6 and the supplemental video). Both mockups apply the same pre-scripted conversation and visual design, with the only difference being that certain messages in **IM1** are augmented with AniBalloons, while all messages in **IM2** are displayed in static text balloons.

The conversation script in the mockups was designed to resemble a typical mobile messaging exchange between a user and a conversation partner discussing the partner's recent holiday trip. The conversation begins with a greeting and inquires about the partner's recent life, then the partner shares that they just returned from a holiday trip and proceeds to describe the details of the trip. Throughout the conversation, the partner mainly expresses their feelings about the trip, while the user's perspective mostly gives comments. The conversation ends with the partner and the user agreeing to travel together in the future. The conversation was divided into thirteen messages, with seven from the user and six from the partner.

In **IM1**, the chat balloons of nine messages (five from the partner and four from the user) were augmented with AniBalloons animations to convey emotions related to joy, surprise, anger, calm, sadness, and fear. These emotions were chosen based on the context of the conversation, for example, joy is conveyed when the partner expresses pleasure about the food and scenery at the destination, and when the user agrees to travel with the partner. Surprise is expressed when the user hears about the unexpected increase of the hotel price, and when the partner suggests traveling together. Anger is shown when the partner talks about the hotel price. Calm is rendered when the user admires the partner's destination. Sadness is communicated when the partner mentions the destination being very crowded. Fear is conveyed by the user when reacting to the crowdedness of the place. In **IM1**, only one AniBalloons animation is displayed at a time to avoid visual clutter and to help users focus on the most recent emotion being conveyed.

Measurements: To assess the hypotheses, a questionnaire has been constructed. As Table 1 shows, Five items (**IM-RS1** to **IM-RS5**) have been used to evaluate participants' affective communication experience of the conversation as a whole (**H1**), including its emotional richness, liveliness, expressiveness, and the perceived mutual understanding of emotions (understand-



Figure 6: Screenshots of the mobile messaging mockup interfaces (with the English translation added).

Table 1: Measurements of Study 3-a.

H1	IM-RS1	Our conversation was emotionally rich.
	IM-RS2	Our conversation was lively.
	IM-RS3	Our conversation was expressive.
	IM-RS4	My partners' emotions were not clear to me.
	IM-RS5	My emotions were not clear to my partner.
H2	IM-RS6	Our conversation included rich nonverbal information.
	IM-RS7	Some nonverbal information supported our communication.
	IM-RS8	I felt as if I could picture my partner's expressions and reactions at the other end.
	IM-RS9	It isn't at all like a face-to-face conversation.
H3	IM-RS10	It was easy to understand my partner.
	IM-RS11	My partner found it easy to understand me.
H4	IOS	Inclusion of Other in the Self Scale (Aron et al., 1992)

ability of Partner's emotions and understandability of one's own emotions to Partner). **IM-RS4** and **IM-RS5** were selected from the "perceived affective understanding" cluster of Networked Minds Social Presence Measure (Biocca et al., 2003).

Four items (**IM-RS6** to **IM-RS9**) were used to specifically evaluate the nonverbal information conveyed in the conversation (**H2**), including the richness of nonverbal information, perceived usefulness of nonverbal information, the ability to picture reactions from the partner, and the resemblance of face-to-face communication. **IM-RS8** and **IM-RS9** were developed based upon two subjective attitude statements from IPO Social Presence Questionnaire (De Greef and Ijsselstein, 2001).

Two items (**IM-RS10** and **IM-RS11**) were used to

assess participants' perceived mutual comprehensibility of the conversation content (**H3**). These two items were selected from the category "perceived message understanding" of the Networked Minds Social Presence Measure (Biocca et al., 2003).

Finally, the Inclusion of Other in the Self (**IOS**) (Aron et al., 1992) Scale has been adopted to assess participants' perceived closeness to the conversation partner (**H4**). **IOS** is a standard single-item scale that measures how close a participant feels to another individual or group (Aron et al., 1992).

There are subtle yet significant distinctions to be clarified for a few items that seem related. Namely, a message interaction may be expressive (**IM-RS3**), but this may not automatically enable participants to vividly imagine nonverbal cues as if in direct, face-to-face communication (**IM-RS8**). Additionally, richer nonverbal cues may not inherently translate to greater perceived closeness (**IOS**). Similarly, **IM-RS4** and **IM-RS5** are confined to the transmission of emotions, whereas **IM-RS10** and **IM-RS11** encompass the broader comprehension of conversation content. All above-mentioned measurements have been constructed as seven-point Likert scales. The Mann-Whitney U test, as a non-parametric alternative to the independent t-test, was used to analyze our data due to that it is suitable for determining if two populations differ significantly without assuming a normal distribution for the data and with a relatively limited sample size.

