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Interactions between text content and emoji types determine perceptions of both messages and senders

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ABSTRACT

Emoji increasingly feature alongside written language in interpersonal communication. Boutet et al. (2021) showed that negative-face emoji led to a negativity effect on perceptions of message tone and senders' mood. We extended their design, considering the role of non-face emoji and the impact of text content and emoji on message clarity. We utilised a 3 (sentence valence: negative, neutral, positive) × 5 (emoji type: no emoji, negative face, neutral face, positive face, object emoji) quasi-experimental design and online survey method. Sixty participants each processed 60 stimuli counterbalanced across conditions, rating messages' emotional tone and clarity, and senders' warmth and emotional state. Cumulative link mixed models were used to analyse responses. We found that sentence valence and emoji type interact, influencing message emotionality and clarity, and perceived sender warmth and state. The congruency of text and emoji was particularly important; results showed that incongruent emoji detracted from message clarity vs. no emoji (or congruent emoji). Congruent emoji typically amplified emotional perceptions of messages and senders. Object emoji were most influential when text was either neutral or positive. Results were consistent with models such as the EASI framework (Van Kleef, 2009), and suggest that compositionality extends to representations of text + emoji.

1. Introduction

Pictographs are increasingly commonplace within online communication, used to convey different aspects of non-verbal communication, such as emotional expression, social cues, and mood (e.g., Walther & D'Addario, 2001). Emoji are a particular example of such pictographs – image-based Unicode symbols, e.g., (Kaye, Malone, & Wall, 2017; Kralj Novak, Smailović, Sluban, & Mozetič, 2015). Emoji – and their predecessors, emoticons, e.g.,:),^_^ – have been postulated to aide senders' personal expression and to determine emotional tone (Kaye, Wall, & Malone, 2016). Despite their near-ubiquity in everyday life, the processing of emoji –and their inter-relationship with accompanying text – has received relatively little attention. The purpose of the current study was to investigate the inter-relationship between the emotional content of written text and emoji type on perceptions of both messages and their senders.

1.1. *Communicating emotion in a digital world*

Interpersonal communication in a face-to-face context is typically rich in non-verbal information; for example, facial expressions can influence the understanding of a communicator's message and emotional state (e.g., Ekman, 1992, Knapp & Hall, 2002). Emoticons typically mimicked real-world facial expressions of emotion – e.g.,: (; research by Lu et al. (2016) and Walther and D'Addario (2001) suggested that emoticons influence how sender's emotional state was perceived. However, as in real-life, there is nuance, subtlety, and often contrast in how 'messages' and 'expressions' are expressed. For example, the congruency message content and the accompanying (digital) expression is important – perceptions of emotional tone are typically enhanced when pictographs are congruent with associated messages (e.g., Derks, Bos, & von Grumbkow, 2008a, 2008b; Filik et al., 2016; Huang, Yen, & Zhang, 2008; Luor, Ted, Wu, Lu, & Tao, 2010). Incongruency between content and expression incurs cost, as indexed by message ambiguity (e.g., Sarkar, Shetty, & Humstoe, 2014) and/or intensity (Thompsen & Foulger, 1996).

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Current digital interpersonal communication is more likely to involve an exchange of text + emoji as opposed to text + emoticon (e.g., Boutet et al., 2021; Sampietro, 2020). Therefore, it is important to explore whether the findings obtained from earlier emoticon studies tally with contemporary studies of text + emoji. Boutet et al. (2021) present a clear summary of the arguments as to why there may be differences between the text + emoticon and text + emoji relationships: emoji are feature-rich and more realistic relative to emoticons (e.g., Bai, Dan, Mu, & Yang, 2019; Coyle & Carmichael, 2019; Kralj Novak et al., 2015), emoticons are typically off-vertical and less-representative of typically-vertical faces and potentially more-challenging for observers to extract emotional information (e.g., Eimer & Holmes, 2002).

1.2. Emoji, written information processing and interpersonal attribution

Relatively few studies of the interactive effects of sentence content and emoji type have been conducted (e.g., Boutet et al., 2021; Daniel & Camp, 2018; Hand, Kennedy, Filik, Pitchford, & Robus, 2022; Kralj Novak et al., 2015; Neel, McKechnie, Robus, & Hand, accepted; Robus, Hand, Filik, & Pitchford, 2020). Non-specifically, previous studies have been limited by their: (lack of variety of) emoji conditions, number of experimental items, (underpowered) analytical techniques, non-holistic outcome measures, or a combination thereof.

As stated previously, interpersonal communication relies upon verbal and non-verbal information, and there is extant evidence to suggest that non-verbal information shapes social perceptions (e.g., Frith & Frith, 1999; Willis & Todorov, 2006). Individuals who smile with greater frequency and/or intensity are typically perceived as being 'warmer' (e.g., Bayes, 1972). It is not yet clear, however, whether emoji – as a proxy for such real-world expression – would lead to a similar effect in the perception of senders of online digital communications. Studies involving emoticons and social media profiles (e.g., Wall, Kaye, & Malone, 2016) would suggest that individuals who use positive emoticon more frequently are perceived more-positively in terms of desirable social traits. However, such communication on social media sites (and interpretation thereof), where profile owner and observer perceptions and behaviours are shaped by personal motivations and individual characteristics (e.g., Hand & Scott, 2022; Hand, Scott, Brodie, Xilei, & Sereno, 2021; Scott et al., 2020; Scott, Wiencierz, & Hand, 2019), may not generalise beyond these social media platforms. Indeed, in professional contexts, positive emoticons did not positively-impact perceptions of sender warmth, and negatively impacted perceptions of competence (Glikson, Cheshin, & Kleef, 2018).

The congruence of verbal and non-verbal information during face-to-face interactions has been shown to be central to processing efficacy (e.g., Burgoon, Buller, & Woodall, 1996). If it is the case that emoji provide additional contextual information for verbal messages, then it is possible that congruency/incongruency between written messages and their paired emoji may impact the processing of those messages and attributions regarding their senders. Boutet et al. (2021) conducted an experimental investigation into the relationship between the emotional content of written sentences and the expression of facial emoji on participants perceptions of sender emotional state, sender warmth, and eye movement processing behaviours. Boutet et al.'s work advanced the work of, for example, Robus et al. (2020) by expanding the array of emoji used and carefully manipulating the emotional valence of written sentences across a large item-set that was representative of real-world digital communication (i.e., short, 'text message'-style communications). Due to their expansive design, Boutet et al. were able to explore the simultaneous effects of sentence valence and emoji type and determined the cost/benefit of incongruence/congruence between them.

Boutet et al. (2021) recruited thirty-eight participants; Stimuli were arranged around a 3 (sentence valence: negative, neutral, positive face) × 4 (emoji type: no emoji, negative face emoji 😠, neutral face emoji 😐, positive face emoji 😀) repeated measures design. The emoji selected had previously been determined to have unambiguous valence (Jaeger, Roigard, Jin, Vidal, & Ares, 2019), and emoji were always sentence-final as this was both ecologically valid (e.g., Provine, Spencer, & Mandell, 2007) and in-line with previous research (e.g., Robus et al., 2020). Participants were presented with 108 experimental items (9 items per sentence-emoji condition). After reading each experimental stimulus (eye movement behaviours were recorded during reading), participants rated the emotional state of the sender from −4 to 4 and provided their perception of the sender's warmth from 0 (not at all warm) to 5 (extremely warm).

Boutet et al. (2021) found a significant interaction between sentence valence and emoji type on perceptions of sender emotional state; the nature of the interaction was such that negative emoji resulted in were associated with negative perceptions of sender state regardless of text valence. Positive emoji were typically only associated with sender-positivity if texts were either (congruent) positive or neutral. Neutral emoji were typically seen as reflective of a sub-positive sender, especially when paired with negative sentences. Boutet et al. also presented evidence of a sentence valence × emoji type interaction on perceptions of sender warmth; this interaction seemed to be characterised by negative sentences + negative emoji resulting in lower perceived warmth than positive sentences + negative emoji and neutral sentences + negative emoji (which did not seem to differ from one another). Positive emoji added to positive texts resulted in inflated perceptions of warmth relative to neutral texts + positive emoji, which in turn were associated with greater perceived warmth than negative texts + positive emoji.

Boutet et al. (2021) found that emoji influenced perceptions of sender's emotional states, particularly in the case of negative emoji, and that emoji influenced the perceived emotionality of the 'verbal' messages. Neutral texts appeared to be vulnerable to the effects of emoji – that is, the presence of an emotionally-valent face emoji swayed participants perceptions of the message. Boutet et al. also showed that positive emoji enhanced warmth; however, due to their experimental design, it is quite difficult to ascertain the extent to which negativity and/or neutrality (sentence-emoji interplay) influenced perceptions of warmth.

1.3. Theoretical perspectives

Our work was informed in part by the Emotions as Social Information model (EASI; Van Kleef, 2009). The EASI model argues that facial expressions of emoji can influence individuals by either or both of two pathways – inferential processes and/or affective reactions. It may be the case that observers experience an emotional contagion based on the sender's use of emoji (e.g., Hatfield, Cacioppo, & Rapson, 1993). Furthermore, the EASI model transcends face-to-face interactions and applies to digital communications, such as those involving text + emoji stimuli (e.g., Erle, Schmid, Goslar, & Martin, 2021). Considering face and non-face emoji, we touch upon the suitability of this model for understanding perceptions of messages and senders.

From a representational perspective, proponents of compositionality argue that message-meaning is determined by the meaning of its constituent parts (e.g., Szabó, 2019). However, there remains debate as to whether visual representations contain the requisite 'syntactic structure' required for compositional semantics (i.e., Fodor, 2007; Greenberg, 2011). Semantic theories for visual representations are fundamentally different from those applied in formal semantics for language. Researchers have argued that indeed pictures represent information in a way that is fundamentally distinct from declarative sentences (Heck, 2007). Our research will inform as to the interplay between text and pictographical information in generation of representations.

