Age Influence on the Effect of Emojis on Affective Vocabulary Items: A Priming Approach

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Abstract

This exploratory study investigated whether younger and older people differ in the extent to which their comprehension of emojis activates associated affective content based on the priming effects of the participants in an affective emoji-word priming experiment. No notable priming effect on accuracy and reaction time (RT) was observed in the emoji-word priming experiment among the two age groups, suggesting that emojis do not significantly influence the results of linguistic processing among people in different generations. However, several limitations in the research method, experiment design, and procedure were identified. Future research on age and emojis with comprehensive approaches is encouraged.

Keywords: **age, emoji, priming, linguistic processing.**

Introduction

Emojis are digital pictograms developed from emoticons and internationalized since 2009 (Giannoulis & Wilde, 2019). They have been widely adopted to compensate for the boundaries of expressing emotions unambiguously through words under the demand for speed and the dearth of nonverbal cues in online text communication (Karpinska et al., 2019). Over 90% of the online population across the globe uses emojis in everyday interactions (Daniel, 2021); however, interpretations of emojis vary across people of different backgrounds, resulting in inconsistent interpretations and sometimes miscommunication (Danesi, 2017).

With the increase of the global ageing population, variations of emoji usage and interpretations among people of different ages have drawn scholars' attention in the past decade. Several corpus-based studies have described age differences in emoji usage in terms of frequency, preference, and valence interpretation, which defines as an individual's subjective attitude toward an entity, either positive or negative (American Psychological Association, n.d.). Younger users tend to include more emojis in texts than older users (López-Santamaría et al., 2019) and prefer using emojis representing emotions, as opposed to older people who favour emojis portraying people and objects. This was shown in the research of Sun (2021) that younger people tended to employ "smile" emojis with positive connotations to express negative meanings, while older people are more likely to use them to demonstrate positive feelings. Some survey-based research has also observed similar patterns (e.g. Herring & Dainas, 2020). Nevertheless, contrary to these results, a number of other investigations using similar approaches have failed to observe notable age differences in emoji use and understanding (e.g. Gallud et al., 2018; Jaeger et al., 2018; Weiß et al., 2020).

Age influence on emoji usage and interpretations remains indefinite based on the irreconcilable results of the previous studies with traditional corpus- and survey-based methods since they involve numerous variations such as applications, contexts, and digital devices. It implies a need for a different approach to emoji research regarding age, which can remove the impact of possible variations in daily communication. Priming is one of the examples. It is a tool conveying the processing of how a stimulus (prime) impacts one's reaction to a subsequent stimulus (target) in terms of speed based on their relatedness (Janiszewski & Wyer, 2014). If a respondent reacts faster to a target preceded by a related prime than the one after an unrelated prime, the related prime activates the target. Recently, Yang et al. (2021) published the first emoji study with a priming approach. An affective priming experiment was implemented on young people in China aged 19 to 26. With evidence from Event-Related Potentials (ERPs), the study shows that emojis contain affective content (the involvement of emotion and feelings) (American Psychological Association, n.d.), which thus helps facilitate the processing of subsequent affective words with a similar valence. However, age differences were not taken into account in the research.

This research takes the priming approach of Yang et al. (2021) as a reference in order to see whether younger and older people differ in the extent to which their comprehension of emojis activates associated affective content. Similar to Yang et al. (2021), participants read target words (positive or negative affective words) preceded by related or unrelated emoji primes; as this is an exploratory study, I measured their reaction times rather than event-related brain potentials. If participants respond faster to words preceded by a related emoji than words preceded by an unrelated emoji, this would be evidence that participants accessed the affective content of the emoji and that it aided in lexical access. Furthermore, if the size of this reaction time difference (the priming effect) differs between younger and older speakers, it would be evidence of an age-based difference in the comprehension of emojis. In addition to the emoji-word priming task, participants also completed a traditional word-word priming task, in which they read words preceded by related or unrelated words; this is a control task to ensure priming, in general, is observable in the sample.

