To appear in Proceedings of Sinn und Bedeutung 25 (2021)

Discourse anaphoricity and first-person indexicality in emoji resolution[1]

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Abstract. This paper proposes a formal semantic classification of emoji-text combinations, focusing on two core sets of emoji: face emoji and activity emoji. Based on different data sources (introspective intuitions, naturalistic Twitter examples, and experimental evidence), we argue that activity emoji (case study I) are essentially event descriptions that serve as separate discourse units (similar to *free adjuncts*) and connect to the accompanying text by virtue of suitable discourse relations. By contrast, face emoji (case study II) are expressive elements that are anchored to an attitude holder and comment on a proposition provided by the accompanying text. We conclude by revisiting emoji semantics from the perspective of formal gesture semantics: we probe interactions of emoji and texts that contain clausal negation, and conclude that emoji generally do not scope under negation; however, the appearance of such a scope relation arises when activity emoji are connected to the accompanying text by virtue of an Explanation discourse relation.

Keywords: discourse anaphoricity, discourse relations, emoji, expressives, first-person indexicality, implicit causality, non-at-issue meaning.

1. Introduction

Today, emoji[2] (e.g. 😀, 😟, ✈️, 🔪) are widely-used in digital communication and have emerged as an object of study in linguistics and beyond (see e.g. Bai et al. 2019 for a recent overview). Emoji are frequently used in text messages, social media posts, emails and other kinds of digital communication. There are different subtypes of emoji, including faces (e.g. 😑), activity-related objects (e.g. ⚽, 🥁) as well as symbols, flags and so on (e.g. ♻️, 🇳🇴). They occur in different positions, including at the start of a message, the end of a message, or message-internally (see e.g. Garrison et al. 2011, Al Rashdi 2015, Cramer et al. 2016, Sampietro 2016, Na'aman et al. 2017). In the present paper, we take initial steps towards a formal semantic analysis of emoji and their relation to the text that they accompany. We focus on two sets of emoji, which we label *face emoji* and *activity emoji*, and argue that they differ in their semantic properties – in particular, we propose that these two subsets of emoji exhibit indexicality and discourse anaphoricity, respectively. Based on naturally-occurring *Twitter* examples as well as native-speaker intuitions, we claim that face emoji and activity emoji are resolved in different ways: We analyze face emoji as sharing the first-person indexicality of expressives, whereas activity emoji describe events with an open argument.

We define our two core terms as follows: *Face emoji* have the shape of a yellow disc with stylized facial expressions (e.g. 😀 and 😟). We limit our discussion to face emoji that have

[1] We would like to thank the audiences at the Super Linguistics Colloquium, the V-NYI summer school 2020, the Perception, Memory and Representation (PMR) research group at Institut Jean Nicod, Sinn und Bedeutung 25, and the LSA 2021 Virtual Annual Meeting, for helpful comments and discussion.
[2] In English, *emoji* has two plural forms, *emoji* and *emojis*. In this paper, we use the unmarked form *emoji*.

an affective meaning, e.g. conveying 'happy' or 'worried' (similar to facial expressions; see Russell & Fernández-Dols 1997). Moreover, we maintain that face emoji may be a subset of *affective emoji*, which include hearts (💕, 💔, ❤️) and certain body parts (👍, 💪) that have a similar affective meaning. By contrast, we define *activity emoji* as emoji that look like objects (⚽) or people (🏄) and describe a related activity (🏄 can mean 'surfing, to surf') or property (🏄 can also mean 'to be a surfer'). The face emoji we investigate are part of the Unicode category 'Smileys & People', whereas many activity emoji are part of the category 'Activity'.[3] We do not consider this Unicode classification to be necessary or sufficient for our purposes; for instance, we treat the object-denoting image of a pizza slice 🍕 (in the reading 'to eat pizza') as an activity emoji, although it is in the category 'Food & Drink'. Conversely, some emoji in the 'Activity' category may not count as activities in our sense.[4]

1.1. Prior research on emoji

In recent years, emoji have been investigated from a wide variety of perspectives, including computer science (see e.g. LeCompte & Chen, 2017 on sentiment analysis), marketing research and communication (see e.g. Luangrath et al. 2017, see also Jaeger et al. 2019 on emoji valence), psychology (see e.g. Li et al. 2018 on personality traits and emoji use), health communication (see e.g. Toriana & Nante 2018), and education (see e.g. Dunlap et al. 2016 on emoji in online learning). We refer readers to Bai et al. (2019) for a recent overview.

Emoji have also attracted the attention of a growing number of linguists (see also Evans 2017 for recent discussion). From a linguistic perspective, researchers have investigated the combinatorial properties of emoji sequences, e.g. whether strings of emoji have grammatical / syntactic properties. Cohn et al. (2019) provide experimental evidence indicating that emoji have only restricted combinatorial properties and do not have grammatical structure of their own. (However, see also Gerke & Storoshenko 2018 for evidence that people's native language may influence their emoji ordering preferences.) What is more relevant for our present purposes is the relation between emoji and the linguistic elements that they typically occur with. One way of approaching this relation is represented by the work of Gawne & McCulloch (2019), who analyze some emoji as digital counterparts of the gestures and facial expressions that accompany spoken language. Another approach relevant for our aim of investigating the relation between emoji and text is Maier's (2020) proposal, which analyzes face emoji and facial expressions as expressives. (We discuss expressives in Section 3.)

1.2. Aims of this work

Our research positions itself in the tradition of emerging formal semantic research on digital communication (such as Bücking & Rau 2013). In the present paper, we propose that a semantic distinction needs to be made between [i.] face emoji, which typically convey

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[3] See https://emojipedia.org/people/ and https://emojipedia.org/activity/

[4] Semantically, we do not require *activity emoji* to be activities in the spirit of Vendler (1957); some of them may denote states or properties. We also remain agnostic as to whether all activity emoji denote eventualities in the spirit of Davidson (1967). These open issues are not crucial for the basic claims made in this paper.

affective information, and [ii.] activity emoji, which convey information about actions and activities. More specifically, we show that face emoji and activity emoji differ in their linguistic properties, with face emoji incorporating first-person indexicality and activity emoji incorporating anaphoricity via an open argument slot. In the rest of this paper, we take initial steps towards a formal semantic analysis of these two subsets of emoji.

