Computers in Human Behavior 139 (2023) 107563

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Exploring the (lack of) facilitative effect of emoji for word processing

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ARTICLE INFO

Keywords:
Emoji
Emotional valence
Lexical decision
Associative linking
Associative-propositional evaluation model

ABSTRACT

We explore whether emoji were associatively linked to emotion concepts represented in emotion-laden words, in line with the Associative-Propositional Evaluation model. Specifically, we tested these principles by exploring whether emotionally-congruent emoji could enhance word processing (Study 1 & 2) and recall (Study 3). In Study 1, participants completed a lexical decision task where word valence was manipulated. Emoji were appended to words which were either congruent, incongruent, or controls. No effects were found for emoji valence on response accuracy or latency. Study 2 presented words which varied in valence alongside congruent or control emoji where self-report valence evaluations were obtained. No effects were observed for emoji valence on word valence evaluations. Study 3 included emoji as primes to test the effect on word recall. No effects were found on word recall accuracy. Overall, the current findings suggest that emoji do not support word processing and may not be associatively linked to emotion concepts.

1. Introduction

The role of emotion in processing is well-established in the psychological literature. This largely suggests that emotions or emotional valence (i.e., the pleasure/displeasure generated by the stimuli; Russell & Ridgeway, 1983) impact the appraisal and processing of stimuli. Although there may be some debate over the efficacy of cognitive paradigms to study affective processing, scholars argue that emotion should not be divorced from cognition, and this is evidenced by the increase of this approach over the last few decades (Eder et al., 2007; Erickson & Schulkin, 2003).

When exploring the role of emotion in cognitive processing, scholars have typically focused on word or face stimuli, and largely indicated that emotional stimuli are processed differently from neutral stimuli (Citron et al., 2014; Kuchinke et al., 2005; Lane et al., 1999). Specifically, it is well established that greater valence (which may be positive or negative) results in a processing advantage over neutral stimuli. This effect has previously been found in the processing of emotional words over neutral words. That is, within lexical decision tasks, valenced words are identified as being a word (compared to a non-word) more accurately and faster than their neutral counterparts (Kousta et al., 2009; Ponari et al., 2015; Vinson et al., 2014).[1] These effects also extend beyond emotion words (e.g., happy) to those with emotional connotations or "emotion-laden" words (e.g., wedding; Vinson et al., 2014). The literature however presents mixed findings on this, which may, in part, be attributed to variations in methodology across studies, with some focusing on explicit valence decision tasks and others measuring this more implicitly. Although not extensively researched, this same processing benefit may apply to other types of stimuli which may be considered to be emotionally charged, such as emoji. If we do indeed observe an equivalent processing advantage for valenced emoji (e.g., happy or sad) relative to neutral emoji, this may suggest that they are bound to emotion concepts.

Because emoji typically appear with written language rather than independently, research is needed to explore how they are processed alongside words. This can help us establish the extent to which emoji can

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[1] The precise polarity of valenced words that drives these effects, however, has been debated (positive versus negative; see Hinojosa et al., 2019, for a detailed review). Specifically, some research finds this effect when comparing neutral words to those positively-valenced but not to negatively-valenced ones (Kuperman et al., 2014), whereas others find an effect irrespective of the polarity of valence (Kousta et al., 2009; Larsen et al., 2008).

https://doi.org/10.1016/j.chb.2022.107563
Received 28 January 2022; Received in revised form 6 October 2022; Accepted 11 November 2022
Available online 12 November 2022

serve a facilitative role in word processing in cases when they depict the equivalent valence as the co-occurring words (e.g., a positive emoji paired with a positive-valenced word). However, the potential facilitative role of emoji here rests largely on the assumption that emoji are indeed bound as emotional concepts. Put another way, a happy emoji is only likely to support the processing of a concurrent positive word if it shares a conceptual link with the emotion of happiness (otherwise described as "associative linking").

The Associative-Propositional Evaluation model (Gawronski & Bodenhausen, 2006, 2007) can go some way to underpin any expected processes and effects from associative linking of words and emoji via shared emotional concepts. The basic operating principle of this model posits that associative linking is the creation of a new association between two concepts based on their co-occurrence (Gawronski & Bodenhausen, 2009). This typically has been used to explain the implicit and explicit pathways underpinning attitudes and associated behavioural responses, based on the extent to which one concept (e.g., White) may be linked to another (e.g., Good) (ibid). The same principle may equally be expected for stimuli which are proposed to share a valence concept. Namely, in respect of emoji and emotion-laden words, associations between these can arguably be strengthened by the fact these typically co-exist based on contingency with a shared valence concept (e.g., a positive emoji may tend to co-occur with words depicting positive sentiment). As such, words and emoji which are proposed to share equivalent valence properties may hold strong associative links. Conversely, an emoji with valence which is incongruent to the valence represented in a co-occurring word would be said to lack an associative link to a shared emotional concept. As such, this may translate into more efficient processing (e.g., faster reaction times) for congruent word-emoji pairing relative to incongruent ones.

The Associative-Propositional Evaluation model draws distinction between these basic operating principles of the associative process, and the secondary conditions of its operation (Gawronski & Bodenhausen, 2009, 2011). Specifically, for associative linking which is arguably implicit in nature, the evaluation or outcome of this process can equally be implicit or explicit. In the case of implicit evaluation (e.g., via implicit measures such as lexical decision tasks), this is void of any implied validity of a mental association between concepts. That is, the link may exist but without subjective judgement about whether this is valid. However, for explicit evaluation (such as via subjective reporting), this reflects the validity of this association as the individual engages propositional processes to act upon this (Gawronski & Bodenhausen, 2011).

When reviewing the existing literature on the role of emoji in word processing, there is little which has specifically interrogated the notion that emoji are bound as emotional concepts. Whilst we have a good evidence base for understanding the range of uses and functions of emoji (Bai et al., 2019), this often pertains to their function being more than just emotional markers, including them having linguistic functions and properties (Dresner and Herring, 2010; Herring & Dainas, 2017). Work which has focused on their emotional properties tends instead to focus on how users select them for emotional expression. For example, facial emoji are regularly used to denote emotional expression in online communications, can help disambiguate emotional intent behind messages (Kaye et al., 2016; Kelly & Watts, 2015), are most often used in sentimental contexts (Ai et al., 2017), and can support interpretation and comprehension efforts (Berengueres & Castro, 2017; Cohn et al., 2018; Derks et al., 2008).

Other research focused on the role of emoji in word processing has focused on the grammatical properties of emoji in written communication (Cohn et al., 2019). Specifically, this has found that when used in messages, emoji have a limited grammatical role and generally lack their own grammatic structure when used outside the context of words and sentences (ibid). Other work has found that ironic (wink) emoji when used at the end of sentences elicits P200 and P600 effects which in turn are correlated with people interpreting this emoji as an indicator of irony (Weissman & Tanner, 2018). Finally, other research has looked at how emoji in the context of written discourse can aid comprehension (Holtgraves & Robinson, 2020; Robus et al., 2020). Holtgraves and Robinson (2020) noted that emoji facilitated the comprehension of message meaning, particularly in relation to endorsing indirect meanings behind written discourse. Additionally, Robus et al. (2020) explored the influence of emoji valence and sentence position (before versus after a sentence) on eye gaze behaviour. Interestingly, although participants spent longer fixating on sentences which had an emoji at the end rather than the beginning of a sentence, emoji valence did not impact upon sentence processing or perceptions of text valence, However, the sentences used in this study were neutrally-valenced and it is unclear whether these findings would vary if emotionally-valenced sentences were used particularly in relation to processing efficacy. This suggests that the emotional impact of emoji is limited. However, there is still a paucity of research that has directly established the extent to which emoji may be bound to emotion concepts from the receiver's perspective. Specifically, at an implicit level, initial evidence suggests that they may not be processed emotionally, and instead may operate more exclusively on a social processing level (Kaye et al., 2021). However, this does not specifically test the effect of associative linking within word processing.