Procedure: The study recruited 72 participants, primarily through word of mouth, who were aged 18-59 (with 90% aged 18-44). The participants were 61.1% women and 38.9% men. They were randomly divided into two groups of 36, with age and gender balance, to experience either **IM1** or **IM2**. Participants filled out a consent form and demographic information at the beginning of the study. They were then asked to imagine

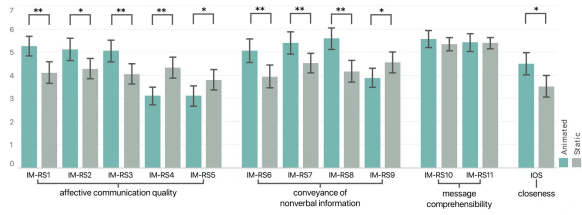


Figure 7: Results of Study 3-a.

themselves in a scenario where they were chatting with a person from their mobile messaging contacts. They were then provided with the pre-scripted design mockup of either **IM1** or **IM2** (both running for 1 min 23 sec) and asked to fill out the questionnaire based on their experience. After the questionnaire data was gathered, 10 participants from the **IM1** group were randomly selected for a 15 min online interview, in which they were also shown **IM2** and asked to comment on their experience and questionnaire responses. The interviews were transcribed and underwent a thematic analysis following the same steps as described in Study 2.

5.2. Results

Perceived Affective Communication Quality (H1): In order to assess **H1**, null hypothesis H_0 was tested: the animated chat balloons would not have influence on any of the measurements of perceived affective communication quality. As Figure 7 shows, Mann-Whitney U tests suggested that applying animations of AniBalloons led to significantly better scores compared to the static (no animation) condition in all five measurements (**IM-RS1** to **IM-RS5**), including emotional richness ($M = 5.25 > 4.11, p = .002$), conversation liveliness ($M = 5.11 > 4.28, p = .019$), reverse-scored emotion understandability of Partner ($M = 3.11 < 4.33, p < .001$), and reverse-scored emotion understandability of Self to Partner ($M = 3.11 < 3.80, p = .026$). Therefore, the null hypothesis is rejected, and **H1** is supported.

Perceived Conveyance of Nonverbal Information (H2): To evaluate **H2**, null hypothesis H_0 was tested: the animated chat balloons would not have an effect on the measurements of perceived conveyance of nonverbal information. Mann-Whitney U tests showed that applying animated chat balloons led to significantly better scores compared to the no-animation condition in all four measurements (**IM-RS6** to **IM-RS9**), i.e., richness of nonverbal information ($M = 5.06 > 3.94, p = .005$), perceived usefulness of nonverbal information ($M = 5.39 > 4.53, p = .007$), ability to picture Partner’s reactions ($M = 5.58 > 4.17, p < .001$), and reverse-scored resemblance of face-to-face conversation ($M = 3.89 <$

$4.56, p < .049$). As a result, the null hypothesis is rejected, and **H2** is supported.

Perceived Message Comprehensibility (H3): Our hypothesis **H3** expects no significant effect from chat balloon animations, thereby it aligns with the null hypothesis H_0 : the animated chat balloons would have no significant influence on the measurements of message comprehensibility. As Figure 7 shows, Mann-Whitney U tests suggested that applying animations of AniBalloons resulted no significant effect on any of the two measurements (**IM-RS10** and **IM-RS11**): comprehensibility of Partner ($M = 5.56$), and comprehensibility of Self to Partner ($M = 5.42$), in comparison with the no-animation condition ($M = 5.33, 5.39$, respectively). The null hypothesis cannot be rejected.

Perceived Closeness to the Conversation Partner (H4): To examining **H4**, null hypothesis H_0 is tested: the animated chat balloons would not influence the perceived closeness to the conversation partner. Mann-Whitney U tests indicated that applying animations of AniBalloons led to significantly higher perceived closeness measured by the Inclusion of Other in the Self (**IOS**) Scale ($M = 4.50 > 3.53, p = .011$). H_0 is rejected, and **H4** is supported.