In terms of empirical data, our strategy is as follows. In this paper, we focus on using both constructed and naturally occurring examples to establish solid intuitions, which are captured by initial hypotheses. In current and on-going work, we test these hypotheses experimentally (e.g. Kaiser & Grosz to appear), thereby corroborating the validity of using constructed examples and introspective intuitions for emoji. It is worth pointing out at this stage that many of the examples used in this paper are naturally-occurring examples from Twitter (marked with a [twitter] superscript). When citing text from social media, one is faced with questions of ethics and privacy (see e.g. Ayers et al. 2018, Tatman 2018, Gawne & McCulloch 2019). In this paper, we remove authors' user names and suppress URLs, but keep the posts as they are, to ensure the linguistic integrity of the examples; all personal names *within* Twitter posts were replaced with *John*, *Smith* or *John Smith*, and @-signs were removed. (None of our examples concern sensitive topics or private information.) If the original Twitter post contained multiple emoji, we maintain them in our examples for reasons of completeness. However, the present work only focuses on message-final emoji and only on the first emoji in a sequence. We leave the intriguing question of emoji sequence interpretation for future work. We chose to focus on message-final emoji because several empirical studies show that they are the most frequent (e.g., Garrison et al. 2011, Novak et al. 2015, Al Rashdi 2015, Cramer et al. 2016, Sampietro 2016, Na'aman et al. 2017, Seyednezhad et al. 2018). Emoji can also occur in other positions (e.g. message-medially and even message-initially), but these positions are less frequent; we leave them for future work.

Our empirical claims, in a nutshell, are as follows. As discussed in Section 2, we propose that **activity emoji** (e.g. 🚴, 🍔, 🏈) incorporate anaphoricity. For example, consider examples (1a-b), which are identical except for the embedded verb (*impressed* vs. *admired*). In (1a), the basketball emoji is likely to convey that Sue impressed Ann because of how she (Sue) played basketball. In contrast, in (1b), the emoji will probably be interpreted as conveying that Sue admired Ann because of how *Ann* played basketball. I.e., connected to the fact that the basketball emoji provides an explanation for the preceding predicate (being impressed or admiring), the inferred agent of basketball-playing is different in (1a) and (1b). As we show in Section 2.2, we can straightforwardly derive this difference from prior work on pronoun resolution if we assume that activity emoji [i.] involve anaphoricity and [ii.] are sensitive to discourse relations (e.g. Explanation, Elaboration, Resemblance) in ways that parallel the sensitivity observed in prior work on pronoun interpretation. (We view our observations as being in line with the claims of Hobbs 1979 and Kehler 2002 that pronoun interpretation in the linguistic domain is a side-effect of general inferencing processes about coherence.)

(1) a. Kate said Sue impressed Ann 🏀
b. Kate said Sue admired Ann 🏀

We propose that activity emoji denote separate discourse units, which freely associate to the text via suitable discourse relations, as exemplified in (2) and (3) for Explanation and

Elaboration relations. (Throughout this paper, we use the wave arrow '⇝' to mark meaning inferences without committing to a particular status of the inference, e.g., whether it is entailed, presupposed or implicated.) We start with an informal understanding of discourse relations: *Elaboration* describes a situation where the events in a discourse unit β are sub-events of the events in a (preceding) discourse unit α (i.e. β elaborates on α); see Asher & Lascarides (2003:159).

(2) Arsenal really impressed me ! ⚽ [twitter] Discourse Relation = *Explanation*
⇝ a football-playing event β explains the impressing event α

(3) Getting ready for tomorrow! 🏋️ [twitter] Discourse Relation = *Elaboration*
⇝ a training event β is a part of the getting-ready event α

In contrast to activity emoji, we propose that **face emoji** (e.g. 😲, 😊, 😟) (e.g. Riordan 2017, Jaeger et al. 2019) – and presumably also other affective emoji, such as 👍, ❤️, 💔 – exhibit first-person indexicality. To see this, let's consider (4a-b).

(4) a. Kate said Sue impressed Ann 😲
b. Kate said Sue admired Ann 😲

Examples (4a-b) are the same as (1a-b), except that the basketball emoji has been replaced by the 'surprised face' emoji. Now, we no longer see the referential switch from Sue to Ann that we observed in (1a-b). Instead, in both cases there is a strong bias to interpret the surprised face emoji as reflecting the emotional state of the first-person author, rather than Kate, Sue or Ann. This default bias for first-person indexicality is known to be a property of expressives (e.g. *damn*, see Potts 2007, Lasersohn 2007, Amaral et al 2007, Harris & Potts 2009). As we show in Section 3, we propose that face emoji have lexical entries along the lines of what is exemplified in (5) for the 'surprised face' emoji (based on the approach to expressive presuppositions from Sauerland 2007 and Schlenker 2007).[5]

(5) $[\![😲]\!]^g = \lambda p_{<s,t>}$: g(author$_0$) has a surprised emotion/response towards p in g(w_0) . p

It's worth noting that face emoji are among the most frequently used emoji; as a group, they are used more often than activity emoji (see e.g. Emojitracker 2021). This is presumably related to their resemblance to facial expressions, which play a central role in human communication. There exists a large literature on facial expressions (e.g. Tomkins & McCarter 1964, Ekman, Friesen & Ellsworth 1972, Russell & Fernández-Dols 1997, Fernández-Dols & Russell 2017, i.a.), but an in-depth discussion of the nature of the relation between face emoji and facial expressions is beyond the scope of this paper.