In the case of emoji in word processing, there are two issues which are currently unclear. Firstly, whether there are indeed associative links which exist whereby emoji are implicitly linked to emotion concepts which are represented in concurrent words. This can be explored using a variety of paradigms which can test concurrent versus sequential presentation of stimuli pairs. The former of these may initially establish the presence of associative linking, whereas the latter may test whether this can be primed. Secondly, irrespective of the presence or absence of these associative links, it is unclear how this may manifest in the evaluation process and whether this would be evident via implicit (e.g., lexical decision task) or explicit evaluation (e.g., self-report measures, recall of words), or indeed both. As such, it is pertinent to use a range of implicit vs explicit paradigms to test this.

As such, within the three studies reported here, we address these limitations. Specifically, all studies test the assumption of associative linking between emotionally-contingent emoji and words, but explore the evaluative process in different ways. Study 1 explores implicit evaluation of words via lexical decision-making whereas Study 2 assesses explicit evaluation via subjective valence judgments of words. Study 3 however includes sequential affective priming, proposed to strengthen the associative linking between emotionally-contingent emoji and words, and tests explicit evaluation via target word recall.

As such, the overarching conceptual research questions (RQs) of the current research are:

RQ1. Are emotionally-contingent emoji and words associatively linked by a shared emotion concept?

RQ2. Is there evidence of associative linking of emotionally-contingent emoji and words via a) implicit evaluation (Study 1) and b) explicit evaluation (Study 2 & 3)?

2. Study 1

Study 1 explored the (facilitative) effect of emoji on implicit word processing. We sought to investigate this form of implicit processing using a lexical decision task which presents different word and emoji conditions that vary in congruence. A lexical decision task was selected based on the fact that previous research on emotional processing of words using this methodology has found it useful in identifying the processing benefits of emotional stimuli (Kousta et al., 2009; Ponari et al., 2015). Therefore, the current findings can more easily be compared to this developing literature. Specifically, we sought to explore how semantic relationships of words and emoji relate to word processing. That is, how emotion-laden words (positive and negative) may be processed differently between conditions of a congruent, incongruent or neutral emoji. If emoji and words are associatively linked to a shared emotion concept, one would expect that congruent conditions (e.g., positively-valenced words accompanied by smiley emoji) would result in faster and more accurate word processing compared to incongruent (e.g., negatively-valenced words accompanied by smiley emoji) or control conditions (words with neutral emoji).

Interestingly, no research to date has applied this work to explore congruence effects of emoji with words. However, other studies have compared congruent (social media message + context-congruent emoji) and incongruent (social media message + context-inappropriate emoji) conditions on outcomes such as understandability and believability of online messages, revealing a congruence effect (Daniel & Camps, 2018). Therefore, it is reasonable to expect a congruence effect will be relevant for automatic emotional processing too. Should a congruence effect exist, it may be inferred that emoji do indeed share a valence concept with co-occurring words.

Drawing upon previous literature we hypothesise that:

H1. Positively-valenced words will be more accurately and quickly processed when accompanied by a smiley (congruent) emoji compared to a frowny (incongruent) or neutral (control) emoji.

H2. Negatively-valenced words will be more accurately and quickly processed when accompanied by a frowny (congruent) emoji compared to a smiley (incongruent) or neutral (control) emoji.

H3. There will be significant differences in accuracy and latency of neutral words between emoji conditions. Namely, neutral words will be more accurately and quickly processed when accompanied by a positive or negative emoji than a neutral one.

3. Method

3.1. Design/procedure

A within-participants design was used in which we operationalised three conditions; congruent, incongruent and control. This was utilised for positive, negative and neutral words. Therefore, overall we had a 3 (word valence; positive, negative, neutral) x 3 (emoji condition; positive, negative, neutral) within-participants design. Specifically, within the design, we had congruent conditions (positive word + positive emoji and negative word + negative emoji), incongruent conditions (positive word + negative emoji and negative word + positive emoji) and control conditions (positive word + neutral emoji and negative word + neutral emoji). In addition, although these were not strictly related to congruence conditions, we also had neutral words which were accompanied by positive emoji, negative emoji or neutral emoji.

Before completing the lexical decision task, demographics were obtained (age, gender, native language). Within the lexical decision task, participants were seated in front of a computer monitor with a keyboard, at a viewing distance of approximately 60 cm. Stimuli were presented centrally on the screen on a white background, in which the letter string was presented centrally with emoji appended to the right. Each of the 30 words (10 positive, 10 negative, 10 neutral) was presented three times, once with each emoji appended. Similarly, the non-words (30) were presented three times with the three emoji combinations. As such this resulted in 180 letter string + emoji combinations. The research was undertaken in five main blocks each consisting of 36 stimuli presentations, with designated rest periods built into the programme between these blocks to alleviate participant fatigue. These featured every 24 trials.

Before the first block, a practice block of six trials was conducted to familiarise participants with the format of the task and provide feedback on accuracy of trials. Overall, the whole experiment lasted approximately 30–40 min.

Each stimulus was preceded by a central fixation cross for 500 ms. The lexical decision task was developed and controlled by Experiment Builder v2.1.512 (SR Research). For each trial, following the presentation of the fixation cross, each stimulus (word + emoji) was presented along with the question "Is this a word?" These questions were preferable to explicitly asking "Is this emotional?" (which would correspond more closely with a valence decision task) to reduce the likelihood of semantic priming (Heyman et al., 2015; Neely et al., 1989). The question remained on the screen either until a response was given, or it timed out after 5000 ms. Participants were instructed to respond as quickly and accurately as possible, by pressing the "a" or "l" key to denote "Yes" or "No". The response keys were counterbalanced across the sample. Reaction time (RT in ms) and accuracy (ACC) were recorded for each trial. RT was calculated based on the time difference from the time recorded at which the stimuli first appeared on screen and the response key was pressed.

3.2. Participants

The final sample had an average age of 21.00 years ($SD = 1.89$), with a gender breakdown of 5 males and 25 females. Participants were based in the UK, primarily recruited as an opportunity sample from a Psychology department in the UK. Participants were required to be native English speakers, and it was advised that participants who had sensory disturbances such as epilepsy may be better not taking part based on the nature of the task. Participants were not compensated for their participation. G*Power (Faul et al., 2009) was used to estimate the sample size needed to replicate a large effect size ($f = 0.40$; $1\text{-}\beta = 0.80$) as in Ponari et al. (2015), with a study of one group and six measures (three valence; positive, negative, neutral, and three emoji; positive, negative, neutral). Following this analysis, at least 9 participants would be needed. When asked about their emoji use across different platforms (1 = I do not use, 4 = I use a lot), Facebook was reported to be the place where they were most used ($M = 3.00$, $SD = 1.14$) in which 86.7% of the sample reported they used them on here at least "a little". This was followed by Snapchat ($M = 2.97$, $SD = 1.10$), and WhatsApp ($M = 2.80$, $SD = 1.00$) which both had 90.0% of the sample reporting they used emoji at least "a little". Prior to the research being conducted, it received full ethical approval from the Department of Psychology Research Ethics Committee at Edge Hill University.