1.4. Methodological and analytical considerations

Boutet et al. (2021) used a −4 to 4 ordinal scale for perceptions of sender state and 0 to 5 for perceived sender warmth. The use of different response scales, and in particular, the lack of a 'negative' (i.e., sub-zero) endpoint for warmth ratings may be problematic. The spatial numerical association of response codes (SNARC) effect was first demonstrated by Dehaene, Bossini, and Giraux (1993), evidencing the representation of numbers from left-to-right in order of least-to-greatest magnitude. Fischer (2003) extended this SNARC effect to suggest that the number line extends further leftward to include negative integers. Alternatively, it has been posited that negative numbers are represented in two-dimensional space by their magnitude (dominant) and polarity (subordinate; Shaki & Petrusic, 2005). Shaki and Petrusic (2005) argue that negative numbers have a number-line representation but only when presented in comparison to positive numbers. They give examples of the numbers "-9 and −8" being coded as "small ++" and "small +" and the numbers "8 and 9" being coded as "large +" and "large ++" (Shaki & Petrusic, 2005, p.936), arguing that there is an important effect of congruence with the intention to select smaller/larger values. Also important are semantic congruity effects (e.g., Banks, Fujii, & Kayra-Stuart, 1976) – that is, the association between left/right space and numbers of differing magnitude. A body of work demonstrates that number and space present dimensional overlap (Gevers et al., 2010; Kornblum, Hasbroucq, & Osman, 1990). There is clear evidence of the association between numeric representations/processing associated with number and verbal concepts such as "small" and "left" and "large" and "right" (e.g., Gevers, Verguts, Reynvoet, Caessens, & Fias, 2006; Santens & Gevers, 2008). Proctor and Cho (2006)'s polarity account integrates perceptions of "small" and "large" numbers with negativity and positivity, respectively.

Previous studies in this area have used general linear model-type analyses to interpret their findings (e.g., Boutet et al., 2021), despite outcomes being measured by ordinal response categories and/or the dataset failing to satisfy the assumptions of the analytical techniques deployed. Although the scale points might appear to be equally spaced and equivalent, there is no evidence to suggest that each participant makes the same judgements as to what constitutes a response at each scale point, or that each participant's evaluations of adjacent points are equal (Taylor, Rousselet, Scheepers, & Sereno, 2021). At the least, the relationship between participant responses and any underlying latent dimension(s) are underspecified (Taylor et al., 2021). The analytical approach used in the current study – CLM modelling – maps ordinal outcomes against ordered regions of a latent distribution (Bürkner & Vuorre, 2019; McCullagh, 1980). There is clear evidence of the problems in using general linear modelling/ANOVA to evaluate ordinal data sets, and the need for CLMM approaches within experimental studies has been successfully argued by, for example, Liddell and Kruschke (2018).

1.5. The current study

We extended upon the work of Boutet et al. (2021) in the following ways. We used the same three 'face' emoji as Boutet et al. within our negative, neutral, and positive emoji conditions. We considered not only 'face emoji', but also non-face object emoji relevant to the content of the written sentences; in reality, users use a blend of face and non-face emoji, and indeed often exclusively use object emoji either as word substitutions or message adornments. Furthermore, we included perceptions of both the messages (their emotional tone and clarity) as well as perceptions of the senders (emotional state and warmth). Evidence has shown that text-pictograph congruency/incongruency can impact message ambiguity/clarity (e.g., Derks et al., 2008a; 2008b) and indeed, under certain circumstances (i.e., positive text + negative emoji) can lead to interpretations of sarcasm or irony which are harder to process/more ambiguous/less-clear (e.g., Filik et al., 2016; Garcia, Țurcan, Howman, & Filik, 2022; Thompson, Mackenzie, Leuthold, & Filik, 2016; Thompson & Filik, 2016). Thus, our consideration of sentence valence (negative, neutral, positive) × emoji type (no emoji, negative face emoji 😠, neutral face emoji 😐, positive face emoji 😀, object emoji) illuminates the interplay between 'verbal' and nonverbal data in information processing, interpersonal communication, and social attribution.

In the current study, we used a consistent 7-point ordinal response scale per outcome measure (from −3 to +3, left-to-right; Dehaene, 1992), with a null/0 neutral mid-point. Arguably, participant responses should reflect truly 'negative' or 'positive' perceptions, in line with verbal-spatial accounts of processing (e.g., Gevers et al., 2010; Proctor & Cho, 2006). Our analytical technique – CLMM – is more appropriate and powerful than, for example, Boutet et al.'s by-subjects (F_1) analysis of variance (ANOVA). This enables the estimation of fixed effects (sentence valence, emoji type, sentence valence × emoji type) and how these fluctuate across the 'randomness' generated by the individual participants and items included in the study (Taylor et al., 2021).

In line with previous research (e.g., Boutet et al., 2021; Erle et al., 2021; Hand et al., 2022; Neel et al., accepted; Robus et al., 2020), we predicted that:

H1. : Interactive effects of sentence valence and emoji type would be observed on all outcome measures;

H2. : negative and positive facial emoji would be especially impactful relative to neutral and / or object emoji;

H3. : clear congruence / incongruence effects would be observed for 'emotional' text-emoji stimuli (i.e., negative sentences + negative / positive emoji; positive sentences + positive / negative emoji);

H4. : object emoji would influence participant perceptions, relative to text-only and neutral emoji conditions. For example, perceptions of Sender Tone, Warmth, and State will be enhanced by the presence of an object emoji relative to text-only and neutral emoji conditions, in part due to enhanced 'social interaction' and emotion.

2. Method

2.1. Participants

An a priori power analysis (G*Power 3.1.9.2), anticipating an effect size of 0.25, and with $\alpha = 0.05$ and desired power = 0.95 (as per Cohen, 1988) suggested a target sample size of 30. Participants were recruited via convenience sampling using adverts posted to social media sites (e.g., Facebook, Reddit, Twitter). Ultimately, 60 adults completed the survey in its entirety. Forty-two participants identified as women, 10 identified as men, 2 as non-binary, 1 as *trans*-male and 5 did not disclose their gender-sex. All participants were aged between 16 and 50 years old (M_{Age} = 28.3 years, SD_{Age} = 8.6). As part of the inclusion/exclusion criteria for this study, participants were required to be either English language natives (n = 43) or highly proficient in the English language (high school level or above; n = 17). Furthermore, all participants reported no diagnosis of dyslexia or other specific learning disability/cognitive impairment; this is consistent with similar previous research (e.g., Hand et al., 2022 – typical control groups; Robus et al., 2020).

2.2. Materials and design

Written sentences were taken from the set of materials developed by Boutet et al. (2021). Boutet et al. extracted their stimuli from resources generated by Tagg (2009) and Weissman and Tanner (2018). Boutet et al. pre-tested their stimuli for 'realism' and to ensure that assumptions about the valence of the written sentences (negative, neutral, positive) were justified. We selected a sub-set of 60 target sentences – 20 emotionally-negative sentences, 20 neutral, and 20 emotionally-positive – from their materials. These 60 stimuli were screened by the lead researcher to ensure, for example, that English (UK) spellings were used, that the materials did not contain any esoteric references which might not be understood cross-culturally, and so on.

For each of the 60 target sentences, a bespoke object emoji was selected, drawn from emojipedia (https://emojipedia.org). We selected object emoji based on either key words or the overall message of the sentence. Where possible the object emoji was anchored against a key noun. For example, "Brianna bought a dress 👗" [a dress/gown emoji] or "Those were disgusting mushrooms 🍄" [a fungus/toadstool emoji]. For certain stimuli, the emoji chosen was concretely aligned with a specific noun, e.g., "Paula drew a picture of a bee 🐝" [a bee emoji], whereas in others it was associated more with concepts, especially if ambiguous words were involved, e.g., "The coach used a bad strategy ⚽" [a soccer ball emoji]. Object emoji were selected with a view to being 'neutral'; that is, we were conscious that we did not want the object emoji to convey a deliberately negative or positive valence, particularly considering their possible effect on affectively neutral sentences. All emoji were presented consistent with Apple Inc.'s iOS operating system, as this format has been suggested to be the most 'recognisable' (Rodrigues, Lopes, Prada, Thompson, & Garrido, 2017). Emoji were input into the online questionnaire as images using the survey host's rich content editor. Emoji were presented in their 'normal' colour and indeed in full colour. All emoji were presented within a 24 pixel × 24 pixel 'square' – that is, emoji did not exceed the parameters of this range (n.b., this equates to approximately 0.64 cm at 96 dpi).

Thus, we employed a 3 (sentence valence: negative, neutral, positive) × 5 (emoji type: no emoji, negative face 😠, neutral/ambiguous face 😐, positive face 😀, object emoji) repeated-measures quasi-experimental design. Each written sentence could be paired with any of the emoji conditions. This is illustrated in Table 1.

We created five distinct stimulus lists – this was to allow written sentence #1 to be presented in each of its five emoji conditions to different participants. We presented all 60 written stimulus items to each participant without repetition of any items, while balancing the number of items per experimental condition. Through counterbalancing and Latin square rotation across the five stimulus sets, all 60 target sentences were presented in all 5 emoji conditions to an equal number of participants, with no single participant seeing the same written frame more than once. Thus, every participant completed 60 trials; 20 stimuli × 3 sentence valence conditions, and 12 items × 5 emoji display condition (4 trials × 15 specific valence-emoji conditions). Counterbalancing is illustrated in Table 2.

2.3. Procedure

The study was designed and conducted in line with British Psychological Society (2018) guidelines. Ethical approval was granted by the Psychology, Social Work and Allied Health Sciences Ethics Committee at [UNIVERSITY]. A link to the study – which was hosted by Qualtrics – was provided within the advertisements placed on social media. We did not seek to recruit nor exclude users of any particular platforms or devices.

Upon clicking the link, the participants were first provided with an information sheet which re-iterated the inclusion/exclusion criteria and explained the purpose and demands on the study. Participants were provided with the lead researcher's contact details if they wished to raise any questions or concerns. All being well, participant then progressed to complete a consent form which re-iterated their right to anonymity, withdrawal at any point without reason or consequence, etc.