The structure of this paper is as follows. Section 2 focuses on activity emoji and presents our analysis that emoji in this subclass involve anaphoricity and are related to the linguistic text

[5] Note that this lexical entry treats the attitude holder (*author*$_0$) and the world of evaluation (w_0) as indexicals, i.e. the first-person indexicality is hard-wired. However, as we will show in Section 3.3, there must be cases where both of these variables shift to another attitude holder and situation, even though we maintain that first-person indexicality is the default; the details of modeling a shifted interpretation exceed the scope of this paper.

that they accompany by means of discourse-level coherence relations. In Section 3, we turn to face emoji. This section presents our proposal that the semantics of face emoji is similar to that of expressives (e.g. *damn*, *f*cking*) and that this subclass of emoji exhibits first-person indexicality: It is by default anchored to the first-person sender (akin to the first-person orientation exhibited by expressives and other perspective-sensitive expressions). Section 4 investigates the scope and projection patterns of emoji relative to negation, building on the proposals made in Sections 2 and 3. Conclusions are in Section 5.

2. Case Study I: anaphoricity in emoji resolution

2.1. Activity emoji and discourse relations

Turning towards a formal implementation, our core proposal amounts to treating activity emoji as non-restrictive modifiers that denote an eventuality and/or property (Davidson 1967). In thinking about the relation between an activity emoji and the text that it accompanies, we draw inspiration from prior work on non-clausal adjuncts such as the gerunds *playing the violin* and *being an artist* in (6b) and (7b) (such gerunds being a paradigm case of *free adjuncts*, see Stump 1985:42).[6] These act as independent utterances (see Zobel 2019, i.a.) that are connected to their 'host clause' by virtue of salient discourse relations (see Hobbs 1979, Lascarides & Asher 1993, Kehler 2002, Asher & Lascarides 2003). In other words, there is no direct compositionality between activity emoji and the accompanying text. It is not central to the claims in this paper whether or not activity emoji should receive a semantic analysis that treats them exactly like free adjuncts. However, the inspiration that we draw on is brought out by using gerunds in the paraphrases.

(6) a. *Original example:* My job is pretty fun 🎻 [twitter]
b. *Sample paraphrase:* My job is pretty fun, [playing the violin / being a violinist]
c. 🎻 ⇝ a violin-involving eventuality / property

(7) a. *Original example:* work today was fun 💁🏾 [twitter]
b. *Sample paraphrase:* work today was fun, [being an artist / creating art]
c. 💁🏾 ⇝ an artist-involving property / eventuality

We propose that this kind of approach can be applied systematically to the relation between activity emoji and the texts they accompany. This is exemplified in (8)-(12) for a (non-exhaustive) set of five different discourse relations (Explanation, Elaboration, Narration, Background, and Result). For ease of exposition, our presentation of each of these examples is structured in the same way: (8a) names and defines the discourse relation, (8b) presents a natural-language example (all from Asher & Lascarides 1993:55), (8c) contains a naturalistic emoji example from Twitter, and (8d) provides a paraphrase of (8c) in line with (8a). When

[6] Our paraphrases highlight ambiguities such as *playing the violin* (activity) vs. *being a violinist* (state). In fact, as pointed out to us by Emar Maier and Louise McNally, the actual semantics of 🎻/💁🏾 may be more minimal, e.g. '(there is a) violin/artist'; crucially, emoji-containing examples would routinely require such a minimal semantics to be coerced into something eventive or stative, to yield (6b) or (7b). We leave such issues for future research, but note that such ambiguities are well-attested in natural language expressions, see e.g. Asher (2011).

discourse relations connect entities such as clauses or emoji, these entities can be referred to with the term *discourse unit*. The Greek letter α refers to the first unit (which is *Max fell* in (8b) and *I really admire this man* in (8c)) and the letter β refers to the second unit (which is *John pushed him* in (8b) and the activity emoji 🎻 in (8c)). Examples (9)-(12) are parallel.

(8) a. **Explanation** (β explains why the eventuality in α happened/arose)
b. *in language:* [$_\alpha$ Max fell.] [$_\beta$ John pushed him.]
c. *with emoji:* I really admire this man 🎻❤️ [twitter]
d. ⇝ [$_\alpha$ I really admire this man] because of [$_\beta$ his violin-playing]

(9) a. **Elaboration** (the event in β is part of the event in α)
b. *in language:* [$_\alpha$ The council built the bridge.] [$_\beta$ The architect drew up the plans.]
c. *with emoji:* When you can't walk normal anymore that's when you know you have trained hard ⚽ #legsaredead [twitter]
d. ⇝ [$_\alpha$ training hard] includes [$_\beta$ playing football]

(10) a. **Narration** (β temporally follows α)
b. *in language:* [$_\alpha$ Max stood up.] [$_\beta$ John greeted him.]
c. *with emoji:* JUST ARRIVED AT SPAREZ ! 🎳🎱 [twitter][7]
d. ⇝ [$_\alpha$ arriving at SpareZ] is followed by [$_\beta$ playing bowling and billiard]

(11) a. **Result** (α causes β)
b. *in language:* [$_\alpha$ Max switched off the light.] [$_\beta$ The room was pitch dark.]
c. *with emoji:* it's rest day but I was bored 🚴 [twitter]
d. ⇝ [$_\alpha$ it's rest day but I was bored] causes [$_\beta$ bike-riding]

(12) a. **Background** (β provides background/circumstance under which α happens)
b. *in language:* [$_\alpha$ Max opened the door.] [$_\beta$ The room was pitch dark.]
c. *with emoji:* Think ima have a nice good talk with John tomorrow!!! 💈✂️ [twitter]
d. ⇝ [$_\alpha$ my talk with John] happens with a backdrop of [$_\beta$ barber-related events]

Note that, in prior work on speech-accompanying gestures, Lascarides & Stone (2009) and Hunter (2019) argued that such gestures are integrated with the accompanying text on the basis of suitable discourse relations. This idea parallels our proposal for emoji, and thus provides additional support for our approach. It is also worth emphasizing that our approach allows for the emoji-text connection to be unconstrained and potentially ambiguous to the receiver of the message. This flexibility in the emoji-text connection is exemplified in (13a). This example seems to be compatible with all five of the above discourse relations, as illustrated in (13b-f). This example also shows variability in the text (α) that the emoji comments on, which is ambiguous between the entire clause (*so glad I stayed home today*), (13b), and the embedded clause (*I stayed home today*), (13c-f).