Qualitative Results: the comments from the interviewed participants further explained why applying animated chat balloons improved the perceived quality of affective communication. Several participants stressed the importance of expressing emotions during conversations, e.g., “When I am chatting with other people, I hope others could feel my emotion [...] so that the conversation doesn’t feel too mechanical.” And they felt that “with the [animated] balloons, you are able to express much more emotion, and I can clearly feel the emotion from the other side.” Moreover, they experienced that the emotion conveyed by animated chat balloons were ‘lively’, ‘intuitive’ and ‘natural’. Regarding the animations’ effects on the conveyance of nonverbal information, a participant explained that with the animated balloons, “it adds to a sense of face-to-face interaction with my friend. In my mind, I could simulate her tone and state when she was saying that, I could imagine her doing exactly the same action [as the animation] when she talks to me.” Another participant thought that the animated balloons enabled spontaneous affective comprehension prior to verbal content: “[the animations] were intuitive. You don’t even need to read the text message to know what the other side wants to express.” No issues were reported with message comprehensibility and the participants did not consider the animations hindered the message readability. And they agreed with our design choice that only the

latest animation on the interface is rendered to avoid visual clustering. Finally, the feedback from the participants helped us understand how the affective animations led to a stronger sense of closeness to the conversation partner: e.g., “when communicating with people close to me, I would try my best to let them feel what I want to express”, and “adding emotional expression will make me feel that he has taken a step further and he values our conversation a lot.” For this reason, the majority of the participants stated that they would like to use AniBalloons with people close to them, such as their family, friends, or significant other.

6. Study 3-b: Potential Effects of Animated Chat Balloons on Chatbot Experience

Chatbot is another important context that could benefit from affective enhancement of messages (e.g., a client service chatbot uses animated balloons to convey affective feedback to the customer). Therefore, we conducted a study with 70 participants to continue probing **RQ3** in this context: whether and how applying the animated chat balloons to messages would influence users’ conversation experience with a chatbot.

6.1. Methods

Hypotheses: In light of our research questions, we have formulated four hypotheses among which H1 and H2 were inspired by Study 3-a and H4 was inspired by prior related work. These hypotheses and the rationales behind them are:

H1: Enabling a chatbot to use animated chat balloons could influence participants’ attitude towards the chatbot. In this study, our measure of ‘attitude’ specifically refers to the chatbot’s fun and likability. As revealed in Study 3-a, participants considered the messages augmented by AniBalloons to be fun and engaging, we thereby hypothesize that people might find a chatbot more fun and likable when its text balloons are augmented with animated affective cues than when they are static.

H2: Enabling a chatbot to use animated chat balloons could increase the perceived emotional expressivity of the chatbot. As reported in Study 3-a, AniBalloons could enhance the emotional expressivity of a conversation in an instant messaging scenario. We thereby hypothesize that the animated balloons could also enhance a chatbot’s emotional expressivity, which is defined in our measure by the extent to which the chatbot is perceived as human-like in its emotional capacity and its ability to express those emotions.

H3: Enabling a chatbot to use animated chat balloons would not influence the perceived verbal communication ability of the chatbot. Since AniBalloons has been designed to enrich the emotionality of messages, we hypothesize that AniBalloons would not have significant impacts on the perceived ability of chatbots to communicate pragmatically.

H4: Enabling a chatbot to use animated chat balloons could influence the perceived personality of the chatbot. Personality is essential in the emotional design of chatbots and it is often mediated by verbal aspects (Kang, 2018; Ruane et al., 2020). By evaluating whether and how AniBalloons could influence the perceived chatbot personality, we aimed to probe the potential of using animated chat balloons to mediate chatbot personality. We adopted the widely used personality measure of TIPI based on the Big-Five personality model (Ehrhart et al., 2009).

Stimuli: To evaluate the potential impact of AniBalloons on the chatbot communication experience, we created two versions of high-fidelity mockups of a customer service chatbot interface: **CB1** and **CB2** (see Figure 8 and the supplemental video). Both mockups use the same conversation script and visual design. The only difference is that the chatbot in **CB1** is able to use chat balloons augmented with AniBalloons to provide affective feedback to the user, while the chatbot in **CB2** only uses static chat balloons.

