6-16-2021

Happy 😊, Sad ☹or Pizza 🍕: A Review of Emoji Effects on Reading Times and their Relation to Mood

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by

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An undergraduate honors thesis submitted in partial fulfillment of the requirements for the degree of

Bachelor of Science

in

University Honors

and

Speech and Hearing Sciences

Thesis Adviser

Sarah Key-DeLyria

Portland State University

2021

Abstract

With recent advancements in technology, emoji are continuously changing the way that people communicate and process language. Their use continues to evolve as a mechanism to counter the loss of the rich nonverbal cues of face-to-face communication. Subsequently, the need for research examining how emoji are processed and how they affect language and communication has become more important. This research specifically examines the scholarship on emoji effects on sentence reading times (RT) and how this relates to mood. Results on the effects of emoji on sentence RT are mixed. In some instances, emoji slowed RT and in others, they sped up RT. Research on emoji placement shows slowed RT for emoji in the sentence-final position, whereas other research shows no effect of emoji placement on RT. This literature review suggests emoji type (face emoji vs noun emoji) and text type (conversation vs narrative) as possible factors contributing to these differing results. No research examining the relationship between the effects of emoji on RT and mood was found. Understanding the collective effects of emoji on RT not only aids in improving the effective use of emoji in daily communication but uncovers areas in need of further research.

Keywords: emoji, reading times, mood

📚Introduction

A new and modern language is being developed that fuses emoji and text. It is adding new phrases, meanings, and cultures to communication. It may seem like it is simple and 'just for fun', but it is affecting businesses, advertising, technology, and personal interactions around the world. To understand its implications, it must be recognized and its effects on personal and international communication must be studied and evaluated.

Emoji[1] originated as a few simple emoticons, initially introduced in 1985 (*Definition of emoticon*, 2021), and have now become a constantly expanding library of thousands of intricate mini-pictures that are paired with virtual messages (Miller et al., 2016). Emoji are easily accessible characters that add supplemental emotional and contextual information when communicating through messaging that replicate the rich nonverbal cues of face-to-face conversations. These important characteristics of emoji have allowed them to thrive in social media and other virtual communication platforms (Rodrigues et al., 2018). As emoji become more abundant, understanding how they affect areas such as mood, language, and communication is essential.

Emoji research has begun to emerge within many specific fields of study including emoji in advertising, emoji interpretation, and emoji prediction technology (Das et al., 2019; Miller et al., 2016; Ramaswamy et al., 2019), but a deeper understanding of how emoji are processed along with the paired text is essential for truly understanding the effects of emoji on language

[1] The word "emoji" originates from the Japanese language and therefore follows Japanese grammar and is used for both the singular and plural form of the word (*Definition of emoji*, 2021; Novak et al., 2015).

processing and communication. Thus, this research will examine how pairing emoji with text affects sentence processing, through the measure of reading times (RT). Since this is a recently emerging area of research, there is limited data on the effects of emoji, especially on sentence RT.

Emoji 🙂 vs. emoticons :)

Emoji are modern characters used to enrich text and to replace nonverbal communication. Emoji were preceded by emoticons which are a series of punctuation marks used to create the image of a face, like :) or =^_^= (*Definition of emoticon*, 2021). Emoticons were created to add emotion to text and to clarify the intent of the writer. With further developments in technology, more complex forms of emoticons were created, called emoji. Emoji are small pictures or characters, used when communicating over technological devices, that represent different objects, actions, facial expressions, etc. (e.g. 😉, 👍, 💤, 💕). Emoji are most commonly used when messaging via social media platforms (e.g. Twitter, Facebook Messenger) (*Emoji statistics*, 2020). While emoticons and emoji are related, the research results from one area cannot always be generalized to the other due to their different characteristics and the different ways they are processed. For this paper, the focus will remain on emoji and not emoticons.