(13) a. So glad I stayed home today 🎮👍 [twitter]
b. *Explanation:* [$_\beta$ video-gaming] **explains** [$_\alpha$ me being glad about staying home]

[7] This post appears to refer to *SpareZ Bowling Center* in Davie, Florida.

⇝ 'I'm glad I stayed home because I could then play video games.'

c. *Elaboration:* [$_\beta$ video-gaming] **was a part of** [$_\alpha$ me staying home]
⇝ 'I'm glad about staying home, part of which was playing video games.'

d. *Background:* [$_\beta$ video-gaming] **describes circumstances of** [$_\alpha$ me staying home]
⇝ 'I'm glad I stayed home, which is where video games happen.'

e. *Narration:* [$_\alpha$ me staying home] **is/was followed by** [$_\beta$ video-gaming]
⇝ 'I'm glad I stayed home, and now I will play video games.'

f. *Result:* [$_\alpha$ me staying home] **was the cause for** [$_\beta$ video-gaming]
⇝ 'I'm glad I stayed home, and, as a result, I played video games.'

2.2. Enter *anaphoricity* in activity emoji

We propose that activity emoji (such as 🏋 and ⚽) share a further property with free adjuncts such as gerunds (in addition to using discourse relations to connect to the accompanying text). They have an anaphoric component, relating to an implicit agent (or other core participant). To illustrate this claim, consider (14a) (repeated from (3)), under the plausible reading where it involves an *Elaboration* discourse relation, as well as the *Explanation* example (15a) (repeated from (2)). A first attempt at a formalization of the integration of the emoji in (14a)/(15a) is given in (14b)/(15b) (loosely inspired by Fabricius-Hansen & Haug 2012:165). In (14b), the agents *x* and *y* of the getting-ready event and the weight-lifting event are free variables that need to be contextually resolved (here, *x* and *y* are both identified with the author of the post); in parallel, *x, y* and *z* are free variables in (15b).

(14) a. Getting ready for tomorrow! 🏋 [twitter] *Elaboration*

b. $\lambda e.[x,y,e_1,e_2 \mid \text{getting-ready}(e_1,x), \text{lifting-weights}(e_2,y), e_1 \leq e, e_2 \leq e_1]$

c. *in words:* a weight-lifting event e_2 (with agent *y*) <u>is a part of</u> the getting-ready event e_1 (with agent *x*) (⇒ we infer: *y=x=author*)

(15) a. Arsenal really impressed me ! ⚽ [twitter] *Explanation*

b. $\lambda e.[x,y,z,e_1,e_2 \mid \text{impress}(e_1,x,y), \text{cause}(e_1,e_2), \text{playing-football}(e_2,z), e_1 \leq e, e_2 \leq e]$

c. *in words:* a football-playing event e_2 (with agent z) caused the impressing eventuality e_1 (with stimulus *x* and experiencer *y*) (⇒ we infer: *z=x=Arsenal*)

Evidence for an anaphoric component in activity emoji (as modeled by the free variables in (14) and (15)) stems from effects such as *implicit causality* (e.g. Garvey & Caramazza 1974, Hartshorne & Snedeker 2013, Bott & Solstad 2014, and many others). The phenomenon of implicit causality is illustrated in (16) (coreference marked by bold type), and amounts to the following observation: an ambiguous pronoun in a causal adjunct (*she* in *because she was hix* – where *hix* is a nonce word in order to avoid influence from world knowledge, following the approach of Hartshorne & Snedeker 2013) is preferably resolved towards the stimulus argument of a main-clause psych predicate. Since *impressed* is a stimulus-experiencer verb, *she* is preferably resolved towards Sue in (16a); by contrast, with the experiencer-stimulus verb *admired* in (16b), *she* is resolved towards Ann.

(16) a. *stimulus-experiencer verb:* kate said **sue** <u>impressed</u> ann because **she** was hix

b. *experiencer-stimulus verb:* kate said sue <u>admired</u> **ann** because **she** was hix

Crucially, we find exactly the same patterns of resolution with activity emoji when the intended discourse relation is *Explanation*. This is schematically illustrated in the constructed minimal pair in (17ab).

(17) a. kate said **sue** impressed ann 🏀 ⇝ (because of how) **sue** played basketball
b. kate said sue admired **ann** 🏀 ⇝ (because of how) **ann** played basketball

Naturalistic examples are in (18), with stimulus-experiencer verbs, and in (19), with experiencer-stimulus verbs. The examples in (18) echo the stimulus-experiencer pattern that we see in (16a) and (17a): The agent of the emoji event is identified with the stimulus of the preceding verb (e.g., the subject of *impressed* in (18a)). To unpack these examples, each of them contains a stimulus-experiencer verb (*impress, disappoint, inspire, amaze, shock, surprise*). In some cases, both arguments are overt, as in (18a), where the stimulus is *Arsenal*, and the experiencer is *me*, i.e. the author of the message. In other cases, both arguments are missing, as in (18b), which is a passivized truncated clause; here, the stimulus of *disappoint* is the implicit 'agent' of *disappoint* ('disappointed **by** ***x***') and the experiencer is the dropped subject ('**I** am [ready to be disappointed]'). In each of (18a-f), the agent of the emoji event is resolved towards the stimulus argument (overt or not) of the predicate in the text. A possible paraphrase for (18b) could thus be given as follows: 'I am ready to be disappointed by someone, namely by the football-player(s)'. Our analysis of (18a) was spelled out in (15a).