The script of the mockups was designed to resemble a typical conversation with a client service chatbot on e-commerce platforms. The script consisted of two common scenarios that would occur in such a conversation. In the first part, the user asks the chatbot about the process of returning a product, and the chatbot explains the steps. Then the user asks the chatbot to complete these steps for them, but the chatbot apologizes and states that it is unable to complete the task but hopes to be able to assist more in the future. In the second part, the chatbot asks if the user needs further assistance and the user asks the chatbot to check their purchase history. The chatbot provides a summary and reminds the user that their expenses have exceeded the monthly budget. Afterwards, the user has no more requests and the chatbot politely concludes the conversation. The conversation was divided into 22 chat balloons, with sixteen from the chatbot and six from the user.

In **CB1**, based on the context of the conversation script, thirteen chat balloons from the chatbot have been augmented with AniBalloons to convey joy, calmness, fear, sadness, and surprise. Joy is expressed by the chatbot when it greets the user, fulfills a request, or bids farewell. Calmness is conveyed when the chatbot is re-



Figure 8: Screenshots of Chatbot mockup interfaces (with the English translation added).

Table 2: Measurements of Study 3-b.

H1	CB-RS1 CB-RS2	The chatbot was fun to interact with. I found the chatbot likeable.
H2	CB-RS3 CB-RS4	the chatbot seemed like a human with its own emotions. I felt the chatbot could express its emotion.
H3	CB-RS5 CB-RS6	It is easy to tell the chatbot what I would like to do. The chatbot explained gracefully that it could not help me.
H4	TIPI1-TIPI10	Ten-Item Personality Inventory (Ehrhart et al., 2009)

rieving requested information. Fear is expressed when it is unable to fulfill a request or when it sees that the user's expenses have exceeded the budget. Sadness is shown when the chatbot apologizes to the user. Surprise is displayed when the chatbot first appears. Similar to the mockup **IM1** in Study 3-a, in **CB1**, only one animation is displayed at a time, with previous animations becoming static to avoid visual clutter and help users focus on the current emotion being conveyed.

Measurements: A questionnaire has been formulated to evaluate our hypotheses. As shown in Table 2, the participants' general attitude towards a chatbot (**H1**) was assessed by two items: fun to interact (**CB-RS1**), and likeability (**CB-RS2**). The perceived emotional expressivity (**H2**) of a chatbot was evaluated by two items: exhibition of human-like emotions (**CB-RS3**) and emotion expression ability (**CB-RS4**). Two items were used to assess whether the perceived ability of a chatbot to communicate pragmatically hinges

on the use of emotional balloons (**H3**): ability to understand the desires communicated by users (**CB-RS5**), and ability to gracefully explain its own limitations (**CB-RS6**). Four of these items (**CB-RS1,2,5,6**) were selected from the item pool used by Chatbot Usability Scale (Borsci et al., 2022), while two (**CB-RS3&4**) were developed by us. To evaluate the perceived personality (**H4**) of a chatbot, we used the Ten-Item Personality Inventory (**TIPI** (Ehrhart et al., 2009)), a standard scale that consists of five pairs of items. Each pair of **TIPI** measures a personality trait suggested by Big-Five model (Ehrhart et al., 2009): Extraversion (**TIPI1&6**), Agreeableness (**TIPI2&7**), Conscientiousness (**TIPI3&8**), Emotional Stability (**TIPI4&9**), and Openness to Experiences (**TIPI5&10**). All measurements took the form of 7-point Likert scales. The Mann-Whitney U test was employed due to its suitability for addressing data without necessarily satisfying a normal distribution and with a limited sample size.

Procedure: The 70 participants were recruited through word of mouth, aged from 18-44 (90% aged 18-34), with 58.6% women, and 41.4% men. They were randomly divided into two groups of 35 with age and gender balance. Each participant first completed a consent form and provided demographic information, and then they were provided with the pre-scripted design mockup of either **CB1** or **CB2** (both running for 1 min 23 sec). After that, they were asked to fill out the questionnaire based on their experience. Afterwards, 10 participants from the **CB1** group were selected for a 15-minute online interview, in which they were shown **CB2** and asked to provide additional feedback. A thematic analysis was performed to analyze the interview transcript, employing the same method as detailed in Study 2.

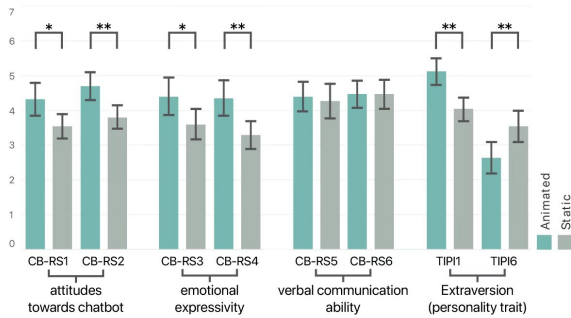


Figure 9: Results of Study 3-b.

