# User Expectations and Preferences to How Social Robots Render Text Messages with Emojis

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## ABSTRACT

Social robots are increasingly entering our households, being able to interact with humans in various ways. One functionality of social robots may be to connect to a user's mobile phone and to read text messages out loud. Such a technology and communication platform should therefore be able to support emojis properly. We therefore address emoji usage in computer-mediated communication in order to develop appropriate emoji conveyance in social robot behavior. Our research explores how participants feel about the behavior of a tabletop robot prototype named Nina that reads text messages to user and to what extent different renderings correspond to user expectations and preferences of how text messages and emoji combinations should be delivered. Based on online animated videos and questionnaires, respondents evaluated the behavior of Nina based on different renderings of text messages with emojis in them. The experiment results and data analysis show that respondents liked the social robot to display emojis with or without sound effect and to "act out" emojis in text messages almost equally well, but rated it less useful, less fun and more confusing to replace the emojis by words.

## CCS CONCEPTS

• Human-centered computing~User studies

• Social and professional topics~Cultural characteristics

## KEYWORDS

Human-Robot Interaction, Social Robot, Computer-mediated Communication, Emojis, Text Messages, User preferences

## 1 Introduction

Designing autonomous robots to understand people and to conform to users' expectations can be a challenging task [1]. In order to create a social robot with features that can correctly respond to the human's expectations of behavior and actions, people have to interact with it [1]. Studying various communicative functions in social robots can improve design and show evidence to users that it can provide value to their lives [1].

Reading text messages out loud is an example of a possible functionality for a social robot. People benefit from text messaging to coordinate day-to-day activities, maintain relationships, and help the time pass [4]. In order to express emotion when sending text messages, emojis are frequently used as a method of nonverbal communication [5]. An emoji in a text message has the power to act as facial expressions, show complex emotion, or to mimic nonverbal cues in verbal speech. Thus, it is important for the delivery or rendering of a text message with emojis to be explored when a social robot is attempting to connect with a user. This paper aims to find out whether a tabletop robot can meet users' expectations and preferences when reading text messages that contain different emoji combinations. If social robots deliver text messages with emojis, it is important from a user's perspective to render the emoji uses appropriately.

## 2 Research Question

This research explores the different ways in which a social robot can deliver text messages with emojis in them and the effects of different renderings on the perception of the respective robot. We explore how text messages and emoji combinations should be rendered by a social robot prototype, Nina. The scenario we

assume is that the users are busy doing something else (such as baking bread) so that the robot has to read the messages for them. The following different options for addressing the rendering of emojis in text messages will be explored:

1. Displaying the emoji on a screen so that users can see the emoji while the text is read out loud.

2. Displaying the emoji on a screen so that users can see the emoji while the text is read out loud., while using sound effects to draw attention to the emoji.

This condition is inspired by how blind people rely on sound effects when interacting with technology [16]. Having sound accompany the visualization of an emoji may provide users the assistance in understanding what the text message is conveying without having to look at the screen itself.

3. Visually animating the emoji in an emotive and creative way.

This condition is inspired by the design and intention of a robot from Honda Research Institute, Haru. The design concepts of Haru focus on creating an emotionally embodied agent that supports long-term human-robot interaction, by positioning Haru as a new kind of companion robot [13]. This could result in a relational bond between human and robot.

4. Replacing the visual features of an emoji by replacing it with words.

This condition rests on the way emojis are rendered for blind people, where screen reading software simply reads the emoji's name [15]. It is unclear to what extent this method accounts for the intent behind the visual representation [16], and multiple emojis and emoji embedded inside a sentence can make it even more confusing to decode the text-emoji relationship. Since this method represents current practice, we include it in our conditions.

## 3  Related Work

### 3.1  Social Robots

According to Bartneck and Forlizzi [2], a social robot is "an autonomous or semi-autonomous robot that interacts and communicates with humans by following the behavioral norms expected by the people with whom the robot is intended to interact". A robot being social means to understand people, to mimic human activity, and attend to values, norms and standards that are accepted by society and the respective culture [2]. Social robots based on emotional models can be effective at holding human attention [3]. For example, a huggable robot named Probo that was found to be effective in maintaining interactions with hospitalized children by expressing emotion non-verbally [3]. Thus, the ability for social robots to express different emotions and hold human attention may also be relevant for the current research.