Once they had provided consent, participants then provided brief demographic data (i.e., age and gender), before being randomly allocated to one of the five counterbalanced stimulus sets. Stimuli were presented in the same pre-determined random order within each of the five lists. Participants were presented with a target stimulus, which they could read at their own pace with the rating dimensions beneath the stimulus item (with most-negative options being left-most and most-positive options right-most). After completing the ratings for all four outcome dimensions, participants moved on to the next target stimulus. General knowledge questions after every 20 trials served as attention-checks/catch-trials. After completing the rating task, participants were presented with a debrief form further clarified the aims and objectives of the research, reiterated their rights, and reminded them of the contact details of the lead researchers if they wished to follow up on any aspect of the study.

2.4. Data analysis

We used the '*ordinal*' package (Christensen, 2019) in *R* (R Development Core Team, 2016; http://www.r-project.org) to generate CLMMs. We used forward model selection to identify optimal random effect structures (see Barr, Levy, Scheepers, & Tily, 2013; Matuschek, Kliegl, Vasishth, Baayen, & Bates, 2017). We used likelihood-ratio tests comparing full and reduced models to test for fixed effects. Post-hoc tests were conducted using the 'emmeans' package (v1.4.8, 26/06/20; Lenth, Singmann, Love, Buerkner, & Herve, 2020), with Bonferroni adjustments. Significance decisions were made at the $\alpha = 0.05$ level, unless adjusted and stated otherwise.

Table 1
Example stimuli across sentence valence and emoji conditions.

	Sentence Valence		
	Negative	Neutral	Positive
No Emoji	He gave me a gross kiss	He is wearing a hat	It's good to be home
Negative Emoji	He gave me a gross kiss 😠	He is wearing a hat 😠	It's good to be home 😠
Neutral Emoji	He gave me a gross kiss 😐	He is wearing a hat 😐	It's good to be home 😐
Positive Emoji	He gave me a gross kiss 😀	He is wearing a hat 😀	It's good to be home 😀
Object Emoji	He gave me a gross kiss 💋	He is wearing a hat 🧢	It's good to be home 🏠

3. Results

Descriptive statistics (mean and standard deviations, rounded to one decimal place) are presented in Table 3, across outcome measures, sentence valences, and emoji conditions. A table of median values in included in Appendix I. Inferential statistics are summarised in Table 4.

3.1. Message emotional tone

Analysis showed that the intercept-only model was improved by adding a random slope based on sentence valence across participant [$\chi^2(2) = 182.34$, $p < .001$]. The fixed effect of sentence valence was significant [$\chi^2(1) = 48.49$, $p < .001$; Cohen's $d = 0.23$]; follow-up comparisons revealed that negative sentences (−1.1) were rated as more-negative than neutral sentences (0.3, $Z = -11.02$, $p < .001$) and positive sentences (0.9, $Z = -11.43$, $p < .001$) – the difference between neutral (0.3) and positive sentences (0.9) was also significant ($Z = -6.12$, $p < .001$).

The fixed effect of emoji type was significant [$\chi^2(1) = 171.77$, $p < .001$; Cohen's $d = 0.45$]; follow-up comparisons are summarised in Table 5.

Stimuli with no emoji were perceived as more-positive than stimuli with negative emoji or neutral emoji, but less-positively than stimuli with either positive or object emoji. Stimuli with negative emoji were perceived as more-negative than all other conditions. Stimuli with

Table 2
Counterbalancing of stimuli across lists.

Trial	Sentence	Valence	List 1 Emoji	List 2 Emoji	List 3 Emoji	List 4 Emoji	List 5 Emoji
1	I've loved every movie he's ever made	Positive	Neutral	Positive	Object	None	Negative
2	Having a great time at the golf club	Positive	Neutral	Positive	Object	None	Negative
3	It was a waste of time to visit the aquarium	Negative	None	Negative	Neutral	Positive	Object
4	Nick has an awful blog	Negative	Negative	Neutral	Positive	Object	None
5	That is a disgusting coffee	Negative	None	Negative	Neutral	Positive	Object
…	…	…	…	…	…	…	…
60	The train will arrive at Kensington station	Neutral	Positive	Object	None	Negative	Neutral

Participants provided ratings of each stimulus on its emotional tone (−3 = *very negative*; +3 = *very positive*), its clarity (−3 = *very unclear*; +3 = *very clear*), the sender's perceived emotional state (−3 = *very negative*; +3 = *very positive*), and the sender's warmth (−3 = *very cold*; +3 = *very warm*).

Table 3
Descriptive statistics across outcome measures and conditions.

	Emotional Tone			Message Clarity		
	Sentence Valence			Sentence Valence		
	Negative	Neutral	Positive	Negative	Neutral	Positive
No Emoji	−1.2 (1.2)	0.4 (1.0)	1.8 (1.0)	2.1 (1.1)	2.0 (0.8)	2.1 (0.9)
Negative Emoji	−1.6 (1.6)	−1.2 (1.4)	−0.9 (1.2)	2.1 (1.2)	0.9 (1.3)	−0.9 (1.6)
Neutral Emoji	−1.1 (1.2)	−0.5 (1.1)	−0.5 (1.1)	1.4 (1.4)	0.7 (1.4)	−0.2 (1.5)
Positive Emoji	−0.6 (1.1)	1.7 (1.0)	2.1 (1.2)	0.3 (1.7)	2.0 (1.1)	2.3 (1.2)
Object Emoji	−0.9 (1.3)	0.8 (0.9)	2.0 (0.8)	1.5 (1.4)	1.9 (1.3)	2.3 (0.9)
	Sender Warmth			**Sender State**		
	Sentence Valence			Sentence Valence		
	Negative	Neutral	Positive	Negative	Neutral	Positive
No Emoji	−0.9 (1.2)	−0.1 (0.8)	1.3 (1.1)	−1.3 (0.8)	0.0 (0.6)	1.6 (0.9)
Negative Emoji	−1.7 (1.1)	−1.7 (1.1)	−1.3 (1.2)	−2.4 (0.7)	−2.2 (0.9)	−1.5 (1.1)
Neutral Emoji	−0.9 (1.1)	−0.7 (1.1)	−0.8 (1.1)	−1.3 (0.9)	−0.8 (0.8)	−1.0 (0.8)
Positive Emoji	0.2 (1.3)	1.8 (1.1)	2.0 (1.2)	0.4 (1.3)	1.9 (1.0)	2.3 (1.0)
Object Emoji	−0.7 (1.3)	0.6 (1.0)	1.8 (0.8)	−1 (1.1)	0.5 (0.8)	2.0 (0.8)

Table 4
Summary of fixed effects and interactions by outcome measure.

Outcome		Valence	Emoji Type	Interaction
Tone	χ^2	48.49	171.77	15.74
	p	<.001	<.001	<.001
	d	0.23	0.45	0.13
Clarity	χ^2	67.00	7.41	74.77
	p	<.001	.007	<.001
	d	0.28	0.09	0.29
Warmth	χ^2	30.54	106.97	19.70
	p	<.001	<.001	<.001
	d	0.19	0.35	0.15
State	χ^2	57.57	118.39	13.71
	p	<.001	<.001	<.001
	d	0.26	0.37	0.12

Note. All hypotheses were supported; H_1 supported by consistent interaction effects; follow-up comparisons across outcomes support H_2 thru H_4.

neutral emoji were perceived as more-negative than no emoji stimuli and less-positively than stimuli with positive or object emoji, Stimuli with positive emoji were perceived as more-positive than any other condition. Stimuli with object emoji were perceived as more-positive than any other condition (except positive face emoji).

The sentence valence × emoji type interaction on message emotional tone was significant [$\chi^2(1) = 15.74$, $p < .001$; Cohen's $d = 0.13$]. The contrasts between emoji types across sentence valences are summarised in Table 6 (n.b., contrasts of sentence valences by emoji type are included in Supplementary Material A). The interaction is illustrated in Fig. 1.

Text-only negative sentences were rated equally-negatively as negative sentences with either neutral or object emoji; however, negative sentences without emoji were perceived as less-negative than negative sentences paired with negative emoji and less-positively than negative sentences paired with positive emoji. Negative sentences with congruent negative emoji were perceived as more-negative than all other emoji conditions. Negative sentences paired with neutral emoji and object emoji were rated as equally negative. Negative sentences paired with positive emoji were perceived as less-negative than any other emoji condition.

When sentence-texts were neutral, all comparisons between emoji types were significant. Neutral sentences without emoji were perceived as more-positive than sentences with neutral emoji. Neutral sentences with negative emoji were perceived as more-negative than any other condition. Neutral sentences with neutral emoji were perceived as less-positive than sentences with positive or object emoji. Neutral sentences with positive emoji were perceived as more positive than all other conditions. Neutral sentences with object emoji were perceived as more-positive than neutral sentences without emoji.

When sentence-texts were positive, there was no difference in perceived positivity between sentences without emoji and sentences with object emoji. Similarly, positive sentences presented with negative and neutral emoji were perceived equally-negatively. Positive sentences presented with congruent positive emoji were perceived as more-positive than all other conditions.

3.2. Message clarity

The fit of the intercept-only model was improved upon by adding a random slope involving emoji type across items [$\chi^2(2) = 67.35$, $p < .001$]. The fixed effect of sentence valence was significant [$\chi^2(1) = 67.00$, $p < .001$; Cohen's $d = 0.28$]; follow-up comparisons revealed that there was no difference in perceived clarity between negative sentences (1.5) and neutral sentences (1.5, $Z = -0.59$, $p > .999$); however, negative sentences were perceived as clearer than positive sentences (1.12, $Z = 2.40$, $p = .050$) – the difference between neutral (1.5) and positive sentences (1.1) was also significant ($Z = 2.97$, $p = .009$).

The fixed effect of emoji type was significant [$\chi^2(1) = 7.41$, $p = .007$; Cohen's $d = 0.09$]; follow-up comparisons are summarised in Table 5. Text-only messages were perceived as clearer than messages paired with digital faces, and equally-clearly as messages paired with object emoji. Messages paired with negative emoji were perceived as equally clear as messages with neutral emoji, but less clear than messages with either positive or object emoji. Messages paired with neutral emoji were less clear than those with positive or object emoji. There was no difference in perceived clarity between messages presented with positive emoji and object emoji.