Methods

Participants

Twenty Cantonese native speakers in Hong Kong recruited from The Hong Kong Polytechnic University campus and personal connections participated in the priming experiment without remuneration. As Gallud et al. (2018) suggested, smartphone owners are six times more likely to use emojis than people without a smartphone. According to the report of the Census and Statistics Department (2020), the two youngest and the two oldest age groups in which the percentage of persons who had at least one smartphone exceeded 95% in 2019 are aged 15–24, aged 25–34, and aged 45–54, aged 55–64 respectively. Participants were categorized into two age groups, i.e. "younger" people aged 18 to 30 and "older" people aged 50 to 64. The younger group incorporated 11 participants (6 women and 5 men), and the older group included 9 participants (5 women and 4 men). All participants were reported as frequent emoji users who have not had any visual impairment nor reading disorders and did not respond to the pre-test beforehand in the pre-experiment questionnaire.

Materials

Emoji Version

Smileys and hand gesture emojis in yellow skin tone, the default colour of "people emojis" among the six skin tones (Evans, 2017), in the WhatsApp version released in August of 2021 (version 2.21.16.20), were adopted for two reasons: emojis representing faces and human beings are the most commonly used emojis on the Internet (Miller et al., 2016), and WhatsApp Messenger is the most prevalent social networking and instant messaging app in Hong Kong (SimilarWeb, 2021). To evade possible influences due to variations of display on different devices, as noted by Miller et al. (2016), all emojis in the study were shown in JPEG format downloaded from the website of Emojipedia.

Pre-test for the selection of emoji stimuli

As some emojis may have different connotations for different people, and the connotations of emojis are continuously changing (Danesi, 2017; Gallud et al., 2018), I first conducted a norming pre-test to identify emojis that the younger and older groups would be likely to interpret in similar ways to ensure that the stimuli in the priming experiment would be emojis with well-agreed-upon affective valence. In line with Yang et al. (2021), an online survey titled "Personal Interpretation of Emojis" in traditional Chinese without a time limit was created with QuestionPro (available at https://www.questionpro.com/t/AUATuZpN2N). Respondents were required to rate the positiveness of 129 emojis (97 smileys and 32 hand gestures) on a 7-point Likert Scale individually, based on their subjective opinions.

A total of 29 valid responses were collected from Hong Kong native Cantonese speakers with frequent exposure to emojis within the university community (9 younger women, 5 younger men, 9 older women, and 6 older men), none of whom took part in the priming experiment afterwards. The average positivity score of each emoji among the two age groups was calculated respectively by averaging the Likert scale ratings across participants within the group, and the average positivity score among older people was subtracted from the average positivity score among younger people to quantify the extent to which a given emoji's interpretation differed between younger and older respondents. The smaller the absolute value of the difference, the more comparable the perceptions among the two parties are. Figure 1 summarizes the results of the pre-test, which were considered for picking emoji stimuli in the priming experiment afterwards.

Stimuli

I selected 80 emojis (59 smileys and 21 hand gestures) whose positivity difference scores differed by less than 0.6 between younger and older respondents and whose valences had average positivity scores across below 3 or above 4 on the 7-point Likert scale. Another 40 emojis were picked randomly from the remaining smiley and hand gesture emojis to be used as the primes for nonword filler targets, i.e. vocabulary items that do not exist in the world. Twenty non-smiley and non-hand-gesture emojis were utilized in the practice section to avoid any possible unwanted activation before the actual experiment. All emoji stimuli were displayed in JPEG format with 160 X 160 pixels on a white background during the experiment.

For word stimuli, I picked 40 vocabulary items for the 80 emoji primes from the latest version of the Chinese Valence-Arousal Words (CVAW) system, CVAW 4.0, which incorporates more than 5,000 affective Chinese vocabulary items with valence scores ranging from 1 (least positive) to 9 (most positive) (Yu et al., 2016). Another 200 non-affective Chinese words were used for i) 120 word stimuli, in-

