Understanding Emoji Interpretation through User Personality and Message Context

Sarah Theres Völkel, Daniel Buschek, Jelena Pranjic, Heinrich Hussmann
LMU Munich, Munich, Germany
sarah.voelkel,daniel.buschek,hussmann@ifi.lmu.de
jelena.pranjic@campus.lmu.de

ABSTRACT

Emojis are commonly used as non-verbal cues in texting, yet may also lead to misunderstandings due to their often ambiguous meaning. User personality has been linked to understanding of emojis isolated from context, or via indirect personality assessment through text analysis. This paper presents the first study on the influence of personality (measured with BFI-2) on understanding of emojis, which are presented in concrete mobile messaging contexts: four recipients (parents, friend, colleague, partner) and four situations (information, arrangement, salutory, romantic). In particular, we presented short text chat scenarios in an online survey (N=646) and asked participants to add appropriate emojis. Our results show that personality factors influence the choice of emojis. In another open task participants compared emojis found as semantically similar by related work. Here, participants provided rich and varying emoji interpretations, even in defined contexts. We discuss implications for research and design of mobile texting interfaces.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in HCI**.

KEYWORDS

Big Five; emojis; mobile text messaging; personality; survey

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1 INTRODUCTION

Mobile text messaging has become a central part of everyday communication, for example to stay in touch with family and friends, or to contact colleagues to arrange a meeting. Text messages thus provide a fast and convenient communication channel. However, texting remains less expressive than meeting up in person: This observation is not new; in the 80's, Daft and Lengel [40] pointed out decreased "media richness" for impersonal communication. For mobile text messaging, recent work similarly highlighted the lack of context and emotional awareness cues [12]. It is easy to see that in the absence of such cues or non-verbal channels, sometimes text messages might be misunderstood. For example, receiving "I really like that" could be honest or ironically intended, which might be difficult to discern by looking at the text alone.

The desire for "rich", understandable, and personal communication seems to underlie many usage practices and design decisions we see today: For example, many users add non-textual cues, such as emojis, images and *memes*, avatars, and so on. All major mobile chat apps provide such features to varying extents (e.g. WhatsApp, Facebook Messenger).

The concrete impact of such cues on avoiding misunderstandings or "managing" conversation tone and flow [20] remains difficult to assess and explain. Focusing on emojis here as a particularly ubiquitous text augmentation, prior work has shown their use and interpretation to vary considerably across users [20, 52, 53], platforms [52, 53], and cultures [65]. User personality has been studied in this context as well [41, 74].

Overall, untangling the influences on use and interpretation of non-verbal text augmentations remains an open challenge with increasing importance, also for system design: Understanding the varied meanings that users assign to cues such as emojis seems crucial, for example, for building "intelligent" mobile interfaces. These might process messages, including emojis, to suggest or generate adequate responses automatically (cf. Google's smart email replies [36]), possibly conveying the user's own style and personality. As systems grow ever more connected, further devices might also rely on understanding mobile text messages as context information (e.g. intelligent voice assistants at the user's home).

Thus, our research in this paper is motivated both by facilitating human-to-human understanding in mobile text messaging, as well as informing future intelligent mobile communication applications. To do so, we aim to better understand interpretation of text augmentations in context. In particular, we follow recent related work [20, 41] with our focus on emojis and the role of user personality. In contrast to the prior work, we measure user personality via the established BFI-2 questionnaire (not via text analysis of public tweets [41]) and study interpretation of emojis presented in contexts (not isolated [44]) with typical scenarios and recipients. Our results show that user personality influences the choice of emojis in an active interpretation task. Moreover, participants qualitatively provided rich and varying emoji interpretations and comparisons.

In summary, we contribute: 1) a new method for assessing emoji interpretation in context, for given scenarios and recipients, including emoji selection and comparison tasks; and 2) insights into the

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link between user personality and emoji interpretation, based on data collected with an online survey (N=646) using our method.

2 RELATED WORK

An emoji is a pictogram that displays a facial expression, symbol, object, or an action [20], such as ☺️, ❤️, 🎉, 🏃. Emojis are a successor of emoticons (e.g. ;-)) and have become highly popular in computer-mediated communication (CMC), for example in social media and instant messaging [41, 67]. In 2017, five billion emojis were sent on Facebook's messenger every day [10]. Although each emoji has a dedicated Unicode specification, emojis can be rendered differently across platforms (e.g. iOS vs. Android) and applications (e.g. Facebook Messenger vs. WhatsApp Messenger)[1]. Furthermore, the functions and intended meanings of emojis can go far beyond their initial Unicode description [20], as discussed next.

2.1 Intentions of Using Emojis

Non-verbal cues are important for interpretation in communication [11]. Due to the absence of the non-verbal channel, CMC is more ambiguous and hence increases the risk for misunderstandings [56, 70]. Emojis and emoticons can serve as a surrogate for these non-verbal cues in CMC: For example, they can display facial expressions and hand gestures [52, 58, 71], often to convey sentiment [1]. Furthermore, emojis that present entities are often used to substitute words (e.g. "The ☀️ is shining.") [1, 39].

Related work has examined people's intentions of using emojis in text messages: As mentioned before, emojis add emotional or situational meaning, for example, to give information about a vacation ("I'm going on vacation tomorrow ⛺") [2, 20, 32, 37]. Emojis can also be used to convey a more intense expression, such as emphasising that the sender is angry ("I'm really angry 😡") [32]. Moreover, emojis can adjust the tone of a message, as in "See you tonight 😘" [20, 32]. Rodrigues et al. [59] found that negative messages with emojis are perceived as more positive. Emojis can also make a message more engaging or playful by providing additional stimuli, such as in "Let's have coffee? ☕" [20, 38]. Furthermore, emojis are used for conversation management, for example, to continue or end a conversation [2, 20, 38]. Finally, users appropriate emojis for inside jokes or references within a relationship [20, 38]. Therefore, emojis can positively impact on relationships by increasing intimacy and closeness [32, 59]. However, they can also harm relationships when they are misunderstood, which happens quite regularly, as the previous research suggests.

