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Multimodal practices of research groups in Twitter: An analysis of stance and engagement

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ABSTRACT

Twitter is being increasingly used in academia as a tool for self-promotion, information sharing, networking and public outreach. To achieve these purposes scholars combine a variety of semiotic resources afforded by this social networking site. The aim of this study is to analyse the use of multimodal semiotic resources to express stance and engagement in the Twitter accounts of research groups. The data for the study consist of 300 tweets taken from the Twitter accounts of four research groups in two different disciplines (Chemistry and Medicine). The analysis reveals a high number and variety of stance and engagement resources (the most prominent being attention-getting resources, self-mentions, and attitude markers), which help research groups to promote their research, make themselves saliently visible, establish interpersonal rapport with diverse audiences, and persuade these audiences to perform actions. In these tweets, stance and engagement are expressed by resources found in other academic genres (see Hyland, 2005b), but also by other resources afforded by the digital medium (e.g. static images, moving images, emoji, @mentions, hashtags). The study shows that these semiotic resources are orchestrated strategically to achieve the promotional, social networking and persuasive purposes of tweets composed by research groups.

1. Introduction

The last decades have seen important changes in how research is conducted and how knowledge is communicated. In many disciplines, research is conducted in teams, who need appropriate tools to communicate with and engage various stakeholders. In this context, Twitter is being employed by research groups for self-promotion, networking, knowledge dissemination, and interaction with peers and with a wider audience (Luzón & Pérez-Llantada, 2022). Achieving these purposes depends in part on the authors' ability to use language and other semiotic resources interpersonally to project a credible authorial identity, express a stance, and interact with the audience strategically.

A considerable number of studies have addressed the interpersonal dimension of academic discourse, analysing stance (i.e. the writer's expression of attitude and commitment to a proposition) and engagement (i.e. the discursive act of acknowledging and connecting to others) (Hyland, 2005b). Stance and engagement have been shown to play an important role in a range of academic genres and genres for science popularisation, both traditional and digital genres, e.g. research articles (Hyland, 2005a, 2010), PhD theses (Kawase, 2015), popular science articles (Hyland, 2010), TED Talk videos (Scotto di Carlo, 2015; Xia & Hafner, 2021), science and academic blogs (Bondi, 2018; Luzón, 2013; Zou & Hyland, 2020), or 3-min thesis presentations (Carter-Thomas & Rowley-Jolivet, 2020; Hyland & Zou, 2022). However, despite the increasing interest in exploring interpersonal resources in digital

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genres, there is little research on how stance and engagement work in tweets composed by academics and on how various resources are combined in these space-constrained texts to achieve specific purposes (see, however, Luzón & Albero-Posac, 2020; Tardy, 2021). Even less attention has been paid to the purposes and discourse features of tweets produced by research groups (see Luzón & Pérez-Llantada, 2022, for an analysis of the purposes for which groups use Twitter).

Another gap in research on stance and engagement in academic genres is that most studies have focused exclusively (or mainly) on the linguistic mode (i.e. on lexical and grammatical markers), not considering other semiotic resources, although recent research has shown that in some digitally mediated genres stance and engagement tend to be achieved by combining various semiotic resources (Luzón & Albero-Posac, 2020; Xia & Hafner, 2021). The aim of this study is to contribute to filling the gaps identified above by analysing the multimodal practices of research groups when using Twitter, focusing in particular on the expression of stance and engagement. Specifically, the study seeks to address the following questions:

RQ1: What stance and engagement markers occur in the Twitter accounts of the research groups in the study?

RQ2: What visual resources are employed in these tweets to express stance and engagement?

RQ3: How do the various interpersonal semiotic resources used in these tweets contribute to achieving the purposes of the genre?

