Anaphoric dependencies in the digital age: On the relation between emoji and text

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Emoji are widely used [2], but have received relatively little attention in psycholinguistics [4,6]. Regardless of one's views about the linguistic status of emoji, readers presumably construct some link between emoji and text. Thus, emoji offer a new window into dependency formation. Based on two studies on emoji-text relations, we argue for (at least) two types of emoji-text dependencies, and explore initial steps to integrate emoji into language processing theories.

Referential dependencies in language include (i) the dependency between a pronoun (or another form) and the individual that it refers to, and (ii) the dependency between an expressive (e.g. *damn, f*king*) and the individual whose opinion it expresses [1,7,10,11]. We extend discussion of dependencies to emoji: We investigate ***face emoji*** which convey affective information (e.g. 😀,😌,😟) and non-face object-related/action-related emoji (e.g.⚾, 🔪, 🍰); we call these ***action emoji***). *We hypothesize both face and action emoji involve anaphoric dependencies (i.e. can be linked to linguistic content), but in different ways:*

We propose **face emoji** resemble expressives (e.g. *damn*), in that they tend to be interpreted as expressing the opinion of a salient ***experiencer*** (the person experiencing the emotion expressed by the face emoji or the expressive word). This experiencer is typically, but not always, the 1st-person speaker [1,7,10]. In contrast, we propose **action emoji** are interpreted based on principles of discourse coherence (e.g. relations like Explanation [9]), potentially akin to coherence-based accounts of pronoun resolution (see [9], Tables1-2).

Exp1-2 presented participants (56 L1 English speakers/exp) with text messages with emoji (32 targets, 20 fillers). In Exp1, people indicated who the emoji provides information about (Fig.1). Exp2 was identical but the question for *face* emoji was reworded to ensure an opinion-based response (Fig.2). The three relevant referents/individuals are the message sender (i.e. 1st-person) and the people mentioned in the message (subject and object, see Table 1).

Verbs. To test whether we see discourse coherence effects (similar to those seen on pronoun resolution) on the interpretation of **action emoji**, we tested *transfer verbs* and *two kinds of implicit causality verbs* [3,5,8]: Stimulus-Experiencer (SE) (exp=obj) and Exp-Stim (ES, exp=sub, Table 1). Using both transfer and SE/ES verbs also allows us to test if **face emoji** are akin to expressives, i.e. sensitive to the presence of experiencers in subject/object position.

Emoji. Messages ended in a face or action emoji (Table 1). Faces were compatible with all 3 candidates (sender/sub/obj; results confirm this). Action emoji with transfer verbs depicted transferred objects. Action emoji with IC verbs provided an explanation of the event (Table 2).

Results are in Figs.3-4. **Face emoji** with transfer verbs disprefer objects and prefer senders (Exp1: p=.078, Exp2: p<.001). The (1st-p) sender preference fits with our hypothesis that face emoji resemble expressives and tend to be interpreted as expressing the opinion of a salient experiencer, often the 1st-person. What about face emoji with IC verbs? Here, the *linguistically-expressed experiencer argument competes with the sender for the role of attitude-holder*: With SE verbs, presence of an experiencer object wipes out the sender preference and boosts the object. With ES verbs, the face emoji strongly prefer the subject (experiencer).

Action emoji with transfer-verbs prefer the subject, disprefer the sender and object in both Exp1-2: A depicted object-of-transfer is interpreted as associated with the subject. This fits with the observation that (agentive) subjects are prominent in discourse. Action-emoji with IC verbs in both Exp1-2 show exactly the patterns we expect if action emoji are interpreted based on discourse coherence, perhaps akin to the domain of reference resolution: the explanation-providing emoji is interpreted as linked to the subject with SE, object with ES. (Note that other interpretations are in principle possible, (4c), as with pronouns, but people disprefer them.)

Our results point to two kinds of emoji-text relations, reflected by action vs. face emoji (maybe affective emoji generally; 👍,❤️). We suggest these two relations resemble existing linguistic dependencies, suggesting a need for more work on emoji in sentence comprehension.