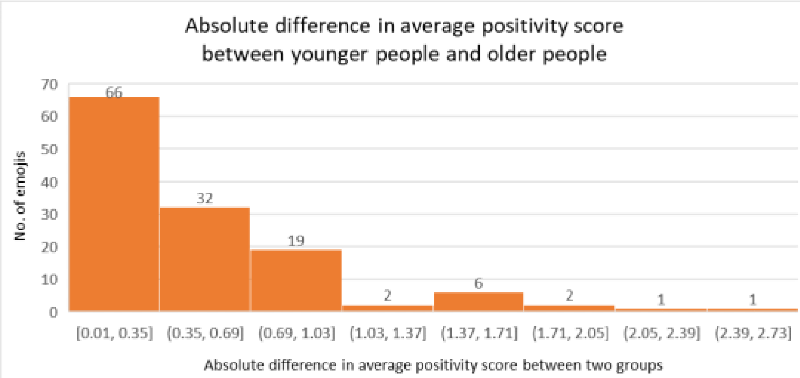

Figure 1. *A histogram summarizing the comparison of the average positivity score between the two groups, i.e. average positivity score of younger people of the emoji minus average positivity score of older people of the emoji (rounded to the nearest two decimal places).*

cluding 40 word targets, 40 congruent word primes, 40 incongruent word primes; ii) 40 word stimuli in the practice trials, encompassing 5 as word targets of congruent emoji primes, 5 as word targets of incongruent emoji primes, 10 as word primes for nonword filler targets, 10 as word primes for 5 congruent word targets and 5 incongruent word targets; as well as iii) 40 word primes for the nonword filler targets. The relatedness between word primes and targets is based on their meanings. Some examples are shown in Table 1. Only two-character Chinese vocabulary items were involved in the experiment to minimize the variations and limitations caused by the number of characters of the word stimuli. All word targets shown in SimSun, font size 20, in black on a white background in the experiment. The full list of primes and targets in different conditions can be found in the Appendices.

The design of emoji-word pairs considered the positivity scores of the pre-test and the mean of valence scores of the Chinese vocabulary items in the CVAW system. Emojis with a higher final average score were matched with terms with a higher valence rating to make up the congruent pairs and lower valence scores to make up the incongruent pairs. Some examples of the matching are summarized in Table 2.

Table 1: *Examples of the matching of word-word pairs*

Word target (English translation)	Congruent word prime (English translation)	Incongruent word prime
唇膏 (lipstick)	胭脂 (rouge blush)	烘乾 (drying)
太陽 (sun)	月亮 (moon)	平板 (tablet)
芭蕾 (ballet)	舞蹈 (dance)	癌症 (cancer)
運動 (sports)	足球 (football)	論文 (thesis)

A total of 200 trials evenly mixing emoji-word pairs and word-word pairs were incorporated in the experiment. The first 40 trials after the instructions at the beginning were for practice, followed by 160 randomized trials comprised of 20 congruent emoji-word pairs, 20 congruent word-word pairs, 20 incongruent emoji-word pairs, 20 incongruent word-word pairs, 40 emoji-nonword pairs and 40 word -nonword pairs. The stimuli were arranged into multiple lists in a Latin square design, so that no participant saw the same word or emoji twice and each word appeared in each condition. (For example, the target word 繽紛 "colourful" was preceded by an affectively congruent emoji for half of the participants and by an affectively incongruent emoji for the other half of participants).

Design and procedure

The experiment was conducted via DMDX (Forster & Forster, 2003). The participants' task was to indicate, as quickly and accurately as

Table 2: *Examples of the matching of emoji-word pairs*

Word target (Eng. translation)	Mean of valence scores in the CVAW system (out of 9)	Congruent emoji prime	Difference in average positivity scores (Younger VS. Older)	Final average positivity score (out of 7)	Incongruent emoji prime	Difference in average positivity scores (Younger VS. Older)	Final average positivity score (out of 7)
繽紛 (colourful)	7.8		-0.46	6.30		0.30	2.28
聰穎 (clever)	7.5		-0.55	5.06		-0.42	2.85
心 (heartbroken)	2.2		0.038	2.55		-0.22	5.82
違法 (illegal)	2.4		-0.11	2.41		-0.081	4.83

possible, whether each target word was a real Chinese word or a nonword. Participants made their responses by pressing the left or right Shift key only when they saw the target. They did not have to press anything when the prime was displayed. All primes were shown on screen for 360 milliseconds before the occurrence of the target, which disappeared when participants pressed a Shift key or the timeout duration (i.e. 2500 milliseconds) passed. After a 200-millisecond inter-trial interval, the prime of the next trial appeared.