3.3. Stimuli

3.3.1. Words and non-words

Word stimuli were taken from Kousta et al. (2009) with the final set consisting of 30 words (10 positive, 10 negative, and 10 neutral) and 30 non-words, extracted from Kousta et al.'s (2009) 40 original triplets. All words were emotion-laden (e.g., wedding) rather than being emotion words (e.g., happy). Words were selected based on a number of criteria. First, these were controlled for emotional valence and arousal based on the findings from Kousta et al. (2009), and therefore this determined the categorisation of stimuli being positive, neutral or negative. Following Kousta et al.'s study (2009), words were therefore also controlled for concreteness, imageability, age of acquisition, familiarity, logarithmic frequency, orthographic neighbourhood, number of letters, number of syllables, number of morphemes and mean positional bigram frequency. This was necessary as these have been found to be confounding factors when measuring valence effects on processing efficiency (Kousta et al., 2009; Larsen et al., 2006). To select the final set of 10 positive-neutral-negative triplets, a randomisation formula was used. Thus, the selected items were picked at random, choosing the first 10. Non-word stimuli were created by changing a letter from remaining emotional words from those in Kousta et al. (2009). These were selected based on them being pronounceable and matched with word stimuli in terms of length. (See Appendix 1 for Study 1 experimental stimuli). Within the lexical decision task, letter strings were presented centrally on the screen in black Times New Roman font size 20.

3.3.2. Emoji

Emoji stimuli were obtained from the Unicode Emoji Charts accessed from http://unicode.org/emoji/charts/full-emoji-list.html. Previous research has used this full dataset to provide ratings on evaluative dimensions of these emoji, including emotional valence (Rodrigues et al., 2018). These ratings varied from 1 (very negative) to 7 (very positive) from which the authors devised three levels of valence (low, moderate and high). To add a further level of rigour, these are rated for emoji across a range of software and operating systems (e.g., Android, Apple, etc). These ratings therefore provided an objective basis for selecting experimental stimuli to represent positive, neutral and negative emoji conditions respectively, whilst also controlling for other key evaluative dimensions such as arousal and familiarity. This is important given the wealth of evidence suggesting dimensions such as arousal impact upon emotional processing (e.g., Larsen et al., 2008).

Within the lexical decision task, we used one emoji stimulus per valence condition based on Rodrigues et al. (2018) emoji norms to maintain experimental control. Emoji images were Android OS depiction of the following unicode: U+1F603 for positive valence emoji, U+1F610 for neutral valence emoji and U+1F626 for negative valence emoji. All images were displayed to the right of each letter string (i.e., after the word), therefore presented right off-centre (location = 591, 386), formatted to the dimensions of 10 × 10 mm (see Fig. 1).

4. Results

The datasets generated during and/or analysed within the current research are available on the Open Science Framework repository, https://osf.io/zrqm4/. Descriptive analyses were undertaken to ascertain accuracy and response latency by experimental condition (see Table 1). To calculate mean RTs for each condition, at trial level, only RTs with accurate responses were computed. Additionally, data was excluded if latencies were faster than 2.5 SDs faster or slower than the mean or timed out.

We performed a sensitivity analysis in our sample with G*Power 3.1 software (Faul et al., 2009). For the analysis, we used F tests with $\alpha = 0.05$, power = 0.80 and the total sample size of 30 participants as input parameters. We performed sensitivity analysis rather than post-hoc power analysis based on previous recommendations noted in the literature (Lakens, 2021; Perugini et al., 2018). The sensitivity analysis, given a sample size of 30 participants, an $\alpha = 0.05$ and an expected power = 0.80, showed that we could detect values down to f = 0.17 (Fcritical = 1.98, df = 8, 232); therefore, obtained F values equal to or larger the critical F-value is significant at the level of probability.

To examine whether stimuli type or valence influenced accuracy a 3 (word valence: positive, negative, neutral) x 3 (emoji valence: congruent, incongruent, control) repeated measures ANOVA was conducted. No significant main effect was found for word valence, $F(1, 25) = 1.35$, $p = .26$, $\eta_p^2 = 0.05$ or emoji valence, $F(1, 25) = < 1$, $p = .52$, $\eta_p^2 = 0.03$. There was also no significant interaction between word valence and emoji valence, $F(2, 50) = < 1$, $p = .99$, $\eta_p^2 = 0.001$.

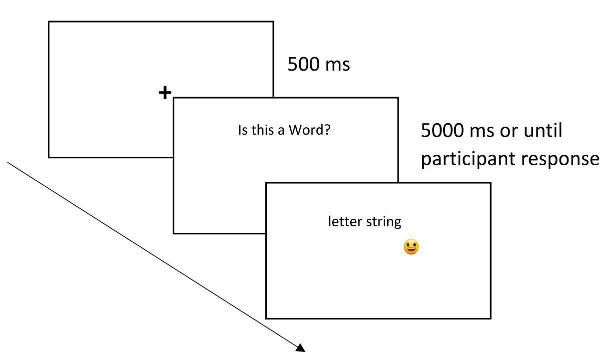

Fig. 1. Trail structure for Study 1.

Table 1
Descriptive analysis of accuracy and latency between experimental conditions for positive, negative and neutral words.

Word Valence	Emoji valence (Condition)	Accuracy (%) *M (SD)*	RT (in ms) *M (SD)*	Min RT *M*	Max RT *M*
Positive Words	Positive (Congruent)	96.97 (.60)	1661.90 (171.28)	1466.17	1911.68
	Negative (Incongruent)	94.67 (.10)	1768.73 (425.71)	1429.60	2520.24
	Neutral (Control)	96.00 (.10)	1699.71 (227.28	1457.22	2035.71
Negative Words	Positive (Incongruent)	96.33 (.06)	1716.65 (204.19)	1448.07	2114.98
	Negative (Congruent)	94.55 (.11)	1730.10 (259.89)	1453.36	2113.16
	Neutral (Control)	95.33 (.13)	1700.78 (155.89)	1452.17	1994.55
Neutral Words	Positive	94.67 (.82)	1765.85 (280.55)	1486.26	2226.12
	Negative	93.00 (.10)	1760.45 (256.65)	1474.40	2236.44
	Neutral	95.45 (.09)	1737.78 (294.76)	1447.62	2143.76

To examine whether stimuli type or valence influenced latency a 3 (word valence: positive, negative, neutral) x 3 (emoji valence: congruent, incongruent, control) repeated measures ANOVA was conducted. A significant main effect was found for word valence, $F(2, 48) = 5.83$, $p = .01$, $\eta_p^2 = 0.20$ but not for emoji valence, $F(2, 48) = 1.33$, $p = .27$, $\eta_p^2 = 0.05$. There was no significant interaction effect for word valence by emoji valence, $F(4, 96) = 1.42$, $p = .23$, $\eta_p^2 = 0.06$. Positive words had quicker latencies ($M = 1627.91$, $SE = 20.21$) than neutral words ($M = 1668.74$, $SE = 21$, $p_{bonf} < .0131$). Latencies between positive words and negative words ($M = 1658.48$, $SE = 25.65$) were not significantly different.