2.2 Interpretation of Emojis

Miscommunication may occur if sender and receiver assign different meanings to a message [16]. Due to the varying ways of use and their graphical display of facial expressions, emojis are often interpreted differently [20, 39]. Moreover, emoji misinterpretation can result from different renderings across platforms, platform versions, and applications [52, 53]. For example, the *smirking* emoji is displayed as 😏 on Apple devices, as 😏 on Google devices, as 😏 on Facebook, and as 😏 on Twitter. In addition, Miller et al. [52, 53] as well as Tigwell and Flatla [69] found that users even disagree on the perceived sentiment of emojis for the same platform rendering.

Intercultural differences in emoji use were identified as another possible cause of miscommunication [5, 43, 65]. Countries vary regarding their emoji preferences: For example, the French seem to use heart-related emoji more often [43]. Moreover, Barbieri et al. [5] found that some emojis are interpreted differently according to the country's socio-geographical characteristics [5]. However, they also indicated that the semantics of the most popular emojis are similar across countries.

Personality could also determine the way emojis – as surrogates of non-verbal cues in CMC – are interpreted, since psychological literature suggests that personality influences the way people show facial expressions [9, 14, 17, 27]. Before presenting previous findings on the relationship between personality and emoji use, we briefly introduce the established Big Five personality model in the following subsection.

2.3 Big Five Personality Traits

Describing people's personality is a major challenge in empirical psychology [61]. The most prominent paradigm in personality research is the Five-Factor Model, also referred to as *Big Five* or *OCEAN* [18, 28, 46]. The model comprises five broad dimensions, which describe individual's tendencies of behaviour and emotions [22–24, 28, 33, 34, 45, 47–49]:

Openness is related to seeking new experiences and novel stimuli. Individuals who score high in openness have wide interests and tend to be more creative as well as artistic.

Conscientiousness describes a tendency to be thorough, organised, and careful. Moreover, conscientious individuals are usually very responsible.

Extraversion is characterised by being outgoing, active, and social. Moreover, extraverted individuals tend to get bored easily when not stimulated externally.

Agreeableness is associated with an individuals' interpersonal relationships and empathy. Individuals who score high in agreeableness tend to be cooperative, socially harmonic, kind, trusting, modest, and try to avoid conflicts.

Neuroticism, also referred to as *Emotional Stability*, describes the frequency of experiencing negative affect. Emotionally instable individuals easily feel anxious, depressed, frustrated, and stressed.

Personality traits are associated with non-verbal behaviour, such as facial expressions and gestures. Previous findings suggest that individuals who score high in extraversion, emotional stability, openness and agreeableness smile more and use more friendly, self-assured and unconcerned facial expressions [9, 17, 27, 50]. Extraverts were also found to gesture more often and more expansively [8, 42].

2.4 Personality and Emoji Usage

So far, only few studies have examined the relationship between personality and emoji use. Marengo et al. [44] asked for participants' self-identification with 91 emojis with the goal of a language-free assessment tool for personality. They found significant correlations with the dimensions agreeableness, extraversion, and emotional stability. Emojis depicting negative affect negatively correlated

[1] www.emojipedia.org

with emotional stability. In contrast, emojis displaying positive sentiments were significantly associated with extraversion. Finally, the authors established a positive link between agreeableness and blushing faces, which they attributed to the tendency of agreeable individuals to present themselves as benevolent.

Li et al. [41] investigated the role of personality traits in emoji usage patterns on Twitter: They estimated personality based on the choice of words in the tweets of each user. They found distinct patterns of emoji use based on personality traits. For example, their results indicate that agreeable users on Twitter use more heart-shaped emojis and only few negative and "dislike" emojis. Moreover, their findings correspond with Marengo et al. [44] in that extraverts use more positive and less negative emojis. Conscientious users also preferred positive over negative emojis while neurotics showed a tendency towards exaggerated facial expressions. Additionally, introverted, agreeable, and emotionally instable users use emojis more frequently than their respective counterparts.

Whereas Li et al. [41] and Marengo et al. [44] focused on the effect of the senders' personality on their usage of emojis, previous results for emoticons suggest that the perceived receiver personality also prompts users to adapt their emoticon usage [74]. However, to the best of our knowledge, these assumptions have not been evaluated for emojis, yet.

2.5 Our Approach

Compared to prior research on emoji use and interpretation, our work differs in a novel combination of four key points to investigate interpretation based on personality and context:

Interpersonal communication: We investigate personality and emojis in text messages in interpersonal communication. This stands in contrast to the use of public tweets in previous work (e.g. [4, 39, 41]). Our focus is further motivated by previous findings, which suggest that emoji usage is different on Twitter versus interpersonal messengers like WhatsApp [67].

Contextualisation: Many existing study approaches involved "standalone" interpretation of emojis without such context factors [53, 69]. Also within the context of tweets (i.e. messages on Twitter), Miller et al. [52] found that there is still a lot of miscommunication. Moreover, reasons for varying use of emojis could result from different user preferences for tweet-worthy content, possibly linked to personality. For example, agreeable users might tweet only positive events, influencing the use of emojis. With our study, we thus present a new method that provides emojis in contexts, with typical situations and recipients, as well as different sentiments of the message. This allows us to investigate the relationship between personality and emojis on a data set that is not biased towards certain content or contexts through self-selection of the users.

Open human interpretation: So far, the semantics of emojis have been studied with a focus on negative vs positive sentiment [39, 52, 53], or with the two dimensions of valence and arousal [69]. Miller et al. [53] also assessed free comments on emojis shown in isolation. Overall, prior work thus focused on interpretation without context [53, 72] and/or along given dimensions [39, 52, 53, 69], or extracted meaning and differences therein automatically from large text data [6, 57]. In contrast, we present a novel emoji comparison task that asks users to freely interpret emojis (and their differences) presented in a given context. Our results indicate that this stimulates users to provide rich interpretations.

Direct personality assessment: Finally, we measure personality with the German version [21] of the established Big Five Inventory-2 (BFI-2) questionnaire [60]. In contrast, Li et al. [41] estimated user's personality from the text content of tweets, using the Linguistic Inquiry and Word Count (LIWC) model [55]. Moreover, Marengo et al. [44] used the short ten item version of the Big Five Inventory questionnaire [29], and showed emojis without context. Therefore, to the best of our knowledge, this paper presents the first published report of a study on personality and emojis in context that assesses personality with an extensive established self-report tool.