2. Twitter in scholarly communication

In recent years, a growing number of studies have examined Twitter for scholarly communication. These studies have shown that academic tweets may serve a variety of purposes. Scholars use Twitter to share resources, publications (their own and others' publications) and media with their peers and with the public (Côté & Darling, 2018; Mohammadi, Thelwall, Kwasny & Holmes, 2018), and to increase their public visibility, promote their work, and enhance their disciplinary reputation (Luzón & Albero-Posac, 2020). They also turn to Twitter to develop their disciplinary network, request help, offer advice, and engage in social interaction (Veletsianos, 2012), to stay up to date with their peers' current research, and to interact with peers and the interested public (Büchi, 2017; Puschmann, 2014; Tardy, 2021). Darling, Shiffman, Côte and Drew (2013) claim that Twitter provides an "echo chamber" (p. 37) that enables scholars to disseminate the findings of a new paper more informally than in the paper and to reach a wider audience.

One of the uses of Twitter that has received more attention is the citation of peer-reviewed publications, that is, including URLs referring to publications (e.g. Jung, Lee & Song, 2016; Klar, Krupnikov, Ryan, Searles & Shmargad, 2020; Priem & Costello, 2010). Research suggests that Twitter citations serve promotional and networking purposes. Jung et al. (2016) observed that Twitter users cite papers mainly to share them or to promote them to their followers. Research groups very often use Twitter to cite and advertise their new publications, thus increasing their visibility, and to make them accessible through links (Luzón & Pérez-Llantada, 2022).

Twitter is also frequently used at conferences, as a space where members of the conference community (organisers, attendees and non-attendees) can spread information and interact informally on issues related to the conference (Luzón & Albero-Posac, 2020; Puschmann, 2014; Ross, Terras, Warwick & Welsh, 2011). Twitter has been found to function as a backchannel (Ross et al., 2011), where attendees and non-attendees can discuss issues related to the presentations, and participate in the discussion. Conference participants also use Twitter to share various resources (e.g., their own papers and posters, other researchers' papers, datasets) related to the conference, to build and maintain disciplinary networks, and to make themselves visible within the community (Luzón & Albero-Posac, 2020).

The potential of Twitter to reach a more diverse audience has also been explored by some studies (Büchi, 2017; Côté & Darling, 2018; Tardy, 2021). Although many scientists use Twitter mainly to interact and share research and information with the scholarly community (Veletsianos, 2012), communication with other publics (media, educational organisations, general public, practitioners) is also important for some scientists, especially regarding scientific issues that require societal action (Côté & Darling, 2018; Tardy, 2021; Walter, Lörcher & Brüggemann, 2019). The imagined audience (Marwick & Boyd, 2011) seems to determine discourse features. Walter et al. (2019) found that when writing tweets on climate change, scientists employ language strategically, adjusting it to different audiences (peers, journalists, civil society, or politicians). Gero, Liu, Huang, Lee and Chilton (2021: 222) examined discourse techniques used in "tweetorials" (i.e. long Twitter threads written by experts to explain complex concepts for a general audience) and found that writers used subjective language, built credibility through hyperlinks, established rapport by using informal language, and incorporated diverse media in unique ways.

Despite the growing popularity of Twitter among academics, and the wide variety of purposes for which academics are using Twitter (as attested by the studies discussed above), there is surprisingly little research on how academics are composing tweets to achieve these purposes. In the following Section I present the analytical model used in this study to explore stance and engagement in these tweets.

3. A model for the analysis of stance and engagement in academic Twitter

Writing and speaking are social acts, where writers/speakers express their attitudes, project themselves in the discourse, anticipate their audience's responses, and establish interpersonal relations with this audience. The term "interpersonality" is used in this paper to refer to this interpersonal use of language.

Several overlapping concepts and models have been proposed to analyse the interpersonal dimension of discourse, e.g. stance (Biber & Finnegan, 1989), evaluation (Thompson & Hunston, 2000), appraisal (Martin & White, 2005), stance and engagement (Hyland, 2005b). Biber and Finnegan (1989: 124) define "stance" as "the lexical and grammatical expression of

attitudes, feelings, judgements, or commitment concerning the propositional content of a message", and distinguish between markers of affect (i.e. positive/negative) and markers of evidentiality (i.e. certainty/doubt). Similarly, Thompson and Hunston (2000: 5) propose the term "evaluation" to refer to the expression of "attitude or stance towards, viewpoint on, or feelings" about entities or propositions. Evaluation involves both affect (i.e. opinions related to entities) and modality (i.e. opinions related to propositions). Martin and White's (2005) concept of "appraisal" comprises attitude (emotional responses and aesthetic and moral evaluations), engagement (the expression of commitment to propositions) and graduation (degree of evaluation). Despite their differences, these models are similar in that they are concerned mainly with different types of writer/speaker's attitude and evaluation, that is, with writer/speaker-oriented features of interaction (see Hyland, 2005b).