The sentence valence × emoji type interaction on message clarity

Table 5
Fixed effect of emoji – follow-up comparisons by outcome measure.

		Tone		Clarity		Warmth		State	
		Z	*p*	*Z*	*p*	*Z*	*p*	*Z*	*p*
No Emoji	Negative Emoji	20.10	<.001	9.85	<.001	16.87	<.001	23.41	<.001
	Neutral Emoji	13.45	<.001	13.43	<.001	10.18	<.001	14.76	<.001
	Positive Emoji	−11.23	<.001	3.17	.015	−13.06	<.001	−16.43	<.001
	Object Emoji	−3.82	.001	0.56	>.999	−6.65	<.001	−5.36	<.001
Negative Emoji	Neutral Emoji	−8.20	<.001	2.09	.370	−9.76	<.001	−14.05	<.001
	Positive Emoji	−27.59	<.001	−7.59	<.001	−27.21	<.001	−26.93	<.001
	Object Emoji	−22.84	<.001	−9.99	<.001	−20.54	<.001	−24.34	<.001
Neutral Emoji	Positive Emoji	−22.29	<.001	−11.15	<.001	−21.43	<.001	−23.18	<.001
	Object Emoji	−16.68	<.001	−13.87	<.001	−15.13	<.001	−17.28	<.001
Positive Emoji	Object Emoji	7.73	<.001	−2.78	.054	8.72	<.001	13.34	<.001

Table 6
Sentence valence × emoji type interaction – message emotional tone.

		Sentence Valence					
		Negative		Neutral		Positive	
		Z	*p*	*Z*	*p*	*Z*	*p*
No Emoji	Negative Emoji	3.79	.002	12.77	<.001	19.02	<.001
	Neutral Emoji	−0.91	>.999	6.49	<.001	17.22	<.001
	Positive Emoji	−4.20	<.001	−10.23	<.001	−5.22	<.001
	Object Emoji	−1.31	>.999	−2.86	.042	−2.50	.124
Negative Emoji	Neutral Emoji	−4.72	<.001	−6.93	<.001	−2.76	.058
	Positive Emoji	−7.78	<.001	−20.66	<.001	−22.07	<.001
	Object Emoji	−5.05	<.001	−15.06	<.001	−20.72	<.001
Neutral Emoji	Positive Emoji	−3.40	.007	−15.67	<.001	−20.44	<.001
	Object Emoji	−0.43	>.999	−9.17	<.001	−19.01	<.001
Positive Emoji	Object Emoji	2.92	.035	7.71	<.001	2.87	.041

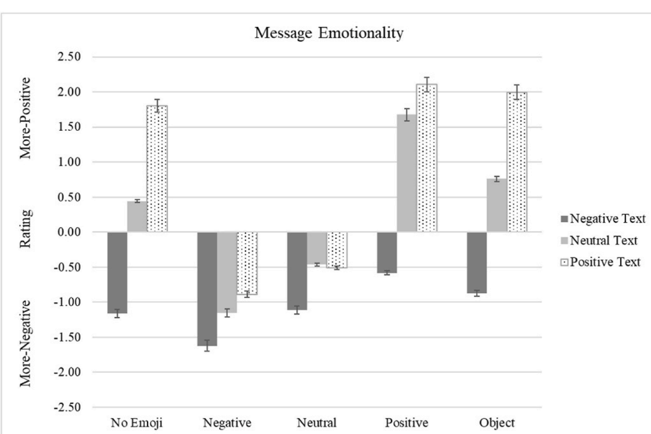

Fig. 1. Message emotional tone across sentence valences and emoji types [5% error bars].

was significant [$\chi^2(1) = 74.77$, $p < .001$; Cohen's $d = 0.29$]. The contrasts between emoji types across sentence valences are summarised in Table 7 (n.b., contrasts of sentence valences by emoji type are included in Supplementary Material A). The interaction is illustrated in Fig. 2.

When sentence-texts were negative, there was no difference in perceived clarity between text-only messages and those paired with congruent negative emoji; both the no emoji and negative emoji messages were perceived as clearer than all other emoji conditions when texts were negative. Messages consisting of negative text with incongruent positive emoji were perceived as less clear than all other conditions. When texts were negative, there was no difference in perceived clarity when messages contained either a neutral or object emoji.

When sentence texts were neutral, messages without emoji were perceived as clearer than messages with negative or neutral emoji, but equally-clearly as neutral sentences paired with either positive or object emoji. Neutral sentences with negative emoji were seen as less clear than all other conditions except neutral emoji. Neutral sentences paired with positive emoji were seen as clearer than those with negative or neutral emoji, and equally-clearly as those with object emoji.

Table 7
Sentence valence × emoji type interaction – message clarity.

		Sentence Valence					
		Negative		Neutral		Positive	
		Z	*p*	*Z*	*p*	*Z*	*p*
No Emoji	Negative Emoji	−0.70	ns	4.82	<.001	12.97	<.001
	Neutral Emoji	4.22	<.001	6.93	<.001	12.50	<.001
	Positive Emoji	9.95	<.001	−1.00	>.999	−3.05	.023
	Object Emoji	4.09	<.001	−0.85	>.999	−2.14	.324
Negative Emoji	Neutral Emoji	4.55	<.001	1.32	>.999	−2.38	.174
	Positive Emoji	9.05	<.001	−5.90	<.001	−15.42	<.001
	Object Emoji	4.04	<.001	−5.84	<.001	−15.15	<.001
Neutral Emoji	Positive Emoji	5.48	<.001	−8.34	<.001	−15.36	<.001
	Object Emoji	−0.69	>.999	−8.26	<.001	−15.00	<.001
Positive Emoji	Object Emoji	−6.59	<.001	0.20	>.999	1.13	>.999

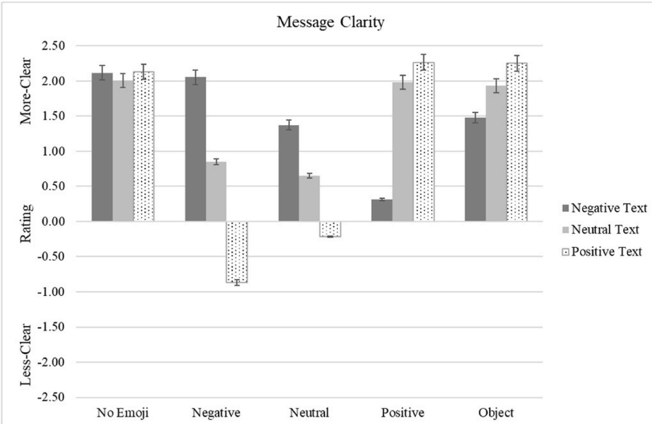

Fig. 2. Message clarity across sentence valences and emoji types [5% error bars].

When sentence texts were positive, text-only messages were perceived to be clearer than those with negative or neutral emoji, equally as clear as those with object emoji, and less-clear than those with (congruent) positive emoji. When sentence texts were positive, messages with negative emoji were seen as less clear than all other conditions except neutral emoji. Those with both positive text and positive emoji were seen as clearer than all other conditions except object emoji.

3.3. Sender warmth

The intercept-only version of our model for sender warmth was improved upon by adding a random slope involving emoji type across items [$\chi^2(2) = 225.27$, $p < .001$]. The fixed effect of sentence valence was significant [$\chi^2(1) = 30.54$, $p < .001$; Cohen's $d = 0.19$]; follow-up comparisons revealed that all comparisons were significant – negative sentences were associated with colder senders (−0.8) than both neutral sentences (0.0, $Z = -8.15$, $p < .001$) and positive sentences (0.6, $Z = -13.88$, $p < .001$), and positive sentences (0.6) were associated with warmer senders than neutral sentences (0.0; $Z = -6.17$, $p < .001$).

The fixed effect of emoji type was significant [$\chi^2(1) = 106.97$, $p < .001$; Cohen's $d = 0.35$]; follow-up comparisons are summarised in Table 5. All comparisons were significant. Messages paired with negative emoji were perceived to be from 'colder' senders than all other conditions. Messages sent with 'neutral' emoji were perceived to be from less-warm senders than all other conditions (except those with negative emoji). Messages with positive emoji were perceived to be from warmer senders than any other condition. Messages with object emoji were perceived as being from warmer senders than text-only messages. Text-only messages were perceived as being from warmer senders than those with negative or neutral emoji, but less-warm than those with positive or object emoji.

The sentence valence × emoji type interaction on sender warmth was significant [$\chi^2(1) = 19.70$, $p < .001$; Cohen's $d = 0.15$]. The contrasts between emoji types across sentence valences are summarised in Table 8 (n.b., contrasts of sentence valences by emoji type are included in Supplementary Material A). The interaction is illustrated in Fig. 3.

When sentence-texts were negative, messages were presented with (congruent) negative emoji were associated with 'colder' senders than any other display condition. There was no difference in perceived sender warmth between text-only messages and those with a neutral emoji if text was negative. Negative texts paired with positive emoji were associated with warmer senders than any other display condition. There was no difference in perceived warmth of sender when object emoji were added to negative texts vs. text-only negative sentences.

When sentence texts were neutral, all comparisons between emoji types were significant. Text-only messages were neither associated with cold nor warm senders; those neutral sentences paired with negative emoji were associated with 'colder' senders than any other conditions. Those paired with 'neutral' emoji were associated with 'colder' senders than those with no emoji, positive, and/or object emoji (but warmer than negative emoji). Those neutral sentences paired with positive emoji were perceived as coming from warmer senders than any other condition; those paired with object emoji were associated with warmer senders than any other condition (except positive emoji).

