Emoji as a Tool to Aid the Comprehension of Written Sarcasm: Evidence from Younger and Older Adults

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Abstract

There is evidence for an age-related decline in the ability to understand non-literal language such as sarcasm. There is also evidence to suggest that devices such as emoticons/emojis may influence sarcasm comprehension in younger adults. However, research examining whether such devices may improve written sarcasm comprehension in older adults is scarce. The present study used an online rating task to investigate the influence of the winking face emoji on both the interpretation and perception of message intent for sarcastic or literal criticism or praise. Results revealed that older adults, in comparison to their younger counterparts, demonstrated deficient ability in interpreting and perceiving sarcastic intent. However, older adults' interpretation and perception of sarcastic intent were significantly improved when the messages were accompanied by the winking face emoji. This would suggest that the winking face emoji is a clear indicator of sarcastic intent, compensating for the absence of non-verbal cues in written communication, and may play a useful role in successful intergenerational communication.

Keywords: Language comprehension; Figurative language; Sarcasm; Emoji; Aging

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1. Introduction

1.1 Sarcasm Comprehension

Irony and sarcasm are forms of figurative language which are typically used to communicate the opposite of what is literally said. Sarcasm is a form of irony in which the target of the comment is a person (Dews et al., 1995; Kreuz & Glucksberg, 1989). Sarcastic criticism is characterised by a mock positive evaluation of a negative situation; for example, uttering "*You're so motivated!*" to a friend who is extremely lazy. Sarcastic praise, on the other hand, involves a mock negative evaluation of a positive situation; for example, uttering "*You're not very clever!*" to a friend who is extremely intelligent (Bruntsch & Ruch, 2017).

During face-to-face conversations, sarcasm can be signalled using several communicative cues: contextual, verbal, and paralinguistic. Contextual cues highlight the disparity between the comment and the situation, verbal cues are the verbal markers which often accompany sarcastic comments (e.g., hyperbolic adverbs and adjectives), and paralinguistic cues are the non-verbal markers often associated with sarcasm, for example, changes in tone of voice and facial expressions (Hancock, 2004). However, for written conversations, the paralinguistic (non-verbal) cues which often accompany sarcasm are unavailable. Therefore, the use of sarcasm in written conversations is relatively risky, as individuals may be less able to accurately recognise a sarcastic comment.

However, research has shown that during written conversations, sarcasm can be facilitated using devices such as emoticons. One of the most commonly studied devices with regards to sarcasm comprehension has been the winking face emoticon ";-)" (Derks et al., 2008; Filik et al., 2016; Howman & Filik, 2020; Thompson & Filik, 2016; Walther & D'Addario, 2001). Advancements in communication technologies have seen the development of emojis, which are graphic ideograms, and the emergence of emojis has led to a decline in the use of emoticons (Pavalanathan & Eisenstein, 2015). Therefore, in this paper we will

focus on the winking face emoji "😉". Furthermore, since research has demonstrated an age-associated decline in the ability to process and interpret sarcasm (Howman & Filik., 2020; Phillips et al., 2015), we will investigate how the winking face emoji influences the comprehension of sarcastic criticism and praise in both younger and older adults.

1.2 Individual Differences in Sarcasm Comprehension

A number of individual difference factors have been shown to play a role in the way that irony/sarcasm is processed and understood (see e.g., Blasko & Kazmerski, 2006). For example, some evidence from functional magnetic resonance imaging (fMRI) (Spotorno, et al., 2012) highlights the role of theory of mind in successful irony comprehension. This of course has implications for irony processing in people with schizotypy/schizophrenia or autism, in which theory of mind may be impaired (e.g., Au-Yeung et al., 2013; Barzy et al., 2020; Del Goleto et al., 2016; Glenwright & Agbayewa, 2012; Pexman et al., 2011; Zalla et al., 2014). In addition, recent evidence from eye-tracking during reading suggests that certain cognitive factors, such as working memory capacity (Olkoniemi et al., 2016; 2019a) can influence irony processing. Emotional processing abilities (Olkoniemi et al., 2016; 2019b) and communication styles such as tendency to use malicious humour (Filik et al., 2018) can also influence processing. Finally, certain personality characteristics, such as shyness, have also been shown to influence irony interpretation (Mewhort-Buist & Nilsen, 2013). Thus, it is apparent that many properties of the perceiver can play an important role in the processing and interpretation of irony and sarcasm. In the present paper, we focus on age.

1.3 The Effect of Aging on Sarcasm Comprehension

Sarcasm is a complex form of communication, and is more cognitively demanding to process and understand than literal language, therefore, older adults may misinterpret sarcasm due to age-associated declines in cognitive skills. In order to examine the effects of aging on sarcasm comprehension, Phillips et al. (2015) presented younger, middle-aged, and older

adults with video and verbal materials to examine their interpretation of sarcastic comments. Results demonstrated no age differences in interpreting literal comments; however, there were significant age differences in interpreting sarcastic comments in both the video and verbal materials. Specifically, older adults were significantly worse at interpreting sarcastic comments, compared to the younger and middle-aged adults. That is, the older adults were more likely to interpret the comments literally, compared to sarcastically.

Similar findings were reported by Howman and Filik (2020). In their study, younger and older adults had their eye movements monitored while they read scenarios which contained ambiguous comments that could be interpreted either literally or sarcastically. Following each scenario participants had to answer a question to examine their interpretation of the comment. Results showed that younger adults interpreted more of the ambiguous comments sarcastically compared to the older adults, further demonstrating age differences in sarcasm interpretation.

It is important to note that these two studies examined the effect of aging on sarcasm comprehension using only sarcastic criticism, which could be problematic as research has demonstrated an age-related positivity bias. This positivity bias means older adults are more likely to attend to positive information, and ignore negative information, whereas younger adults are more likely to attend to negative information, and ignore positive information (Charles & Carstensen, 2008; Reed et al., 2014). Thus, older adults may have interpreted the comments literally to retain the positive evaluation (e.g., of a comment such as "*You're so motivated!*"), whereas the younger adults may have interpreted the comments sarcastically to produce the negative evaluation.

This potential age-related positivity bias in sarcasm comprehension was examined by Pomareda et al. (2019), who presented younger and older adults with stories containing sarcastic criticism and sarcastic praise. Following each story participants were asked three

questions, where one of the questions required them to rate the extent to which they thought the final utterance was intended to be kind or mean. Results illustrated that older adults rated the sarcastic criticisms (e.g., saying "*You're a brilliant artist!*" to someone whose painting was awful) as significantly more kind than the younger adults, whereas the younger adults rated the sarcastic praise (e.g., saying "*You're a terrible artist*!" to someone whose painting was excellent) as significantly more kind than the older adults. This finding goes against the age-related positivity bias as older adults were more likely to interpret the sarcastic praise literally and accept the negative evaluation, whereas a positivity bias would instead have resulted in older adults interpreting sarcastic praise sarcastically in order to produce the positive evaluation. Thus, older adults were more likely than younger adults to interpret the comments literally, for both sarcastic criticism and sarcastic praise. These results offer support to the findings of Phillips et al. (2015) and Howman and Filik (2020).

1.4 The Effect of Emoticons and Emojis on Sarcasm Comprehension

One of the earliest studies examining the role of emoticons in sarcasm comprehension was conducted by Walther and D'Addario (2001). Although Walther and D'Addario (2001) reported that in 85% of cases, participants associated a winking face emoticon with sarcasm, this was not significant compared to happy and sad face emoticons, and no emoticon. Furthermore, Hancock (2004) found the ellipsis (triple dot often used when omitting text; …) to be the most frequent indicator of irony in written communication. Hence, from initial research, it was unclear whether the winking face emoticon can facilitate sarcastic language comprehension. Following this, however, Derks et al. (2008) found that messages accompanied by a winking face emoticon were perceived as significantly more sarcastic than messages without the emoticon.