3 ONLINE SURVEY

We conducted an online survey to examine the relationship between emoji interpretation and personality. Overall, the questionnaire comprised three parts:

One part presented participants with mock-up chat conversations and a set of emojis. People then had to select emojis which they would have sent along with the given message. With this task we assess "active interpretation" of emojis, that is, interpretation reflected in people's active emoji choices.

In another part, participants were asked to qualitatively describe differences between two emojis within a chat conversation. With this task we assess "passive interpretation" through the description of given emojis presented in message context.

Finally, the third part included demographic information and the German version of the Big Five Inventory questionnaire by Danner et al. [21].

The following subsections motivate and explain our choice of the used chat situations and set of emojis. Afterwards, we describe the survey design in more depth.

3.1 Choice of Chat Situations

In the survey, we used four familiar chat situations based on prevalent text messaging use-cases from related work [30, 68]. In particular, we chose the following four situations to cover a wide range of common text messaging situations within a practically suitable survey duration of about 20 minutes:

For the first situation, we combined Thurlow's most frequent functional orientations, *friendship maintenance* and *salutory* [68], which both describe friendly greetings or words of support to friends. The second situation was motivated by Thurlow's *social and practical arrangement* orientations [68], which cover the widespread use of text messaging for arranging activities or adjusting plans [30]. The third situation addressed the sharing of information, which is included in Thurlow's *informational-relational* and *-practical* orientations [68]. Finally, the fourth situation illustrated a romantic situation.

3.2 Choice of Emoji Set and Rendering Style

Since there are currently more than 1,600 emojis, we had to select a subset for the survey: We based our choice on emoji popularity, considering the Twitter Top 100 emojis[2] and the most popular emojis on Facebook, Instagram, and Apple (November 2018). We

[2] http://emojitracker.com

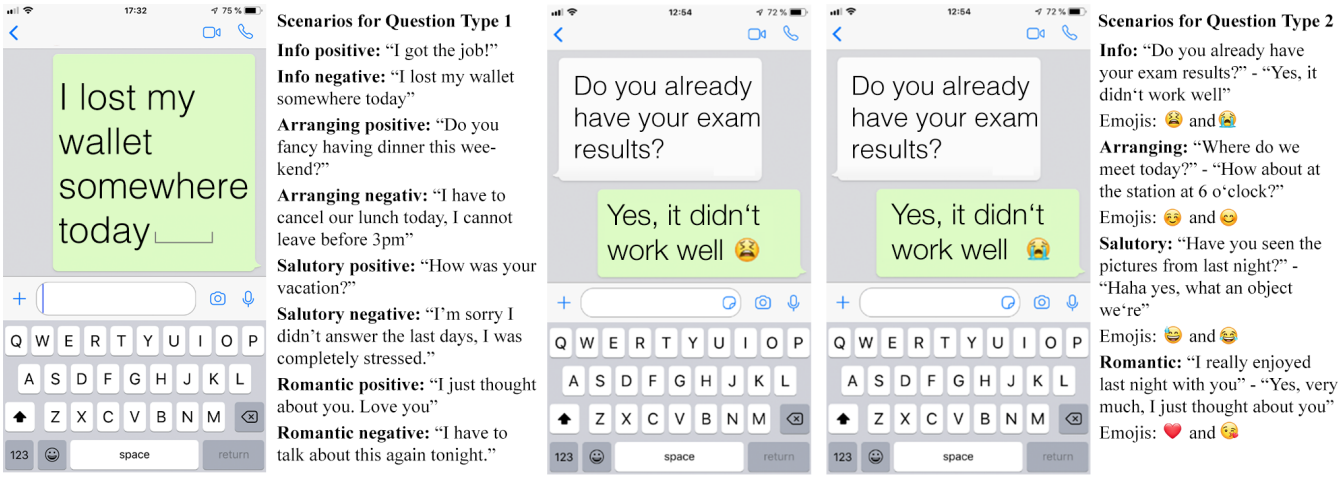

Figure 1: Chat situations presented in our online survey for the first question type *active interpretation via emoji selection* (left) and the second question type *passive interpretation via emoji comparison* (right).

did not base our selection on emoji categories since previous work suggests that "official" categories do not correspond to actual usage [20]. However, we ensured to include all facial expression emojis provided in *WhatsApp*, due to our focus on emotional use of emojis in interpersonal communication [57]. In this way, we ended up with 118 emojis. We presented these emojis with the visuals used in *WhatsApp* for Android, due to the popularity of this app and smartphone operating system [63, 64].

3.3 Survey Design

3.3.1 Question Type 1: Active Interpretation via Emoji Selection. In this question type, our survey presented participants with mock-up chat conversations for different *recipients*, texting *situations*, and different *sentiments*. We henceforth use the term *scenario* to describe a concrete combination of these three context factors.

We asked participants to imagine sending the given text message and to select those emojis which they would add at the position of the placeholder (see Figure 1 left). Participants could only place emojis at the end of the message to simplify the entry, since positioning a cursor on a mobile display is quite a cumbersome task. Moreover, participants were explicitly made aware that they are allowed to concatenate several emojis or to choose no emoji at all. They could also select that they were unfamiliar with the scenario.

Informed by a short prestudy, we decided to present emojis always in the same order: Randomisation would have been annoying here since participants then would have needed to scan the 118 emojis anew for each question. Instead, emojis were presented in a 2D grid in the same order as in *WhatsApp's* emoji keyboard.

We next explain the contexts in more detail: We presented both positive and negative messages for each of the four described situations (see Figure 1 left). Moreover, since the use of emojis likely varies depending on the recipient of the message, we presented each situation with four different recipients: 1) friends, 2) parents, 3) romantic partner, and 4) colleagues. These were chosen based on Battestini et al.'s findings [7] on most popular text messaging recipients. We omitted siblings since we expected similar findings as for friends and favoured to reduce the overall number of scenarios presented. For the romantic situations, only the "partner" was presented as a recipient.

Hence, in total the survey showed: four situations × neg./pos. sentiment × four recipients (yet only one recipient for the romantic scenarios), resulting in 26 scenarios. These were presented in random order.

3.3.2 Question Type 2: Passive Interpretation via Emoji Comparison. In this part of the survey, participants were presented with new chat conversations for each of the four situations described above, in random order. In particular, for each situation, two identical conversations were shown, which only differed in the emoji at the end of the message (see Figure 1 right). Participants were asked to compare and describe differences in the two chat conversations in an open question. This was motivated by gaining insight into: 1) how an emoji in a message is interpreted between different participants and 2) how the interpretation of a message differs depending on the shown emojis.