To explore the effect of emoji valence further, we conducted Bayesian Null Hypothesis testing comparisons (Rouder et al., 2009, 2012) to compute the Bayes Factors for the congruent versus. Incongruent (averaged across positive and negative word conditions) emoji conditions. Results of the Bayesian paired sample t-tests showed that the null hypothesis (BF_{01}) was able to explain the effects 2.33 times better than the alternative hypothesis for the reaction time data, and 4.98 times better for the accuracy data, thus providing support in favour of the absence of differences across conditions.

5. Discussion

Study 1 aimed to ascertain evidence of associative linking of emotionally-contingent emoji and words (RQ1) and the extent to which there may be observable effects via implicit evaluation (RQ2a). This was achieved by utilising a lexical decision paradigm in which words of varying valence (i.e., positive, negative and neutral) were combined with congruent and incongruent emoji (and neutral emoji).

Findings revealed that despite accuracy rates being equivalent across word and emoji valence, a main effect was found for latency for word valence in which positive words were processed more quickly than neutral words. However, the interaction between word and emoji valence was not significant. Consequently, neither H1 nor H2 were supported. Even for neutral words, where the introduction of an emoji may either elicit or remove ambiguity, there did not appear to be convincing evidence that emoji valence interacted with processing efficiency (therefore refuting H3). As such, we found no emoji congruence effect for word processing. This may suggest an absence of associative linking between emotionally-contingent emoji and words or alternatively, that this does not manifest via implicit evaluation methods.

5.1. Study 2

In Study 2, we further sought to explore the possibility of associative linking between emotionally-contingent emoji and words but via an explicit rather than implicit evaluation task. As such there were two key distinctions from Study 1. Firstly, we utilised self-report valence ratings rather than a lexical decision task. Latency data from Study 1 were relatively long suggesting that the combination of words and emoji may raise the word recognition threshold. Secondly, rather than presenting letter strings accompanied by emoji, we simultaneously presented words on a background contextual image of emoji, for participants to make explicit evaluative judgements. To test this, positive, negative and neutral words were individually presented on the screen inserted in congruent or control visual contexts that included emoji. Participants assessed the valence of the displayed words using a 9-point rating scale.

Drawing upon previous literature we hypothesised that:

H4. Positively-valenced words will be rated more positively when presented in a positively-valenced (congruent) emoji context as compared to a control context.

H5. Negatively-valenced words will be rated more negatively when presented in a negatively-valenced (congruent) emoji context compared to a control context.

6. Method

6.1. Design

A 3 (word valence; positive, negative, neutral) x 2 (emoji background; congruent, control) within-participants design was used to test the impact on valence evaluation of words. Congruent conditions consisted of words being sequentially presented on a screen with a background of emoji representing the same valence (e.g., positively-valenced word on a background of positive emoji). Control conditions included words being sequentially presented on a screen with a background of emoji-like stimuli (i.e., yellow circles without faces; see Fig. 2).

6.2. Participants

The sample consisted of 67 native Spanish participants, 23 males (*M* = 23.43 years old, *SD* = 3.73) and 44 females (*M* = 26.82 years old, *SD* = 6.88), with normal or corrected-to-normal vision. Participants were recruited from both Universidad Antonio de Nebrija and Universitat de València, and they voluntarily participated in the study in exchange for a 25€ voucher that was raffled for every 15 participants. Prior to the research being conducted, it received full ethical approval from the Research Ethics Committee at Universidad Antonio de Nebrija.

7. Stimuli

7.1. Words

One hundred and twenty words were used based on the valence ratings determined from Stadthagen-Gonzalez et al. (2017). The final list of materials consisted of 120 words of which 40 were positive, 40 were negative, and 40 were neutral in valence, categorised based on previous studies. ANOVAs showed that the three valence categories were statistically different from each other, $F(2, 117) = 2920$, $p < .005$. Additionally, words were controlled for on other relevant dimensions. Specifically, all three emotional word dimensions were matched for concreteness [$F(2, 117) = 0.009$, $p = .990$], word frequency [$F(2, 117) = 0.015$, $p = .985$] and length [$F(2, 117) = 0.034$, $p = .877$]. Two sub-lists that did not statistically differ from each other were created from each main list of positive, negative and neutral words, each containing 20 words [all $ps > .850$] (see Table 2, and see Appendix 2)

7.1.1. Emoji

Emoji stimuli for the screen background conditions were chosen from the Lisbon Emoji and Emoticon dataset (Rodrigues et al., 2018). The three emoji which represented positive (unicode: U+1F603), negative (unicode: U+2639), and neutral (unicode: U+1F636) valence were selected. For the control condition, one geometric element (emoji-like, round and yellow) was created to control for the visual information presented in the experimental conditions. Each background was composed of 24 graphic elements, distributed on groups of 6 over each quadrant of the canvas, avoiding a canvas-centred blank spot so that words could fit without interfering with the background elements (see Fig. 2). All backgrounds were created with Adobe Illustrator (Adobe Inc., 2019).

7.2. Procedure

A 3 (word valence: positive, negative, neutral) x 2 (emoji

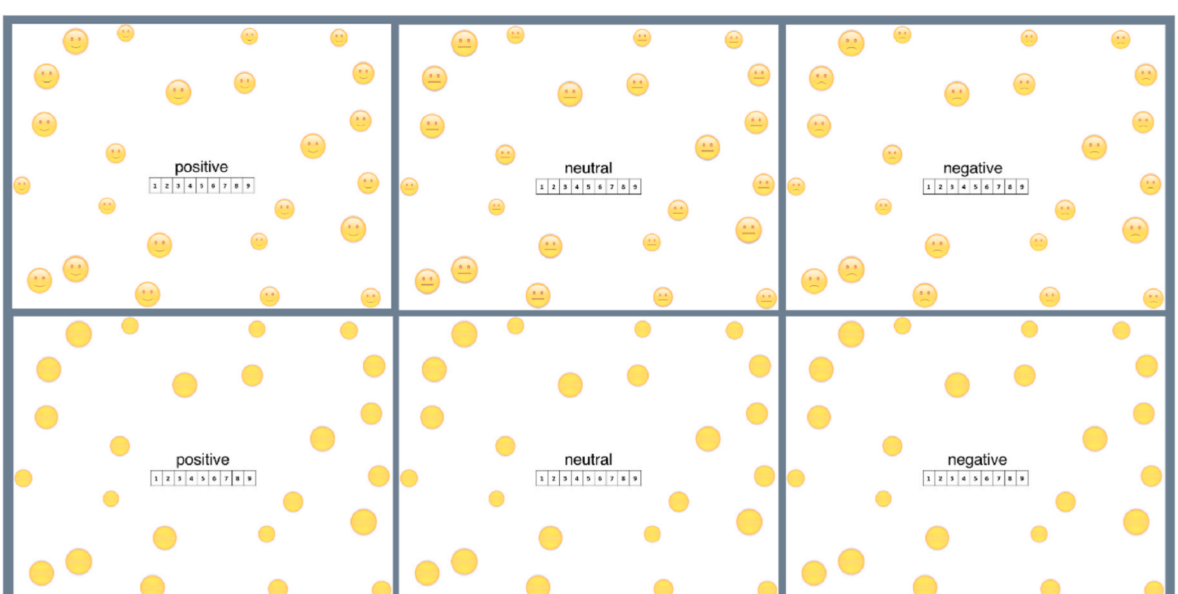

Fig. 2. Visualization of the experimental conditions based on the combination of word valence on congruent (top row) and control (bottom row) backgrounds.