More recently, Thompson and Filik (2016) suggested that the tongue face and winking face emoticons indicate sarcastic intent, whereas the ellipsis (…) is more associated

with criticism. Similarly, Filik et al. (2016) found that compared to the ellipsis or exclamation mark, the winking face emoticon had a greater influence on the comprehension of sarcastic criticism and praise. Finally, Howman and Filik (2020) investigated the influence of the winking face emoticon on how younger and older adult readers interpreted comments that were ambiguous between a literal and sarcastic interpretation. They found that the winking face emoticon increased the likelihood that younger, but not older, adults would interpret a comment sarcastically. Overall, the results suggest that the winking face emoticon, in particular, can clarify and mediate written sarcasm interpretation, in younger adults at least. This may be because the winking face emoticon is believed to introduce ambiguity via the discrepancy between the smiling face and the winking eye. For instance, the smiling face is believed to communicate positivity, whereas the winking eye suggests there is an unknown, or hidden, meaning behind the message (Derks et al., 2008). It is important to note here that there is not a straightforward one-to-one mapping between specific emoticons and particular meanings (Dresner & Herring, 2010). For example, the winking face does not unambiguously signal sarcasm, and may also signal other intentions, such as flirtation. However, as outlined above, research suggests that it is the principal indicator of sarcastic intent (Thompson & Filik, 2016).

Thus, it can be seen that the majority of research to date has focused on the use of emoticons to enhance written sarcasm comprehension, yet emojis are now more ubiquitous in computer-mediated communication (CMC) platforms such as instant messaging, emails, and blogs (Weissman & Tanner, 2018). Emojis are ideograms, such as graphic symbols, which serve to facilitate more expressive messages (Novak et al. 2015). Emojis can represent various facial expressions (e.g., a grinning face 😀), emotions (e.g., an angry face 😡), animals (e.g., a dog 🐶), abstract concepts (e.g., the world 🌍) and many more (Rodrigues et al. 2018). They were first introduced in Japan by Shigeta Kurita and are now available around

the world to users on platforms such as Facebook and Twitter as well as Android and iOS devices (Ljubešić & Fišer, 2016). After emojis were introduced on iOS and Android devices in 2011 and 2013, their usage took an immediate uprise (Bai et al., 2019). According to Monllos (2015), six billion emojis are sent every day on mobile messaging applications around the world, indicating the high frequency of their usage. In support of this, studies suggest that between 92-95% of the on-line community use emojis on a daily basis (Kaye et al., 2017). Additionally, a study conducted by Gallud et al. (2018) found no significant difference in emoji use between older and younger adults. Thus, it seems that emojis are popular amongst both younger and older individuals.

Recent research using event-related potentials (ERPs) has revealed that winking face emojis elicit a P600 effect (a large positive peak in electrical brain activity) comparable to that elicited by word-induced irony (Weissman & Tanner, 2018). Likewise, Gantiva, et al. (2019) found that participants displayed similar neural responses to emoji faces in digital communication to those that are observed in face-to-face communication, indicating similarity in processing. These findings suggest that the winking face emoji may be an effective tool to aid written sarcasm comprehension and therefore reduce the risk of miscommunication in CMC. However, research conducted by Miller et al. (2017) demonstrated widespread variability in the way individuals interpret emojis in terms of sentiment and semantics. This illustrates the potential for miscommunication when using emojis. Additionally, according to Gallud et al. (2018), older individuals find it more challenging than younger individuals to interpret emojis. Thus, an emoji, as a cue to sarcastic intent, may hinder older adults' sarcasm comprehension. However, due to the relatively recent nature of their widespread use, there has not been comprehensive research investigating the role of emojis in facilitating written language comprehension.

1.5 The Current Study

In summary, as the literature demonstrates an age-related decline in the ability to comprehend non-literal language such as sarcasm, it is necessary to identify features of written language that can facilitate this process during computer-mediated communication. Hence, the current study aimed to identify whether the winking face emoji (😉) would serve as an effective indicator of sarcasm. Specifically, we examined its influence on the comprehension of sarcastic versus literal criticism and praise in both younger and older adults. The task was based on that used by Filik et al. (2016) Experiment 1, and involved participants reading a series of scenarios in which the target comment could be intended either literally or sarcastically, as either criticism or praise, and was either accompanied by a winking face emoji or not. For example, scenarios such as, *Sky spotted Erin across the room at the party and noticed that she was looking a bit scruffy. She texted her to say, "I see you made an effort"*. The participants' task was to rate the target comment on two dimensions. Firstly, their interpretation of the comment was assessed by a question (*Question a*) such as *Will Erin think that Sky thought she hadn't bothered to dress up?*. The second question (*Question b*), *Will Erin think that Sky is being sarcastic?*, assessed the participant's perception of the comment as sarcastic. Filik et al. only examined the perception of irony/sarcasm (similar to our *Question b*). In the current study, we explicitly probed the way in which the comment was actually *interpreted* (with *Question a*), which is likely to be a more reliable indicator of correct interpretation, as people's views on what it means to be 'sarcastic' may vary.

1.6 Hypotheses

Based on previous evidence indicating an age-related decline in the ability to comprehend sarcasm (e.g., Phillips et al., 2015; Pomerada et al., 2019), we hypothesise that when there is no emoji present, younger adults will interpret and perceive sarcastic scenarios as significantly more sarcastic than older adults. In contrast, we would hypothesise no age

difference in the interpretation or perception of literal comments. The key question then arises of whether the decline in sarcasm comprehension in older adults can be offset by the use of emojis. If so, we would hypothesise that in conditions where an emoji is present, older adults' sarcasm interpretation and perception ratings should become more similar to those of younger adults. It is important to note that it is not clear at this stage whether this will be the case, since research conducted by Gallud et al. (2018) identified that older adults have difficulty interpreting emojis, and findings from Howman and Filik (2020) indicated that the winking face emoticon influenced interpretation for younger adults only. However, it is important to note that in Howman and Filik's study, the target comment was completely ambiguous, and so an interpretation of the comment as sarcastic would indicate a preference, rather than a 'correct' response, and that they only studied comments that could be interpreted as sarcastic criticism.

1.7 Significance of the Current Study

If it is the case that emojis can counteract the decline in sarcasm comprehension in older adults, this would suggest that the use of emojis can aid intergenerational (and indeed, intragenerational) communication involving figurative language. In contrast, if it was the case that emojis further impair sarcasm interpretation in older adults, this would also have important implications, in that care would need to be taken in using these devices in order to avoid a deepening of miscommunication. Such miscommunication can be particularly harmful in cases of sarcastic praise, where something negative (e.g., *You're not very clever!*) is stated in order to convey a more positive message. In this case, an incorrect literal interpretation would be construed as an insult, potentially leading to relationship damage. Ultimately, this study will be highly informative regarding the best approach for communicating sarcasm and will have potential implications for successful social interactions between younger and older individuals. In terms of broader implications, results will add to

the literature on individual differences in sarcasm comprehension, as well as literature on the use of emojis as devices to aid on-line communication.

2. Method

2.1 Participants

There were 96 native-English speaking participants; 48 younger adults (24 females, 24 males, M_{age} = 20.81, SD = 2.30, range = 18-28 years old) and 48 older adults (24 females, 24 males, M_{age} = 70.79, SD = 4.54, range = 65-81 years old). The sample size (48 younger adults and 48 older adults) was based on a previous study conducted in our lab (Filik et al., 2016, Experiment 1), which the current study is based on, who recruited 48 participants per between-subjects condition. Our sample size is also in line with that employed by Pomerada et al. (2019), who used similar stimuli to examine sarcasm processing in younger and older adults (without emojis), and recruited 40 younger adults and 38 older adult participants.

Participants were recruited online through opportunity sampling, via social media, where advertisements contained a URL link directing them to the online survey hosted by Qualtrics. In addition, 16 first-year undergraduate Psychology students at the University of Nottingham participated in the study in exchange for course credit, as part of the younger adult group.