When sentence texts were positive, those paired with negative emoji were associated with 'colder' senders than any other condition, and those paired with neutral emoji were perceived as coming from colder senders than any other condition (except negative emoji). Text-only positive sentences were associated with less-warm senders than those paired with either positive or object emoji, and when texts were positive,

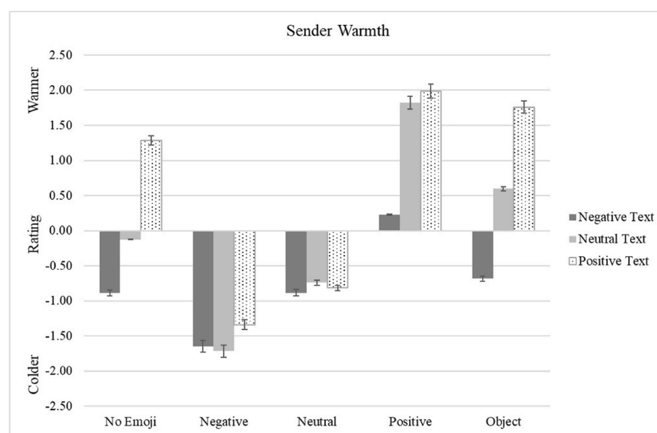

Fig. 3. Sender warmth across sentence valences and emoji types [5% error bars].

Table 8
Sentence valence × emoji type interaction – sender warmth.

		Sentence Valence					
		Negative		Neutral		Positive	
		Z	*p*	*Z*	*p*	*Z*	*p*
No Emoji	Negative Emoji	3.78	.002	10.26	<.001	15.78	<.001
	Neutral Emoji	−1.37	>.999	4.46	<.001	14.31	<.001
	Positive Emoji	−6.08	<.001	−11.04	<.001	−5.93	<.001
	Object Emoji	−1.78	.748	−5.36	<.001	−4.52	<.001
Negative Emoji	Neutral Emoji	−5.68	<.001	−7.44	<.001	−3.96	<.001
	Positive Emoji	−10.03	<.001	−20.41	<.001	−20.35	<.001
	Object Emoji	−5.00	<.001	−13.72	<.001	−18.23	<.001
Neutral Emoji	Positive Emoji	−5.63	<.001	−15.45	<.001	−17.90	<.001
	Object Emoji	−0.39	>.999	−8.95	<.001	−17.15	<.001
Positive Emoji	Object Emoji	4.94	<.001	7.62	<.001	2.68	.073

there was no difference in perceived sender warmth between messages sent with positive emoji or object emoji.

3.4. Sender state

The intercept-only version of our model for sender state was improved upon by adding a random slope involving emoji type across items [$\chi^2(2) = 240.61$, $p < .001$].

The fixed effect of sentence valence was significant [$\chi^2(1) = 57.57$, $p < .001$; Cohen's $d = 0.26$]; follow-up comparisons revealed that all comparisons were significant – negative sentences were associated with more-negative senders (−1.1) than both neutral sentences (−0.1, $Z = -11.80$, $p < .001$) and positive sentences (0.7, $Z = -19.98$, $p < .001$), and positive sentences (0.7) were associated with warmer senders than neutral sentences (−0.1; $Z = -9.47$, $p < .001$).

The fixed effect of emoji type was significant [$\chi^2(1) = 118.39$, $p < .001$; Cohen's $d = 0.37$]; follow-up comparisons are summarised in Table 5. All comparisons were significant. Messages paired with negative emoji were perceived to be from more-negative senders than all other conditions. Messages sent with 'neutral' emoji were perceived to be from more-negative senders than all other conditions (except those with negative emoji). Messages with positive emoji were perceived to be from more-positive senders than any other condition. Messages with object emoji were perceived as being from more-positive senders than text-only messages. Text-only messages were perceived as being from less-negative senders than those with negative or neutral emoji, but less-positive than those with positive or object emoji.

The sentence valence × emoji type interaction on sender emotional state was significant [$\chi^2(1) = 13.71$, $p < .001$; Cohen's $d = 0.12$]. The contrasts between emoji types across sentence valences are summarised in Table 9 (n.b., contrasts of sentence valences by emoji type are included in Supplementary Material A). The interaction is illustrated in Fig. 4.

When sentence-texts were negative, messages were presented with (congruent) negative emoji were associated with more-negative senders than any other display condition. There was no difference in perceived sender state between text-only messages and those with a neutral emoji if text was negative. Negative texts paired with positive emoji were associated with more-positive senders than any other display condition. There was no difference in perceived emotional state of sender of sender between object emoji messages and text-only negative sentences.

When sentence texts were neutral, all comparisons between emoji types were significant. Text-only messages were neither associated with emotionally-negative nor emotionally-positive senders; those neutral sentences paired with negative emoji were associated with more-negative senders than any other conditions. Those paired with 'neutral' emoji were associated with more-negative senders than those with no emoji, positive, or object emoji (but less-negative than negative emoji). Neutral sentences paired with positive emoji were perceived as coming from more-positive senders than any other condition; those paired with object emoji were associated with more-positive senders than any other condition (except positive emoji).

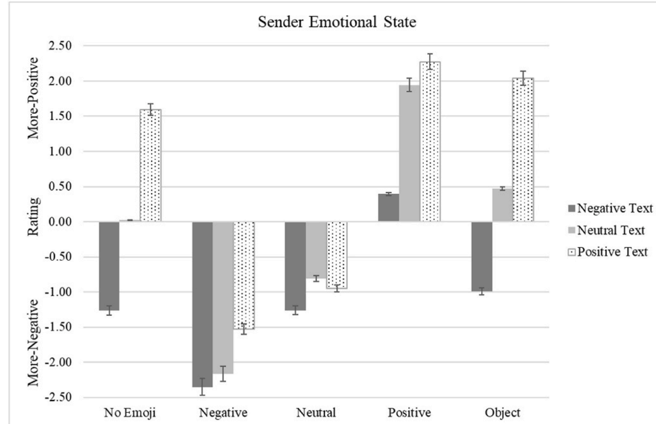

Fig. 4. Sender emotional state across sentence valences and emoji types [5% error bars].

When sentence texts were positive, all comparisons were significant. Those paired with negative emoji were associated with emotionally-negative senders more-so than any other condition, and those paired with neutral emoji were perceived as coming from more-negative senders than any other condition (except negative emoji). Text-only positive sentences were associated with less-positive senders than those paired with either positive or object emoji, and when texts were positive, (congruent) positive emoji led to greater ratings of sender positivity than messages sent with object emoji.

4. Discussion

4.1. Summary of findings and relationship with prior work

Our study was conducted to explore the interplay between the written content of short communications and the absence/presence of emoji of different types on perceptions of both message content and impressions formed of senders. We conducted an ecologically valid quasi-experimental study, with powerful CLMM analyses. Our study improves upon previous high-quality work in this area by considering non-face object emoji that were semantically related to the written messages, used CLMM analyses more appropriate for embracing random variance and ordinal outcome measures related to both messages and senders. We found significant sentence valence × emoji type interactions on ratings of message emotional tone, message meaning clarity, perceptions of sender warmth, and impressions of sender's emotional states. Our findings support our hypotheses. Furthermore, our results are consistent with models such as the EASI framework (Van

Table 9
Sentence valence × emoji type interaction – sender's state.

		Sentence Valence					
		Negative		Neutral		Positive	
		Z	p	Z	p	Z	p
No Emoji	Negative Emoji	7.59	<.001	14.83	<.001	20.10	<.001
	Neutral Emoji	−0.02	>.999	7.06	<.001	18.24	<.001
	Positive Emoji	−10.36	<.001	−12.23	<.001	−6.89	<.001
	Object Emoji	−0.82	>.999	−3.74	.002	−4.81	<.001
Negative Emoji	Neutral Emoji	−8.82	<.001	−10.69	<.001	−5.51	<.001
	Positive Emoji	−12.95	<.001	−18.93	<.001	−18.91	<.001
	Object Emoji	−7.42	<.001	−15.70	<.001	−21.08	<.001
Neutral Emoji	Positive Emoji	−9.38	<.001	−15.43	<.001	−18.63	<.001
	Object Emoji	−0.69	>.999	−9.30	<.001	−19.94	<.001
Positive Emoji	Object Emoji	10.08	<.001	10.01	<.001	3.49	.005

Kleef, 2009), and suggest that compositionality extends to representations of text + emoji.

In general, our results were characterised by congruency/incongruency effects – that is pairing unambiguous negative/positive face emoji with unambiguous negative/positive written messages resulted in the most-polarised participant ratings across outcomes. This is consistent with previous research (e.g., Boutet et al., 2021), but somewhat inconsistent with other research which has typically found such amplification in negative token | negative text conditions (e.g., Walther & D'Addario, 2001).

We found that our ambiguous, 'neutral' emoji was effective in influencing perceptions of messages and senders, especially when the text valence was neutral/ambiguous. We specifically selected this emoji for two reasons: i) it was used by Boutet et al. (2021) as their 'neutral' emoji; ii) it did not have the stereotypical features of classic facial expressions of positive or negative emotions. We believed that flatness of the mouth and 'typicality' of the eyes made it a suitable proxy for a neutral state. Interestingly, this type of emoji was associated with 'negativity' by our participants; this is consistent with the findings of Boutet et al. It may be that the lack of 'positive' expression on this emoji results in a negative evaluation or a perceived negativity when it is used. Indeed, Emojipedia notes that this emoji is sometimes used to indicate mild concern, or as part of deadpan humour. This 'neutral' emoji was disadvantageous in terms of message clarity, except for comparisons against clearly incongruent positive emoji | negative texts and negative emoji | positive texts.

Our analyses revealed that our object emoji behaved differently to digital faces, and that object emoji were 'effective' relative to no emoji presentations in most cases. Object emoji – relative to texts without emoji – typically enhanced message clarity and the positivity messages and senders, except when robustly and unambiguously negative texts were presented. All other differences related to object emoji seemed to hang on the other emoji's congruence/incongruence with the text; that is, object emoji were beneficial relative to incongruent/ambiguous text-emoji pairings, and non-advantageous when there was clear(er) congruence between text and emoji.