😎Emoji Popularity

As emoji popularity grows, new emoji are created to add to the lexicon of expressive characters. While any individual can create an emoji, the process of approving and registering emoji to the Unicode Standard[2] is extremely rigorous. As of September 2020, there are a total of 3,521 different emoji in the Unicode Standard (🙋 *FAQ*, n.d.). According to Miller et al. (2016),

[2] The Unicode Standard is a system in which the written character of languages are stored for worldwide interchange, processing, and display (*About the Unicode Standard*, 2021)

each of these registered emoji are rendered differently from platform to platform (Apple, Google, Whatsapp, etc.). Furthermore, if a sender and receiver of an emoji are using different platforms, the emoji is presented to the receiver in the version of their device/platform and not that of the sender. Miller et al. (2016) found that participant sentiment and semantic ratings for emoji (of the same rendering) were significantly different from one another. Even greater differences were found between ratings of different renderings of an emoji. With drastically different renderings, such as  (Google) and  (Apple) for the "grinning face with smile eyes" emoji (Miller et al., 2016)[3] emoji can often be misunderstood and lead to confusion between sender and receiver. This complicates emoji interpretation and plays an important role in understanding or misunderstanding an individual's message that includes emoji. These intricate details place great importance on expanding emoji research to more accurately use emoji and to reduce misunderstandings due to misinterpretation of emoji.

📄 *Areas of Emoji Scholarship*

As emoji popularity continues to increase, emoji become a foundational part of modern-day communication. A literature search indicates 15,000 new studies on emoji have been published in the last ten years. Emoji research has developed in many fields. In advertising, it is used to explore the effects of emoji on consumers (Yakın & Eru, 2017). In computer sciences, it is used to develop advanced processing systems that can support emoji users (Wu et al., 2018). In emoji interpretation, it is used to understand how people use and perceive emoji (Novak et al.,

[3] Miller et al. (2016) uses the Unicode Standard as the source for the different "grinning with smile eyes emoji" renderings. However, the Unicode Standard's current emoji renderings for the "grinning with smile eyes emoji" are no longer this drastically different (*Full Emoji List, V13.1*, 2021). The renderings may have been amended due their differences in their perceived meaning/sentiment.

2015). These are only a few of the areas currently being studied. The information from each of the different domains of emoji research can be examined collectively to build broader understandings of emoji and to optimize their use and functionality. Having a broader understanding of how emoji are used and interpreted facilitates more accurate interpretations of research on the processing and reading times of text paired with emoji.

📺*Emoji in Advertising and Technology*

Emoji function and use has been the target of advertising research in recent years. Research studying how consumers react to emoji in advertising has found that consumers experience higher positive affect and demonstrate higher purchasing intentions when presented advertisements that included emoji (Das et al., 2019). A study examining the efficacy of emoji use in social marketing has also found that emoji use is equally successful in social advertising campaigns (Yakın & Eru, 2017). Research continues to support the use of emoji in advertising and continues to bring to light the intricate effects of emoji advertising on consumers. The subsequent increase of emoji use within advertising results in society's greater exposure to emoji not only in the domain of virtual communication but also in media and other spaces. This exposure emphasizes the need to understand emoji and their effects on the content they are paired with and their users.

🖥️*Device Programs that Predict Emoji for Users*

Emoji are also studied in order to train devices to quickly and accurately predict and suggest emoji to users. Emoji are often used when communicating via fast-paced chat platforms and social media. Therefore, it is important that users can access emoji quickly and easily. The research aims to target quick access by training processing systems to recognize patterns in user

text and accurately predict what emoji the user will pair with that text. Ramaswamy and colleagues (2019) demonstrated the usefulness of training devices to not only predict and suggest emoji to users but to also refine and expand dictionary patterns based on user responses. Wu et al. (2018) also created an emoji prediction program. Their program used a multilayer technique that predicted emoji based on the individual characters used in the text as well as contextual information embedded within the text. This system was shown to outperform many baseline methods as well as humans attempting to complete the same task. With past research on emoji processing systems and emoji prediction algorithms, systems have become somewhat efficient and effective, but research continues to strive to improve these systems and make emoji use easier on users. Greater background research on how emoji are processed and how emoji effect sentence processing is needed to further improve these programs.