(18) *Implicit causality effects with stimulus-experiencer verbs (Twitter examples)*
a. Arsenal really impressed me ! ⚽ ($agent_{football}$ ⇝ $stimulus_{impress}$)
b. Ready to be disappointed ⚽ 😳 ($agent_{football}$ ⇝ $stimulus_{disappoint}$)
c. I am so impressed you're pushing on! Because of you I'm joining a class on Wednesdays. Thanks for inspiring me! 🏋 ($agent_{weight\text{-}lifting}$ ⇝ $stimulus_{inspire}$)
d. Don't forget John Smith - you will be amazed! 🎸 ($agent_{guitar}$ ⇝ $stimulus_{amaze}$)
e. I'm going to shock the World!!!! 🏀 ($agent_{basketball}$ ⇝ $stimulus_{shock}$)
f. Two new HHH_NB songs hit my inbox earlier today. They always know how to keep me on my toes and surprise me. 🎸🎸🎸 ($agent_{guitar}$ ⇝ $stimulus_{surprise}$)

Similarly, the examples in (19) corroborate the stimulus-experiencer pattern that we see in (16b) and (17b). Once again, in all of the examples in (19), the agent of the emoji event is identified with the stimulus of the preceding verb (e.g. the object of *envy* in (19a)). In (19a)), the stimulus of *envy* is identified with the referent of *a lot of people*, while the experiencer is identified with *I*, i.e. with the author; again, a paraphrase could be given as follows: 'I envy a lot of people right now, namely those who play football'. As in (18), there are cases of truncation, such as (19b), which behave the same way.

(19) *Implicit causality effects with experiencer-stimulus verbs (Twitter examples)*
a. I envy a lot of people right now ⚽ ($agent_{football}$ ⇝ $stimulus_{envy}$)
b. Still admire John Smith ⚽ ($agent_{football}$ ⇝ $stimulus_{admire}$)
c. Ok so I actually made it on time and also got to reunite with John after the concert! I really admire this man 🎻 ❤️ ($agent_{violin}$ ⇝ $stimulus_{admire}$)
d. She is literally such a beautiful person. I love her so much. 🏄 ($agent_{surfing}$ ⇝ $stimulus_{love}$)

e. For John Smith cause he's awesome and I love him 🎺😊
(agent$_{trumpet}$ ⇝ stimulus$_{love}$)

To conclude, we have argued that activity emoji serve as free-standing event descriptions, whose core argument is anaphoric, and which connect to the accompanying text through suitable discourse relations. This idea receives further support from experimental work by Kaiser & Grosz (to appear) on the interpretation of activity emoji. We now take a closer look at face emoji, which exhibit a different behavior.

3. Case Study II: 1st person indexicality in emoji resolution

3.1. Face emoji as expressive modifiers: Basic proposal

Having argued that activity emoji have a semantic component similar to anaphoric elements, we now proceed to our proposal for face emoji. We argue that face emoji (and presumably affective emoji more generally) can be modeled on a par with expressives such as *damn* or *f*cking* (e.g. Potts 2007). The core intuition is exemplified by (20). We argue that the 😡 emoji – officially called the 'pouting face' emoji – in (20a) makes a contribution that is very similar to the expressive element *f*cking* in (20b). (Note that we are not claiming that (20a) and (20b) are identical in their meaning, simply that – as will become clear below – both the emoji and the expressive convey the author's/speaker's anger.)

(20) a. kate said that sue sent the report to ann 😡
b. kate said that sue sent the **f*cking** report to ann

A possible alternative approach treats face emoji as an innovated sort of *interjection* (language-specific affective vocalizations such as *wow*, *whew*, *yuck*, *ugh*, *oh my*; see e.g. Goddard 2013 and references cited therein; see Rett 2018 for a formal semantics approach). Crucially, in either case (i.e. whether face emoji behave like expressives or interjections), we predict a preference for *first-person indexicality*. The default attitude holder of the subjective affect conveyed by a face emoji is the author of the message (see Potts 2007, Lasersohn 2007), although the attitude holder can shift away from the author in some contexts (e.g. Amaral et al 2007, Harris & Potts 2009, Kaiser 2015, Kaiser & Grosz to appear).

To make this prediction explicit, we propose lexical entries such as (21a) and (21b) for negatively valenced (😩) and positively valenced (😊) emoji, respectively. For concreteness' sake, these lexical entries assume an indexical presupposition approach (Schlenker 2007, Sauerland 2007), but nothing hinges on this choice. As shown in (21a), we propose that an emoji such as 😩 essentially adds a non-at-issue comment on the author's feeling or attitude towards a proposition *p*. This proposition does not need to be directly encoded by the accompanying text, as shown in (22a), which intuitively receives the interpretation in (22b). Crucially, the person whose feeling/attitude is conveyed is typically the author (though it is known that the *author$_0$* variable can shift towards another attitude holder; see Section 3.3).

(21) a. $[\![😩]\!]^g = \lambda p_{<s,t>}$: g(author$_0$) has a **negative** feeling/attitude towards p in g(w$_0$) . p

b. $[\![😊]\!]^g = \lambda p_{<s,t>}$: g(author$_0$) has a **positive** feeling/attitude towards p in g(w_0) . p

(22) a. yessss plus that's my fckn birthday 😩😩😩😩

b. ⇝ The author in the utterance context has a negative feeling/attitude towards [$_p$ something undesirable happens on the author's birthday].