Text sentiment had a powerful effect on perceptions, particularly of message tone, sender warmth, and sender emotional state. An interesting finding was that in certain cases, positive emoji could 'take the edge off' negative messages, relative to no emoji, 'neutral' or object emoji. This was most-clearly seen in perceptions of sender warmth and emotional tone. However, it must be stressed that positive emoji did not counteract unambiguous negative text in terms of message sentiment, and an incongruent positive emoji paired with a negative text dramatically impaired message clarity (as did a negative emoji paired with a positive text sentiment); this is likely to be related to perceptions of irony and/or sarcasm (e.g., Filik et al., 2016; Garcia et al., 2022; Thompson & Filik, 2016). It is possible that our findings with text + emoji stimuli can be considered in the context of the Tinge Hypothesis (Dews & Winner, 1995). The Tinge Hypothesis posits that when a processor encounters an ironic utterance, the evaluative tone of its literal meaning automatically *tinges* the perception of the intended meaning (Dews & Winner, 1995). In the way that the Tinge Hypothesis argues that irony can 'mute' the meaning conveyed by literal language (Dews & Winner, 1995, p.15), it is possible that the attenuation or augmentation of text sentiment by emoji in the current study reflect similar underlying processes.

Emoji are often used to express emotions, but they are also effective in conveying semantic meaning in communication (Na'aman et al., 2017). It is interesting to note that in certain cases – specifically when emotionally-neutral messages were presented – messages without emoji were perceived as clearer than neutral messages with supposedly-congruent 'neutral' emoji. According to Gawne and McCulloch (2019), emoji meaning varies according to context, whereby differing semantics and interpretative flexibility can contribute to increased ambiguity. In this way, it is plausible to assume that adding emoji to a neutral or ambiguous message might not necessarily be advantageous and might lead to misperception of message sentiment and/or sender state. In other words, when processors encounter an emotionally-neutral text without an emoji, there might be a reasonably normal distribution of valence perceptions, with a (sharp) peak around the neutral mid-point. When processors encounter an emotionally-valent (i.e., negative or positive) sentence without an emoji, it is likely that perceptions would be (heavily) skewed towards the appropriate end of the rating scale. Visual inspection of the current data for negative, neutral, and positive sentence – no emoji ratings supports this. Furthermore, it is likely that the addition of an emoji to these three different styles of sentence would impact the distribution of ratings differently; that is, there is likely to be only a minimal impact on the skewed distributions when texts are valent, but it is likely that the distribution of responses will shift substantially when negative texts are paired with emoji (especially unambiguous negative/positive face emoji). Again, visual inspection of the data from the current study support this interpretation.

4.2. Critical evaluation and applied value

We believe that our current research represents a step forward in the study of the interplay between written text and emoji. First, we have expanded recent high-quality work (e.g., Boutet et al., 2021) by considering non-face, object emoji with semantic relationships to the written messages. Our research has utilised CLMM analyses to explore the independent and fixed effects of sentence valence and emoji type. We believe that these techniques are far more suited to the ordinal-type ratings obtained in our study (and previous work) than the ANOVA analyses of, for example, Boutet et al. (2021).

We see from our results that these object-denoting emoji stimuli are not as 'effective' as (in)congruent digital faces, are typically associated with more-positive perceptions than ambiguous, 'neutral' face emoji, and result in shifted perceptions of messages and sender relative to messages presented without emoji. Although we took care to select object emoji that were relevant to the written sentences, and typically anchored these against keywords/imageable nouns, we did not 'norm' the object emoji themselves. Therefore, it might be the case that there are systematic differences and/or biases in our set of object emoji. It is possible that they themselves are somewhat 'positive' (or indeed negative). Future research in this area should incorporate perceptions of the emoji as stand-alone objects into their designs and analyses. This could also be extended to our 'neutral' emoji; we chose this as it has no clear, stereotypical facial expression of negative or positive emotion; however, it may be the case that this emoji was in fact perceived 'negatively. In this paper, we discuss 'valence'; however, we know that an important consideration is in relation to emotional 'arousal'. Previous research in psycholinguistics has demonstrated the importance of both emotional valence and arousal (e.g., Scott, O'Donnell, Leuthold, & Sereno, 2009). Standard stimulus banks for English-language words generally include both measures of valence and arousal (e.g., the ANEW database, Bradley & Lang, 1999; the Glasgow Norms, Scott, Keitel et al., 2019). Indeed, the Lisbon Emoji and Emoticon Database (LEED; Rodrigues, Prada, Gaspar, Garrido, & Lopes, 2018) presents normative data for both emotional valence and arousal (among other dimensions) for emoji stimuli. We did not formally control for arousal in our written or emoji stimuli – this should be a focus of future research.

By taking our study 'out of the lab', and onto participants' personal electronic devices, we believe that our findings have a higher level of ecological validity than previous studies. Our method of data collection was far more likely to reflect how participants process text + emoji in everyday life, rather than, for example, the lab-based studies of Robus et al. (2020; desktop tracker with chin and forehead restraints) and Boutet et al. (2021; head mounted tracker). We would of course like to explore the current research questions in an eye movement study, but logistically and ethically, it is not possible to do so given the ongoing

COVID-19 pandemic. Future research should combine the design and stimuli of the current study, but with the eye tracking methodologies of, for example, Boutet et al. (2021) or Robus et al. (2020).

Our convenience sample of 60 individuals was suitable in terms of statistical power, but perhaps lacked the diversity/representativeness of a larger sample of the general population. Although our models contain random effects structures for inter-individual differences, our study did not fully explore the contribution of potentially important individual differences. Autism quotient scores, alexithymia scores, depression inventory scores, etc., could be collected in future studies. Future research may wish to consider between-groups approaches; for example, a formally diagnosed group of depressed individuals vs. age-matched controls. Differences in emoji interpretation between typical and neurodivergent individuals is an area that is yet to be sufficiently explored (Van Dam et al., 2019). Evaluating the impact of emoji in mental health care with atypical populations might be able to tell us whether emoji could facilitate communication between mental health practitioners and their clients. This can possibly improve mental health initiatives by helping clients to accurately describe mood and emotions more precisely, leading to more positive therapeutic outcomes.

With the growing popularity of teletherapy, affixing emoji to text might enhance communication efforts between sender and receiver in virtual counselling (Hall, Cole-Lewis, & Bernhardt, 2015). Lee, Tang, Yu, and Cheung (2008) have suggested that use of the sad emoticon was associated with greater depressive symptomology in patients, post-stroke. Thus, emotional well-being scales with emoji may have the potential to help us gain a better understanding of a client's mental and emotional experience. Tracking depressed clients' well-being with mental health apps with emoji functionality, for instance, could be advantageous for both client and practitioner. Clients might be more willing to regularly track their progress if it is user-friendly and engaging, while practitioners might be able to more accurately determine the best course of treatment or gain a better understanding of what is working for the client.

Instead of using typical ordinal numeric scales, researchers have found that using emoji is beneficial for assessing the emotional, physical, and quality of life for patients (Thompson, Novotny, Bartz, Yost, & Sloan, 2018). Emoji responses from patients were associated with traditional patient-reported outcomes; patients also reported a preference for using portable devices to track outcomes & activity (Thompson, Yost, Bartz, Kumar, & Ruddy, 2018). Wearable/portable technology may be advantageous for its convenience, while also introducing a simple method of monitoring moods, emotions, and symptoms, and enhancing communication between practitioners and clients. Furthermore, emoji have the potential to overcome language barriers and minimise misinterpretation for individuals communicating transnationally/*trans*-linguistically (Lotfinejad, Assadi, Aelami, & Pittet, 2020). Emoji might also reveal important information and early clinical signs and symptoms (Skiba, 2016). Marengo et al.'s (2017) study suggested that emoji-based language-free assessment tools for personality might have value.

Within Counselling Psychology, mood, emotions, and symptoms are usually dictated by self-report measures that are privy to recall bias; moreover, they are unsuitable in addressing behaviours that change over time and across different contexts (Shiffman, Stone, & Hufford, 2008). To ameliorate this issue, ecological momentary assessments (EMAs) are beneficial in tracking behaviour and experiences in real time and real-world settings (Shiffman et al., 2008). With advancements in language and communication over time, EMAs using emoji to monitor psychological outcomes may provide a more accurate picture of a client's mental health status. Van Dam et al. (2019) found that emoji associated with emotional affect, while suggesting that analysing emoji use patterns could be advantageous for clinical purposes. The development and implementation of psychological measurement tools incorporating emoji may be effective in determining mental health outcomes, as emoji usage is associated with 'Big Five' (e.g., Costa & McCrae, 1992) personality traits, distress, and self-monitoring (Derks et al., 2008a; Hall & Pennington, 2013; Li, Chen, Hu, & Luo, 2018). Moreover, it was found by Phan et al. (2019) that emoji anchors within interest scales illustrated the same psychometric properties as lexical anchors, and that in some contexts, emoji anchors might predict certain outcomes better than lexical scales (Phan et al., 2019). Emoji studies that have been conducted in the field of medicine could likely be extended to psychological contexts due to similarities in areas related to personal behaviour and improving doctor-patient communication (e.g., Bai et al., 2019).

4.3. Conclusion

We provided a robust exploration of the relationship between written information and emoji cues on message perception and impression formation. Using state-of-the-art analysis techniques, we demonstrate that there is an interactive relationship between 'verbal' (i.e., written sentiment) and non-verbal information (i.e., emoji); congruency/incongruency between these sources of information is at the heart of message/sender perceptions. Ambiguous/neutral messages are 'vulnerable' to misinterpretation when non-concrete emoji are used. Emoji + text pairings could be applied effectively in a variety of settings.

Declarations of competing interest

The authors have no conflicting interests to declare.

Data availability

Data will be made available on request.

Appendix J. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chbr.2022.100242.