In this paper I draw on Hyland's (2005b) model of stance and engagement, because it provides a more comprehensive framework for the analysis of interpersonal behaviour in academic texts. First, unlike the models presented above, it also accounts for reader-oriented features, i.e. discourse resources and strategies through which the writer seeks to connect with their audiences and involve them (Hyland, 2005b). Second, Hyland's taxonomy of stance and engagement features was developed from the analysis of academic texts. This is important, because, as Hyland (2005b: 175) notes, meanings are produced "in the interaction between writers and readers in specific social circumstances", and, therefore, the resources employed by academics for stance taking and involving their audiences are related to and dependent on the practices and value system of the community.

Hyland (2005b: 176) regards stance and engagement as "two sides of the same coin", contributing to the interpersonal dimension of discourse. Stance is concerned with writer-oriented features of interaction and comprises three components: evidentiality, affect and presence (Hyland, 2005b: 178). Evidentiality, i.e. "the writer's expressed commitment to the reliability of the propositions he or she presents and their potential impact on the reader", is expressed through hedges (e.g. *possible, may*) and boosters (e.g. *clearly, demonstrate*). Affect, i.e. "personal and professional attitudes towards what is said, including emotions, perspectives and beliefs", is frequently expressed lexically through attitude markers (e.g. *agree, unfortunately, remarkable*). Presence is "the extent to which the writer chooses to project her or himself into a text". Self-mentions, expressed through first person pronouns and possessive determiners, enable writers/speakers to express their beliefs, enhance the credibility of their claims, and achieve proximity.

Engagement, the other side of the coin, is the reader-oriented aspect of interpersonality, defined by Hyland (2005b: 176) as follows: "This is an alignment dimension where writers acknowledge and connect to others, recognising the presence of their readers, pulling them along with their argument, focusing their attention, acknowledging their uncertainties, including them as discourse participants, and guiding them to interpretations". It is therefore concerned with the discursive choices that writers/speakers make to create rapport with their audience, signal solidarity and affiliation, attract the audience's interest, and persuade them. Hyland (2005b) argues that academics can connect with the reader in five ways: by bringing the reader into the discourse through reader pronouns (reader mentions), by asking questions, by appealing to shared knowledge, by making suggestions and directing the reader to another part of the text or to another text, to perform an action or to interpret an argument (directives), and by commenting on what has been said (personal asides). In the academic context, reader mentions and asides can create solidarity and signal membership in a disciplinary group, and thus foster interpersonal relations. Questions, directives and references to shared knowledge are used to persuade the reader/listener, who may disagree, and guide them to a particular interpretation. It should be noted that the boundary between stance and engagement is fuzzy, and these concepts overlap because "forms often perform more than one function at once" (Hyland, 2005b: 176–177). Many resources used by the authors to express attitude and position themselves also help them to establish rapport and engage the audience.

Hyland's model has revealed itself as a useful and well-established framework for the analysis of the interpersonal dimension of academic discourse. However, as noted by Suau-Jiménez, Lorés-Sanz, Mapelli and Herrando-Rodrigo (2021), the model needs to be adapted in two ways if it is to account for interpersonal resources in genres other than conventional academic genres. Firstly, Hyland discusses stance and engagement as components of interpersonal metadiscourse, which he defines as "self-reflective" and distinct from propositional content (which is concerned with the external world) (Hyland, 2005a: 37). He acknowledges, however, that this distinction "is difficult to apply in practice" (Hyland, 2017: 5). Propositional content has been proved to be a key element in establishing interpersonal author/reader relations and achieving the persuasive purpose in promotional genres, such as hotel websites (e.g. "exceptionally modern architecture") (Suau-Jiménez et al., 2021). As the current paper is not concerned with delimiting a space for metadiscourse, propositionality is not excluded when analysing interpersonal meaning. Secondly, research has revealed that in some genres stance and engagement may be expressed through resources that are not considered in Hyland's model. For instance, in hotel websites self-mentions can be expressed through nouns, as in "*the hotel* offers wireless access" (Suau-Jiménez et al., 2021: 115), and in corporate documents the category attitude markers could be realised by pictures (for example, by a picture of a smiling, happy client) (De Groot, Nickerson, Korzilius & Gerritsen, 2016). Therefore, Hyland's model should also be adapted and extended by including new markers and new realisations.