3.2. Face emoji as expressive modifiers: Hypothesis space for possible implementations

One central question for future research, which results from this paper, concerns the exact rendering of the affective content of face emoji. There are at least two options worth considering (building on Greenberg 2020): face emoji may be *iconic*, in which case their meanings would derive from a generalized rule-like semantics, e.g. (23), or they may be *symbolic*, in which case their meanings would be listed in a user's lexicon, e.g. (25). While we will remain agnostic as to which approach is correct, we discuss these two options in turn.

Using a Greenberg-style iconic semantics, we may capture *all* face emoji with a single lexical entry, as sketched in (23). To unpack this analysis, we arbitrarily pick 😶 as a place-holder for all face emoji, i.e. 😶 stands for {😠, 😢, 😊, ...}. Greenberg's (2020:slide 38) idea is that a lexical entry is iconic if the form of the meaning-bearing object also occurs in its denotation. In our example, this means that 😶 occurs both to the left and to the right of the equals sign.

(23) *Hypothesis 1: Iconic Semantics for Face Emoji*
For any face emoji 😶 ('face without mouth' as a **place-holder** for face emoji)
$[\![😶]\!]^g = \lambda p_{<s,t>}$: g(author$_0$) has an emotional attitude towards p in g(w_0) that corresponds to a facial expression that resembles 😶 . p

If we now substitute *any* face emoji for 😶 in (23), we get a well-formed lexical entry, two of which are given in (24a-b). The iconic semantics in (23) is *rule-like* in that a lexicon of face emoji does not need to store (24a) or (24b), as they simply derive from the more general (23).

(24) a. $[\![😠]\!]^g = \lambda p_{<s,t>}$: g(author$_0$) has an emotional attitude towards p in g(w_0) that corresponds to a facial expression that resembles 😠 . p

b. $[\![😢]\!]^g = \lambda p_{<s,t>}$: g(author$_0$) has an emotional attitude towards p in g(w_0) that corresponds to a facial expression that resembles 😢 . p

The alternative to an iconic semantics for face emoji is a symbolic semantics, which 'stores' the emoji's meaning in its lexical entry; this is illustrated in (25a-b), also for 😠 and 😢.[8,9]

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[8] These entries are based on the meaning descriptions on *Emojipedia*; 😢 is described as 'moderately sad' in comparison to 😭, which expresses more intense sadness/grief.

[9] The task to decide between an iconic semantics and a symbolic semantics is not specific to face emoji, but equally arises for activity emoji. In Section 2, we did not posit concrete lexical entries for activity emoji, but we can illustrate the relevant issue in (i.) (which would be symbolic) vs. the rule-based and iconic (ii.).

i. *symbolic semantics for activity emoji:* $[\![⚽]\!]$ = λe . e is a football-playing event

ii. *iconic semantics for activity emoji:* For **any** activity emoji 💥: $[\![💥]\!]$ = λe . e is an 💥-based event

(25) *Hypothesis 2: Symbolic Semantics for Face Emoji*

a. $[\![😠]\!]^g = \lambda p_{<s,t>}$: g(author$_0$) feels **angry** about p in g(w$_0$) . p

b. $[\![😢]\!]^g = \lambda p_{<s,t>}$: g(author$_0$) feels **moderately sad** about p in g(w$_0$) . p

Note that there are various ways of fleshing out a symbolic semantics; while (25a-b) uses English emotion terms in the metalanguage, lexical entries could be based on Jaeger et al.'s (2019) observation that face emoji contribute emotivity with varying degrees of valence (negative/positive) and arousal (calm/excited), which they model numerically in a valence-arousal model of emotion (e.g. Russell 1980). Rather than using a metalanguage that contains emotion terms, such as *angry* or *moderately sad*, the denotations of 😠 and 😢 could be defined more abstractly in terms of their valence and arousal properties on a numerical scale.

3.3. Shifting perspective

So far, we have argued that activity emoji involve anaphoricity, whereas face emoji act like 1st-person indexical expressives. To show this, consider the paradigm in (26) and (27). Native speaker judgments suggest the judgments indicated on the examples by the prefixes '^{OK}' (definitely acceptable), '$^{??}$' (marginally acceptable), '?#' (more or less unacceptable), and '#' (definitely unacceptable). (Below, we discuss controlled experimental evidence from Kaiser & Grosz to appear, which involves similar examples). The contrast in (26a) vs. (26b) reproduces the implicit causality patterns found in naturalistic data in (18) and (19). In sharp contrast, examples (27a) and (27b) appear to receive a homogeneous interpretation, where the attitude holder for the emoji is systematically resolved towards the author of the message.

(26) a. kate said sue impressed ann 🏀
⇝ {#the author / #Kate / ^{OK}**Sue** / #Ann} plays/played basketball

b. kate said sue admired ann 🏀
⇝ {#the author / #Kate / ?#Sue / ^{OK}**Ann**} plays/played basketball

(27) a. kate said sue impressed ann 😠
⇝ {^{OK}**the author** / $^{??}$Kate / ?#Sue / ?#Ann} is/was angry

b. kate said sue admired ann 😠
⇝ {^{OK}**the author** / $^{??}$Kate / #Sue / ?#Ann} is/was angry

The behavior of the face emoji in (27) is clearly parallel to that of expressives, such as *f*cking*, which also preferably select the speaker as their attitude holder.

In two psycholinguistics studies (Kaiser & Grosz to appear), we show that the interpretation of face emoji can shift from the first-person author to another attitude-holder in the presence of psych verbs when a condition on *plausibility matching* is met. In (28), it is *implausible* for the angry face emoji to convey the affective state of Sue or Ann, because the angry face emoji is negatively valenced while the predicates *impressed* and *admired* are positively valenced. But what happens if multiple plausible attitude holders are present? This was tested in Kaiser & Grosz (to appear); the basic findings are summarized in Table 1. Simplifying somewhat, bold type indicates: (i.) the preferred resolution of the attitude holder of face

emoji, (ii.) who the activity emoji provides information about (presumably, who is inferred to be the agent). For a concrete example ('richie annoyed **adrian** 😑'), the information should be read as follows: participants preferred the emoji to be interpreted as expressing Adrian's emotion, as opposed to Richie's, or the author's. This shows that shifting (here: from the author to *adrian*) is possible if the character has the thematic role of experiencer, and both author and character are plausible attitude holders. (See Kaiser & Grosz to appear.)