🤔*Emoji Meanings*

There have also been some research studies aiming to understand how people attribute meaning to emoji and how these meanings differ across individuals. Collectively, it is evident that there is variability in how individuals interpret the meaning of emoji as well as their sentimental value. As mentioned earlier in this text, Miller and colleagues' (2016) research on emoji interpretation within and across platforms demonstrates that individuals perceive emoji differently. The participants' emoji interpretations differed for both the semantics (meaning) and sentiment (negative, neutral, or positive) of emoji. And while these differences were more drastic when comparing the responses for different renderings of an emoji, there were still significant differences in ratings of the same exact rendering of emoji.

Researchers have been able to identify general sentiment ratings (positive, negative, or neutral) often associated with various emoji. Novak and colleagues, in their 2015 study, published the first-ever sentiment lexicon. In the study, participants indicated their perceived sentiment ratings for tweets from 13 European languages. These ratings were compiled to create an emoji lexicon containing 751 of the most commonly used emoji. While emoji interpretation does differ, much has been learned about the meaning and ways people perceive emoji, semantically and sentimentally. Understanding how people perceive the meaning and sentiment of emoji leads to a better understanding of the role emoji semantics and sentiment play in emoji and text processing. This allows for more accurate and broader interpretations of emoji text RT.

😄😑😡*Mood*

Emoji research needs to examine the relationship between emoji and mood because emoji, especially those representing facial expressions, are often used to convey emotional information or clarify the tone of a message. The tone or emotional information can vary greatly depending on the mood of the sender. According to Konrad et al. (2020), user reports show that people use emoji more frequently when in a good mood. However, their reports also show that emoji can be used when feeling mildly upset or for somewhat serious conversations. In these circumstances, they are used to counteract the tension of the conversation. Relatedly, mood has been shown to affect linguistic processing in several ways. Research shows that when negative moods were induced, participants were better able to detect linguistic ambiguity. Furthermore, negative moods lead to longer and more attentive language processing (Matovic et al., 2014). While emoji have become a major part of language and mood has been shown to affect linguistic processing, research has yet to directly explore the relationship between emoji and mood. This

review attempted to explore this relationship from the aspect of emoji effects on RT but found no studies currently available to review.

🕐*Language Processing and Reading Times*

To investigate how emoji are processed, psycholinguistic methodologies can be used. Individuals process language and sentences incrementally with interpretations continuously being updated as new information is acquired. As an individual reads text, they process each word connecting the information with an overall meaning. Some words may be encountered that challenge the developing meaning. In this case, previous segments must be revisited and reinterpreted in an attempt to make sense of the new information. This process of reinterpretation takes more effort than if the original interpretation is not challenged by later information (Key-DeLyria & Altmann, 2016).

RT is the measurement of the time it takes for an individual to process the information they receive (Boston et al., 2011). It can be measured at many different points in a stimulus. For example, RT can be measured for the entire sentence or it can be measured word-by-word as the sentence is presented. RT can provide information on whether processing is more difficult or effortful (slower RTs indicate more effort) (Holtgraves & Robinson, 2020). Moving window paradigms and eye-tracking technology provide more detailed measures of RT. They help to identify specific points at which processing is more effortful (Robus et al., 2020). RT provides valuable insight into the sequential processing of text and any challenges that are encountered.

📜*Current Study*

Emoji research is emerging in fields as diverse as emoji interpreting and advertising. These different areas of emoji research stand to offer insight into their specific purposes, but

when examined collectively, they build a broader and more encompassing understanding of emoji. Emoji research will evolve as emoji evolve; research will continue to expand in the listed areas and others, including language processing, language acquisition, and mood. This study will focus on language processing in relation to emoji.

This review sets out to examine research exploring emoji effects on RT to understand how emoji affects the effort needed for processing text paired with emoji. Emoji play a critical role in replicating the rich facial expressions and nonverbal cues of face-to-face communication within virtual communication. Understanding the interactions and relationships between people and emoji allow us to properly utilize this supplemental information and to optimize our virtual communication and understanding. This is especially important in today's society due to the increase in virtual communication over in-person interactions.