### 3.2  Text Messages with Emojis

Users benefit from text messaging to coordinate activity, maintain social relationships, fill dead time, and share information with others on social media [18]. Emojis have become increasingly prevalent in mobile communication, and in some mobile platforms almost half of text posts contain an emoji [5]. Text messages are not always easy to decipher since tone of voice and body language is removed. Therefore, emojis offer an interesting way to express emotions to avoid misunderstandings of the message's tone [6]. It is important to understand how different users interact with other people through text messaging depending on their relationship, what their intent is, and the emotions they are trying to achieve.

The sender and the receiver of a text message rely on the context in combination with shared knowledge established between the sender and receiver in order to understand a message correctly [7]. Speakers can use emojis to build meanings that are uniquely interpretable within a particular relationship [8]. If the main point of using emojis is to improve the message understanding and to guide the receiver when different interpretations are possible, emojis can enhance communication by providing contextual information through relationship specific emotional cues to how the message should be read. The extent to which text messaging can create the feeling of connectedness in users creates possibilities for other medium applications [9]. Social robots can act as a technological system that strengthens personal relationships of users when paired with a mobile phone that already uses text messaging to maintain such relationships.

Emojis are used as a method of nonverbal communication to offer a way of expressing emotion and avoid misunderstandings in text messages. From a human-computer interaction perspective, emojis have an advantage over plain text in making the communications of smartphone users go more smoothly through the compactness of emojis which reduces the effort of input and the rich semantics which expresses ideas and emotions more vividly [10]. Emojis can help enhance computer-mediated communication the same way facial expression, body language, and vocal intonation support face-to-face communication [11]. Without an emoji, messages can be ambiguous or lead to confusion about the perceived emotional valence of a text. Due to their frequent and global usage, it is important to have an understanding of the different ways emojis can be used ambiguously. This understanding can be used to help design technologies, such as social robots, that support emoji usage.

Much previous work has addressed the question of why people use emojis. Kelly & Watts  [8] describe the ways in which emojis are used to facilitate communication. They suggest that  emojis allow the expression of feelings and attitudes with greater ease, faster and easier message construction, the maintenance of a conversational connection, and the creation of unique messages tailored to the recipient. Cramer, Juan & Tetreault [5] further analyze the reported motivations for including emojis in text messages and propose that emojis add meaning to the message, adjust the tone, and function as a social tool. The shared habit of using emojis also enables closeness and relationship maintenance.

To sum up, previous work suggests that when interpreting emojis, it is important to first assess intent and consider the conversational context or intimate knowledge, before assessing the message's meaning in terms of a translation [5]. Supporting emojis properly should be a priority for communication platforms due to the universal value and functions. It is important to consider the previous research on emoji usage in computer-mediated communication in order to develop appropriate emoji renderings through social robots.

## 4 Method and Design

A between-subjects experiment was conducted in order to understand how a table-top robot-like Nina should animate text messages with emojis. Five scenarios (corresponding to five different text messages with different emoji combinations) were created that demonstrate four different conditions in order to investigate how users prefer a social robot to relay text messages with emojis. The four conditions are: a) Display the emoji as is, b) show the emoji as is with a sound effect, c) acting the emoji out, and d) replacing the emoji with words.

The method in which Nina displays the emoji is thus different in each of the four different conditions. In order to test the different methods with which Nina delivers a text message with an emoji, five text message conversation scenarios were developed based on a corpus analysis of text message conversations between people of varying relationships. Emojipedia was consulted to identify the most popular emojis, as well as literature about text message conversations [4] [5] [7]. The emoji combinations considered are: 😂😂😂; 😟🍆; 🔥🔥🔥; 😍👍; 💘❤️; 💕💕💕.