2.2 Materials and Design

Forty-eight experimental items from Filik et al.'s (2016) Experiment 1 were modified for the current study (see Table 1 for an example and Supplementary Material 1 for the full set of items). Each item described an interaction between two characters and consisted of two sentences. The first sentence provided the context, and the second sentence contained the comment which was messaged from one character to another. Depending on the context sentence, the correct interpretation of the messaged comment could be either literal or

sarcastic, and either intended as criticism or praise. In addition, the comment could be followed by a wink emoji "😉", or by no emoji. Thus, the study consisted of a 2 (literality: literal vs. sarcastic) x 2 (valence: criticism vs. praise) x 2 (emoji presence: winking face emoji vs. no emoji) x 2 (age group: younger adults vs. older adults) mixed design. The literality, valence, and emoji presence factors were within-subjects and within-items, and the age group factor was between-subjects and within-items.

The 48 experimental items were interspersed with 24 "filler" items. The filler items followed the same structure as the experimental items, but the comments were followed by a mixture of emojis, such as "😡", "😎", "😂", emoticons, such as ":)", and punctuation devices, such as ellipses "...", and exclamation marks "!". These filler items were included to reduce the likelihood of participants noticing that the study was investigating the winking face emoji, and so the aim was simply to include a range of different devices.

There were eight different versions of the questionnaire. The experimental items were distributed across these eight versions such that each participant saw each item in only one of the eight conditions. For example, participants viewing Version 1 would see Item 1 in the *sarcastic criticism with emoji* condition, participants viewing Version 2 would see Item 1 in the *sarcastic criticism no emoji* condition, and so on. Overall, each participant saw 48 experimental items in total: six items in each of the eight conditions, plus all 24 filler items. The items in each questionnaire were presented in a different randomised order for each participant. Please see Supplementary Material 1 for the full set of stimuli.

Table 1

Example Experimental Item in all Conditions and Example Filler Item

Condition	Item

Sarcastic criticism (with emoji)	Sky spotted Erin across the room at the party and noticed that she was looking a bit scruffy. She texted her to say, "I see you made an effort 😉"
Sarcastic criticism (no emoji)	Sky spotted Erin across the room at the party and noticed that she was looking a bit scruffy. She texted her to say, "I see you made an effort"
Literal criticism (with emoji)	Sky spotted Erin across the room at the party and noticed that she was looking a bit scruffy. She texted her to say, "I see you didn't make much effort 😉"
Literal criticism (no emoji)	Sky spotted Erin across the room at the party and noticed that she was looking a bit scruffy. She texted her to say, "I see you didn't make much effort"
Sarcastic praise (with emoji)	Sky spotted Erin across the room at the party and noticed that she was looking very smart. She texted her to say, "I see you didn't make much effort 😉"
Sarcastic praise (no emoji)	Sky spotted Erin across the room at the party and noticed that she was looking very smart. She texted her to say, "I see you didn't make much effort"
Literal praise (with emoji)	Sky spotted Erin across the room at the party and noticed that she was looking very smart. She texted her to say, "I see you made an effort 😉"
Literal praise (no emoji)	Sky spotted Erin across the room at the party and noticed that she was looking very smart. She texted her to say, "I see you made an effort"
Filler item	Theo made Zack laugh today after telling a joke in class. Zack texted him later to say, "You are hilarious 😂"

Each item was followed by two questions, which were each followed by a response scale from one to eight. The first question probed participants' interpretation of the comment

(*Question a*), and the second question assessed participants' perception of the comment as sarcastic (*Question b*):

a) *Will Erin think that Sky thought she hadn't bothered to dress up?*

   Very Unlikely 1 2 3 4 5 6 7 8 Very Likely

b) *Will Erin think that Sky is being sarcastic?*

   Very Unlikely 1 2 3 4 5 6 7 8 Very Likely

To prevent participants from adopting strategies in their responding, following half of the experimental items, *Question a* focused on the negative interpretation (e.g., *Will Erin think that Sky thought she hadn't bothered to dress up?*), and for the other half *Question a* focused on the positive interpretation (e.g., *Will James think that Ella thought he was helpful?*). The 24 filler items were followed by similarly designed questions.

2.3 Procedure

Participants accessed the study through a URL link hosted by Qualtrics (https://www.qualtrics.com). Prior to taking part, they were informed that their participation was voluntary, they could withdraw from the study at any time, and that their data would be used for research purposes only and kept confidential. They were then presented with the General Data Protection Regulation and consent form, which required that they indicate their consent before the study would commence. The study began with questions regarding age and gender identity, after which participants were instructed to read the 72 short scenarios and following each scenario answer the two questions. Upon completion of the study, participants were debriefed and to thank them for their involvement they could enter a prize draw to win a £30 Amazon voucher. First-year Psychology students were instead awarded course credit for taking part.

3. Results

Data analysis was performed in R (version 4.0.1; R Core Team, 2020) using linear mixed modelling (*lme4* package version 1.1-23; Bates et al., 2015). Interactions were decomposed using the function *testInteractions* (from the *phia* package version 0.2-1, where the chi-square is the default test; all reported *p* values are Bonferroni corrected; De Rosario-Martinez, 2015). Linear mixed effects modelling is a powerful and flexible approach to the analysis of psycholinguistic data (Locker et al., 2007), and it has the advantages of being able to analyse incomplete data sets and being robust against violations of homoscedasticity and sphericity (Quené & van den Bergh, 2004). It allows the introduction of random intercepts and slopes for subjects and items; in other words, a mixed effects model takes all the data into consideration and does not require prior averaging (Baayen et al., 2008). Also, the introduction of random intercepts and slopes for subjects and items means that the analysis now accounts for intrinsic differences between participants and between the experimental items, which were not manipulated experimentally (for example, some participants might be differently sensitive to a certain manipulation). The same data analysis method was used in previous papers, such as Filik et al. (2016), which the current paper is based on.

As a first step, the maximal model was fitted to the data. This contained random intercepts for both subjects and items, as well as random slopes for subjects for the within-subjects variables (literality, valence, and emoji presence) and random slopes for items for the within-items variables (literality, valence, emoji presence, and age group). The fixed-effects and random-effects structure of the maximal model was: *literality x valence x emoji_presence x age_group + (1 + literality + valence + emoji_presence|subject) + (1 + literality + valence + emoji_presence + age_group|item).*

The second step was to establish the appropriate random-effects structure. When the maximal model failed to converge, the random-effects structure was simplified by removing one random slope at a time - the one that explained the least amount of variance in the

previous non-converging model. This procedure was in line with Barr et al.'s (2013) recommendations and was documented in more detail in Ţurcan and Filik (2016).

Once the random-effects structure had been established, the third step was to perform a series of likelihood ratio tests comparing the fit of models with different fixed-effects structures in order to reach the best model fit for the data. The procedure used was to compare the model with the four factors in interaction with progressively simpler fixed-effects structures (e.g., three factors in interaction and a main effect).

See Tables 2 (*Question a*) and 3 (*Question b*) for the detailed results of the analysis. The tables list the models that had the best fit for the data, the fixed-effects and their parameters (estimate, standard error, and *t*-value), as well as their 95% confidence interval and effect size (partial eta-squared). Please see Supplementary Material 2 for the series of likelihood ratio tests performed in order to reach the best models.

Table 2

Best Fitting Models, Confidence Intervals (CI), Effect Sizes, and Fixed-Effects Parameters for Question a