📝Methodology

A scoping literature review was conducted. Articles were selected through a Google Scholar search for peer-reviewed journal articles, in English, including the phrases “emoji” and “reading times,” that were published within the last 5 years (since 2017). These search parameters retrieved 30 results. These results were refined by excluding four books and conference reports, eleven articles that did not examine the effects of emoji on RT, two research articles examining emoticons, and nine articles not accessible through the Portland State University Library (including book and other formats). Articles that met the review criteria were examined across three parameters: emoji presence/absent, emoji placement, and emoji type. None of the studies explored the relationship between emoji effects on RT and mood.

Results

Four relevant articles met the review criteria. These are listed in Table 1.

Table 1

Summary of Articles Being Reviewed

	Cohn et al. (2018)	Barach et al. (2021)	Holtgraves and Robinson (2020) study 1	Holtgraves and Robinson (2020) study 2	Robus et al. (2020)
Number of Participants	72	60	76	49	44
Independent Variable[4]	presence/absence	presence/absence	presence/absence	placement	placement
Emoji Placement[5]	replace words	added after	added before	added before and after	added before and after
Emoji Type	nouns and verbs	nouns	facial expression	facial expression	facial expression
Stimuli Example					
Condition 1	John loves eating pizza every Friday (control)	Homemade cookies are delicious (control)	It's hard to give a good presentation (control)	😬It's hard to give a good presentation	🙂 Steven waited at home for his order to be delivered in the morning
Condition 2	John loves eating 🍕 every Friday (noun replacement)	Homemade cookies are delicious 🍪	😬It's hard to give a good presentation	It's hard to give a good presentation😬	Steven waited at home for his order to be delivered in the morning 🙂
Condition 3	John 🖤 eating pizza every Friday (verb replacement)	N/A	N/A	N/A	N/A
Mood	not studied	not studied	not studied	not studied	not studied
Findings	longer RT for text and emoji	longer RT for text and emoji	shorter RT for text and emoji	no significant effect based on placement	longer RT for emoji after text

[4] Independent variable options include emoji presence/absence and emoji placement.
[5] Placement options include replacing text with emoji, adding the emoji before the text, and adding the emoji after the text.

Cohn et al.

Cohn and colleagues (2018) researched how replacing words within text with emoji affects participant RT[6]. Participants, who were ages 17 to 62 years, were presented with a sentence, either containing only text or containing an emoji used to replace a word within the text. They found that participants had longer RTs when reading text with words replaced by emoji than text only containing words. They did not, however, find any significant difference in RT for emoji used to replace nouns and those used to replace verbs. For emoji that replace words of a different word class (e.g. noun emoji used to replace verb text and vice versa), participants had longer RTs for verb emoji used to replace noun text than noun emoji used to replace verb text. Furthermore, they found that delays in RT extended over words that followed the emoji as well. They did not find any significant reductions in comprehension of the text due to emoji use.

Barach et al.

Barach and colleagues (2021) studied the time course of semantic processing for text paired with emoji. This differs from Cohn and colleagues' research in that no words were removed and replaced by emoji, rather emoji were added to the end of the text. Participants, with a mean age of 19 years, were presented with experimental sentences paired with three types of emoji (1) emoji that matched a target word in the sentence (synonymous), (2) emoji that did not match the target word's meaning (incongruent), and (3) no emoji. Eye movement was tracked as participants read the stimuli. Their research found longer RT for text paired with emoji than text alone. For text paired with emoji, RTs were longer for incongruent stimuli than for synonymous stimuli.

[6] This research had additional experiments using stimuli (i.e. logos) that did not fulfill the inclusion criteria for this review.

Holtgraves and Robinson

Holtgraves and Robinson's 2020 study "Emoji can facilitate recognition of conveyed indirect meaning" examines emoji effect on processing times. Their study aimed to examine the role that emoji play in the processing of ambiguous yet possible emotionally-threatening conversational replies. They did so by measuring participant's (ages not specified) RT to stimuli that were composed of a scenario and a possibly emotionally-threatening response. They found significantly longer RT for text-only stimuli than stimuli that included both text and an emoji. However, participants endorsed indirect, emotionally-threatening interpretations of the reply more often and more quickly when an emoji was paired with the text. They then developed a second experiment that only differed in emoji placement to determine if emoji placement affects RT. This experiment found no significant differences between participant RT when the emoji was placed before or after the text.