6.2. Results

General Attitude Towards the Chatbot (H1): To evaluate **H1**, we tested null hypothesis **H0**: the animated chat balloons would not have any influence on the measurements of participants’ general attitude towards the chatbot. As [Figure 9](#) illustrates, Mann-Whitney U tests suggested that applying animated chat balloons led to significantly better scores than no-animation condition in the two measurements (**CB-RS1** and **CB-RS2**), i.e., fun to interact ($m = 4.31 > 3.54$, $p = .018$) and likeability ($M = 4.69 > 3.80$, $p = .002$). The null hypothesis is thus rejected, and **H1** is supported.

Perceived Emotional Expressivity (H2): To assess **H2**, null hypothesis **H0** was tested: the animated chat balloons would not have any influence on the measurements of perceived emotional expressivity of the chatbot. Mann-Whitney U tests showed that applying animated chat balloons led to significantly better scores than the no-animation condition in both measurements (**CB-RS3** and **CB-RS4**): showing human-like emotions ($M = 4.40 > 3.60$, $p = .023$), and ability to express emotions ($M = 4.34 > 3.29$, $p = .003$). As a result, null hypothesis **H0** is rejected, and **H2** is supported.

Perceived Verbal Communication Ability (H3): Our hypothesis **H3** aligns with null hypothesis **H0**: the animated chat balloons would not have a significant effect on the measurements of the chatbot’s verbal communication ability. As [Figure 9](#) shows, Mann-Whitney U tests suggested that applying animations of AniBalloons led to no significant effect on both measurements (**CB-RS5** and **CB-RS6**): ease of communication ($M = 4.40$), and graceful explanation when unable to help ($M = 4.45$), in comparison with the no-animation condition ($M = 4.26, 4.25$, respectively). **H0** cannot be rejected.

Perceived Personality Traits (H4): To assess **H4**, the null hypothesis **H0** was tested: the animated chat balloons would not influence any of the personality trait measurements: the Ten Item Personality Inventory

(TIPI). TIPI is a brief measure for the Big Five personality traits, comprising two items for each of the five dimensions: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness. As [Figure 9](#) illustrates, Mann-Whitney U tests suggested that applying animated chat balloons led to significantly higher scores in the personality trait measurements of Extraversion (**TIPI1** and **TIPI6**) than no-animation condition, including chatbot being extroverted and enthusiastic ($M = 5.11 > 4.03$, $p < .001$), and (reverse-scored) chatbot being reserved and quiet ($M = 2.63 < 3.54$, $p = .007$). However, no significant difference was observed in other personality traits (Conscientiousness, Emotional Stability, Openness to Experience) except for Agreeableness, in which only one measurement (TIPI7) showed a significant difference: chatbot being sympathetic and warm ($M = 4.54 > 3.38$, $p = .012$). The null hypothesis is hence rejected, and **H4** is supported.

Qualitative Results: Regarding their general attitude towards the chatbot, a few participants mentioned that they would be more interested to interact with a chatbot applying animated chat balloons than static ones: e.g., “*It was very fun experience, and I would like to chat with it for a longer time [...]*” With this increased interest, they might also be more patient with the chatbot: “*with the chat balloon animations, I might be more patient in waiting for the chatbot’s response.*” Specifically, several participants appreciated the calmness animations used when the chatbot was retrieving requested information, since “*it made the process less boring*” or “*it could reduce the anxiety while waiting*”. Similar to the instant messaging context, the animated balloons enhanced the emotional expressivity of the chatbot, and according to the participants, this made the chatbot appear more like a human than conventional chatbots: e.g., “*I felt that the chatbot with animations is more lively, more like a human assistant.*” “*because it is in motion, it feels like a real person*”, and “*I can intuitively feel that the chatbot might be a little emotional [when it failed to help]*” And such increased emotionality seemed to be a valuable part of user experience: “*most of the time, chatbot client support cannot really solve my problem. Therefore, if it could bring me at least some emotional feedback, it is already useful.*” As shown above, the animated chat balloons did not influence the chatbot’s perceived verbal ability. However, they seemed to make the chatbot more excusable and empathized when it failed to help users. E.g., “*It was crying when it cannot help, and I felt sorry for it*” or “*It’s cute [...] It cannot help me, but is still cute [...] and I really want to excuse it.*” This suggests a potential opportunity for further research on how nonverbal emotional expression (such