Appendix I

Table i
Median values by Sentence Valence and Emoji Type across outcome measures

	Emotional Tone			Message Clarity		
	Sentence Valence			Sentence Valence		
	Negative	Neutral	Positive	Negative	Neutral	Positive
No Emoji	−1	0	2	2	2	3
Negative Emoji	−2	−2	−1	3	1	−1
Neutral Emoji	−1	0	−1	2	1	−1

(*continued on next page*)

Table i (*continued*)

	Emotional Tone			Message Clarity		
	Sentence Valence			Sentence Valence		
	Negative	Neutral	Positive	Negative	Neutral	Positive
Positive Emoji	−1	2	3	1	3	3
Object Emoji	−1	1	2	2	3	3
	Sender Warmth			**Sender State**		
	Sentence Valence			Sentence Valence		
	Negative	Neutral	Positive	Negative	Neutral	Positive
No Emoji	−1	0	1	−1	0	2
Negative Emoji	−2	−2	−1	−2	−2	−2
Neutral Emoji	−1	−1	−1	−1	−1	−1
Positive Emoji	0	2	2	1	2	3
Object Emoji	−1	0	2	−1	0	2

References

Bai, Q., Dan, Q., Mu, Z., & Yang, M. (2019). A systematic review of emoji: Current research and future perspectives. *Frontiers in Psychology, 10*. https://doi.org/10.3389/fpsyg.2019.02221

Banks, W. P., Fujii, M. S., & Kayra-Stuart, F. (1976). Semantic congruity effects in comparative judgments of magnitudes of digits. *Journal of Experimental Psychology: Human Perception and Performance, 2*, 435–447.

Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language, 68*(3), 255–278. https://doi.org/10.1016/j.jml.2012.11.001

Bayes, M. A. (1972). Behavioral cues of interpersonal warmth. *Journal of Consulting and Clinical Psychology, 39*(2), 333–339. https://doi.org/10.1037/h0033367

Boutet, I., LeBlanc, M., Chamberland, J. A., & Collin, C. A. (2021). Emojis influence emotional communication, social attributions, and information processing. *Computers in Human Behavior, 119*. https://doi.org/10.1016/j.chb.2021.106722

Bradley, M. M., & Lang, P. J. (1999). *Affective norms for English words (ANEW): Stimuli, instruction manual and affective ratings (Technical Report C-1)*. Gainesville, FL: University of Florida, NIMH Center for Research in Psychophysiology.

British Psychological Society. (2018). *BPS code of human research Ethics*. here (March 2021).

Burgoon, B., Buller, D., & Woodall, W. G. (1996). *Nonverbal Communication: The unspoken dialogue*. New York: McGraw-Hill.

Bürkner, P.-C., & Vuorre, M. (2019). Ordinal regression models in Psychology: A tutorial. *Advances in Methods and Practices in Psychological Science, 2*(1), 77–101. https://doi.org/10.1177/2515245918823199

Christensen, R. H. B. (2019). Ordinal - regression models for ordinal data. R package version 2019.4-25. Retrieved from https://cran.r-project.org/web/packages/ordinal/index.html.

Costa, P., & McCrae, R. (1992). *Revised NEO personality inventory and NEO five-factor inventory professional manual*. Odessa, Fla: Psychological Assessment Resources, Inc.

Coyle, M. A., & Carmichael, C. L. (2019). Perceived responsiveness in text messaging: The role of emoji use. *Computers in Human Behavior, 99*, 181–189. https://doi.org/10.1016/j.chb.2019.05.023

Daniel, T. A., & Camp, A. L. (2018). Emojis affect processing fluency on social media. *Psychology of Popular Media Culture, 9*(2), 208–213. https://doi.org/10.1037/ppm0000219

Dehaene, S. (1992). Varieties of numerical abilities. *Cognition, 44*, 1–42. https://doi.org/10.1016/0010-0277(92)90049-N

Dehaene, S., Bossini, S., & Giraux, P. (1993). The mental representation of parity and number magnitude. *Journal of Experimental Psychology: General, 122*, 371–396.

Derks, D., Bos, A. E. R., & von Grumbkow, J. (2008a). Emoticons and online message interpretation. *Social Science Computer Review, 26*(3), 379–388. https://doi.org/10.1177/0894439307311611

Derks, D., Bos, A. E. R., & von Grumbkow, J. (2008b). Emoticons in computer-mediated communication: Social motives and social context. *CyberPsychology and Behavior, 11*(1), 99–101. https://doi.org/10.1089/cpb.2007.9926

Dews, S., & Winner, E. (1995). Muting the meaning: A social function of irony. *Metaphor and Symbol, 10*(1), 3–19. https://doi.org/10.1207/s15327868ms1001_2

Eimer, M., & Holmes, A. (2002). An ERP study on the time course of emotional face processing. *NeuroReport, 13*(4), 427–431.

Ekman, P. (1992). Facial expressions of emotion: New findings, new questions. *Psychological Science, 3*(1), 34–38. https://doi.org/10.1111/j.1467-9280.1992.tb00253.x

Erle, T. M., Schmid, K., Goslar, S. H., & Martin, J. D. (2021). Emojis as social information in digital communication. *Emotion*. https://doi.org/10.1037/emo0000992. Advance online publication.

Filik, R., Țurcan, A., Thompson, D., Harvey, N., Davies, H., & Turner, A. (2016). Sarcasm and emoticons: Comprehension and emotional impact. *The Quarterly Journal of Experimental Psychology, 69*(11), 2130–2146. https://doi.org/10.1080/17470218.2015.1106566

Fischer, M. H. (2003). Cognitive representation of negative numbers. *Psychological Science, 14*, 278–282.

Fodor, J. A. (2007). The revenge of the given. In B. P. McLaughlin, & J. D. Cohen (Eds.), *Contemporary debates in philosophy of mind. Blackwell* (pp. 105–116).

Frith, C. D., & Frith, U. (1999). Interacting minds—a biological basis. *Science, 286*(5445), 1692–1695. https://doi.org/10.1126/science.286.5445.1692

Garcia, C., Țurcan, A., Howman, H., & Filik, R. (2022). Emoji as a tool to aid the comprehension of written sarcasm: Evidence from younger and older adults. *Computers in Human Behavior, 126*. https://doi.org/10.1016/j.chb.2021.106971

Gawne, L., & McCulloch, G. (2019). *Emoji as digital gestures. Language@ Internet 17*.

Gevers, W., Santens, S., Dhooge, E., Chen, Q., Van den Bossche, L., & Fias, W. (2010). Verbal-spatial and visuospatial coding of number–space interactions. *Journal of Experimental Psychology, 139*, 180–190. https://doi.org/10.1037/a0017688

Gevers, W., Verguts, T., Reynvoet, B., Caessens, B., & Fias, W. (2006). Numbers and space: A computational model of the SNARC effect. *Journal of Experimental Psychology: Human Perception and Performance, 32*, 32–44.

Glikson, E., Cheshin, A., & Kleef, G. A. van (2018). The dark side of a smiley: Effects of smiling emoticons on virtual first impressions. *Social Psychological and Personality Science, 9*(5), 614–625. https://doi.org/10.1177/1948550617720269

Greenberg, G. (2011). *The semiotic spectrum*. PhD dissertation. Rutgers: Dept. of Philosophy.

Hall, A. K., Cole-Lewis, H., & Bernhardt, J. M. (2015). Mobile text messaging for health: A systematic review of reviews. *Annual Review of Public Health, 36*, 393–415. https://doi.org/10.1146/annurev-publhealth-031914-122855

Hall, J. A., & Pennington, N. (2013). Self-monitoring, honesty, and cue use on Facebook: The relationship with user extraversion and conscientiousness. *Computers in Human Behavior, 29*(4), 1556–1564. https://doi.org/10.1016/j.chb.2013.01.001

Hand, C. J., Kennedy, A., Filik, R., Pitchford, M., & Robus, C. M. (2022). Emoji identification and emoji effects on sentence emotionality in ASD-diagnosed adults and neurotypical controls. *Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s10803-022-05557-4

Hand, C. J., & Scott, G. G. (2022). Beautiful victims: How the halo of attractiveness impacts judgments of celebrity and lay victims of online abuse. *Computers in Human Behavior*. https://doi.org/10.1016/j.chb.2021.107157

Hand, C. J., Scott, G. G., Brodie, Z. P., Xilei, Y., & Sereno, S. C. (2021). Tweet valence, volume of abuse, and observers' Dark Tetrad personality factors influence victim-blaming and the perceived severity of Twitter cyberabuse. *Computers in Human Behavior Reports, 100056*. https://doi.org/10.1016/j.chbr.2021.100056

Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1993). Emotion contagion. *Current Directions in Psychological Science, 2*(3), 96–100. https://doi.org/10.1111/1467-8721.ep10770953

Heck, R. (2007). Are there different kinds of content? In B. P. McLaughlin, & J. D. Cohen (Eds.), *Contemporary debates in philosophy of mind. Blackwell* (pp. 117–138).

Huang, A. H., Yen, D. C., & Zhang, X. (2008). Exploring the potential effects of emoticons. *Information & Management, 45*(7), 466–473. https://doi.org/10.1016/j.im.2008.07.001

Jaeger, S. R., Roigard, C. M., Jin, D., Vidal, L., & Ares, G. (2019). Valence, arousal and sentiment meanings of 33 facial emoji: Insights for the use of emoji in consumer research. *Food Research International, 119*, 895–907.

Kaye, L. K., Malone, S. A., & Wall, H. J. (2017). Emojis: Insights, affordances, and possibilities for psychological science. *Trends in Cognitive Sciences, 21*(2), 66–68. https://doi.org/10.1016/j.tics.2016.10.007

Kaye, L. K., Wall, H. J., & Malone, S. A. (2016). Turn that frown upside-down": A contextual account of emoticon usage on different virtual platforms. *Computers in Human Behavior, 60*, 463–467. https://doi.org/10.1016/j.chb.2016.02.088

Knapp, M. L., & Hall, J. A. (2002). *Nonverbal communication in human interaction* (5th ed.). Australia: Wadsworth Thomas Learning.

Kornblum, S., Hasbroucq, T., & Osman, A. (1990). Dimensional overlap: Cognitive basis for stimulus–response compatibility—a model and taxonomy. *Psychological Review, 97*, 253–270.