Recipients were not varied here to maintain a reasonable survey duration, as these open questions otherwise might have taken too long to fill in for many scenarios. Thus, we showed four questions of this type, one per situation.

Each pair of chats required us to choose a pair of emojis, as explained next: In general, we selected emojis, which emphasise the emotional tone of the message (e.g. sad emojis for unsuccessful test results). More specifically, we chose pairs of emojis which were found to be semantically similar. For this, we chose similar emojis based on Pohl et al.'s work on semantic similarity extracted from Twitter data with vector embeddings [57]. Our motivation here was to gain novel insights into the role of context (chat situations) on open interpretation of similar emojis, since prior work asking for free comments had only presented participants with emojis without context [53].

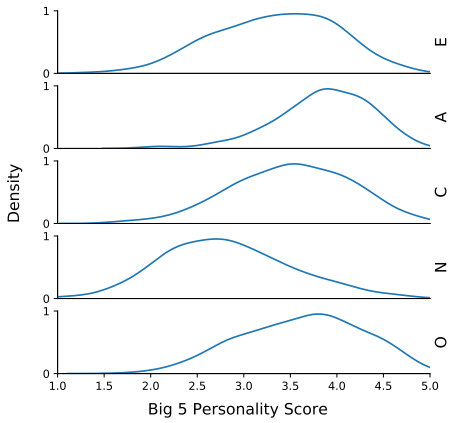

Figure 2: Distribution of the Big Five personality scores in our sample.

3.4 Participants

We recruited participants via university mailing lists, social media, and online survey communities. 646 people completed the survey (74.5% female; mean age 25.7 years, range 17-68 years). 57% of them had an Android-based smartphone, 42% an iPhone and less than 1% used a Blackberry, Windows, or other phone (five did not know their smartphone OS). 64% used their mobile device to fill in the survey. Participants had a high educational level (53% a-level degree, 37% a university degree). Participants had a chance to win one of three €50 vouchers. Figure 2 shows the distribution of their personality scores in the Big Five model.

4 QUANTITATIVE ANALYSIS (QUESTION TYPE 1)

4.1 Data set Overview

Overall, participants selected 21,214 emojis with a mean of 33 per participant (std: 13). Per task, participants selected 1.31 emojis on average (std: 0.78).

Split by recipient, per task participants on average selected 1.08 emojis (std: 0.73) for colleagues, 1.22 (std: 0.67) for parents, 1.41 (std: 0.91) for friends, and 1.48 (std: 1.12) for partners. Split by scenario, per task participants on average selected 1.03 emojis (std: 1.02) for romantic, 1.21 (std: 0.73) for salutory, 1.22 (std: 0.75) for arrangement, and 1.59 (std: 1.04) for information.

Emojis were selected 187 times on average with a large standard deviation of 248, indicating varying relative use of single emojis, as also visible in Figure 3. The long tail shows that many emojis were only used in a few cases. Thus, we decided to focus our quantitative analysis on the top used emojis, which we defined as those which were selected in at least 1% of all tasks shown across all participants (i.e. 1% of 26 scenarios × 646 participants).

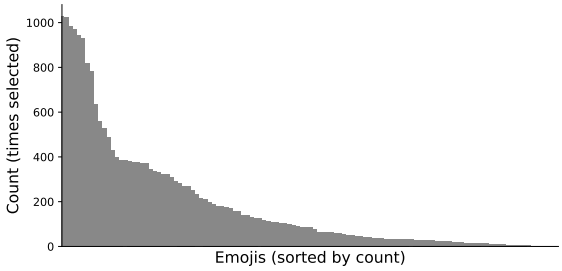

Figure 3: Total number of times (count) each emoji was selected in the study. Each bar represents one emoji, ordered by their counts.

4.2 Emoji Clustering

We grouped these top emojis into clusters to improve interpretability and clarity for this report. Clustering also helps to address the issue that some emojis look very similar and thus selection might be distributed across them simply because they look alike. Note that we address similar emojis in the second question type. The clustering is shown in Table 1, along with emoji selection statistics per cluster.

Clustering emojis is a difficult problem due to ambiguity, as is evident from the variety of approaches and groupings presented in recent related work (e.g. [6, 25, 57]): A common underlying idea is to gather a large text data set and compute high-dimensional vector embeddings [51] for emojis, including their word contexts (e.g. from twitter data [6, 25, 57]). Emojis in the learned high-dimensional space can then be plotted for visual inspection using dimensionality reduction methods such as t-SNE (e.g. [25]).

We based our clustering on the most recent such work by Guibon et al. [31], who compared a variety of approaches. Moreover, they labelled their clusters based on Ekman's six basic emotions [26], which adds a more interpretable perspective on the otherwise purely data-based clusterings. Our cluster labels in Table 1 are based on the labels in this related work.

We refined Guibon et al.'s clusters as follows: Their original clusters only cover 63 face emojis. Thus, we added our other top emojis to the clusters, and merged and split some of those to better account for the extended set. This refinement procedure was conducted by two researchers independently, who then discussed the clusters to reach an agreement. Note that our goal in this paper is not to present a "definitive clustering", yet merely to separate basic groups of emojis for our analysis.

4.3 Analysis

We used generalised linear regression with emoji count as the dependent variable and Big Five personality scores as predictors. In particular, we chose a Quasi-Poisson model, since count data typically follows a Poisson distribution [54]. We used Quasi-Poisson regression instead of Poisson regression to account for over-dispersion in our data (i.e. variance larger than mean). These modelling choices follow an approach from previous work on count data and personality scores in a mobile HCI context [62].