			95% CI					
Question	Model	Fixed Effects	2.5%	97.5%	Effect size (η^2_p)	Coef	SE	t
a	~ literality x valence x emoji_presence x age_group + (1 + literality|subject) + (1|item)	(Intercept)	6.02	6.72		6.37	0.18	35.63
		literalityliteral	-3.51	-2.46	0.80	-2.98	0.27	-11.21
		valencepraise	-0.54	0.06	0.001	-0.24	0.15	-1.58
		emoji_presenceabsent	-2.21	-1.61	0.13	-1.91	0.15	-12.54
		age_groupYA	-0.49	0.49	0.24	0.001	0.25	0.01
		literalityliteral:valencepraise	-0.45	0.40	0.000	-0.02	0.22	-0.11
		literalityliteral:emoji_presenceabsent	-0.34	0.51	0.000	0.08	0.22	0.39
		valencepraise:emoji_presenceabsent	-0.41	0.43	0.000	0.01	0.22	0.04
		literalityliteral:age_groupYA	-1.11	0.37	0.03	-0.37	0.38	-0.99
		valencepraise:age_groupYA	0.01	0.86	0.001	0.43	0.22	2.00
		emoji_presenceabsent:age_groupYA	1.00	1.84	0.02	1.42	0.22	6.59
		literalityliteral:valencepraise:emoji_presenceabsent	-0.50	0.70	0.001	0.10	0.30	0.33
		literalityliteral:valencepraise:age_groupYA	-0.72	0.47	0.000	-0.12	0.30	-0.41
		literalityliteral:emoji_presenceabsent:age_groupYA	-1.20	-0.01	0.000	-0.61	0.30	-1.99
		valencepraise:emoji_presenceabsent:age_groupYA	-1.27	-0.08	0.000	-0.68	0.31	-2.22
		literalityliteral:valencepraise:emoji_presenceabsent:age_groupYA	-0.13	1.56	0.001	0.72	0.43	1.66

a - criticism	~ literality x emoji_presence x age_group + (1 + literality|subject) + (1|item)	(Intercept)	6.03	6.72		6.37	0.17	36.66
		literalityliteral	-3.50	-2.47	0.80	-2.99	0.26	-11.40
		emoji_presenceabsent	-2.20	-1.61	0.12	-1.91	0.15	-12.54
		age_groupYA	-0.48	0.48	0.13	-0.003	0.25	-0.01
		literalityliteral:emoji_presenceabsent	-0.33	0.51	0.001	0.09	0.21	0.40
		literalityliteral:age_groupYA	-1.10	0.35	0.04	-0.37	0.37	-1.00
		emoji_presenceabsent:age_groupYA	1.00	1.84	0.02	1.42	0.22	6.60
		literalityliteral:emoji_presenceabsent:age_groupYA	-1.21	-0.01	0.002	-0.61	0.30	-2.01
a - literal criticism	~ age_group x emoji_presence + (1|subject) + (1|item)	(Intercept)	3.12	3.66		3.39	0.14	24.59
		age_groupYA	-0.76	0.01	0.000	-0.37	0.19	-1.93
		emoji_presenceabsent	-2.09	-1.55	0.17	-1.92	0.14	-13.10
		age_groupYA:emoji_presenceabsent	0.42	1.20	0.02	0.81	0.20	4.12
a - sarcastic criticism	~ age_group x emoji_presence + (1|subject) + (1|item)	(Intercept)	6.00	6.74		6.37	0.19	33.45
		age_groupYA	-0.49	0.48	0.10	-0.01	0.25	-0.02
		emoji_presenceabsent	-2.22	-1.59	0.10	-1.91	0.16	-11.96
		age_groupYA:emoji_presenceabsent	1.00	1.89	0.04	1.45	0.23	6.36
a - praise	~ age_group x emoji_presence + literality + (1 + literality|subject) + (1|item)	(Intercept)	5.94	6.50		6.22	0.14	43.85
		emoji_presenceabsent	-2.02	-1.59	0.14	-1.81	0.11	-16.70
		age_groupYA	-0.10	0.37	0.26	0.14	0.12	1.14
		literalityliteral	-3.48	-2.79	0.77	-3.13	0.18	-17.70
		emoji_presenceabsent:age_groupYA	0.50	1.10	0.01	0.80	0.15	5.21
a - sarcasm	~ age_group + (1 + valence +	(Intercept)	5.50	6.09		5.79	0.15	38.28
		age_groupYA	0.10	0.88	0.06	0.49	0.20	2.47

emoji_presence|subject)
+ (1 + valence +
emoji_presence|item)

Table 3

Best Fitting Models, Confidence Intervals (CI), Effect Sizes, and Fixed-Effects Parameters for Question b

			95% CI					
Question	Model	Fixed Effects	2.5%	97.5%	Effect size (η^2_p)	Coef	SE	t
b	~ literality x valence x emoji_presence x age_group + (1 + literality + emoji_presence|subject) + (1|item)	(Intercept)	5.92	6.61		6.26	0.17	35.81
		literalityliteral	-2.23	-1.25	0.75	-1.74	0.25	-6.91
		valencepraise	-0.12	0.46	0.01	0.17	0.15	1.14
		emoji_presenceabsent	-2.74	-1.63	0.56	-2.18	0.28	-7.74
		age_groupYA	-0.09	0.85	0.18	0.38	0.24	1.57
		literalityliteral:valencepraise	-1.38	-0.55	0.005	-0.97	0.21	-4.58
		literalityliteral:emoji_presenceabsent	-0.85	-0.03	0.003	-0.44	0.21	-2.09
		valencepraise:emoji_presenceabsent	-0.68	0.14	0.000	-0.27	0.21	-1.28
		literalityliteral:age_groupYA	-1.09	0.31	0.03	-0.39	0.36	-1.10
		valencepraise:age_groupYA	-0.65	0.18	0.000	-0.23	0.21	-1.10
		emoji_presenceabsent:age_groupYA	0.32	1.89	0.06	1.10	0.40	2.77
		literalityliteral:valencepraise:emoji_presenceabsent	0.09	1.26	0.003	0.68	0.30	2.27

		literalityliteral:valencepraise:age_groupYA	-0.35	0.82	0.000	0.23	0.30	0.78
		literalityliteral:emoji_presenceabsent:age_groupYA	-1.17	0.01	0.001	-0.58	0.30	-1.94
		valencepraise:emoji_presenceabsent:age_groupYA	-0.51	0.66	0.000	0.08	0.30	0.25
		literalityliteral:valencepraise:emoji_presenceabsent:age_groupYA	-0.74	0.92	0.000	0.09	0.42	0.22
b - criticism	~ literality x emoji_presence x age_group + (1 + literality + emoji_presence|subject) + (1|item)	(Intercept)	5.89	6.64		6.27	0.19	32.89
		literalityliteral	-2.27	-1.22	0.65	-1.75	0.27	-6.57
		emoji_presenceabsent	-2.75	-1.62	0.54	-2.19	0.29	-7.60
		age_groupYA	-0.15	0.88	0.13	0.37	0.26	1.39
		literalityliteral:emoji_presenceabsent	-0.86	-0.03	0.01	-0.44	0.21	-2.10
		literalityliteral:age_groupYA	-1.11	0.36	0.04	-0.38	0.38	-1.00
		emoji_presenceabsent:age_groupYA	0.31	1.91	0.05	1.11	0.41	2.72
		literalityliteral:emoji_presenceabsent:age_groupYA	-1.15	0.02	0.002	-0.57	0.30	-1.88
b - literal criticism	~ emoji_presence + (1 + emoji_presence|subject) + (1|item)	(Intercept)	4.20	4.84		4.52	0.16	27.46
		emoji_presenceabsent	-2.74	-1.97	0.60	-2.36	0.20	-12.10
b - sarcastic criticism	~ age_group x emoji_presence + (1 + emoji_presence|subject) + (1|item)	(Intercept)	5.89	6.66		6.28	0.20	31.95
		age_groupYA	-0.18	0.84	0.13	0.33	0.26	1.26
		emoji_presenceabsent	-2.80	-1.60	0.38	-2.20	0.31	-7.16
		age_groupYA:emoji_presenceabsent	0.30	2.01	0.07	1.15	0.44	2.65
b - praise	~ literality x emoji_presence x age_group + (1 +	(Intercept)	6.08	6.79		6.44	0.18	35.56
		literalityliteral	-3.01	-2.40	0.38	-2.71	0.16	-17.33
		emoji_presenceabsent	-2.99	-1.90	0.53	-2.44	0.28	-8.80
		age_groupYA	-0.34	0.64	0.15	0.15	0.25	0.60

	emoji_presence|subject)	literalityliteral:emoji_presenceabsent	-0.20	0.66	0.000	0.23	0.22	1.03
	+ (1|item)	literalityliteral:age_groupYA	-0.60	0.27	0.003	-0.17	0.22	-0.75
		emoji_presenceabsent:age_groupYA	0.37	1.90	0.06	1.14	0.39	2.90
		literalityliteral:emoji_presenceabsent:age_groupYA	-1.07	0.16	0.001	-0.45	0.31	-1.44
b - literal	~ age_group +	(Intercept)	3.07	3.85		3.46	0.20	17.42
praise	emoji_presence + (1 +	age_groupYA	0.16	0.86	0.08	0.51	0.18	2.87
	emoji_presence|subject)	emoji_presenceabsent	-2.25	-1.48	0.49	-1.87	0.19	-9.61
	+ (1|item)							
b -	~ age_group x	(Intercept)	6.11	6.77		6.44	0.17	38.26
sarcastic	emoji_presence + (1 +	age_groupYA	-0.29	0.58	0.11	0.14	0.22	0.64
praise	emoji_presence|subject)	emoji_presenceabsent	-3.03	-1.89	0.47	-2.46	0.29	-8.38
	+ (1|item)	age_groupYA:emoji_presenceabsent	0.35	1.98	0.08	1.16	0.42	2.80
b -	~ age_group + (1 +	(Intercept)	5.55	6.10		5.82	0.14	41.64
sarcasm	valence +	age_groupYA	0.13	0.85	0.07	0.49	0.18	2.68
	emoji_presence|subject)							
	+ (1 + valence +							
	emoji_presence|item)							