Examples			
Verb type		**Action emoji**	**Face emoji**
Transfer verbs		(1a) abigail brought dessert to emily	(1b) abigail brought dessert to emily
Implicit causality verbs	Stimulus-experiencer (SE) verbs	(2a) richie annoyed adrian	(2b) richie annoyed adrian
	Experiencer-stimulus (ES) verbs	(3a) daniel admires aaron	(3b) daniel admires aaron

Table 1. (Both positive and negative face emoji and negative and positive IC verbs were used)

Implicit causality verbs	Stimulus-experiencer (SE) verbs	(4a) **richie**$_{\textbf{stim}}$ annoyed adrian$_{exp}$ *[possible linguistic paraphrase of emoji, not shown in experiment: because* ***he***$_{\textbf{ritchie}}$ *played the drums]*
	Experiencer-stimulus (ES) verbs	(4b) daniel$_{exp}$ admires **aaron**$_{\textbf{stim}}$ *[because* ***he***$_{\textbf{aaron}}$ *won first prize]*
	Other readings are also possible in principle:	(4c) **richie**$_{\textbf{stim}}$ annoyed adrian$_{exp}$ *[because* ***he***$_{\textbf{adrian}}$ *hates drums]*

Table 2. Illustration of how emoji in IC verb conditions were chosen to provide explanations in line with verb bias (ES/SE verbs are known to elicit explanations about what the *stimulus* did)

Fig.1 Exp.1 sample item

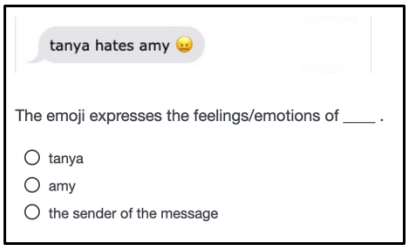

Fig.2 Exp.2 sample item illustrating question used on face emoji trials (action trials were as in Exp.1)

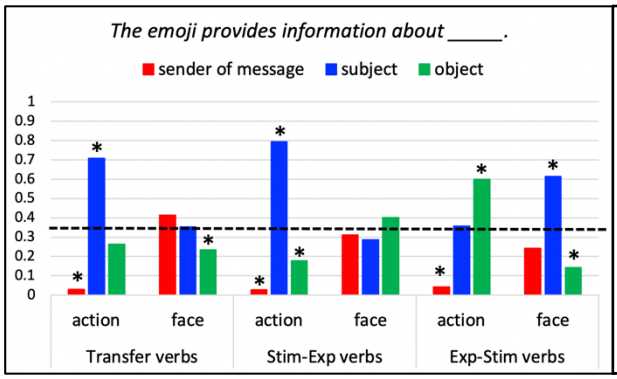

Fig.3 Exp1 results (Line shows chance, 1/3. * shows difference from chance, p<.05 or smaller).

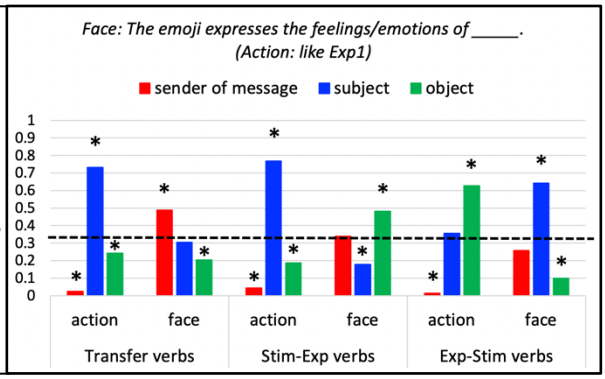

Fig.4 Exp2 results

References: [1] Amaral et al 2007 [2] Bai et al. 2019 [3] Bott & Solstad 2014 [4] Cohn et al. 2018 [5] Garvey & Caramazza 1974 [6] Gawne & McCulloch 2019 [7] Harris & Potts 2009 [8] Hartshorne & Snedeker 2013 [9] Kehler 2002 [10] Lasersohn 2007 [11] Potts 2007