This flexibilisation of the model is particularly important to account for the role of visual semiotic resources in the construction of interpersonal meaning in the digital context. As Barton and Lee (2013) show, stance taking in social media is multimodal: stance is not only marked through linguistic resources but also through other semiotic resources (e.g. emoji, emoticons, images). A few studies have shown the important role of non-verbal resources to construct interpersonality in digital genres for science communication (e.g. Luzón, 2019; Xia & Hafner, 2021). In her analysis of online science videos, Luzón (2019) found that multiple semiotic resources from different modes were orchestrated to express attitude and evaluation and to engage the audience. Similarly, Xia and Hafner (2021) found that in TED Talk videos engagement is achieved by a combination of semiotic resources (e.g. speech, gestures, gaze, visuals).

Focusing on Twitter, previous research has revealed that interpersonal meaning may be realised not only by linguistic resources, but also by visuals such as emoji, pictures, or memes. Studies of emoji in tweets have shown that they may be used to

express attitudes and construct relationships between the interactants (Kreis, 2017; Logi & Zappavigna, 2021). Memes that circulate in Twitter also serve a social bonding purpose and help to shape the user's identity (Zappavigna, 2012). In addition, interpersonal meaning can also be realised by other Twitter-related features, such as the @mention feature and the hashtag. The @mention feature is an engagement mechanism which helps to create connections with the "mentioned" users. It may be used to indicate that the user is referred to or as a vocative, i.e. a form of address, to send the user a notification (Honeycutt & Herring, 2009). Hashtags are defined by Zappavigna (2015:15) as "searchable talk", which allows the users to engage with other users interested in the same topic and facilitates bonding and affiliation between these users. They may also provide metaevaluative commentary, reflect the producer's beliefs or stance towards a topic, or indicate identity (Kreis, 2017; Zappavigna, 2015). A model for the analysis of stance and engagement in academic tweets must therefore take account of all resources afforded by the medium, including linguistic and visual resources, and features such as @mentions and hashtags.

4. Corpus and method

4.1. Corpus

The dataset analysed in this study is a corpus of 300 tweets (13,481 words) taken from the Twitter accounts of four research groups in two different disciplines: Chemistry -Martin Group (MG), Fors Research Group (FG)- and Medicine -SOLTI Group (SG) and TOPIC Research Group (TG).[1] The Twitter accounts were retrieved by using the Google searches: "Twitter + research group + medicine" and "Twitter + research group + chemistry". To be selected for the study, the research groups' Twitter accounts had to meet the following criteria: (i) active accounts with regular tweets (accounts with at least 50 tweets in the last year, and at least two tweets in the last month); (ii) popular accounts, with a high number of followers (more than 1,000, although three of the groups had about 4,000 followers), since popularity may be considered an indication of effective communication; and (iii) accounts with all or most of the tweets written in English (only the Twitter profile of one of the groups includes some tweets in Spanish). The Chemistry groups do research on organic Chemistry and, according to information on their Twitter profile page, their Twitter accounts are run by PhD students in the group. The SOLTI research group does research on breast cancer. This group organises workshops for practitioners and patients, and states on their homepage that they want to empower patients to deal with their disease. The TOPIC research group does research on mental health and states on the homepage that their work is "underpinned by close consultation with children, young people, parents/carers, and practitioners" (https://www.psy.ox.ac.uk/research/topic-research-group). Hence, for the Medicine groups reaching audiences beyond academia is important.