3.1 *Question a*: Interpretation of the Comment

The data for *Question a* were coded such that a score of 1 corresponded to a literal interpretation of the comment and a score of 8 corresponded to a sarcastic interpretation. Descriptive statistics can be found in Table 4.

Table 4

Descriptive Statistics for Question a (SEM = Standard Error of the Mean)

Literality	Valence	Emoji presence	Age group	Mean	SEM
literal	criticism	wink emoji	younger adults	3.01	0.11
literal	criticism	no emoji	younger adults	2.00	0.09
literal	criticism	wink emoji	older adults	3.39	0.14
literal	criticism	no emoji	older adults	1.57	0.08
sarcastic	criticism	wink emoji	younger adults	6.37	0.12
sarcastic	criticism	no emoji	younger adults	5.89	0.12
sarcastic	criticism	wink emoji	older adults	6.38	0.12
sarcastic	criticism	no emoji	older adults	4.47	0.16
literal	praise	wink emoji	younger adults	3.07	0.11
literal	praise	no emoji	younger adults	2.21	0.10
literal	praise	wink emoji	older adults	3.12	0.13
literal	praise	no emoji	older adults	1.41	0.06
sarcastic	praise	wink emoji	younger adults	6.57	0.11
sarcastic	praise	no emoji	younger adults	5.41	0.13
sarcastic	praise	wink emoji	older adults	6.13	0.12
sarcastic	praise	no emoji	older adults	4.24	0.16

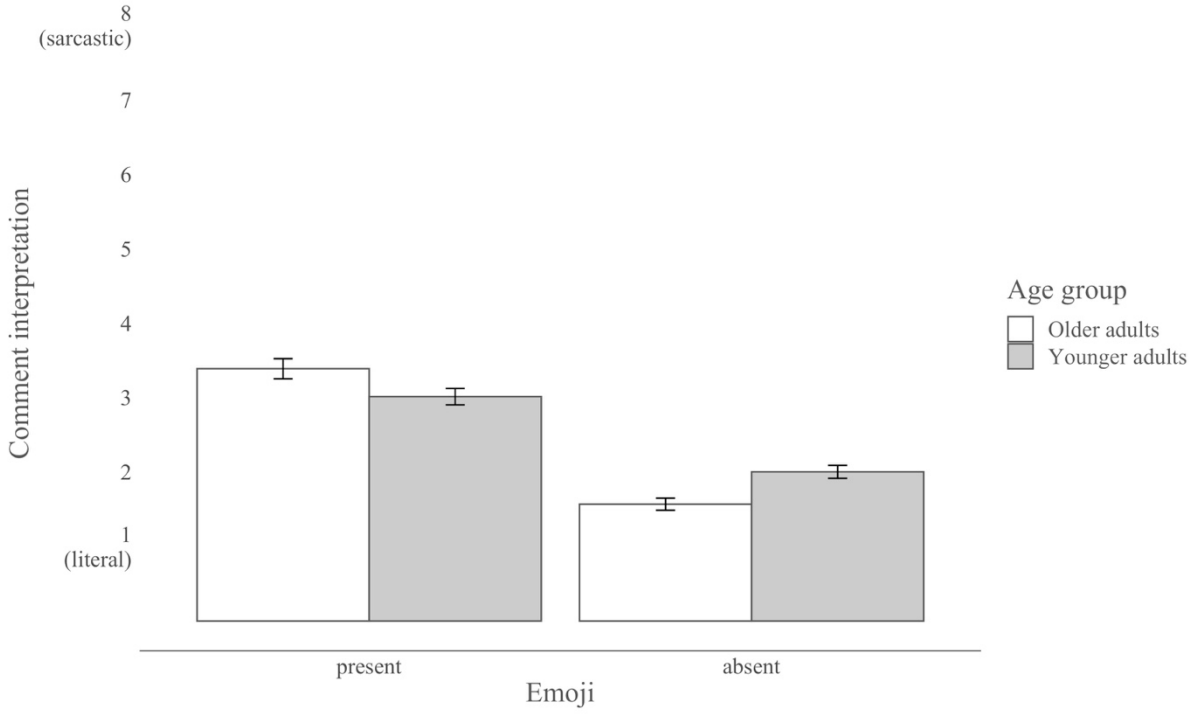
Analyses indicated that a four-way interaction was present (see Table 2). In order to investigate this interaction in more detail, we will present the results separately for criticism and praise.

3.1.1 Interpretation of comments intended as criticism

A three-way interaction was found between literality, emoji presence, and age group. For literal criticism, there was an interaction between emoji presence and age group. Both younger and older adults interpreted the comments that were accompanied by an emoji as more sarcastic than those without an emoji (younger adults: $\chi2(1, N = 48) = 52.76, p < .001$; older adults: $\chi2(1, N = 48) = 171.42, p < .001$). Additionally, when literal comments were not accompanied by an emoji, younger adults interpreted them as significantly more sarcastic than older adults ($\chi2(1, N = 96) = 5.01, p = .05$), but the two age groups did not differ in their interpretation of literal criticisms with an emoji ($\chi2(1, N = 96) = 3.71, p = .1$) – see Figure 1.

Figure 1

Mean comment interpretation ratings for literal criticism. Error bars represent ±1 SEM.

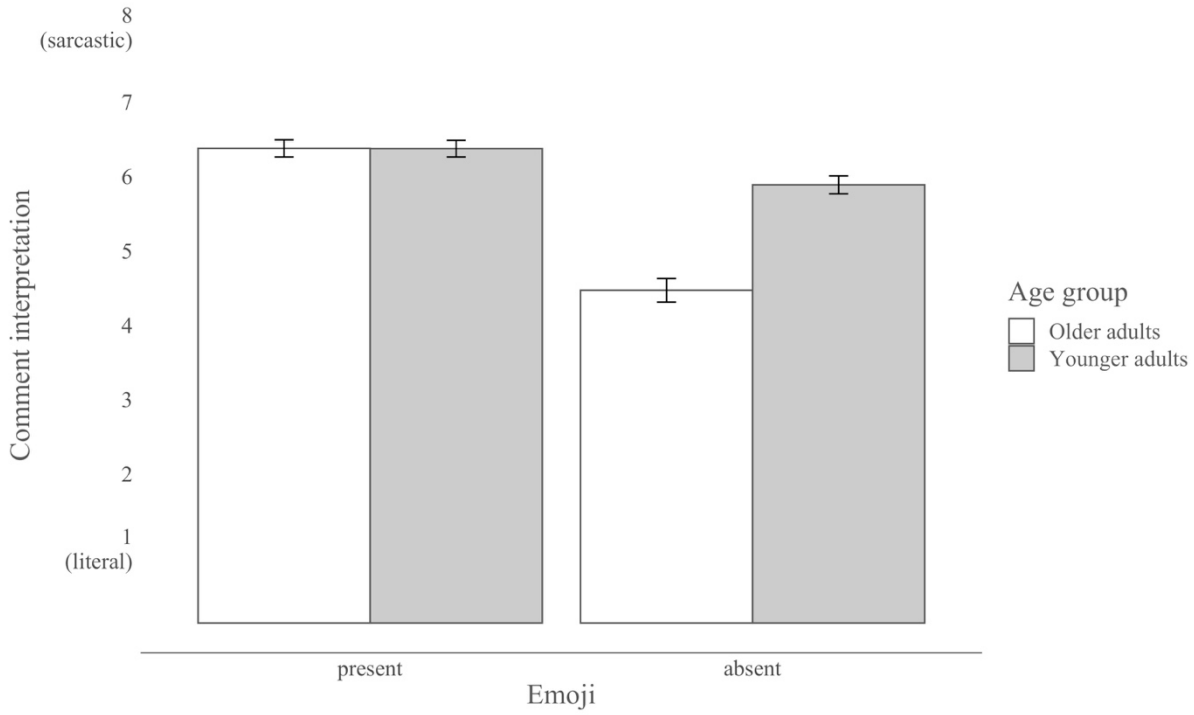


For sarcastic criticism, there was an interaction between emoji presence and age group. Both younger and older adults interpreted the comments that were accompanied by an