Different coloured stickers were employed to assist participants in finishing the experiment quickly and accurately by lowering the efforts required to memorize the rules over the entire task. Participants were instructed to press the corresponding coloured rectangle stickers to indicate the validity of formed Chinese vocabulary items: a green sticker placed on the right Shift key to indicate correct items, and a red sticker placed on the left Shift key to indicate incorrect items. Usage of the green and red stickers on the two Shift keys was highlighted in the Cantonese introductory speech before the commencement of the experiment. During the experiment, no feedback was provided for participants' response times or errors in order to minimize distractions.

All recruited participants completed a short pre-experiment questionnaire in traditional Chinese on Google Forms to provide their demographic background information. Eligible participants were then invited to their most convenient indoor area without much background noise to take the priming experiment on a portable 14" ASUS X407U laptop. Participants were only told that they would work on a short task judging Chinese vocabulary; the invitation and instructions did not emphasize emojis or priming. To minimize the influence of stress on their judgements and reaction times (RT) during the task, the experimenters created a pressure-free environment by leaving the participants alone and unsupervised. The entire process took approximately 10 to 15 minutes per participant.

All accuracy and reaction times (RT) data were collected and gathered in .azk files for further analysis. Only trials with correct responses were included in the RT analysis, as the RT for targets involving invalid and incorrect responses (i.e. not reacting to the target within 2500 milliseconds, the time-out duration, or judging a nonword target as a correctly formed Chinese vocabulary item by pressing the inconsistent right Shift key or vice versa) may not reflect priming effects accurately. Data were visualized using R (R Core Team, 2022), Excel, and GraphPad Prism.

Results

Accuracy

The percentage of accuracy in responding to the targets in four conditions among younger and older age groups is depicted in Figure 2. Generally, the two groups achieved more than 80% accuracy when reacting to the targets in either condition during the experiment. However, older people tended to have a lower accuracy percentage in the emoji-word priming experiment (around 80% in both conditions) than in the word-word task (close to 90% in both conditions), while younger people, in general, attained over 90% accuracy in all four conditions.

Figure 2 shows that people responded more accurately to related targets than unrelated targets, particularly among older participants. Although priming effects were mostly predicted in reaction times, not in accuracy, the results indicate a consistency with a priming effect. In order to examine whether this apparent priming effect in accuracy is robust across participants, two graphs of individual priming effects in accuracy were made, as illustrated in Figure 3 (Weissgerber

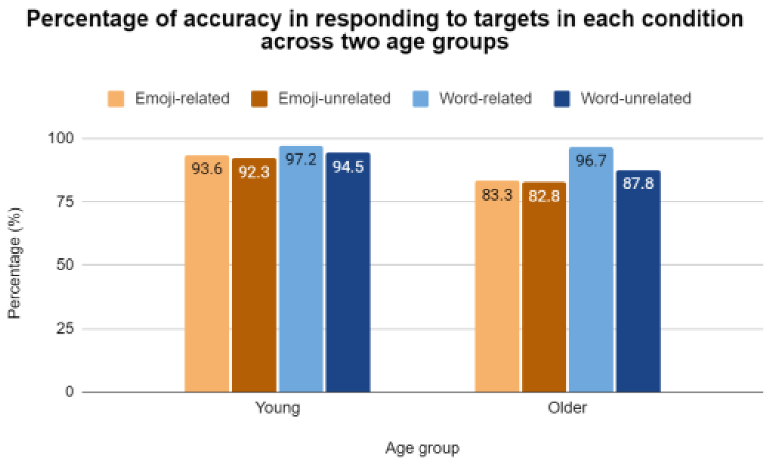

Figure 2. Percentage of accuracy in responding to targets in each condition across two age groups.

et al., 2015; Politzer-Ahles & Piccinini, 2018). Most priming effects in the accuracy of all participants are zero or close to zero (±5% - ±10%), and the apparent large priming effect for words among older participants was driven by just two participants and was not present in the others. I therefore concluded that there is not a substantial priming effect on accuracy rates in either group.