Table 1: *resolution preferences*	**stimulus-experiencer verb**	**experiencer-stimulus verb**
i. attitude holder (face emoji)	richie annoyed **adrian** 😑	**daniel** admires aaron 😊
ii. agent (activity emoji)	**richie** annoyed adrian 🥁	daniel admires **aaron** 🥇

Note that Kaiser & Grosz (to appear) also found that transfer verbs (*brought*) exhibit a numerical preference for face emoji to receive an author orientation, (28). This is expected, as this is the default resolution preference for face emoji.

(28) abigail brought dessert to emily 😌
↝ *preferred interpretation:* The author is the attitude holder for the emoji 😌

We conclude that the attitude holder of face emoji is often the author, but it can shift to a potential attitude holder mentioned in the text if such an association is plausible, e.g. if the referent is the experiencer of a psych predicate that semantically does not conflict with the emoji's meaning. These findings are compatible with an analysis of face emoji as expressives, given that expressives have been argued to shift away from the speaker (Amaral et al. 2007), though they do so under highly constrained conditions (Harris & Potts 2009).

4. Negation, Projection, Emoji and Scopes

So far, we have argued for a formal semantics of activity emoji (Section 2) and face emoji (Section 3), which can form the foundation for more intricate questions. Specifically, Pierini (to appear) and Pasternak & Tieu (2020) investigate whether emoji can scopally interact with material inside the accompanying text. We proceed to revisit this question based on our own findings; we observe that emoji have a strong preference to scope *over* (or rather *outside*) all accompanying text. However, if activity emoji combine with an Elaboration discourse relation, the appearance of scope interactions can be attested.

4.1. The projective properties of emoji

Recent research in linguistics argues that different kinds of non-speech material, like gestures (Ebert & Ebert 2014, Schlenker 2018) and sound effects (Pasternak 2019), exhibit so-called *projection behavior* in combination with speech. In other words, they interact in non-trivial ways with logical operators (e.g., negation, modals, conditionals, quantifiers, etc.) in the accompanying speech, giving rise to non-at-issue inferences, like presuppositional and supplement meaning. Following these studies, Pierini (to appear) and Pasternak & Tieu (2020) argue that text-accompanying emoji display the same projection behavior as co-speech gestures (based on Schlenker's 2018 account of the projective properties of gestures).

In particular, they argue that emoji, when appearing in a message-final position,[10] as in (29), are interpreted in the scope of negation, with the projection behavior of conditionalized presuppositions (also called 'co-suppositions' by Schlenker 2018), i.e., assertion-dependent presuppositions in which the content of the emoji is entailed by the local context of the text.

(29) Yesterday, John didn't train for two hours 🏋️ (from Pierini, to appear)
↝ Yesterday, if John had trained, it would have involved weightlifting

If this is true, then message-final emoji would project through negation in the same way as co-speech gestures do, as given in (30)[11], following Schlenker (2018).

(30) Little Johnny didn't [punish]+**SLAP** his team mate
↝ If Little Johnny had punished his team mate, slapping would have been involved

In Sections 4.2 and 4.3, we aim to explain the projection patterns of emoji with negation described here using the insights that we gained so far.

4.2. Emoji outscope negation

In order to address the projection behavior of emoji, we start with naturally occurring examples where activity emoji occur with negation. In (31a) from Twitter, ⚽ appears together with an experiencer-stimulus verb, *envy*. If we analyze its non-negated, constructed counterpart (31b), we find that the intended discourse relation is Explanation. As predicted from the analysis we developed in Section 2.2, the agent of the event denoted by ⚽ is identified with the stimulus, *Smith*. This reading is preserved in (31c) (a simplified version of (31a)); here too the salient discourse relation appears to be Explanation. If this is correct, then the emoji is not in the scope of the negation. As such, no projection as the kind described by Pierini (to appear) and Pasternak & Tieu (2020) is detected, i.e. there is no evidence for a co-suppositional inference, as spelled out in (31d).

(31) a. The whole story is rough. Don't envy Smith rn. ⚽ Why is John Smith Belgium coach? Does he secretly want France to win World Cup? [twitter]
b. I envy Smith right now ⚽ Discourse Relation: *Explanation*
↝ Smith's soccer-related activities are the reason for why I envy him
c. I **do not** envy Smith right now ⚽ Discourse Relation: *Explanation*
↝ Smith's soccer-related activities are the reason for why I **do not** envy him
d. ↛ ? If I did envy him, it would be because of his soccer-related activities

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[10] In their experimental stimuli, Pasternak & Tieu (2020) use text-surrounding emoji, such as (iii) and (iv) (see https://osf.io/2txjn/ for their complete set of stimuli). Since we focus on message-final emoji in this paper, we do not take this version into account, but we do expect our findings in Sections 4.2 and 4.3 to apply to such text-surrounding emoji as well.
iii. The student will not 🚽 step out of the classroom 🚽
iv. The party will not ☂️ be cancelled tomorrow ☂️

[11] This example, modeled after examples in Schlenker (2018), comes from Pierini (to appear). The notation '[word]+**SLAP**' indicates that the slapping gesture and the targeted word are simultaneous.

A similar case can be made for stimulus-experiencer verbs, such as *disappoint*. Consider the Twitter example (32a). As spelled out in (32b) (parallel to (31c)), we find that the discourse relation by which 🏀 integrates with the text is, once again, Explanation. Again, the emoji scopes outside of negation, and there is no evidence for a co-suppositional inference, (32c).