Cluster Name	Total Use	Emojis													
Sadness	5,376	😭	😔	😫	😞	😢	😩	😓	😥	😰	😟	😕	☹️	😖	😣
count		820	785	528	387	382	378	371	325	285	272	251	214	198	180
%		15	15	10	7	7	7	7	6	5	5	5	4	4	3
Hearts	2,930	❤️	😍	😘											
count		1,027	973	930											
%		35	33	32											
Sensory Pleasure	2,373	😊	☺️	🙂	🤗										
count		985	559	490	339										
%		42	24	21	14										
Contentment	2,107	😁	😑	😃	😎	😄	😆	😀							
count		431	399	373	323	232	178	171							
%		20	19	18	15	11	8	8							
Excitement Noface	1,325	🎉	💪												
count		946	379												
%		71	29												
Others Monkey	1,029	🙈													
count		1,029													
%		100													

Cluster Name	Total Use	Emojis			
Irony	984	🙄	🙃	😏	😌
count		345	271	188	180
%		35	28	19	18
Contempt	945	😕	😒		
count		637	308		
%		67	33		
Excitement	542	😊	🤩		
count		331	211		
%		61	39		
Others Sun	384	🌞			
count		384			
%		100			
Fear Surprise	290	😱			
count		290			
%		100			

Table 1: Overview of the emoji clustering used in our quantitative analysis. The clusters and cluster labels are based on the recent work by Guibon et al. [31] and their consideration of Ekman's six basic emotions [26].

Emoji Cluster	Total Use			Quasi-Poisson Regression Coefficients $\exp(\beta)$															
				Extraversion			Agreeableness			Conscientiousness			Neuroticism			Openness		
	all	pos	neg	all	pos	neg	all	pos	neg	all	pos	neg	all	pos	neg	all	pos	neg
Hearts	2,930	2,436	494	**1.16**	**1.15**	1.21	**1.36**	**1.33**	**1.50**	1.04	1.03	1.10	**1.19**	**1.21**	1.14	**0.85**	0.89	**0.70**
Contentment	2,107	1,598	509	0.89	0.91	0.84	**0.74**	**0.72**	0.84	1.06	1.10	0.97	**0.77**	0.82	**0.63**	1.10	1.12	1.01
Excitement	542	539	3	1.25	1.25	-	1.15	1.16	-	1.23	1.23	-	1.10	1.10	-	0.94	0.94	-
Excitement Noface	1,325	1,322	3	1.01	1.01	-	1.21	1.21	-	1.02	1.02	-	1.06	1.06	-	0.98	0.98	-
Fear Surprise	290	34	256	1.13	-	1.13	1.15	-	1.19	0.92	-	0.97	1.23	-	1.18	1.09	-	1.12
Contempt	945	1	944	0.97	-	0.97	0.93	-	0.93	0.90	-	0.90	0.93	-	0.92	1.00	-	1.00
Sadness	5,376	12	5,364	1.07	-	1.07	1.03	-	1.03	1.04	-	1.04	**1.25**	-	**1.26**	1.03	-	1.03
Sensory Pleasure	2,373	2,334	39	0.90	0.90	-	1.18	1.18	-	1.11	1.10	-	**1.22**	**1.23**	-	1.12	1.11	-
Irony	984	575	409	1.12	1.07	1.18	0.98	1.01	0.94	0.95	0.90	1.05	1.00	1.03	0.94	0.89	1.03	0.72
Others Monkey	1,029	90	939	0.83	-	0.87	1.17	-	1.14	1.08	-	1.06	0.91	-	0.88	1.04	-	1.03
Others Sun	384	384	0	1.12	1.12	-	1.38	1.38	-	1.09	1.09	-	0.85	0.85	-	1.09	1.09	-
Whole Data set	21,214	11,132	10,440	1.05	1.03	1.06	**1.11**	1.11	1.07	1.04	1.04	1.00	**1.10**	**1.12**	**1.10**	0.98	1.02	0.98

Table 2: Summary of results from the Quasi-Poisson regression analysis: From left to right, this table shows the cluster name, the total emoji counts from this cluster in both/positive/negative scenarios, and the exponentiated regression coefficients for each Big 5 personality factor. These indicate the change in emoji counts per one point increase in personality score. For example, 1.36 for *Agreeableness* for cluster *hearts* (all) indicates that if person *A* scores one point higher on *Agreeableness* than person *B*, we expect *A* to use 36% more *hearts* emojis (all else being equal). Conversely, coefficients < 1 indicate a decrease (e.g. 0.75 means -25%). Significant predictors in the models are highlighted. Dashes ("-") mark cases for which we did not compute regression models due to very few data points (use counts <1% of all tasks shown across all participants). The last row shows results for the whole data set. Note that this includes emojis which are not part of any cluster. Thus, the total use counts are higher than the sums of the cluster counts.

Since this is an exploratory study, and not a confirmatory one, we computed several regression models: In particular, per data (sub)set (all data, positive scenarios only, negative scenarios only), we computed one such model for each emoji cluster and one for total emoji use overall. We report significance at the $\alpha = 0.05$ level, using Benjamini-Hochberg correction for all p-values, to account for the fact that we computed multiple models in our exploratory analysis.

4.4 Results

Table 2 summarises the results. Our following report refers to the model coefficients $\exp(\beta)$, which indicate the change in emoji counts per one point increase in personality score. For instance, a coefficient of 1.36 for *Agreeableness* in the model for cluster *hearts* indicates that if a person *A* scores one point higher on *Agreeableness* than a person *B*, we expect *A* to use 36% more *hearts* emojis (all else being equal). Conversely, coefficients smaller than one indicate a decrease (e.g. 0.75 means -25%).

In the models on total use (last row in Table 2), significant predictors were *Agreeableness* and *Neuroticism* with 10-12% increase of emoji use per point increase in these personality scores. For models for use counts of emojis from specific clusters, we found significant predictors for:

- *Extraversion* and *hearts* (+16% use of heart emojis per point increase in that personality score)
- *Agreeableness* and *hearts* (+33% for positive scenarios, +50% for negative ones), as well as *contentment* (-26% for all and -28% for positive scenarios)
- *Neuroticism* and *hearts* (+19% for all and +21% for positive scenarios), *contentment* (-23% for all and -37% for negative scenarios), *sadness* (+26% for negative scenarios), and *sensory pleasure* (+23% for positive scenarios)
- *Openness* and *hearts* (-15% for all and -30% for negative scenarios)

Thus, described in terms of the emoji clusters, increased use of *hearts* emojis was associated with higher *Agreeableness* (+36%), *Neuroticism* (+19%), and *Extraversion* (+16%) – while less frequent use was associated with higher *Openness* (-15%). For *contentment* emojis, less frequent use was associated with higher *Agreeableness* (-26%) and higher *Neuroticism* (-23%). Moreover, for *sadness* and *sensory pleasure* emojis, more frequent use was also associated with higher *Neuroticism* (+25% and +22%).