Reaction times

Figure 4 shows the average reaction time (RT) for each condition of younger people and older people, offering a broad picture of the results of the priming experiment. On average, both age groups seem to have priming effects on the word-word priming task. For younger people, the average RT of the targets with congruent word primes is 26 milliseconds faster than that of the targets with incongruent word primes, while for older people, the average RT of the targets with congruent word primes is 43 milliseconds quicker than that of the targets with incongruent word primes. However, for the emoji-word priming task, the two groups tend to react to targets congruent to the

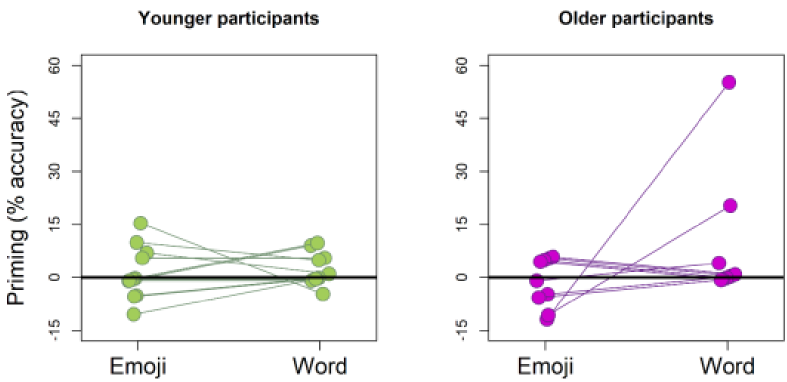

Figure 3. The priming effects in accuracy (unrelated minus related) of each participant among the younger people group in both priming tasks. Dots above zero mean participants reacted more accurately in unrelated condition than the related condition. Dots are slightly jittered both horizontally and vertically to avoid completely overlapping one another.

emoji primes 22– 25 milliseconds slower than those with incongruent emoji primes, suggesting that, on average, priming effects might not occur in the emoji-word priming task among the two age groups.

Two graphs of individual priming effects were also created to evaluate how robust these results are across participants (Weissgerber et al., 2015; Politzer-Ahles & Piccinini, 2018). Figure 5 illustrates the priming effects of each participant among the younger group in the two tasks. Among the 11 younger participants, the priming effects of nine participants (82%) are positive in the word-word priming task, demonstrating strong evidence that a semantic congruent word stimulus can facilitate the processing of the subsequent word stimulus among younger people. In the emoji-word priming task, the number of the positive and the negative priming effects tend to distribute evenly: five younger participants' priming effects are above zero, while the remaining six are the opposite, suggesting that there is no notable priming effect in the emoji-word priming experi-

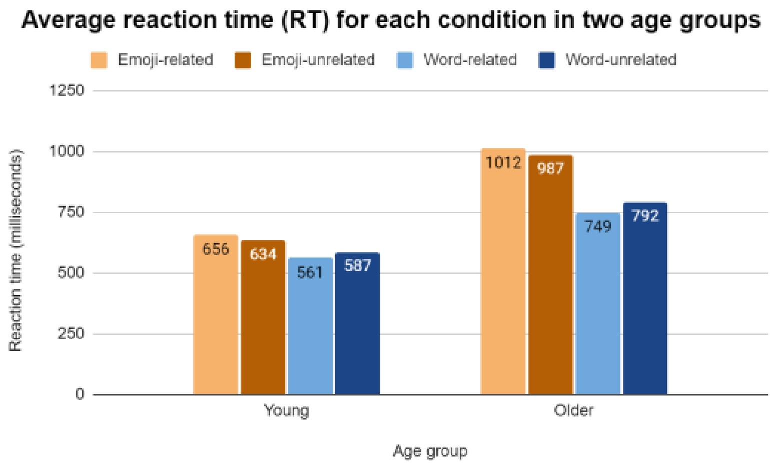

__Figure 4__. Average reaction time (RT) for each condition in two age groups.

ment. A valence-congruent emoji stimulus tends not to activate the processing of the ensuing word stimulus as a semantic congruent word among younger people.

The priming effects of each individual in the older group in the two tasks are depicted in Figure 6. Five out of nine participants show a positive priming effect in the word-word priming task. Although the remaining four reveal a negative priming effect, the numbers are close to zero, whereas the participants with positive priming effects tended to have quite large effects (note also that the magnitude of the priming effect for words is larger in this group than it is in the younger group, 43 ms vs. 26 ms). A semantic congruent word stimulus can also stimulate the processing of the succeeding word stimulus among older people. In the emoji-word priming task, five participants have a positive priming effect, while the other four possess a priming effect below zero. Similar to younger people, the number of individuals with a positive priming effect and those with a negative priming effect in the older group tend to distribute evenly. The priming effects of older people in the emoji-word priming task are not