Table 2
Descriptive analysis of experimental word stimuli.

	Positive *M (SD)* [M min-max]		Neutral *M (SD)* [M min-max]		Negative *M (SD)* [M min-max]	
	Sub-list 1	Sub-list 2	Sub-list 1	Sub-list 2	Sub-list 1	Sub-list 2
Valence	7.69 (0.39) [6.95–8.50]	7.69 (0.34) [7.10–8.35]	5.00 (0.08) [4.90–5.10]	5.00 (0.09) [4.90–5.20]	2.28 (0.44) [1.23–2.85]	2.26 (0.38) [1.65–2.95]
Concreteness	4.82 (1.02) [2.73–6.37]	4.84 (0.77) [3.08–6.06]	4.82 (0.91) [3.23–6.32]	4.83 (0.88) [2.78–5.90]	4.81 (0.58) [3.76–5.63]	4.80 (0.81) [3.22–6.12]
Frequency	4.06 (0.43) [3.03–4.64]	4.06 (0.52) [3.08–4.78]	4.04 (063) [3.31–5.52]	4.04 (0.63) [2.68–5.15]	4.04 (0.510) [2.95–4.79]	4.05 (0.49) [3.04–4.97]
Length	6.55 (0.51) [6.00–7.00]	6.55 (0.51) [6.00–7.00]	6.50 (0.51) [6.00–7.00]	6.50 (0.51) [6.00–7.00]	6.55 (0.51) [6.00–7.00]	6.55 (0.51) [6.00–7.00]

background: congruent, control) within-participants design was implemented. The experiment set up and data collection were undertaken on the Gorilla Experiment Builder online platform (Anwyl-Irvine et al., 2020, www.gorilla.sc). Each of the 120 words were sequentially randomly displayed in the centre of the screen superimposed over the corresponding background in Helvetica Regular in font size 30px. Each word was presented once, resulting in a total of 120 trials. The instructions were similar to those given in the Spanish adaptation of Affective Norms for English Words (ANEW) by Redondo et al. (2007) (see Appendix 3). Participants were asked to rate the valence of each of the presented words on a 9-point scale from 1 (unhappy) to 9 (happy), with 5 as neutral, and they were prompted to give a response based on their first impression. Each trial displayed the word and the 9-point scale underneath. Before every trial, a central fixation cross was presented for 500 ms. At the top of the screen, a dynamic bar would inform participants about their progress in the task. A self-controlled resting period was included after 60 trials which was the mid-point of the trial sequence. Overall, the whole task was completed between 6 and 8 min.

8. Results

All trials with response times under 500 ms were removed as an a priori set exclusion criterion (0.07% of the trials). A descriptive analysis was first conducted to assess word valence evaluations by emoji background condition (see Table 3).

We conducted a sensitivity analysis in our sample with G*Power 3.1 software (Faul et al., 2009). For the analysis, we used F tests with $\alpha = 0.05$, power = 0.80 and the total sample size of 67 participants as input parameters. We performed sensitivity analysis rather than post-hoc power analysis based on previous recommendations noted in the literature (Lakens, 2021; Perugini et al., 2018). The sensitivity analysis, given a sample size of 67 participants, an $\alpha = 0.05$ and an expected power = 0.80, showed that we could detect values down to f = 0.13 (Fcritical = 2.24, df = 5, 330); therefore obtained F values equal to or larger the critical F-value is significant at the level of probability.

A 3 (word valence: positive, negative, neutral) x 2 (emoji background: congruent, control) repeated measures ANOVA was performed to assess the impact on valence rating. A significant main effect of word valence was found ($F(2, 132) = 1037.77$, $p <$ 001, $\eta_p^2 = 0.913$). Post hoc analyses revealed that differences occurred between negative words and neutral words ($MD = -2.62$, $SE = 0.113$, $p_{bonf} < .001$) and between negative and positive words ($MD = -5.17$, $SE = 0.113$, $p_{bonf} < .001$). Additionally, positive words were rated significantly higher than neutral words ($MD = -2.55$, $SE = 0.113$, $p_{bonf} < .001$). Importantly, no main effect of emoji background was found ($F(1, 66) = 1.19$, $p = .279$, $\eta_p^2 = 0.000$), and there was not an interaction between word valence and emoji background ($F(2, 132) = 1.30$, $p = .277$, $\eta_p^2 = 0.000$).

The further explore the effect of emoji background, we conducted Bayesian Null Hypothesis testing comparisons to compute the Bayes Factors for the congruent versus. Control (averaged across word valence conditions) emoji conditions. Results of the Bayesian paired sample t-tests showed that the null hypothesis (BF_{01}) was able to explain the effects 4.23 times better than the alternative hypothesis, endorsing the absence of differences across conditions.

Table 3
Descriptive analysis of word valence rating per *emoji background condition.*

	Congruent *M (SD)*	Control *M (SD)*
Negative	2.14 (.69)	2.22 (.73)
Neutral	4.78 (.58)	4.83 (.50)
Positive	7.37 (.68)	7.33 (.71)

9. Discussion

Displaying words in visual contexts with valence-congruent emoji did not appear to impact on explicit evaluation of valence. Namely, no main effect of word valence or interactions with emoji context were found. As such this refutes H4 and H5, suggesting that when (congruent) emoji are presented with positively and negatively-valenced words, this does not result in more polarised scores relative to a control condition. These findings corroborate those from Study 1 pertaining to null effects which may equally suggest that emoji are not associatively linked to words which share valence properties (RQ1). Further, it does not appear that any effects are evident via explicit evaluative processes (RQ2b). Given the absence of evidence in Study 1 and 2 that emoji and words are associatively linked, for Study 3 a more subtle manipulation was performed, aligned with preceding studies exploring how emotional context could exert a form of priming effect in encoding of words.

10. Study 3

As evidence of associative linking between emoji and words was not forthcoming in Study 1 and 2, Study 3 included affective priming to encourage/strengthen the associative linking process between emotionally-contingent emoji and words, and to test any effects of this through explicit evaluation via target word recall.

Affective priming has more typically been applied to emotion-label or emotion-laden words (Wu et al., 2021) or to faces depicting basic emotions (Aguado et al., 2007), but not so widely to emoji. It would be expected that this would equally apply to (positive) emoji, if indeed they are candidates tied to emotion concepts. Based on previous research exploring affective priming effects (e.g., Kazanas & Altarriba, 2015, 2016), we expected that emoji may function in this way in the encoding process. Concretely, we were interested in exploring whether emoji could convey any priming effect for accompanying words in a word learning paradigm. Of specific interest was whether emoji could have a facilitative effect on encoding of words with the same valence polarity.