In terms of directionality, *Agreeableness* and *Neuroticism* appeared as significant predictors with both positive and negative direction, predicting higher and lower use for different emoji clusters (higher *hearts*, lower *contentment*; for *Neuroticism* also higher *sadness* and *sensory pleasure*). In contrast, *Extraversion* only appeared as a significant predictor for higher use (of *hearts* emoji), while *Openness* appeared only for lower use (again, of *hearts*).

To summarise, *Neuroticism* was the personality factor that appeared most often as a significant predictor for emoji use in our data (significant for four emoji clusters and overall emoji use), followed by *Agreeableness* (significant for two emoji clusters and overall use). *Extraversion* and *Openness* each appeared as a significant predictor for emoji use for one cluster, respectively.

5 QUALITATIVE DATA ANALYSIS (QUESTION TYPE 2)

5.1 Coding Procedure

We coded participants' free comments on the meaning and differences between the two chats per scenario in question type two (see chats in Figure 1 right). The first three authors reviewed 8 % of participants' answers for each scenario to derive a coding scheme per scenario. The coders assigned codes independently first, and then discussed these to construct a code book. In a second step, a random sample of another 8 % of the answers for each scenario was coded by the three coders independently, using the code book. The inter-coder agreement was Fleiss' $\kappa = 0.83$ on average across the four scenarios. Since often codes differed due to small language differences and favouring different almost synonymous adjectives (e.g. disappointed vs disappointing), we saw the need that all three annotators met to manually compare and discuss the coding of each response. To eliminate any discrepancies we discussed all inconsistencies until consensus was reached and updated the code book accordingly. The remaining data set was split between the three coders for the final coding. Overall, codes were chosen on a fine-grained level, to preserve participants' choice of words.

5.2 Results

Figure 4 summarises the results by presenting the top five most common codes for both chats for each of the four scenarios. The last plot on the right additionally shows how often participants explicitly stated that they saw no difference between the two chats in a scenario. To read the figure, compare the occurrence of individual words between the two chats (C1, C2) per scenario.

Interesting differences emerge: For example, for *Info*, both emojis dominantly convey sadness. However, the emoji 😫 in C1 also resulted in an increased perception of anger, compared to the emoji 😭 in C2 (compare second bar in C1 and fifth bar in C2). For instance, one participant wrote: *"C1 expresses more aggression or anger, while C2 looks more like desperation and resignation."*[3]

For *Arrange*, interpretation seems to vary little between the two chats. However, participants speculated about different relationships of the chat partners: The emoji 😏 in C1 painted the picture of a dating context for some users (fifth bar in C1), whereas the emoji 😊 in C2 conveyed friendship (fourth bar). For instance, one participant wrote: *"Chat 1 seems more insecure or shy. I would interpret this in the way that the person is somewhat more excited ahead of the meeting maybe like ahead of a date. Chat 2 in contrast seems like the person just wanted to be nice."*

In the *Salutory* scenario, there was a clear difference in interpretation, with the emoji 😅 in C1 conveying embarrassment, shame, and awkwardness. In contrast, the emoji 😂 in C2 resulted in participants perceiving the situation as overall amusing. For example, one participant who imagined herself in this context wrote: *"Left [C1]: We look super awkward and I find it funny but I'm also a bit ashamed about the picture. Right [C2]: We just look funny and I also find it amusing."*

Similarly, in the *Romantic* scenario, there was a clear difference in interpretation between the two emojis: With the emoji ❤️ in C1, the situation was predominantly seen as a couple texting with each other, whereas with the emoji 😘 in C2 people interpreted relationships that varied from friends to flirts and dating contexts. For instance, one person wrote: *"For me the red heart is very romantic. In one [C1] it is a deeper affection than in two [C2]. Although two also shows intimacy, it could also be meant in an amicable way. The emoji in two is also more abrupt, like an end to the conversation."*

Finally, the number of times participants explicitly stated that there was no difference between C1 and C2 shows that the *Arrange* scenario stands out: Here, the two emojis resulted in the least variation in interpretations, compared to the other three scenarios. Conversely, these counts indicate that the emojis in the other three scenarios led to clearly differently perceived meanings.

[3] All quotes translated from German.

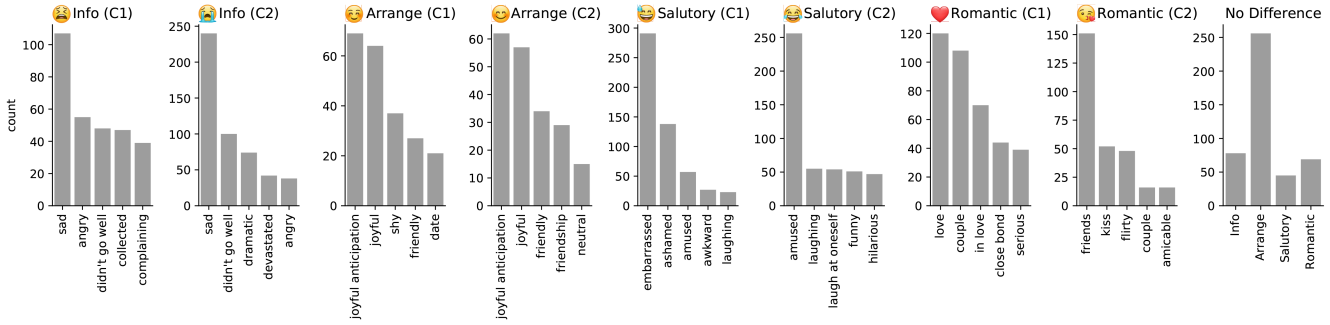

Figure 4: Top five most commonly occurring codes from the coding of participants' open comments, for each of the four different emoji comparison scenarios presented in our survey (in Question Type 2). Each pair of plots shows the top codes for one scenario, for chat 1 and 2. The last plot to the very right shows the number of times participants explicitly stated that they see no difference in each of the four comparison scenarios.

6 LIMITATIONS

Our sample is biased towards female users and younger people. Since related work found that females use more emojis than males [43, 66], the results obtained here should not be interpreted as representative of the whole population without further investigation.