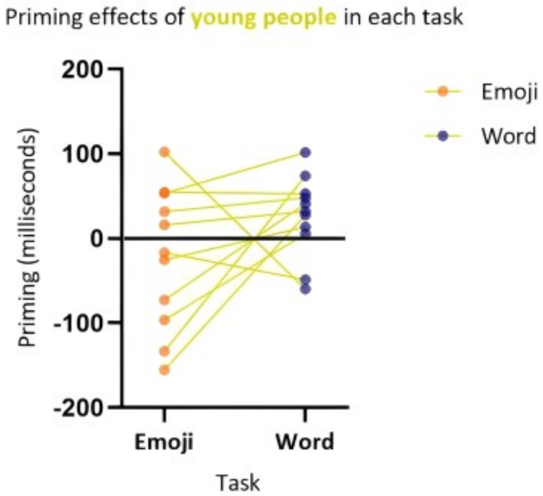

Figure 5. *The priming effects (unrelated minus related) of each participant among the younger people group in both priming tasks. Dots above zero indicate participants who had priming effects in the expected direction.*

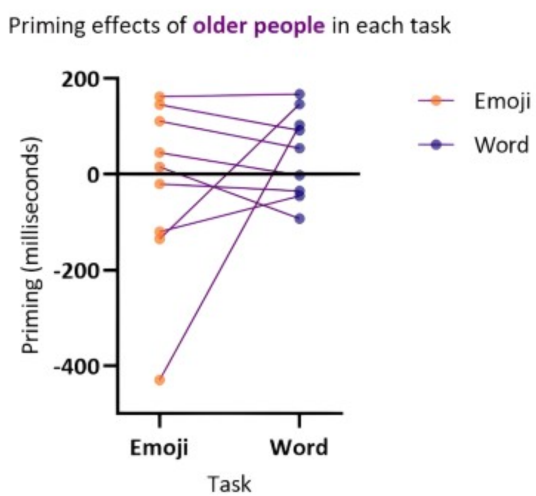

Figure 6. *The priming effects (unrelated minus related) of each participant among the older people group in both priming tasks. Dots above zero indicate participants who had priming effects in the expected direction.*

substantial, showing that an emotional word is not necessarily facilitated by a prior emoji with a congruent affective content among older people.

Table 3 briefly summarizes the priming effects of younger people and older people in the two priming tasks. The result presents that age influence was not identified in terms of the impact of emojis on processing the succeeding affective vocabulary items.

	Priming effect	
	Emoji-word priming task	**Word-word priming task**
Younger people	No notable priming effect	Positive
Older people	No notable priming effect	Tend to be positive

Table 3: *A summary of priming effects of the two age groups in the two tasks*

Discussion

The present study examined priming between emojis and words, as well as priming between word pairs, in both younger and older readers. For emoji-word pairs, neither group showed a priming effect: responses to words preceded by related emojis were no faster than responses to words preceded by unrelated emojis. On the other hand, for word pairs, both groups of participants showed priming effects, with faster reaction times to words preceded by related primes rather than unrelated primes.

The notion that age is not the only but perhaps one of the determinants causing miscommunication arising from emojis is reinforced, which is in line with previous studies suggesting that apart from age differences and the potential factors that this study attempted to evade (i.e. variations of cultural background and platform diversity), other multifarious factors can generate misunderstandings led by emojis, such as the unceasing development of the definition of emojis (Gallud et al., 2018), communication contexts (Gawne & McCulloch, 2019), personal habits and the social relationship between the sender and the receiver in the interaction (Herring & Dainas, 2020). Since numerous factors other than age may affect the influence of emojis on words, the differences within an age group seem more perceptible than the differences between the two age groups. This may explain the diverse distribution of priming effects in the emoji-word priming task within each age group in Figures 5 and 6.

Without a notable priming effect in the emoji-word priming task in both age groups, the assumption that emojis can function as adjectives is challenged. Since the outcomes suggest that a valence-congruent emoji tends not to activate the processing of the subsequent word stimulus as a congruent word prime, this research tends to contradict the belief that emojis are more than complementary and have the ability to somewhat replace words (e.g. Danesi, 2017; Thurlow & Jaroski, 2020; Albert, 2020). Rather, it agrees with the idea that emojis cannot replace words on a large scale (McCulloch, 2016) and are mainly "auxiliary means of communication" (Bai et al., 2019, p. 4). As a complement to written messages, when emojis are employed individually as a visual prime without a particular context as they were in the experiment, they may not possess a certain emotional content and tend not to facilitate the processing of the following vocabulary items with a congruent valence content linguistically.