Seventy-five tweets from each account were collected working backwards from 16 December 2021. The start dates for each dataset are as follows: 22 September 2020 (MG), 9 October 2020 (FG), 2 November 2021 (SG), 15 October 2021 (TG). The dataset included tweets and retweets, both "unedited/uncommented retweet" (i.e. tweets forwarded to the user's followers without adding any comment) or "edited/commented retweets" (i.e. tweets where the retweeted message is prefaced by a text commenting on it) (Gruber, 2017). The reason is that, as Gruber (2017) points out, through uncommented retweeting, retweeters align with the stance of the original tweet; and through the comment in the edited tweets, the retweeter displays his or her stance towards the retweeted text.

Since I sought to examine how various interpersonal markers (linguistic and visual) are combined in tweets, the tweets were collected manually using Fireshot, a screen capture tool, and saved as PDF documents.

4.2. Method

The first step in the analysis consisted of exploring the purposes for which the groups in the study used the tweets. Previous research (Luzón & Pérez-Llantada, 2022) has revealed that tweets by research groups may have one or more of the following purposes: (i) community building and networking (e.g. tweets that are used to share resources, publications and disciplinary information, to evaluate other researchers' output positively, or to make the groups' disciplinary links public); (ii) self-promotion and publicising of their research output (e.g. tweets used to notify that a new paper has been published, or inform of the members' achievements); (iii) calls to action (i.e. tweets that encourage various stakeholders to do something, such as access resources, register or take part in academic activities, participate in studies, or join the group); and (iv) public dissemination and outreach (i.e. tweets intended to disseminate academic knowledge to wider audiences). Since the purpose of the tweets may determine the resources used to make meaning and the interpersonal markers deployed, tweets were coded according to their purpose(s). It should be pointed out that most tweets are multipurpose (e.g. a tweet may be used simultaneously to promote the group research and ask the readers to do something or maintain disciplinary networks) and therefore they were coded into more than one category. This is the case for instance of the tweet in Figure 1. It has a networking purpose, because the group shares resources that may be useful for others, but also a promotional purpose, since they promote their own research ("the #CoSpace study"). Therefore, the coding of tweets according to their purpose is not intended as part of a quantitative analysis which seeks to determine the most frequent purposes, but as a preliminary step for a qualitative analysis of the function of interpersonal markers in these tweets.

The second step was to examine the tweets in order to determine the categories of stance and engagement utilised and the various semiotic resources through which stance and engagement were expressed. I followed a multimodal approach, which assumes that the meanings in a text are conveyed not only through language (writing or speech) but through the combination

[1] The research reported here is part of a larger research project that explores the digital practices of scholars in these two disciplines.

of all the modes in the text (Kress & van Leeuwen, 2001). Each mode has different modal resources, which are combined in a specific context to make meaning. Therefore, I analysed all resources (i.e. linguistic and visual resources, hashtags, @mentions) that were used in the tweets to express stance and engagement.

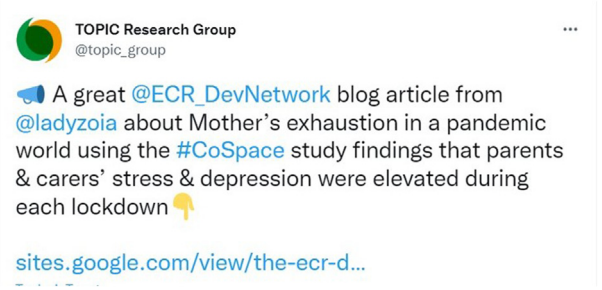


Figure 1. A multipurpose tweet.