Kralj Novak, P., Smailović, J., Sluban, B., & Mozetič, I. (2015). Sentiment of emojis. *PLoS One, 10*(12), Article e0144296. https://doi.org/10.1371/journal.pone.0144296

Lee, A., Tang, S., Yu, G., & Cheung, R. (2008). The smiley as a simple screening tool for depression after stroke: A preliminary study. *International Journal of Nursing Studies, 45*(7), 1081–1089. https://doi.org/10.1016/j.ijnurstu.2007.05.008

Lenth, R., Singmann, H., Love, J., Buerkner, P., & Herve, M. (2020). Package 'emmeans'. https://cran.r-project.org/web/packages/emmeans/emmeans.pdf.

Li, W., Chen, Y., Hu, T., & Luo, J. (2018). Mining the relationship between emoji usage patterns and personality. In *Paper presented at the twelfth international AAAI conference on web and social media*.

Liddell, T. M., & Kruschke, J. K. (2018). Analyzing ordinal data with metric models: What could possibly go wrong? *Journal of Experimental Social Psychology, 79*(August), 328–348. https://doi.org/10.1016/j.jesp.2018.08.009

Lotfinejad, N., Assadi, R., Aelami, M. H., & Pittet, D. (2020). Emojis in public health and how they might be used for hand hygiene and infection prevention and control. *Antimicrobial Resistance and Infection Control, 9*(27), 1–6. https://doi.org/10.1186/s13756-020-0692-2

Lu, X., Ai, W., Liu, X., Li, Q., Wang, N., Huang, G., et al. (2016). Learning from the ubiquitous language: An empirical analysis of emoji usage of smartphone users. In *Proceedings of the 2016 ACM international joint conference on pervasive and ubiquitous computing* (pp. 770–780). https://doi.org/10.1145/2971648.2971724

Luor, T., Ted, Wu, L., Lu, H.-P., & Tao, Y.-H. (2010). The effect of emoticons in simplex and complex task-oriented communication: An empirical study of instant messaging. *Computers in Human Behavior, 26*(5), 889–895. https://doi.org/10.1016/j.chb.2010.02.003

Marengo, D., Giannotta, F., & Settanni, M. (2017). Assessing personality using emoji: An exploratory study. *Personality and Individual Differences, 112*, 74–78. https://doi.org/10.1016/j.paid2017.02.037

Matuschek, H., Kliegl, R., Vasishth, S., Baayen, H., & Bates, D. (2017). Balancing Type I error and power in linear mixed models. *Journal of Memory and Language, 94*, 305–315. https://doi.org/10.1016/j.jml.2017.01.001

McCullagh, P. (1980). Regression models for ordinal data. *Journal of the Royal Statistical Society: Series B, 42*(2), 109–127. https://doi.org/10.1111/j.2517-6161.1980.tb01109

Na'aman, N., Provenza, H., & Montoya, O. (2017). Varying linguistic purposes of emoji in (twitter) context. In *Paper presented at the ACL 2017, student research workshop*. https://doi.org/10.18653/v1/P17-3022

Neel, L.A.G., McKechnie, J.G., Robus, C., & Hand, C.J. (accepted). Emoji alter the perception of emotion in otherwise affectively neutral text messages. Journal of Nonverbal Behavior.

Proctor, R. W., & Cho, Y. S. (2006). Polarity correspondence: A general principle for performance of speeded binary classification tasks. *Psychological Bulletin, 132*, 416–442.

Provine, R. R., Spencer, R. J., & Mandell, D. L. (2007). Emotional expression online: Emoticons punctuate website text messages. *Journal of Language and Social Psychology, 26*(3), 299–307. https://doi.org/10.1177/0261927X06303481

R Development Core Team. (2016). *R: A language and environment for statistical computing.* R Foundation for Statistical Computing.

Robus, C. M., Hand, C. J., Filik, R., & Pitchford, M. (2020). Investigating effects of emoji on neutral narrative text: Evidence from eye movements and perceived emotional valence. *Computers in Human Behavior, 109*, Article 106361. https://doi.org/10.1016/j.chb.2020.106361

Rodrigues, D., Lopes, D., Prada, M., Thompson, D., & Garrido, M. V. (2017). A frown emoji can be worth a thousand words: Perceptions of emoji use in text messages exchanged between romantic partners. *Telematics and Informatics, 34*, 1532–1543. https://doi.org/10.1016/j.tele.2017.07.001

Rodrigues, D., Prada, M., Gaspar, R., Garrido, M. V., & Lopes, D. (2018). Lisbon Emoji and Emoticon Database (LEED): Norms for emoji and emoticons in seven evaluative dimensions. *Behavior Research Methods, 50*(1), 392–405. https://doi.org/10.3758/s13428-017-0878-6

Sampietro, A. (2020). Use and interpretation of emoji in electronic-mediated communication: A survey. *Visual Communication Quarterly, 27*(1), 27–39. https://doi.org/10.1080/15551393.2019.1707086

Santens, S., & Gevers, W. (2008). The SNARC effect does not imply a mental number line. *Cognition, 108*, 263–270.

Sarkar, T., Shetty, N., & Humstoe, M. (2014). *Emoticons-emotions-Contextual-interpretation-in-textmessages-consensus-of-meaning.pdf* (Vol. 3, pp. 24–33).

Scott, G. G., Brodie, Z. P., Wilson, M. J., Ivory, L., Hand, C. J., & Sereno, S. C. (2020). Celebrity abuse on Twitter: The impact of tweet valence, volume of abuse, and dark triad personality factors on victim blaming and perceptions of severity. *Computers in Human Behavior, 103*, 109–119. https://doi.org/10.1016/j.chb.2019.09.020

Scott, G. G., Keitel, A., Becirspahic, M., Yao, B., & Sereno, S. C. (2019). The Glasgow Norms: Ratings of 5,500 words on nine scales. *Behav Res, 51*, 1258–1270. https://doi.org/10.3758/s13428-018-1099-3

Scott, G. G., O'Donnell, P. J., Leuthold, H., & Sereno, S. C. (2009). Early emotion word processing: Evidence from event-related potentials. *Biological Psychology, 80*(1), 95–104. https://doi.org/10.1016/j.biopsycho.2008.03.010

Scott, G. G., Wiencierz, S., & Hand, C. J. (2019). The volume and source of cyberabuse influences victim blame and perceptions of attractiveness. *Computers in Human Behavior, 92*, 119–127. https://doi.org/10.1016/j.chb.2018.10.037

Shaki, S., & Petrusic, W. M. (2005). On the mental representation of negative numbers: Context-dependent SNARC effects with comparative judgments. *Psychonomic Bulletin & Review, 12*, 931–937. https://doi.org/10.3758/BF03196788

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology, 4*, 1–32. https://doi.org/10.1146/annurev.clinpsy.3.022806.091415

Skiba, D. J. (2016). Face with tears of joy is word of the year: Are emoji a sign of things to come in health care? *Nursing Education Perspectives, 37*(1), 56–57. https://doi.org/10.1097/01.nep.0000476112.24899.a1

Szabó, Z. G. (2019). Semantic explanations. In E. Lepore, & David Sosa (Eds.), *Oxford studies in philosophy of language* (pp. 240–275). Oxford: Oxford University Press.

Tagg, C. (2009). *A corpus linguistics study of SMS text messaging.* UK: University of Birmingham.

Taylor, J. E., Rousselet, G. A., Scheepers, C., & Sereno, S. C. (2021). Rating norms should be calculated from cumulative link mixed effects models. https://doi.org/10.31234/osf.io/3vgwk accessed 23/08/21.

Thompsen, P. A., & Foulger, D. A. (1996). Effects of pictographs and quoting on flaming in electronic mail. *Computers in Human Behavior, 12*(2), 225–243. https://doi.org/10.1016/0747-5632(96)00004-0

Thompson, D., & Filik, R. (2016). Sarcasm in written communication: Emoticons are efficient markers of intention: Sarcasm in writing: Emoticons mark intention. *Journal of Computer-Mediated Communication, 21*(2), 105–120. https://doi.org/10.1111/jcc4.12156

Thompson, D., Mackenzie, I. G., Leuthold, H., & Filik, R. (2016). Emotional responses to irony and emoticons in written language: Evidence from EDA and facial EMG. *Psychophysiology, 53*(7), 1054–1062. https://doi.org/10.1111/psyp.12642

Thompson, C. A., Novotny, P. J., Bartz, A., Yost, K. J., & Sloan, J. A. (2018). Development of novel emoji scale to measure patient-reported outcomes in cancer patients. *Journal of Clinical Oncology, 36*(7), 174.

Thompson, C. A., Yost, K. J., Bartz, A., Kumar, A., Ruddy, K. J., Stan, D. L., et al. (2018). Patient-reported outcomes, emoji, and activity measured on the Apple Watch in cancer patients. *Journal of Clinical Oncology, 36*(15). https://doi.org/10.1200/JCO.2018.36.15-suppl.6501

Van Dam, L., Rietstra, S., Van der Drift, E., Stams, G., Van der Mei, R., Mahfoud, M., et al. (2019). Can an emoji a day keep the doctor away? An explorative mixed-methods feasibility study to develop a self-help app for youth with mental health problems. *Frontiers in Psychiatry, 10*(593), 1–11. https://doi.org/10.3389/fpsyt.2019.00593

Van Kleef, G. A. (2009). How emotions regulate social life: The emotions as social information (EASI) model. *Current Directions in Psychological Science, 18*(3), 184–188. https://doi.org/10.1111/j.1467-8721.2009.01633.x

Wall, H. J., Kaye, L. K., & Malone, S. A. (2016). An exploration of psychological factors on emoticon usage and implications for judgement accuracy. *Computers in Human Behavior, 62*, 70–78. https://doi.org/10.1016/j.chb.2016.03.040

Walther, J. B., & D'Addario, K. P. (2001). The impacts of emoticons on message interpretation in computer-mediated communication. *Social Science Computer Review, 19*(3), 324–347. https://doi.org/10.1177/089443930101900307

Weissman, B., & Tanner, D. (2018). A strong wink between verbal and emoji-based irony: How the brain processes ironic emojis during language comprehension. *PLoS One, 13*(8), Article e0201727.

Willis, J., & Todorov, A. (2006). First impressions: Making up your mind after a 100-ms exposure to a face. *Psychological Science, 17*(7), 592–598.