emoji as more sarcastic than those without an emoji (younger adults: $\chi2(1, N = 48) = 8.20$, $p = .008$; older adults: $\chi2(1, N = 48) = 143.10$, $p < .001$). Additionally, when sarcastic comments were not accompanied by an emoji, younger adults interpreted them as significantly more sarcastic than older adults ($\chi2(1, N = 96) = 33.62$, $p < .001$), but the two age groups did not differ in their interpretation of sarcastic criticisms with an emoji ($\chi2(1, N = 96) = 0.001$, $p = 1$) – see Figure 2.

Figure 2

Mean comment interpretation ratings for sarcastic criticism. Error bars represent ±1 SEM.



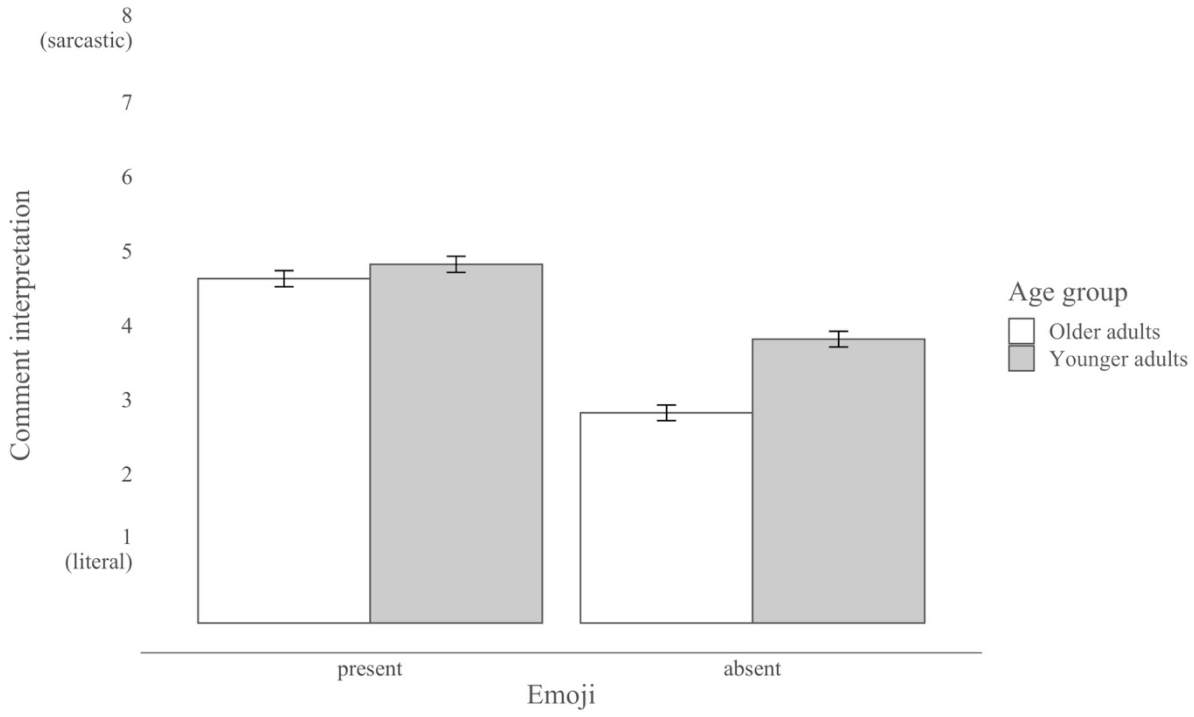
3.1.2 Interpretation of comments intended as praise

There was a two-way interaction between emoji presence and age group, as well as a main effect of literality. The main effect of literality showed that sarcastic praise was interpreted as being significantly more sarcastic than literal praise ($M_{literal} = 2.45$, $SEM = 0.06$, $M_{sarcastic} = 5.59$, $SEM = 0.07$).

The interaction between emoji presence and age group showed that both younger and older adults interpreted praising comments accompanied by an emoji as being significantly more sarcastic than those without an emoji (younger adults: $\chi2(1, N = 48) = 86.90$, $p < .001$; older adults: $\chi2(1, N = 48) = 278.89$, $p < .001$). Additionally, when praising comments were not accompanied by an emoji, younger adults interpreted them as significantly more sarcastic than older adults ($\chi2(1, N = 96) = 60.94$, $p < .001$), but the two age groups did not differ in their rating of praise accompanied by an emoji ($\chi2(1, N = 96) = 1.30$, $p = .51$) – see Figure 3.

Figure 3

Mean comment interpretation rating for praise – emoji presence x age group. Error bars represent ±1 SEM.



In summary, the presence of an emoji led both younger and older participants to interpret comments less literally. Importantly, in the absence of an emoji, older participants interpreted sarcastic comments more literally than younger adults did, which reflects a

possible decline in their ability to correctly interpret sarcasm. Indeed, results shown in Table 4 and Figure 2 clearly show that in the absence of an emoji, older adults overall tend to rate sarcastic comments around the middle of the scale. Importantly, the results indicate that the presence of an emoji can help older adults overcome this decline.

3.2 *Question b*: Perception of the Comment as Sarcastic

Descriptive statistics for *Question b* can be found in Table 5. A four-way interaction was present for *Question b*. In order to investigate this interaction in more detail, we will again present the results separately for criticism and praise.

Table 5

Descriptive Statistics for Question b (SEM = Standard Error of the Mean)

Literality	Valence	Emoji presence	Age group	Mean	SEM
literal	criticism	wink emoji	younger adults	4.52	0.14
literal	criticism	no emoji	younger adults	2.43	0.11
literal	criticism	wink emoji	older adults	4.52	0.15
literal	criticism	no emoji	older adults	1.90	0.12
sarcastic	criticism	wink emoji	younger adults	6.62	0.11
sarcastic	criticism	no emoji	younger adults	5.57	0.13
sarcastic	criticism	wink emoji	older adults	6.27	0.12
sarcastic	criticism	no emoji	older adults	4.07	0.16
literal	praise	wink emoji	younger adults	3.71	0.13
literal	praise	no emoji	younger adults	2.18	0.10
literal	praise	wink emoji	older adults	3.73	0.14
literal	praise	no emoji	older adults	1.52	0.08
sarcastic	praise	wink emoji	younger adults	6.61	0.12
sarcastic	praise	no emoji	younger adults	5.30	0.13
sarcastic	praise	wink emoji	older adults	6.42	0.11
sarcastic	praise	no emoji	older adults	3.99	0.16