Items expressing stance or engagement in the corpus were coded with Atlas.ti, a program for qualitative data analysis. Coding was performed by starting with an initial list of anticipated codes, based on Hyland's (2005a) categories of stance (self-mentions, attitude markers, hedges, boosters) and engagement (reader mentions, attitude markers, directives, questions, appeals to shared knowledge, personal asides). This list evolved over time, as some codes were eliminated (reference to shared knowledge, personal asides) or combined with other codes (questions), and new codes emerging from the data were added (attention-getting resources, appeals to shared interest, discipline related humour) (see Table 1 below for the final list of categories). Within each category, items were also coded according to the type of resource (e.g. first person pronoun, photograph of the group, attitudinal emoji). For this coding I drew on previous research (Hyland, 2005a, 2005b; Logi & Zappavigna, 2021; Zappavigna, 2012, 2015), but most of the codes were generated on the basis of my observation of the data, using the "coding in vivo" option of Atlas.ti. For instance, in "From *@_SOLTI we* hope to provide more information", "*@_SOLTI*" was coded as "Self-mention: @mention" and "we" as "Self-mention: first person pronoun". The coding of visuals was particularly fine-grained, in order to obtain a detailed account of the types of visuals that may have an interpersonal function in these academic tweets. Attention-getting emoji were further categorised into different types.

The third step was to explore how stance and engagement markers are used in the different types of tweets, in order to understand how they are orchestrated to achieve the purposes of these tweets. There is not, however, a one-to-one match between the purpose of tweets and specific stance and engagement markers, because, first, tweets tend to be multipurpose, and, secondly, one type of marker may occur in tweets with different purposes.

5. Results and discussion

5.1. Purposes of tweets

The research groups in the study used Twitter for the four main purposes identified by Luzón and Pérez-Llantada (2022): community building and networking, self-promotion, call to action, public dissemination and outreach. As pointed out above, many tweets were multipurpose, and it was not always possible to identify a predominant purpose. Therefore, I did not quantify the purposes of the tweets in the corpus. However, the coding of the tweets according to purpose revealed some differences between the Twitter accounts, which suggest that their imagined audiences were different.

The Chemistry groups posted tweets to promote their research, to inform of new publications or of their academic activities and achievements, and to strengthen their disciplinary networks. The tweets which encouraged the readers to do something were intended for experts (e.g. "check our paper") and a few for graduate students (e.g. "join our group"). None of their tweets seemed intended for communication with the public.

The Medicine groups, involved in cancer research and in mental health research, posted many tweets which seemed intended for wider audiences (which might include experts but also practitioners and the general public). This is in agreement with the mission stated on their homepages. In addition to communicating with experts, these two groups used Twitter to share research results or useful information and resources with practitioners and the interested public, and to ask these non-expert audiences to do something (e.g. register for a workshop, participate in a study). Seventeen tweets in the SOLTI dataset and 19 in the TOPIC dataset were intended to share resources with practitioners and/or the public (e.g. "Short films about mental health (…) A great resource for young people and practitioners" in a tweet in the TOPIC dataset).

In the following sections the different types of interpersonal resources (linguistic and visual) which are combined in tweets to achieve these purposes are discussed.

5.2. Interpersonal features in tweets by research groups: overall results

Table 1 presents the stance and engagement features in the corpus, and the number of occurrences.

Table 1
Stance and engagement features.

	Nº of occurrences	Frequency per tweet
Stance features	**609**	**2.03**
Self-mentions	382	1.27
Attitude markers	214	0.71
Boosters	9	0.03
Hedges	4	0.01
Engagement features	**800**	**2.66**
Attention-getting resources	391	1.3
Appeals to shared interest	149	0.5
Reader mentions	140	0.47
Directives	100	0.33
Discipline related humour	20	0.06

As can be seen in Table 1, these tweets are rich in resources to convey interpersonal meaning. Overall, there were 609 stance devices and 800 engagement devices in the corpus, with a frequency of 2.03 and 2.66 occurrences per tweet and 45.17 and 59.34 occurrences every 1,000 words respectively. The frequency of engagement devices is particularly high, when compared with figures given for other academic genres (see Hyland & Zou, 2022), such as research articles (39.2 occurrences per 1,000 words), or even 3 min theses (43.7), which Hyland and Zou (2022: 41) describe as a genre with "a heavy investment in engagement". Focusing on the different categories, attention-getting resources, self-mentions, and attitude markers are particularly prominent, with a frequency of 1.3, 1.27, and 0.71 per tweet respectively. This can be accounted for by the fact that many of these tweets seek to increase the public visibility of the group, hook the readers, and direct them to information or publications on other sites. By contrast, the frequency of hedges and boosters, which mark evidentiality, is almost negligible, which suggests that these tweets are not argumentative texts where authors need to express their commitment to claims.