Robus et al.

Robus and colleagues (2020) conducted a similar experiment investigating the effects of emoji on neutral narrative text. Participants, ages 18 to 59, were presented with emotionally neutral text, some containing emoji and others containing text only. Some emoji were placed at the beginning of the text while others were placed at the end to assess the effects of emoji placement on RT. RT was measured as well as eye fixation and participant rating valence of the sentences. They found that participants had significantly longer RTs for sentences with emoji in the sentence-final position than those with emoji in the sentence-initial position. Furthermore, they found no significant effects of emoji placement or emoji valence on ratings of the perceived emotional valence of the text.

Discussion

⏱️*Emoji Effect on Reading Times*

This study set out to review the state of research on the effects of emoji on sentence RT and how this relates to mood and what research has been done in this area. Overall, the review showed various effects of emoji on sentence RT and no research on how this relates to mood. Two main parameters were found across research on emoji effects on RT: (1) the presence/absence of emoji and (2) emoji placement (before or after the text). For the presence/absence of emoji, the studies do support the understanding that emoji affect sentence RT, but the effects vary. Cohn and colleagues (2018) and Barach and colleagues (2021) found longer RTs for text paired with emoji; however, Holtgraves and Robinson (2020) found shorter RTs for text paired with emoji. It is possible that the difference in emoji type between studies led to the differing results. Cohn et al. (2018) and Barach et al. (2021) both used emoji that represented nouns or verbs where Holtgraves and Robinson (2020) used emoji that represented facial expressions/emotions. Noun/verb emoji and facial expression/emotion emoji may be processed differently leading to these differences in results between studies.

Research shows that brain responses for emoji faces in online interactions are processed similarly to human faces in face-to-face communication (Gantiva et al., 2020). However, research has yet to study the difference in processing between emoji of facial expressions and emoji that represent other objects. A difference in the way these emoji are processed may explain the differences in findings between the Holtgraves and Robinson (2020) study that uses emoji of

facial expressions and the Cohn et al. (2018) and Barach et al. (2021) studies that use other emoji.

Research examining the effects of emoji placement on sentence RT also has differing results. Holtgraves and Robinson (2020) found no significant effects of emoji placement in sentence-initial position versus sentence-final position on sentence RT. On the other hand, Robus and colleagues (2020) found significantly longer sentence RT when the emoji were in the sentence-final position than when they were in the sentence-initial position. These studies followed similar procedures and used similar face emoji stimuli; however, Holtgraves and Robinson (2020) used textual conversation whereas Robus and colleagues (2020) used emotionally neutral narratives. The differing results may be due to the differences in processing for textual conversations and narratives.

🛣️*Future research*

This work highlights that the research examining the effects of emoji on sentence RT is very limited and that further research is needed especially on the three aspects examined in this review. Research is needed on the role emoji type plays in differences in text processing and RT, specifically the difference between emoji representing facial expressions and emoji representing nouns. Research is needed that explores how emoji may affect text differently depending on the type of text it is paired with, specifically textual conversations versus narratives. There is also a great need for research examining the relationship between emoji and participants' underlying moods. Furthermore, research on emoji needs to be more clearly connected to other potentially related areas of research such as gestures, facial expressions, etc.

💡Conclusion

This research shows that emoji do affect RT, however, there is still a lot that is unknown about the effects of emoji on RT and sentence processing. The differences in RT between the studies suggest that emoji effects may differ due to the type of emoji used and the type of text they are paired with. However, the few studies that have been examined vary in some ways that may have led to differences in RT. Furthermore, no research has been done on how emoji and mood interact with one another. This examination of prior studies has highlighted multiple areas of emoji research that require more research in order to better understand emoji and their effects on language processing.

Emoji effects on sentence RT is still a new area of study. With the advancements in technology and subsequent popularity in emoji use, understanding emoji is essential in optimizing computer-mediated communication. Our continued use of technology and greater reliance on virtual interactions places even more emphasis on this need. While the available research on emoji provides information on their use and function, the continuously developing nature of emoji and emoji use demands a deeper analysis of its present and future effects on communication.

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