as animated message balloons) could mediate users' empathy and tolerance towards conversational agents. Lastly, the participants' comments offered experiential insights echoing our quantitative finding that the animated chat balloons influenced the perceived personality of the chatbot. Without the animations the chatbot felt like "*indifferent*", "*regular customer support*". And with the affective animations, people "*may feel a little bit of temperature*". And "*It feels like a relatively young person who does not have a lot of experience but is rather enthusiastic and positive about the work.*" This implied the need for deeper and more detailed research into how various strategies of implementing affective animations could affect specific personality traits.

7. Discussion

The prominence and ubiquity of message-based interaction have made chat balloons a universal type of interface component across mobile and wearable platforms. A few recent studies explored the use of chat balloon shape and color to convey emotions in messages (Aoki et al., 2022; Chen et al., 2021a), but little research has examined the use of chat balloon animations. Our design-driven research (Study 1) aims to tackle this under-explored opportunity by creating AniBalloons, a set of 30 chat balloon animations that convey six emotions: Joy, Anger, Calmness, Fear, Sadness, and Surprise (RQ1). Using AniBalloons as a vehicle of inquiry, we further address two research questions regarding users' perception (RQ2) and their experiences (RQ3) with chat balloon animations.

In regard to RQ2, our Study 2 showed that even without any context from the message content, 24 designed chat balloon animations were effective in communicating the intended emotions (recognized by the majority of the participants (Lan et al., 2022; Ma et al., 2012)), with 20 designs reached an accuracy of 65% or higher. Moreover, our analysis of the designs' perceived emotional properties on the valence-arousal plane revealed that each emotion category includes animations that span a certain range, allowing for nuanced differences in affective expressions. And the overall distribution range of AniBalloons compared to the distribution of commonly used emojis suggests that the designs can largely cover the affective expressions needed in daily communication.

In regard to RQ3, our Study 3-a and 3-b examined the effects of animated chat balloons on conversation experience in two common contexts of message-based interaction: mobile messaging and chatbot interaction. The results revealed that the use of animated chat balloons

in mobile messaging improved the perceived quality of affective communication, specifically by increasing the emotional richness, liveliness, expressiveness, and mutual understanding of emotions in the conversation. Additionally, the animated chat balloons augmented the perceived conveyance of nonverbal information, by making participants feel that they had a better understanding of the partner's reactions and that the conversation felt more like a face-to-face interaction. However, the animated chat balloons did not have a significant impact on the comprehensibility of the message itself. Furthermore, the results demonstrated that the animated chat balloons increased participants' perceived interpersonal closeness to the partner. These findings, echoing the Social Information Processing Theory (Walther, 2015), suggest that chat balloon animations may offer new opportunities to enhance the nonverbal, affective communication experience (which has been largely restricted in mobile or wearable messaging (Hancock et al., 2007; Liu et al., 2017; Aoki et al., 2022)) and mediate interpersonal closeness in social applications.

In Study 3-b, it has been found that the animated chat balloons could significantly influence the participant's attitude to chatbot, making it more enjoyable to interact with and more likable. The animations also significantly increased the chatbot's perceived emotional expressivity, i.e., the ability to express human-like emotions. As expected, the affective animations did not have a significant impact on the chatbot's verbal communication abilities. Last but not the least, the animated chat balloons significantly influenced the participants' perceived personality of the chatbot in the trait of Extroversion (Ehrhart et al., 2009). These findings indicate that chat balloon animations can be effectively utilized as a design tool to shape the interaction experience and the emotional expressivity of text-based conversational agents and even configure their perceived personality traits. To date, these purposes have been mainly achieved by designing the verbal aspects of artificial agents (Kang, 2018; Ruane et al., 2020). Future research could thereby further explore animated chat balloons as a nonverbal approach for emotional design of conversational agents in various relevant scenarios, such as client support, or children's social-emotional learning (Fu et al., 2022).