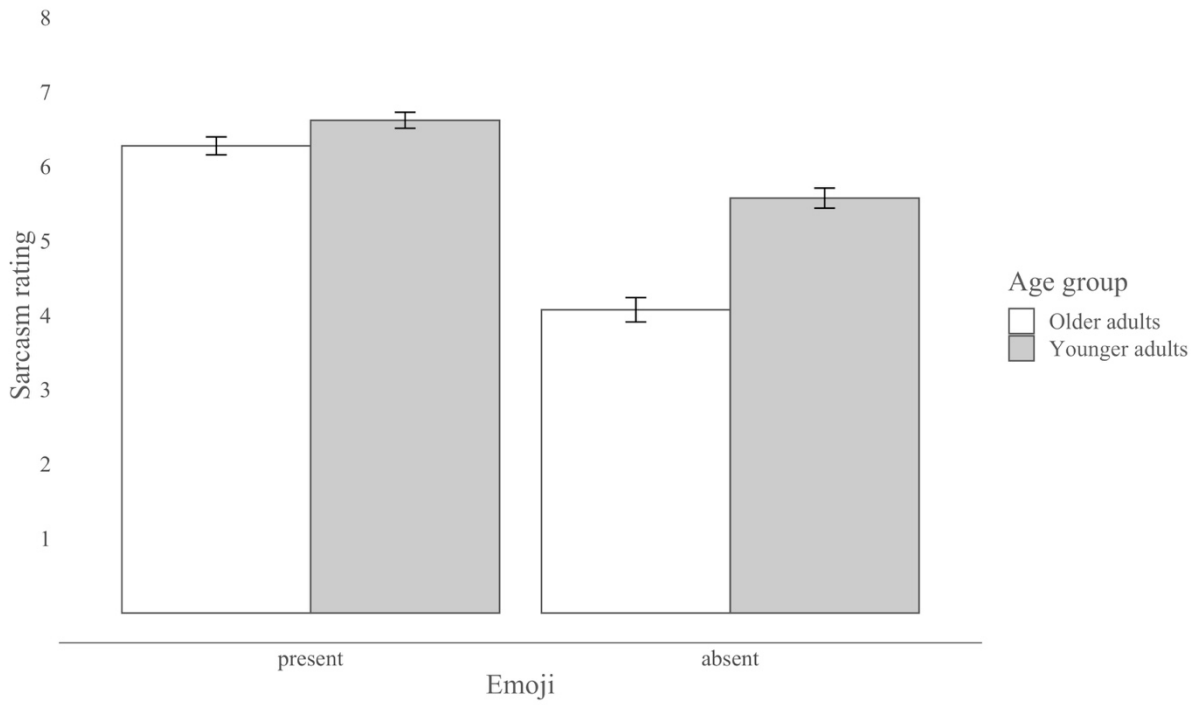
3.2.1 Perception of comments intended as criticism

A three-way interaction was present between literality, emoji presence, and age group. For literal criticism, both younger and older adults perceived the comments that were accompanied by an emoji as more sarcastic than those without an emoji (M_{with_emoji} = 4.52, *SEM* = 0.10; $M_{without\_emoji}$ = 2.16, *SEM* = 0.08), but there was no difference between the two age groups, since the model with the best fit included only a main effect for emoji presence.

For sarcastic criticism, both younger and older adults rated comments accompanied by an emoji as significantly more sarcastic than those without an emoji (younger adults: $\chi2(1, N = 48) = 11.52$, $p = .001$; older adults: $\chi2(1, N = 48) = 51.26$, $p < .001$). Additionally, when sarcastic comments were not accompanied by an emoji, younger adults rated them as significantly more sarcastic than older adults ($\chi2(1, N = 96) = 15.08$, $p < .001$), but the two age groups did not differ in their rating of sarcastic criticisms with an emoji ($\chi2(1, N = 96) = 1.58$, $p = .42$) – see Figure 4.

Figure 4

Mean rating of perceived sarcasm for sarcastic criticism. Error bars represent ±1 SEM.



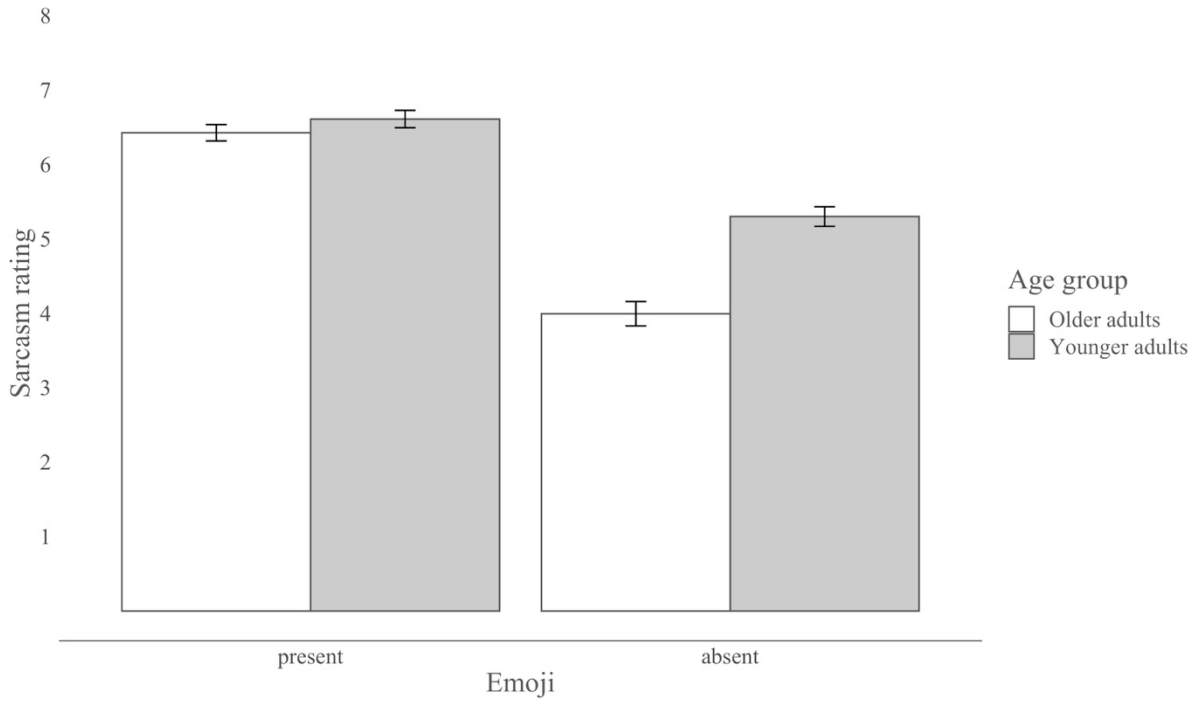
3.2.2 Perception of comments intended as praise

A three-way interaction was present between literality, emoji presence, and age group. For literal praise, there were main effects of emoji presence and age group. Literal comments accompanied by an emoji were perceived as more sarcastic than those without an emoji (M_{with_emoji} = 3.72, *SEM* = 0.10; $M_{without\_emoji}$ = 1.85, *SEM* = 0.07). Also, younger adults perceived literal praise as more sarcastic than older adults (M_{YA} = 2.95, *SEM* = 0.09; M_{OA} = 2.62, *SEM* = 0.09).

For sarcastic praise, the results were the same as for sarcastic criticism: both younger and older adults rated comments accompanied by an emoji as significantly more sarcastic than those without an emoji (younger adults: $\chi 2(1, N = 48) = 19.39$, $p < .001$; older adults: $\chi 2(1, N = 48) = 70.16$, $p < .001$). Additionally, when sarcastic comments were not accompanied by an emoji, younger adults rated them as significantly more sarcastic than older adults ($\chi 2(1, N = 96) = 13.06$, $p < .001$), but the two age groups did not differ in their rating of sarcastic praise with an emoji ($\chi 2(1, N = 96) = 0.42$, $p = 1$) – see Figure 5.

Figure 5

Mean rating of perceived sarcasm for sarcastic praise. Error bars represent ±1 SEM.



In summary, results from both Questions a and b showed that in the absence of an emoji, older adults demonstrated a reduced ability to correctly interpret sarcastic messages, when compared to younger adults. Importantly, they also suggest that accompanying a sarcastic comment with an emoji helps older adults overcome their difficulties associated with interpreting non-literal language.