(32) a. Our boys don't disappoint 🏀 #tribe [twitter] (Discourse Relation: *Explanation*)
b. ⇝ Our team's basketball-playing is the reason for why they **do not** disappoint us
c. ⇏ ? If they did disappoint us, it would be because of their basketball-playing

4.3. Explaining the scope of emoji: Effects of different discourse relations

Based on the discussion in Section 4.2, we affirm that activity emoji must scope outside of the negation whenever the intended discourse relation is Explanation.[12] However, how do we explain cases like (29), in which the emoji seems to scope under negation, giving rise to a conditional presupposition? We propose that this stems, crucially, from the discourse relation at hand: while many activity emoji are resolved by virtue of Explanation, they appear to be acceptable in the scope of negation when the intended discourse relation is *Elaboration*. An illustrative example (parallel to (29)) is given in (33). Recall from Section 1.2 that Elaboration holds in an emoji-text combination when the emoji-related events are sub-events of events described in the accompanying text.[13] The effect of construing (33a) by virtue of Elaboration is spelled out in (33b); this gives rise to the inference in (33c), which resembles a co-suppositional inference of the type proposed in Pierini (to appear) and Pasternak & Tieu (2020). For now, we leave open which option is correct: [i.] On the one hand, the emoji in (33a) may outscope negation, with (33c) arising as an illusion from (33a)+(33b). [ii.] On the other hand, the emoji may truly scope below negation in (33a), with (33c) arising as a co-suppositional inference.

(33) a. By now, Sue hasn't trained for months 🏄
b. ⇝ Surfing is part of training (*Elaboration*)
c. ⇝ If Sue had trained, it would have involved surfing

In addition to the constructed (33a), we find naturally occurring Twitter examples, (34a) and (35a), which can be analyzed in exactly the same way as (33), with the conditional inference in (34c)/(35c) possibly deriving from the Elaboration inference in (34b)/(35b).

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[12] Interestingly, affective emoji (which directly operate on the text, without mediating discourse relations) seem to generally outscope negation as well. Consider the naturalistic Twitter data in (v) and its constructed, non-negated counterpart in (vi), which we can interpret using the analysis developed in Section 3. As shown in (vii), 💪/👍 seem to fall outside the scope of the negation; therefore a co-suppositional reading, (viii), is not available.
v. Well done! You didn't give up and kept going 💪👍 Super work !!! [twitter]
vi. You gave up 💪👍 ⇝ The author feels positively about the fact that the addressee gave up
vii. You didn't give up 💪👍 ⇝ The author feels positively about the fact that the addressee didn't give up
viii. ⇏ ?? If the addressee had given up, the author would feel / have felt positively about it

[13] This is a simplified definition of Elaboration, which reduces to a part-of relation, glossing over more complex views of how Elaboration should be defined, including Asher & Lascarides (1993, 2003) and Kehler (2002).

(34) a. didn't train 🏊😂 [twitter]
b. ⇝ Swimming is part of training (*Elaboration*)
c. ⇝ If author had trained, it would have involved swimming

(35) a. Haha, no worries! I got nervous, I thought "But I didn't train!"🏃‍♀️ [twitter]
b. ⇝ Running is part of training (*Elaboration*)
c. ⇝ If author had trained, it would have involved running

To conclude this discussion, it is worth mentioning that Hunter's (2019) analysis of the typology of the projective properties of co-speech gestures proposed by Schlenker (2018) is very similar to ours. She suggests that all the examples of co-speech gestures with negation provided in Schlenker (2018) – which appear to give rise to conditional presuppositions – involve an Elaboration discourse relation.[14] Future research will require careful empirical investigation of both gestures and emoji, to determine whether they must outscope negation, or whether they scope under negation, triggering a projective conditional inference.

5. Conclusion

In this paper, we argued for an initial semantic typology of emoji that draws a distinction between activity emoji (🎸, 🏋️, 🏓) and face emoji (😄, 🙄, 😆). We argued that both types of emoji are connected to an individual that functions as the agent (for activity emoji) or attitude holder (for face emoji), respectively. However, they differ as follows. Activity emoji largely behave like event-denoting free adjuncts with anaphoric properties; i.e., they anaphorically pick up an individual that serves as the agent or other core participant in the denoted eventuality. By contrast, face emoji incorporate the type of 1st person indexicality commonly found with expressives; they typically pick up the author as the attitude holder, though there are shifted cases where face emoji pick up an experiencer introduced by a psych predicate – provided that the psych predicate and the emoji match in valence. With regards to scopal behavior, we argued that most emoji scope outside of the text that accompanies them, by virtue of which they scope over negation in the text. The exception seem to be *Elaboration* cases, where the emoji further specify an eventuality described in the text, thus creating the appearance of scoping below negation. We leave open whether there are true cases of emoji scoping below negation (giving rise to projective conditional inferences), or whether such scope interactions are merely illusory.

A major open question concerns the emoji that are outside the scope of the bipartition introduced in this paper. There is a large set of emoji that are neither activity emoji nor face emoji, including weather emoji (🌞, 🌦️), animals (🐕, 🐻), and pointing emoji (👉, ➡️). These have varying uses not addressed in this paper, such as the prominence-marking use of the combination 👉 and 👈, illustrated in (36). Future research will address whether such emoji

[14] To give a concrete example, Hunter (2019:322-323) argues that (ix) should be analyzed as in (x), and states: "something that might at first look like a conditional presupposition triggered by the gesture might be better understood as a side effect of whatever semantic mechanisms the gesture content is actually contributing to."
ix. Little Johnny didn't [punish]+**SLAP** his team mate.
x. Little Johnny didn't punish his team mate. He didn't slap him.

share properties with activity and face emoji, such as the orientation towards an agent or attitude holder, or if additional categories of emoji need to be introduced.

(36) Omg this drink is 👉 green 👈 I think this is the first time ever I think seeing a green drink omg 😮 #Watermelon [twitter]

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