Besides answering the two research questions, our studies have shown that animated chat balloons can effectively complement existing affective communication methods in mobile or wearable social messaging, such as emojis and stickers. While these methods are often focused on conveying static facial expressions or body poses (Vinciarelli et al., 2009), animated chat balloons

can capture the dynamic, temporal aspects of nonverbal interaction. Namely, the participants found that Ani-Balloons allowed them to more vividly envision the affective reactions from the other side, likely enhancing the feeling of “face-to-face” in the conversation, which suggests a deeper and more detailed study into how Ani-Balloons would mediate Social Presence in messaging interactions (De Greef and Ijsselsteijn, 2001; Yen and Tu, 2008). Moreover, the participants felt that the emotional information conveyed by the chat balloon animations was intuitively received before their reading of the message content. This suggests that as similar to color (Chen et al., 2021a), the animation of chat balloons might also be used as affective clues for voice messages whose content is not immediately presented to the receiver. Future research could explore specific contexts of voice messages, especially on smartwatches (see a subsequent work by An et al. (2024)), since chat balloon animations seem more compatible with small screens than certain affective cues (e.g., typefaces (Choi and Aizawa, 2019; Wang et al., 2004a)).

For future researchers and developers to practically implement AniBalloons in their message-based systems, we envision an integration into messaging environments. In social messaging, they could be incorporated directly into the keyboard interface, offering users the ability to select emotional animations while typing, with suggestions provided based on the semantic meaning of the text (or voice) input. For customer support chatbots, AniBalloons can be automatically applied in line with the chatbot responses, powered by either rule-based or generative algorithms, enhancing emotional expressiveness of the chatbot (while the users do not have to respond to the chatbot with AniBalloons). In the social messaging context, a suitable recommendation mechanism is deemed important to balance the richness of animation options with user convenience of selection. For instance, as mentioned, applying a semantic analysis would help predict most fitting emotional animations, making it easier for users to express themselves accurately without sifting through all 30 options. The key is to ensure both quick selection and the exploration of diverse options for those who wish to personalize their messages further. Last but not least, as we have found, the abstract nature of animated chat balloons allows for universal communication of emotions without being tied to specific features such as gender or skin tones (which may lead to stereotyping or exclusion of certain cultural or ethnic groups). This interestingly surfaces a unique benefit of designing relatively “abstract” animations to convey emotion (as also seen in (Liu et al., 2019)), which could be further explored.

Limitations. Our study has faced several limitations that open avenues for future research. One such area we did not focus on is the user experience associated with browsing and selecting these animations through a keyboard interface in social messaging scenarios. This oversight suggests a promising direction for future investigation to optimize user interaction at the selection stage. Furthermore, the use of mock-up interfaces in our study, rather than fully functioning applications, points to the necessity of deploying these animations in real-world settings. Future work should aim to develop and implement these affective animations in longitudinal, naturalistic environments to capture more comprehensive insights into their utility and user engagement. Additionally, our research did not address the accessibility related aspects, which are crucial for ensuring inclusivity. Future studies could explore how these animations may improve the accessibility of message based interaction for a wider range of users, including those with disabilities, to foster a more inclusive digital communication space. Lastly, while our study initiates the conversation on animated chat balloons in enhancing communication, the limited diversity of conversation topics explored indicates the need for a broader examination. Future research is invited to test these animations across varied conversational scenarios, further validating their effectiveness and broadening their applicability. In essence, our study serves as a stepping stone in the affective communication landscape, underlying a preliminary basis for more extensive explorations into animated chat balloons. By addressing these highlighted areas, future research can significantly contribute to enriching nonverbal affective communication channels for messaging-based interactions.

8. Conclusion

this paper presents an exploration of chat balloon animations as a form of affective communication support for messages. Through the design and research of Ani-Balloons, a set of 30 chat-balloon animations conveying six types of emotions, we aimed to understand how chat balloon animations can be designed to express emotions, and how they influence the conversation experience. Our results show that 80% of the designed animations effectively communicated the intended emotions without context from the message and covered a wide range of valence-arousal parameters. Moreover, we found that animated chat balloons could enhance perceived emotional communication quality, nonverbal information conveyance, and interpersonal closeness in mobile instant messaging. Animated chat bal-

loons could also make a chatbot more fun to interact with and more likable, and mediate its perceived personality trait. Overall, our research suggests that animated chat balloons can be adopted as a design means to intentionally mediate particular aspects of conversation experience in text-based communications. We thereby contribute to a set of chat balloon animations that can complement nonverbal affective communication for a range of text-based interfaces and empirical insights into how animated chat balloons influence conversation experience in instant messaging and chatbot interaction.

Acknowledgements

Placeholder texts for acknowledgement after publication.

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