Emotion has been found to modulate memory encoding (Forgas, 2017; Tyng et al., 2017), whereby emotional stimuli can be remembered better than neutral ones (Ferre et al., 2015). This may largely be through encouraging deeper levels of processing (see Brase & Mani, 2017; Erk et al., 2003). Specifically, previous work suggests that the emotional properties of context of learning in which encoding takes place play a significant role in memory-related processes (Guo et al., 2018). For example, it has been shown that learning faces with neutral expressions embedded in the context of a happy story enhances recall compared to when they are embedded in sad stories (Bridge et al., 2010). More recently, Frances et al. (2020) found that a positive semantic context can aid the incidental acquisition of new vocabulary that lacks emotionality, showing a spill-over effect of the emotionality of the context over word learning. In this same line, Erk et al. (2003) demonstrated that positive emotionality from visual content improved encoding of temporally-adjacent stimuli such as neutral words. Interestingly, Bowen and Kensinger (2017) found that this effect was significantly larger when the emotional context involved an emotional, expressive face rather than an emotional scene, and was especially relevant for negatively-valenced contexts. Hence, given the benefit of this emotional contextualisation at the encoding of stimuli, it could be tentatively predicted that emoji could enhance encoding efficacy for emotion-congruent words.

Although previous research has established this effect for various stimulus types, including words, pictures and videos (Congleton & Berntsen, 2020; Kuperman et al., 2014; Xia & Evans, 2020), no research to date has explored this in relation to emoji. It is well established that the influence of emotional material impacts the memorisation process from its initial stages, altering encoding that will ultimately modulate consolidation and future retrieval (Payne et al., 2008). As such, it is intriguing to explore the effects which emoji may have on the encoding and retrieval processes.

Based on the similarity of our experimental design to the one of Erk et al. (2003), we expected to see a priming benefit for words when displayed following a positive emoji. Based on this premise, we developed the following hypotheses:

H6. Recall of positively-valenced words will be significantly higher when primed with a positive emoji relative to a neutral emoji.

H7. Recall of neutrally-valenced words will be significantly higher when primed with a positive emoji relative to a neutral emoji.

11. Method

11.1. Design

A 2 (word valence; positive vs neutral) x 2 (emoji valence; positive vs neutral) within-participants design was used to test the impact of valence on memory recall of words. The congruent condition included an emoji which matched the valence of the subsequently presented word (e.g., positive emoji followed by a positive-valenced word), whereas the control condition included words which followed a neutral emoji.

11.2. Participants

The sample was equivalent to that in Study 2.

11.3. Stimuli

11.3.1. Words

We selected a set of 40 words (20 positive and 20 neutral) for the memorisation phase. The items were extracted from Stadthagen-Gonzalez et al. (2017). Words were selected based on their emotional valence to determine their positive/neutral categorisation. Words were also controlled for concreteness, frequency (zifp value), and number of letters. For each of the word valence conditions, two sub-lists were created to be randomly paired with emoji stimuli (see Appendix 4). These sub-lists were matched for the critical variables. A Welch's *t*-test was conducted to ensure that positive ($M = 7.05$, $SD = 0.29$) and neutral words ($M = 5.01$, $SD = 0.11$) were statistically different in the critical valence dimension, $t(24.5) = -29.045$, $p < .001$, but that the controlled variables did not differ between valence conditions. No differences were found for concreteness ($M = 5.52$, $SD = 0.59$ for positive words; $M = 5.59$, $SD = 0.58$ for neutral; $t(38.0) = 0.381$, $p = .705$), word frequency ($M = 4.03$, $SD = 0.61$ for positive words and $M = 4.00$, $SD = 0.35$ for neutral; $t(30.3) = 0.190$, $p = .850$), or number of letters ($M = 6.50$, $SD = 0.51$ for positive words and $M = 6.45$, $SD = 0.51$ for neutral; $t(38.0) = 0.309$, $p = .759$). These analyses were also conducted between the sub-lists of positive and neutral words. For positive word lists, no statistical differences were found in any of the tested dimensions: valence $t(38.0) = 0.086$, $p = .931$; frequency $t(38.0) = 0.077$, $p = .939$; concreteness $t(38.0) = 0.094$, $p = .925$; number of letters $t(38.0) = 1.285$, $p = .206$. For neutral word lists, parallel results were also found: valence $t(38.0) = 0.024$, $p = .935$; frequency $t(38.0) = 0.315$, $p = .754$, concreteness $t(38.0) = 0.505$, $p = .616$; number of letters $t(38.0) = -0.936$, $p = .355$ (for descriptive statistics, see Table 4).

11.3.2. Emoji

As per Study 1 and 2, emoji were selected from the Lisbon Emoji and Emoticon dataset (Rodrigues et al., 2018). We selected a positive (unicode: U+1F603) and a neutral (unicode: U+1F636) emoji depicted from the mobile operating system iOS (Apple, 2020) while controlling for their arousal, familiarity, and clarity (see Table 4).

For the word stimuli, two sub-lists were created for each of the valence conditions, including 10 positive and 10 neutral words per list. Each sub-list was randomly paired with one out of the two emoji blocks.

11.4. Procedure

The experimental set-up was built using the Gorilla Experiment Builder (Anwyl-Irvine et al., 2020, www.gorilla.sc), and data collection was undertaken using Gorilla's online platform (Anwyl-Irvine et al., 2020). Study 3 had two phases: a memorisation phase and a recall phase. In the memorisation phase, participants were shown a sequential list of 40 words and instructed to memorise the maximum number of words as possible. They were presented in two blocks, each consisting of 20 trials. One block was the "positive emoji" block in which a trial consisted of a positive emoji as a pre-target fixation cue being presented for 2000 ms sequentially followed by a word which was also presented for 2000 ms. Critically, words were randomly presented to represent the congruent condition (a positively-valenced word) or the incongruent condition (a neutrally-valenced word). The other block was the "neutral emoji" block which was equivalent to the "positive emoji" block except each word was preceded by a neutral emoji as the pre-target fixation cue. Block order and word sub-list allocation was counterbalanced across participants, and word order (trial-level) was random within each block. All stimuli were centred on the screen. Emoji were displayed at a size of 72pp and words were presented in black Open Sans in font size 14px. In total, the memorisation phase lasted just over 3 min. See Fig. 3 for a visual of the emoji blocks and trial structure.

Prior to the recall phase, a distraction task was used. Participants were given a series of 40 equations (e.g., $9 + x = 14$) and were asked to solve each of them within a maximum of 8 s by selecting the correct answer from four given options. The task lasted around 6 min. The purpose of this distraction task was to prevent participants' rehearsal before the recall phase. Following the distraction task, participants started the recall phase. Participants were given 3 min to type in a response box all the words they could recall.

Table 4
Descriptive analysis of stimuli characteristics.