The selection of lexical decision task for the emoji-word priming experiment might also influence the results. Although a lexical decision task, classifying whether the target is a real word or a nonword, can help reflect a reliable priming effect in the affective priming paradigm, the small magnitude limits the results, even with a rigorous control procedure (Ferré & Sánchez-Casas, 2014). Perhaps employing typical tasks, such as the evaluative decision task, in the affective priming paradigm, can help obtain more robust and significant results. The evaluative decision task, or the "affective word categorization task" (Yang et al., 2021) involves asking participants to determine whether the target is positive or negative. Moreover, the design of the word-word priming control task impacts the outcomes of priming effects since the relationship between primes and targets in the two experiments is different. In the emoji-word priming task, primes and targets are related in terms of meanings' positiveness, but they are congruent in terms of meanings in the word-word priming task, resulting in a more noticeable positive priming effect in the word-word task than in the emoji-word experiment.

An isolated priming experiment may not be sufficient to manifest age influence on the effect of emojis on the subsequent affective words exhaustively. In the research of Yang et al. (2021), no priming effects were demonstrated in the behavioural data of the priming experiment, but the capability of emojis to boost the attentional level in succeeding texts with a congruent meaning was concluded with the electroencephalogram (EEG) data, suggesting that congruent emojis do not affect the results of linguistic processing but enrich the attentional level and facilitate better processing due to fewer cognitive demands than incongruent emojis. A future study with proper control task design and EEG data collection is needed to investigate the effect of emojis on affective vocabulary items comprehensively.

Several other limitations of the experiment may have also hindered the results, such as the variation in venues where the experiment was conducted and the inconsistent backgrounds of the materials. The valence scores in the CVAW system developed in Taiwan might not apply to the perceptions of Hong Kong people pragmatically. As a result, some emoji-word pairs might not be congruent or incongruent for some participants, leading to inaccurate priming effects. Ideally, the experiment should be implemented in a designated language laboratory, with different pre-test tasks. Instead of only requiring participants to rate the positivity of each emoji with the 7-point Likert scale, the experiment should either ask respondents to score both the selected emojis and adjectives or request them to choose the most related adjectives in the emojis provided. This change might facilitate the design of the emoji-word trials in the priming experiment and ensure the pairs are congruent or incongruent in the Hong Kong context.

Finally, the present findings suggest some future research topics regarding the relationship between age and emojis. Interestingly, the average RT of the two conditions in the emoji-word priming experiment among older people are much longer than that of younger people, compared to the corresponding average RT of the two conditions in the word-word priming task, as depicted in Figure 4. It tends to be related to the findings of Koch et al. (2022) that younger people prefer employing emojis that help convey emotions while older people favour those representing people and objects. As younger people are more likely to use smiley and hand gesture emojis to give emotional meanings rather than to illustrate objects and people, older people, even those who claim to be frequent emoji users, may not be familiar with the selected emojis in the experiment. This unfamiliarity with the selected emojis in the experiment could have distracted them during the lexical decision task, ending up with a longer RT. However, this is a speculative suggestion, and a future study with a proper approach and design should be done to examine and provide a more concrete conclusion on the relevant issues.

Conclusion

In summary, the present exploratory study attempted to investigate whether age-based differences in the comprehension of emojis, especially smiley and hand gesture emojis, exist. By using an affective emoji-word priming experiment with a semantic word-word priming task as a control comparison after a pre-test grasping the latest general definitions of emojis in Hong Kong based on the reaction times (RT) and priming effects of each individual and on average, no notable priming effect was indicated in the emoji-word priming experiment for both age groups, which showed a certain extent of positive priming effects in the word-word priming task. The results suggest that emojis do not significantly impact the outcomes of linguistic processing. However, limitations of the experiment design and procedure might affect the outcomes, and the isolated priming experiment is not enough to conclude the effect of emojis on affective words besides linguistic processing. Future studies regarding age and emojis with comprehensive design and advanced statistical analysis methods are highly recommended.

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