With regard to the selection task, people's choice of emojis could differ for texting in their everyday lives. Future work could consider employing an experience sampling method (e.g. triggering a question after sending a message with emoji). However, our novel survey design allowed us to cover emoji interpretation in interpersonal communication without the privacy issues of observing participants' actual messaging, and in a way that is comparable across all participants.

For emoji comparisons we omitted recipients as context to keep the study duration acceptable. A dedicated study could investigate our novel comparison task for different recipients as well. However, omitting recipients here triggered many participants to speculate on the relationship of the chat partners. This presents an interesting aspect of emoji interpretation in itself, as our results indicate differences in perceived relationship due to emojis (e.g. romantic vs friendship).

Our survey presented emojis in a grid with fixed order, which might influence selection. However, the correlation between emoji rank in the presentation and total count of selections was only 0.11, indicating no considerable order effects.

To study interpretation in context, we presented a limited set of scenarios. Texting in everyday life likely includes further context influences and scenarios not covered in this study. However, since only few participants stated that they did not know a scenario in the survey, we conclude that we indeed covered typical mobile texting scenarios.

Finally, while we investigated a widely used subset of emojis, it might be possible that some rarely used emojis also show interesting relationships to personality.

7 DISCUSSION

7.1 The Many Meanings of Emoji

Our results confirm previous findings regarding the ambiguity of emojis [52, 53, 69]. Different interpretations are not only related to sentiment (as examined by Miller et al. [52]) but also to semantics. Most importantly, both our qualitative and quantitative results show that the usage and interpretation of emojis greatly varies even if participants are presented with a predefined context:

Our passive interpretation task stimulated rich and varying interpretations for one and the same emoji, as well as between semantically similar emojis. For example, participants made widely differing presumptions about the relationship of sender and receiver, solely based on different emojis at the end of the same text message.

Similarly, considerable differences in interpretation occurred for single emojis: For instance, while the majority of participants saw the loudly crying emoji 😭 as a clear indicator for sadness, others perceived this emoji as sarcastically or exaggerated.

Overall, these varying interpretations of emojis in given contexts emphasise that there is more to emoji interpretation than context. Besides influences of the communication partners' intimate knowledge and inside jokes [20], our quantitative findings indicate that *personality* influences how users interpret emojis in context, which we discuss in the following subsections.

7.2 Personality and Overall Usage of Emojis

In general, participants concatenated (several) emojis to their messages for the majority of scenarios. In correspondence with Li et al. [41], agreeable and emotionally instable users seem to add more emojis to their messages. However, in contrast to their results, our findings do not indicate a relationship between introversion and total emoji usage. Li et al. [41] assumed that this effect is based on introverts' preference for implicit expressions. A possible reason for our contradicting findings could be that it is easier for introverts to express themselves directly in interpersonal conversation (as examined in this paper) in contrast to publicly available tweets (as examined by Li et al. [41]).

More generally, the frequencies of emojis in our data set overall imply that emoji choice in interpersonal communication differs from emojis used on public platforms such as Twitter [5, 57, 67]. Although these frequencies only refer to specific scenarios and not users' natural use, they still underline the importance of studying emojis in interpersonal communication to better understand their interpretation.

We did not find a significant link between conscientiousness and emoji usage. Agreeableness, extraversion, and neuroticism are more related to affective processing, while openness and conscientiousness are more related to cognitive processing [19]. Thus we can expect less effects related to the latter two factors.

7.3 Influence of Personality on Intentions of Using Emojis

In our Related Work section, we presented different intentions of using emojis. Our findings indicate that personality influences how users try to realise these intentions.

7.3.1 Adding Emotional Meaning. The most common intention of emojis in CMC is adding emotional meaning to convey sentiment, acting as a surrogate for facial expressions [1]. Our findings indicate that the choice of emojis reflects the user's personality by showing similar tendencies of experiencing affect. Individuals who score high in neuroticism experience more negative affect, in particular anxiety, insecurity, and self-pity [17]. It thus seems fitting that neurotic participants used more emojis depicting sadness – and less emojis displaying contentment. However, it is interesting to note that neurotic participants also used more sensory pleasure emojis. A possible reason could be that these emojis display positive emotions in a more reserved way, underlined by our participants' qualitative descriptions of blushing emojis as more "shy" or "a neutral polite standard emoji". Hence these emojis could reflect the absence of expressive gestures associated with neuroticism [14].

Interestingly, agreeable participants used less contentment emojis although agreeableness is positively linked to friendly facial expressions [9]. However, our findings indicate a tendency for agreeable people to use more sensory pleasure emojis, as also found by Marengo et al. [44]. Although not significant, we can observe similar trends for other positive emojis, such as excitement and sun. Therefore, it seems plausible to assume that agreeable users might have preferred these indicators for positive sentiment over the ones from the contentment cluster. Thus, we see an opportunity for future work to further study the relationship between agreeableness and a range of emojis with positive sentiment in a hypothesis-driven approach.

Apart from the hearts cluster, we could not find a significant association between emoji usage and extraversion. Although related work indicates that extraverted individuals tend to smile frequently and show more friendly facial expressions [9], our findings do not suggest a similar relationship between extraversion and content or pleasure emoji usage. A possible explanation might consider that extraverts are able to express their feelings more easily [17]. Thus, they might be more used to directly describing their emotions in the text and hence might not feel the need to emphasise them via emojis.

7.3.2 Adjusting and Intensifying the Tone of the Message. Our participants used more emojis in positive scenarios than in negative ones, in line with previous results for emoticons by Rodrigues et al. [59]. However, while emojis with negative sentiment (e.g. sadness, contempt) are almost exclusively used in negative scenarios, positive sentiment emojis (e.g. contentment, hearts) are used in both positive and negative scenarios. Moreover, emojis depicting excitement or sensory pleasure are primarily used in positive scenarios.

These findings underline that emojis are often intended to intensify or adjust the tone of the message [20, 32]. In particular, it seems that sad and contemptuous emojis as well as sensory pleasure emojis are primarily used to reinforce the negative or positive tone of the message, respectively. In contrast, contentment and heart emojis are used to moderate negative messages.

Participants also often used the playful and less negative *see no evil-monkey* 🙈 for such moderation. Although we did not find significant predictors for this, our results provide preliminary indications that this strategy was particularly adopted by agreeable participants. This could be explained by agreeable individuals' tendencies towards harmonic and socially cooperative behaviour. Hence, we suggest that future work further examines the relationship between agreeableness and moderating negative message sentiment through positive and playful emojis.