Each scenario created embodies a specific emotion or sentiment based on the text, emoji used, and the sender/receiver relationship. A social robot prototype named Nina was designed to conduct this experiment (see Figure 1). Videos were created to animate Nina's behavior. The experiment was conducted as an online survey. We asked participants to evaluate the robot's different renderings on a Likert scale by asking how *fun*, *confusing*, *useful* or *annoying* they found the text messages with emojis delivered. Five text message scenarios with different emojis were distributed across three questionnaires such that each participant saw only one rendering/condition of each scenario. The respondents' evaluations and feedback about their perceptions of the emoji/text message representations constitute the dependent variables, whereas the conditions in which each scenario was presented, constitute the independent variables. In addition, a yes/no question was asked to identify user preferences for the use of a sound effect compared to no sound effect when an emoji was in a text and was put on Nina's screen (condition 1 and 2).[1] Please note that because

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[1] The videos of Nina's renderings participants saw can be found here:

Scenario 1, Condition 2: https://youtu.be/JIK_FPxs5Jg
Scenario 1, Condition 3: https://youtu.be/D6GUCIbxoNU
Scenario 1, Condition 4: https://youtu.be/dojeitKLVNE
Scenario 2, Condition 2: https://youtu.be/pdRNnZXtpr4

of the different types of emojis, not all emojis occur in all conditions. Furthermore, we did not modify Nina's base, so that she is smiling in all conditions.

## 5 Data Analysis

The data was analyzed to determine which one of Nina's behaviors will correspond closest to user expectations and preferences of how text messages with different emoji combinations are delivered. Altogether, the three questionnaires had 82 respondents. 54 participants (77.04%) were female and 28 participants (22.96%) were male. The first questionnaire had 25 respondents, the second questionnaire had 35 respondents and the third questionnaire had 23 respondents. The average age for the participants was 27 years. Regarding nationalities, there were 23 different nationalities. Danish had the most respondents (26.8%), Romanian was the second (10.9%), and third largest group were German (9.7%).

An analysis of variance (ANOVA) was conducted to compare the effect of four different conditions. The independent variable being the behavioral conditions of how Nina renders text messages with emojis and the dependent variable is how users feel about the different conditions.



**Figure 1: Nina, the tabletop social robot prototype**

## 6 Results

The overall analysis shows that there are significant differences between the conditions concerning how much fun the presentation is $(F_{(3, 258)}= 4.194, p= .006)$, how confusing it is $(F_{(3, 258)}= 10.064, p= .000)$, and as how useful it is perceived $(F_{(3, 258)}=$

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Scenario 2, Condition 3: https://youtu.be/p_Dt5uKUYwc
Scenario 2, Condition 4: https://youtu.be/refNGAC72qc
Scenario 3, Condition 1: https://youtu.be/J61d1JqCp3c
Scenario 3, Condition 3: https://youtu.be/MtZhsnoDN4w
Scenario 3, Condition 4: https://youtu.be/Afmdw7612_o
Scenario 4, Condition 1: https://youtu.be/lm9VtehvilA
Scenario 4, Condition 2: https://youtu.be/uHYK8txO7tE
Scenario 4, Condition 4: https://youtu.be/1F0Nb_p5R7w
Scenario 5, Condition 1: https://youtu.be/N-iBxdmGBrE
Scenario 5, Condition 3: https://youtu.be/yk-sGOoGgTw
Scenario 5, Condition 4: https://youtu.be/VBI6DImCGTU

4.192, p= .006). The comparison of the rating of the renderings as annoying shows no significant differences. Inspection of the data (see also Figure 2) shows that displaying the emoji without sound and acting the emoji out are rated almost equally useful and fun, directly followed by the condition, in which the emoji is displayed with an accompanying sound, which also receive slightly higher confusion ratings. Just replacing the emoji with a word or phrase is rated consistently lower with respect to perceived fun and usefulness, and higher on confusion.
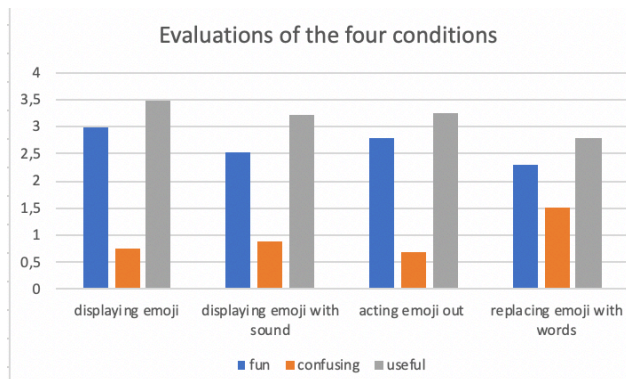