4. Discussion

The aim of this study was to investigate the effect of the winking face emoji on the interpretation and perception of sarcasm in CMC in both younger and older adults. Overall, the results showed that in the absence of an emoji, older adults, in comparison with their younger counterparts, demonstrated deficient ability in comprehending written sarcastic language. This applied to both the interpretation of the comment and the perception of the

comment as sarcastic, and to both sarcastic criticism and sarcastic praise. This supports Phillips et al.'s (2015) finding that older individuals exhibit an impaired understanding of sarcasm compared to younger individuals and supports claims that figurative language such as sarcasm is difficult to comprehend in older adulthood (Qualls & Harris, 2003). Importantly, younger and older adults' interpretation and perception of sarcastic comments did not differ significantly when they were accompanied by the winking face emoji, suggesting that the winking face emoji could aid successful intergenerational communication. Interestingly, this contradicts the prediction that the emoji would hinder older adults' ability to understand sarcasm due to them experiencing difficulty in interpreting emojis (Gallud et al. 2018), and instead highlights the value of the winking face emoji in denoting sarcastic intentions in written communication, which can mitigate age-related declines in sarcasm comprehension. Importantly, the results seem to show that in the absence of the winking face emoji, older adults' performance in correctly identifying sarcasm is around chance level. In contrast, when an emoji is present, their performance becomes as good as (or at least not significantly different from) that of younger adults.

In general, the current data provide strong support for the winking face emoji as an effective indicator of sarcastic intent. This was demonstrated in the findings that both younger and older adults' interpretation of comments as being sarcastic, and perception of sarcasm, were significantly increased when comments were accompanied by the emoji compared to when they were presented without the emoji. These results could be explained by the findings from Weissman and Tanner (2018) which demonstrated that winking face emojis elicit a P600 effect similar to that elicited by word-induced irony, indicating similarity in processing. In relation to theoretical accounts, our results can be considered in the context of Pierce's Theory of Signs (e.g., Short, 2007). Specifically, it could be argued that the winking face emoji adds clarity to the object considered in semiosis (sarcasm). That is, the

presence of an emoji clarifies the relation between the sign (e.g., the utterance) and the object (sarcasm), enabling readers to understand the object of the sign more fully. This was demonstrated by enhanced sarcastic understanding by both younger and older individuals when a sarcastic utterance was accompanied by an emoji.

The findings from the current study extend those of our previous work in this area in a number of important ways. Specifically, Filik et al. (2016, Experiment 1), who used a similar design to the current study, demonstrated that young adults rated literal comments as more ironic when accompanied by the winking face emoticon, '**;-)**'. The current study revealed that this was the case for both younger and older adults. In addition, in the current study, the presence of a winking face emoji made sarcastic comments appear more sarcastic than when no emoji was present. In contrast, in Filik et al.'s (2016) study, the winking face emoticon had no influence on the perception of sarcastic comments (only literal comments), which suggests that emojis may be a stronger cue to sarcasm than their corresponding emoticons. This is important, given that a large body of previous work in this area was conducted using emoticons, whereas emojis are now more commonplace.

In addition, Filik et al. (2016) only examined the perception of irony/sarcasm (i.e., similar to our *Question b*), whereas in the current study, we further probed the way in which the comment was actually *interpreted* (using data from *Question a*). This is particularly crucial in this case, since *Question a* is likely to be a more reliable indicator of correct interpretation, as people's views on what it means to be 'sarcastic' may vary. Finally, Howman and Filik (2020) found that the winking face emoticon influenced the interpretation of ambiguous comments for younger but not older adults. Importantly, the comments that were used in their stimuli were designed to be ambiguous, thus, interpreting them as sarcastic indicated an interpretive preference, or bias, rather than a 'correct' response (as there was no correct response). In contrast, in the current study, the context indicated whether the

comments should be interpreted as sarcastic or not, and so it was possible to assess whether participants had interpreted them 'correctly' (as in this case, there was a correct answer). This gives us a much better indication of whether older adults experience a decline in successful comprehension, and whether this can be mitigated by emojis, which does seem to be the case. In addition, Howman and Filik (2020) only investigated criticism, whereas we investigated both criticism and praise – this is important, since sarcastic praise can be particularly difficult to interpret.

The current study has a number of limitations that should be considered. Firstly, as in most previous studies, sarcasm comprehension was examined from a third-person perspective - future studies should also feature a first-person perspective as this may more closely resemble real-life sarcastic exchanges. Moreover, it has been claimed that social and cultural factors influence the likelihood that a statement is perceived as sarcastic (Katz et al., 2004). In order to eliminate potential confounds, the current task used artificially created scenarios and characters, thus, social and cultural factors were not considered. Future studies could examine the comprehension of sarcasm in real-life online conversations. Additionally, it would be valuable to manipulate the familiarity of the characters used in the scenarios, for example, illustrating the protagonist as, 'Your friend' (Pomareda et al., 2019). This may further reduce age differences in sarcasm comprehension, as research suggests that when familiarity is increased, older adults' motivation to perform well on social cognition tasks increases (Zhang et al. 2013). Another consideration is that research exploring age-related differences in humour interpretation have demonstrated that older adults have greater difficulty than younger adults in comprehending humour, due to cognitive decline (Daniluk & Borkowska, 2017; Mak & Carpenter, 2007; Shammi & Stuss, 2003). Although we did not explicitly ask for ratings of humour in the present study, this may be an interesting avenue for future research, since the intent to be humorous can be a key aspect in sarcasm use (see e.g.,

Pickering et al., 2018, for discussion). In addition, there are a large number of other individual differences factors that have been shown to influence sarcasm processing and comprehension (outlined in Section 1.2). Since all of these established factors (and a number of currently uninvestigated factors, such as level of education or socio-economic status) were not controlled for across the two age groups, it is possible that inter-group differences other than age may have contributed to the pattern of effects that were observed. Finally, the influence of the winking face emoji on sarcasm interpretation and perception was not compared to any other device. Therefore, there is further scope to determine the most successful approach to communicate sarcasm in writing.

Given the nature of our participant sample and procedures, we would expect this effect to generalise across opportunity samples of UK-based native-English speaking participants of within the same age groups as those tested in the present study, who engage with social media. We would also expect our effects to generalise across stimuli written in English in which the context of the written scenario determines whether the target comment should be interpreted literally or sarcastically. A direct replication would employ the stimuli available in Supplementary Material 1, and would recruit a sample of native-English speaking participants from the same age ranges, who would then perform the task on-line on their own devices. Younger adults would be predominantly University students, and older adults would be social media users recruited through opportunity sampling. We note that, although our sample sizes were equivalent to other related published studies in the field, they could be regarded as modest. The main finding in this study, the interaction between emoji presence and age group, was a small to medium effect size (partial eta-squared ranging from 0.01 to 0.08 – see Tables 2 and 3). Therefore, it is possible that replications with larger sample sizes may reveal a different pattern of effects. We have no reason to believe that the

results depend on other characteristics of the participants, materials, or context (other than those noted above).

Despite the limitations discussed above, the results from this study highlight practical applications for online communication. Utilising the winking face emoji in CMC, to accompany sarcastic comments, can reduce the risk of these messages being misinterpreted by the receiver and provides additional clarity of intentions in online conversations. This is beneficial due to the ambiguous nature of digital communication and to assist sarcasm comprehension, particularly for older individuals. Furthermore, according to Pomareda et al. (2019), the development of rapport between older and younger individuals requires a shared understanding of non-literal communication. Thus, reduced comprehension of sarcasm as demonstrated by older adults may act as a potential barrier to successful communication. Interestingly, the results from the current study also suggest that the winking face emoji should not be used to accompany a message that is intended to be interpreted literally, since doing so will increase the chances that the comment will be misinterpreted as sarcastic. The findings from the current study may, therefore, have real-life implications for intergenerational interaction as the winking face emoji will be beneficial in reducing the possibility of miscommunication in CMC. Consequently, rapport will be enhanced between younger and older individuals.

In conclusion, this study extended the findings of Filik et al. (2016), by investigating the effect of the winking face emoji on the interpretation and perception of written sarcastic language in younger and older adults. Essentially, we found that older adults demonstrated reduced ability to correctly interpret sarcastic comments and to perceive sarcastic intent. Importantly, the winking face emoji significantly improved written sarcasm interpretation and perception amongst both younger and older adults. Consequently, the emoji should be

utilised in CMC to accompany a sarcastic remark, as a tool to facilitate successful intergenerational communication.

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