7.3.3 Increasing Intimacy and Maintaining Relationships. The cluster most frequently associated with personality in our study comprises heart-related emojis. These emojis are usually used to express intimacy [32]. Here, the strongest effect was found for agreeableness, confirming previous findings by Li et al [41]. This also fits to the known importance of interpersonal relationships for agreeable individuals.

Moreover, it is noteworthy that agreeableness is the only personality dimension which is also significantly associated with heart-related emojis for *negative* scenarios. Since agreeable individuals tend to be modest and to avoid conflicts, they might consider heart emojis in particular to adjust the tone of their message (cf. above), and to convey positive emotions to the recipient despite of the negative text message.

Moreover, extraversion is also positively associated with the use of heart-related emojis in our results. Although Marengo et al. [44] and Li et al. [41] did not find a direct link between heart emojis and extraversion, this relationship corresponds with their results that extraverts use more positive emojis. Since extraverts are also characterised by social spirit and an extensive network, they might select these emojis to maintain their relationships.

Individuals who score high in neuroticism also tended to use more heart-related emojis in our study. A possible reason could be that emotionally instable individuals tend to be more insecure in relationships, experiencing more anxious and depressed emotions. They might thus consider to select these emojis to express their affection and to provoke mutual approval.

Finally, our results indicate a negative association between openness and heart-related emojis. To the best of our knowledge, this has not been discussed in related work. Hence, we recommend to explore this relationship more closely in future work.

7.4 Implications for Mobile Applications

Several apps have already recommend emojis to users, for example based on recent use or the immediate text content (e.g. Google's keyboard app[4]). Reply generation could be extended to include emojis as well (cf. [36]). Our findings suggest that personality could be taken into account as an additional factor in emoji recommenders. For example, such a system might consider that heart emojis can be recommended for agreeable users even in chat situations with negative sentiment.

Moreover, our qualitative findings indicate that users tend towards rich interpretations of differences in concrete contexts, even for seemingly very similar emojis, like 😊 and 🙂. Hence, it might be useful for mobile messenger apps not only to consider the sender's personality but also the receiver's. For example, an emoji recommender could suggest to avoid very exaggerated emojis (e.g. 😭) since the chat partner, say, a more neurotic person, might perceive it as more dramatic than intended by the sender.

Our findings also inform machine understanding of text messages, such as chatbots, which are often used in service areas [73]. Based on the similarity attraction paradigm [3, 13], users might prefer bots reflecting their own personality. Hence, our results could also be used to inform chatbots to send messages with emojis chosen based on the user's personality.

These ideas require applications to know the user's personality. This could either be achieved by filling in a questionnaire, for instance, as part of an app's enrolment procedure. Alternatively, systems might be able to estimate personality from user behaviour, including from emoji use itself (cf. [44, 62]). For example, this could be implemented as a keyboard app that counts entered emojis to estimate personality and inform adaptive messaging apps or chatbots as described above.

7.5 Implications for Future Research

Regarding methodology, our survey design with the two presented question types (emoji selection and comparison) provides a new method for assessing emoji interpretation in concrete message contexts. Future research can build on our design here, for example, to study how several emojis are combined in different contexts, possibly again in combination with personality assessment.

Moreover, the codes obtained from participants' open comments in our comparison task can inform future study designs by providing answer categories: For instance, we could present similar chats and ask users to select the most appropriate codes (i.e. short descriptions) from a list (code book). The influence of personality on these answers could be analysed quantitatively as well, similar to our analysis for the emoji selection task. In contrast to related study tasks in prior work, this presents a new interpretation task in which the semantic dimensions are first derived from contextualised open comments by users (i.e. our code book), not from one or two dimensions from the literature (e.g. pos/neg, valence & arousal).

Related, our results from the open interpretation inform data-driven similarity modelling for emojis, since we found that users may interpret even (in these models) similar emojis rather differently. This suggests that future work could include interpretations from users with different personalities, for example to derive personalised similarity measures that reflect the interpretations associated with the user's personality.

Finally, our presented exploratory analysis of the influence of personality on emoji selection can guide further studies: For example, future work could use the significant associations in our study to form and validate specific hypotheses. These might also include, for example, studying personality influences in further messaging contexts, for actual chats, for different population samples (e.g. female and male [15]), for other non-verbal cues in text-based communication (e.g. stickers[75], gif [35]), and so on. Our contexts presented here can also be used to investigate real world messaging: Examining real world interpersonal messaging and direct personality assessment entails severe privacy issues (e.g. logging private messages). Instead of directly analysing users' messages, participants could be presented with a list of all messages containing emojis and be asked to assign to each message one of our contexts defined here.

8 CONCLUSION

Emojis are commonly used as non-verbal cues in mobile text messaging. However, they may also lead to misunderstandings since their intended meaning often remains ambiguous. This motivates research on emoji interpretation, both to avoid misunderstandings in computer-mediated human communication, as well as for intelligent systems that need to interpret text messages including emojis. We discussed several concrete implications for mobile applications and research based on the results of our online survey (N=646).

Among other factors, user personality has been linked to the understanding of emojis. However, prior work studied this for emojis isolated from message context, or estimated user personality through text analysis on public Twitter data. In contrast, we presented the first study on the influence of personality – measured via self-report (BFI-2) – on understanding of emojis presented in concrete mobile messaging contexts.

As a key finding, our results show that personality factors influence the choice of emojis in such contexts, with interesting differences for emojis from different semantic clusters and message sentiments. Moreover, our data shows that choice and interpretation of emojis varies greatly between users, even if emojis are presented in a defined message context. This motivates further research into personality and emoji use. Here, our exploratory study provides several pointers for follow-up investigations on specific associations of personality and emoji clusters of interest.

Finally, discussing our findings in comparison to related work clearly shows that emoji interpretation differs between public messages (e.g. on Twitter) and our context of interpersonal communication (text chat). As detailed in our discussion, we thus see plenty of opportunities to further study personality and emoji interpretation in different contexts, guided by the insights of this work.

9 PROJECT RESOURCES

Visit the project website for access to the study data, coding, and analysis files: https://www.medien.ifi.lmu.de/personality-emojis

[4] https://play.google.com/store/apps/details?id=com.google.android.inputmethod.latin

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