**Figure 2: Comparisons of the different conditions regarding the features *fun, confusing* and *useful***

The question whether users prefer a sound effect or not when an emoji occurs in a text supports the use of a sound effect: Overall, people find it is appropriate to have a sound effect when an emoji is used in a text message and also displayed on the screen. When asked if a sound effect was appropriate when displaying an emoji, there were 152 affirmatives (67.6%) to the question, while 73 said no (32.4%). Moreover, when we asked about the appropriateness of having no sound effect when displaying the emoji, there were 28 affirmative answers (40%) and 42 negative ones (60%). After testing these questions with the Chi-square test, the p-value is 0.000037.

## 7 Discussion

Our research shows that the delivery of messages through Nina in the scenario proposed (where the user is busy baking a bread and thus cannot hold her phone) can be fun and enjoyable. Nina uses a variety of modalities and behaviors to deliver a message, and our results show that display and animation of the emojis is experienced as entertaining for the user, with the potential to lead to a more visually engaging and interactive experience [14]. Using animation and design to "act out" an emoji used in text messages can furthermore help give life to a robot's personality and can have a positive influence in how humans perceive them [14]. Thus, the results suggest that a social robot can serve as assistive technology to display text messages with emojis. Consequently, the kind of application proposed here (and pursued by Honda [13]) seems to be useful.

In contrast, the condition in which the emojis were rendered in words was by far the least favorable condition among the respondents. For instance, in scenario 5, in which the text message

contains various heart emojis (💕, 💘, ❤️), the participants considered Nina's rendering of the messages to be the most annoying, confusing, and the least useful in real life. Hearing the name of the emoji takes away the visual aspect, interferes with the text message and thus confuses the receiver of the text message. This finding is in line with previous work [15]. Furthermore, when Nina rendered the multiple two-hearts emoji 💕 💕 💕 by saying, "two pink hearts, two pink hearts, two pink hearts," participants judged the robot's behavior as awkward. Moreover, emojis can be used as a method for engaging the recipient by mixing up a text with visual decoration [5], and without such visualization, the text is not as funny or engaging for the sender or the recipient. When replaced with words, the enjoyable aspect of emojis is lost.

Regarding the sound effect, many people rated the sounds accompanying the display of the emoji as appropriate. In real-life applications, it remains to be seen, however, at which point acoustic animations may become annoying, and whether the acoustic displays possibly need to be adapted to the respective contexts.

To what extent our findings on the rendering of emojis can be useful for blind users remains an open question worth exploring; the fact that replacing the emoji with words is least liked by the participants suggests that the current practice to read the emoji's name may not be the most favorable solution. Since one of the main benefits of using an emoji is to clarify or enhance the intent of a message, for those with visual disabilities, the use of a sound may be helpful for disambiguating the message. On the other hand, blind people may prefer a more detailed description of the emoji and what it looks like [16]. Therefore, more work is needed in order to decide on best strategy of rendering emojis when delivered to blind users. In addition, those with reading disabilities, young children or older adults might benefit from receiving text messages with emojis presented by a social robot. For future work, considering design implications for those with disabilities can help solve difficulties those have with technology and enrich user's daily lives.

## 9 Conclusion

This research explored different ways in which a social robot can deliver text messages with emojis. The aim of this study is to find out which of the implemented behaviors of Nina corresponds best to users' expectations and preferences of how text messages and emoji combinations are delivered. We found effects of the strategy used on how users perceive the social robot; participants overall preferred the robot to act the emojis out or to display the emoji on screen. Accompanying the display of an emoji with a sound effect was welcomed by the majority of the participants. Given the important role emojis play in text messaging, finding appropriate ways to render them is crucial; our study presents first steps to understanding how emojis can be rendered by multimodal interfaces such as social robots. Future research will have to identify the preferences of specific user groups.

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