Stimuli	Positive *M(SD)* [*M* min-max]		Neutral *M(SD)* [*M* min-max]	
Words	Sub-list 1	Sub-list 2	Sub-list 1	Sub-list 2
Valence	7.06 (.20) [6.70–7.85]	7.05 (.26) [6.60–7.85]	5.01 (.12) [4.83–5.15]	5.02 (.11) [4.85–5.15]
Frequency	4.02 (.67) [3.13–5.30]	4.04 (.59) [2.82–4.76]	3.40 (.30) [3.55–4.17]	4.01 (.42) [3.54–4.48]
Concreteness	5.56 (.60) [4.60–6.52]	5.48 (.60) [4.53–6.57]	5.62 (.69) [4.61–6.46]	5.55 (.48) [4.63–6.57]
Length	6.50 (.53) [6.00–7.00]	6.50 (.53) [6.00–7.00]	6.60 (.52) [6.00–7.00]	6.30 (.48) [6.00–.7.00]
Emoji				
Valence	6.71 (.64)		3.74 (1.07)	
Familiarity	6.54 (1.00)		2.44 (1.75)	
Arousal	6.10 (1.36)		2.84 (1.25)	
Clarity	6.68 (.69)		2.51 (1.72)	

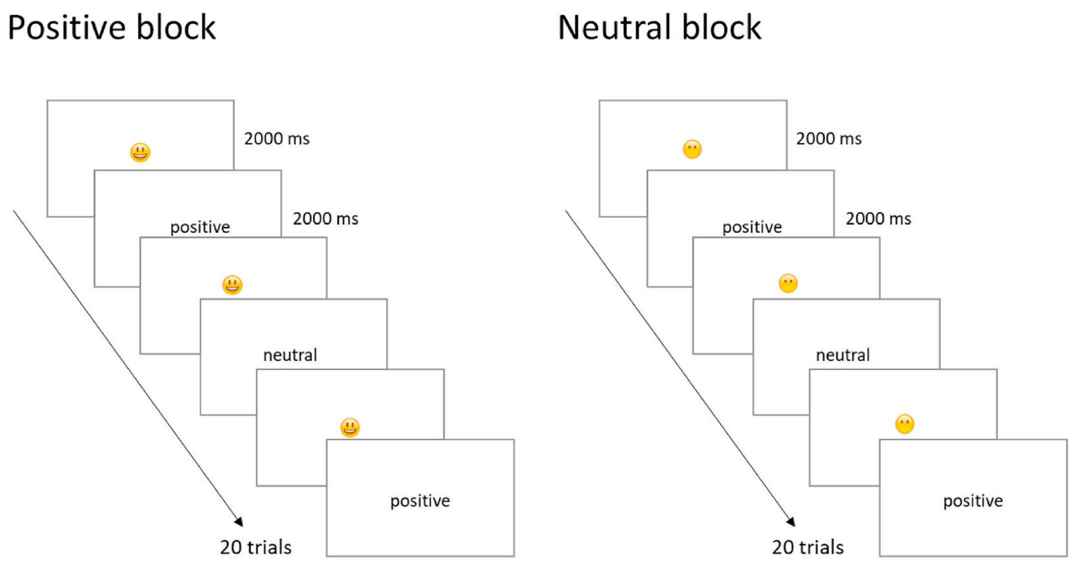

Fig. 3. Trail structure of Study 3 by emoji blocks.

12. Results

As an a priori set exclusion criterion, participants with an accuracy in the distractor task lower than 70% were removed from further analysis. Following this criterion, eight participants were excluded, leaving valid data from 59 participants. Participants who could not remember a minimum of 1 word per block were also excluded from further analysis. Consequently, 13 participants were removed, leaving a total of 46 participants, 16 males (*M* = 23.62, *SD* = 3.76) and 30 females (*M* = 27.70, *SD* = 78.82). Participants' recall responses were automatically processed in RStudio (RStudio Team, 2020) and manually checked by research assistants to correct for possible misspellings then accuracy was assessed. Those words incorrectly recalled (i.e., not presented in the memorisation phase) were marked as erroneous, and recall accuracy was calculated based on the percentage of correct responses per list. A descriptive analysis was executed on participants' recall accuracy (see Table 5).

We performed a sensitivity analysis in our sample with G*Power 3.1 software (Faul et al., 2009). For the analysis, we used *F* tests with $\alpha = 0.05$, power = 0.80 and the total sample size of 46 participants as input parameters. The sensitivity analysis, given a sample size of 46 participants, an $\alpha = 0.05$ and an expected power = 0.80, showed that we could detect values down to f = 0.17 (Fcritical = 2.67, df = 3, 135); therefore obtained F values equal to or larger the critical F-value is significant at the level of probability.

A 2 (emoji valence: positive, neutral) x 2 (word valence: positive and neutral) repeated measures ANOVA was conducted to test the effect on word recall. No significant main effect was found for emoji valence ($F(1, 45) = 0.904$, $p = .347$, $\eta_p^2 = 0.020$). However, the main effect of word valence was significant ($F(1, 45) = 12.280$, $p = .001$, $\eta_p^2 = 0.214$). Post hoc analysis revealed that positive words had a higher recall percentage ($M = 6.08$, SE = 1.73, $p_{bonf} < .001$) compared to neutral words. No significant interaction between word and emoji valence was found ($F(1, 45) = 0.047$, $p = .830$, $\eta_p^2 = 0.001$).

The effect of emoji valence was further analysed using Bayesian Null Hypothesis testing comparisons, to compute the Bayes Factors for the positive versus. Neutral (averaged across word valence conditions) emoji conditions. Results of the Bayesian paired sample t-tests showed that the null hypothesis (BF_{01}) was able to explain the effects 4.09 times better than the alternative hypothesis.

Table 5
Descriptive analysis of the percentage of word recall between experimental emoji conditions for positive and neutral words.

Emoji prime	Word Valence	Recall (%) *M (SD)*
Neutral	Neutral	20.21 (15.98)
	Positive	26.73 (18.86)
Positive	Neutral	23.04 (18.96)
	Positive	28.69 (17.97)

13. Discussion

The findings from Study 3 revealed a main effect of word valence, demonstrating that positively-valenced words showed higher percentages of recall than neutral words. However, the main effect of emoji and the interaction between word and emoji were not significant, responding to the H6 and H7 in a conclusive manner: no contextual congruency effect was observed on word recall as a function of emoji presentation. As such, it appears that associative linking between emotionally-contingent emoji and words cannot be primed (RQ1) and this does not manifest in any effects for explicit memory recall of words (RQ2b).

14. General discussion

The principles of associative linking within the Associative-Propositional Evaluation Model (Gawronski & Bodenhausen, 2006, 2007) suggest that if emoji are associatively tied to emotion concepts represented by co-occurring words, we should expect them to hold a facilitative effect for word processing. This could manifest in various ways via implicit or explicit evaluation processes. Specifically, we conducted a series of three studies which tested these assertions in respect of implicit evaluation (Study 1) and explicit evaluation (Study 2 & 3). The following sections discuss the main findings and their implications.

Study 1 was the first of its kind to empirically test assertions about whether emoji are emotional via implicit evaluation of words. Understanding this in the contexts in which emoji occur (e.g., written communication) is a pertinent area of enquiry. Our findings demonstrate an absence of associative linking; insofar of effects being evident through implicit evaluation. Specifically, emoji do not facilitate word processing suggesting they may perhaps operate more exclusively on a social processing level rather than an emotional one. From a theoretical point of view, if emoji are associatively linked to emotion concepts, then we would expect a processing advantage, in line with previous research exploring this effect in other emotional stimuli (Kousta et al., 2009; Ponari et al., 2015; Vinson et al., 2014). Study 1 findings however do not corroborate this effect and suggest that alternative perspectives may be useful when exploring the psychology of emoji. This may however vary based on the perspective taken in the interactional exchange. From a sender's perspective, it may indeed be the case that emoji are used to convey emotion: they have been used in sentimental contexts (e.g., Ai et al., 2017) and are reported to be useful in portraying emotion in online communication (e.g., Kaye et al., 2016). However, they do not appear to be inherently emotional from the receiver's point of view. It is important to note that this may be divergent from any subjective appraisals which may be associated with receiving them which may be captured through self-report evaluations. Therefore, there may be emotional or sentimental associations of emoji both from the sender and the receiver's perspectives, but these do not appear to operate on an implicit level.

Consequentially, Study 2 explored explicit self-report valence evaluations of words which were presented alongside valent-congruent emoji. Findings were in line to those from Study 1. That is, we did not find any facilitative effects of emoji for the evaluation of words. Therefore, this extends Study 1 findings to indicate that null effects are not simply because of the lexical decision paradigm failing to find an implicit processing effect, but rather associative linking does not seem evident in explicit evaluation either.

Given an absence of evidence of associative linking between emoji and words, Study 3 sought to prime this via an affective priming paradigm and test the effects via explicit evaluative word recall. More precisely, we explored whether a positively-valenced emoji could support word encoding in a classic word learning task. Similar to the findings from Study 1 and 2, Study 3 found no evidence for a beneficial effect of emoji. Word recall was not found to be different between conditions of positive versus neutral emoji. This lends further support to the notion that emoji do not share an emotional concept with emotion-laden words, at least from the potential receiver's viewpoint. Study 1, 2 and 3 combined provide a helpful addition and qualification to a recent review which identifies the various functions of emoji, including that of emotional functions (Bai et al., 2019).

From a theoretical point of view, the current findings contribute to the evidence base of the Associative-Propositional Evaluation Model (Gawronski & Bodenhausen, 2006, 2007). Namely, it extends the literature base which explores the extent to which emotion concepts may exist and be manifested as part of associative linking. In this case, it provides a useful framework to suggest that emoji may not be associatively linked conceptually to emotion. Whilst additional research could be beneficial to corroborate this bold assertion, our findings do provide useful evidence to distinguish whether different evaluation processes (implicit versus explicit) may offer differential insights on this (which apparently, they do not!). It would be especially interesting to replicate these findings by using emoji-word pairing depicting other emotions. Happiness and sadness (as proposed to be depicted in the emoji in the current work) may not elicit specific action tendencies in the same way that other discrete emotions such as fear or anger may do (Frijda et al., 1989). That is, fear may be proposed to elicit an urge to flee or anger with an urge to revolt, and as such may prompt stronger associative linking and/or behavioural responses. Action tendencies for positive (and negative) emotions are arguably less specified (Fredrickson & Levenson, 1998) and may to some extent explain our null effects in behavioural responses.

There are a number of additional avenues needed in future research. First, the existing literature has not identified how these functions may operate differently for the sender versus the receiver. That is, the emotional functions of emoji may be more exclusive to senders rather than receivers. In line with the suggestion of these potential variations, sender versus receiver perspectives may require different empirical approaches to understand the affordances of these. Whilst sender-centric research may wish to further explore emotional processing approaches to understand emoji, receiver-centric perspectives may benefit from social information processing or communication approaches which broaden the focus away from emotional communication. Further work in this area should synthesise the findings of emoji research to date (e.g., Bai et al., 2019) to contribute to the development of core communication theory. That is, this synthesis can help identify the current limitations in what we know about the functions of emoji within discourse and how this applies differently to senders versus receivers. This can therefore set out an integrated research agenda to more fully recognise the functions of emoji for different interaction partners.

These assertions should be made with caution, given that the emotional affordances of emoji are likely to vary considerably by the context in which they are used. In some cases, emoji are not there to act as an emotional indicator but instead to decorate a message, to replace words, or to demonstrate intention (Felbo et al., 2017). Specific consideration should be paid to the diversity of emoji and how this corresponds to the various ways they may be used. For the current research, although we focused exclusively on basic facial emoji, it should be recognised that emoji use is far more diverse than this and may only be revealing one aspect of a much broader phenomenon.

15. Limitations

Control conditions utilised in the current research used neutrally-valenced emoji rather than no emoji at all. This was selected based on the principle that conditions with no emoji would present participants with less information which would therefore be likely to result in shorter processing times (especially relevant for Study 1) and in turn, confound the results. As such, the use of neutral emoji was introduced to alleviate this issue. Related to this is the observation that the neutral emoji selected can be interpreted somewhat negatively. However, it is important to note that emoji were controlled and selected based on normative data from previous research which garnered ratings of valence (and other evaluative dimensions) and was identified as moderate/neutral in valence (Rodrigues et al., 2018).

Despite both males and females taking part in this current study, there was a much larger proportion of females relative to males across all studies. This could be considered problematic in light of evidence showing that there are gender variations in the way emoji are used, particularly for depicting emotion, and most likely in the way they were appraised (Herring & Dainas, 2020; Jones et al., 2020). Namely, these studies have found that women tend to give stronger ratings of valence. Even with such a bias in the sample, the fact we observed null results suggests this did not facilitate any processing effects therefore may not be a significant concern in this case.

Finally, the ecological validity of the tasks requires some scrutiny. In the "real world", people would be more likely to be encoding emoji alongside messages rather than just single words. As such, emoji in these cases may serve a stronger function in message interpretation and sentiment appraisal. Words rather than messages were used for a number of different purposes. Firstly, this study is largely exploratory and so warrants a fine-tuned focus on the way stimuli is applied to answering these questions. Secondly, using words rather than messages to test processing advantages for example, is a standardised approach in the corresponding research (e.g., Kousta et al., 2009). This helps ensure our research is replicating the methodological principles in the wider literature which in turn can help determine where support or refute of these findings may exist. Future research could be useful to extend our findings and indeed test message versus word conditions with corresponding emoji to help elucidate the possibility that emoji may be more functional at message level, as well as perhaps address some of the aforementioned suggestions about distinguishing between emotional versus social processing of emoji.

16. Conclusion

In summary, across three studies exploring a receiver's perspective, valent-congruent emoji do not appear to support word processing and thus we argue may not be associative linked to emotion concepts. It is recognised however that emoji may serve a more prominent role in social information processing rather than being inherently emotional. Further work is needed to recognise how (emotional) functions of emoji may vary based on interaction partner as well as for different types of emoji in different contexts.

Author contributions

Conceptualization: LK, SRC, HW, SM, FR, JAD, Methodology LK, SRC, HW, SM, FR, JAD, Software: LK, FR, Validation: LK, JAD, Formal analysis: HW, SM, SRC, BRJ, FR, JAD, Investigation: BRJ, FR, Resources: LK, JAD, Data Curation: LK, BRJ, FR, Writing - Original Draft: LK, FR, Writing - Review & Editing: LK, HW, SRC, SM, FR, JAD, Visualization: LK, FR, Supervision: LK, JAD, Project administration: LK, JAD.

Declaration of competing interest

There are no conflicts of interest to disclose.

Data availability

The datasets generated during and/or analysed for the current research are available on the Open Science Framework repository, https://osf.io/zrqm4/

Acknowledgements

This research has been partially funded by grants PID2021-126884NB-I00 and RED2018-102615-T and RED2018-102615-T from the Spanish Government and H2019/HUM-5705 from the Comunidad de Madrid.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chb.2022.107563.

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