5.3. Markers of stance in tweets by research groups

Table 2 presents the types of stance markers in the corpus, the different ways they are expressed, and the number of occurrences in each Twitter dataset.

Table 2
Semiotic resources to express stance in the corpus.

Stance features	Resources to express stance	Number of occurrences				
		Martin Group	Fors Group	TOPIC Group	SOLTI Group	Total
Self-mentions	First person pronouns	24	13	20	17	74
	Proper names of group/members	27	11	17	9	64
	@mentions (self)	44	22	29	62	157
	Hashtags	0	0	10	14	24
	Photographs of group/members	23	7	6	19	55
	Images in videos	0	2	4	2	8
	Total self-mentions	**118**	**55**	**86**	**123**	**382**
Attitude markers	Linguistic expressions	56	45	28	36	165
	Attitudinal emoji (e.g. 🤗)	19	15	3	12	49
	Total attitude markers	**75**	**60**	**31**	**48**	**214**
Boosters	*Total boosters*	**3**	**1**	**1**	**4**	**9**
Hedges	*Total hedges*	**0**	**0**	**3**	**1**	**4**
Total stance markers		**196**	**116**	**121**	**176**	**609**

5.3.1. Self-mentions

Self-mention, the "explicit author presence in the text" (Hyland, 2005a: 53), is a frequent feature in the corpus, which is in agreement with other studies which have found a high frequency of personal pronouns in online academic genres (Bondi, 2018; Zou & Hyland, 2022). In the Twitter accounts in the corpus, self-mention takes a variety of forms, some of them unique to social media: @mentions of the group/group members, name of the members, first person pronouns and possessive adjectives, hashtags referring to the group's studies (e.g. "#estudioTOTHER", "#CoSpace"), and images of the group/researchers in photos and videos (e.g. 1–3).

(1) Learn how *our* team at Oxford led by Professor *@Cathy_Creswell* has been helping families cope during the COVID-19 crisis (TG)
(2) Congrats to *Craig and Rosie* (MG)
(3) From *@_SOLTI we* hope to provide more information with SOLTI-1804 HER2-PREDICT (SG)

Self-mentions play an important role in promotional tweets, where they help to bring the group's research and findings to the audience's attention and demonstrate their disciplinary credentials. The most salient form of self-mention in the corpus

were @mentions of the group/members, which are sometimes combined with the name (e.g. "Monday motivation by *Dr Martin @TitoBraulio*") and/or with the researcher(s)' picture. This feature enhances the public visibility of the group/members, and makes them searchable: it enables the readers to access the @username Twitter account and get more information on their research, which helps to emphasise their competence. @mentions are therefore a tool for self-promotion of the group. The personal pronouns and possessive adjectives were mainly used to highlight the group's contribution to the discipline (e.g. "we have a new paper", "we can rapidly build up molecular complexity"). However, the group (members) also used personal pronouns for other purposes, such as the following: (i) to project a more personal identity, which helps to create intimacy with the audience (e.g. "I've loved #science since I was a kid"); (ii) to inform of what they need from the readers and encourage the audience to respond (e.g. "We are looking for primary schools in England to take part in our project", "We are hiring"); (iii) to express acknowledgement and thanks (e.g. "We are so grateful to"); (iv) to express their feelings and values, so as to indicate their bonding with a broader audience ("We are supporting #InternationalPronounsDay").

Tweets also display different types of visual representation of the group (or group members), such as pictures of individual members, sometimes in academic activities (e.g. conferences) or in flyers announcing their participation in academic events, or pictures of the whole group posing or engaging in social activities related to the discipline. Short videos (under 2 min), where members of the group appear on screen presenting their research, are also used for self-presentation. Videos may also be used more creatively for this purpose, as can be seen in Figure 2. The embedded video shows members of the group, dressed as pirates, doing laboratory work while they sing a "chemistry sea shanty". These visual realisations of self-mention help the groups project both an academic and a personal identity and bring the group closer to the audience, thus serving both a promotional and a networking function. The high number of visual representations of the group (members) suggest that they are regarded as a powerful way of projecting their identity.

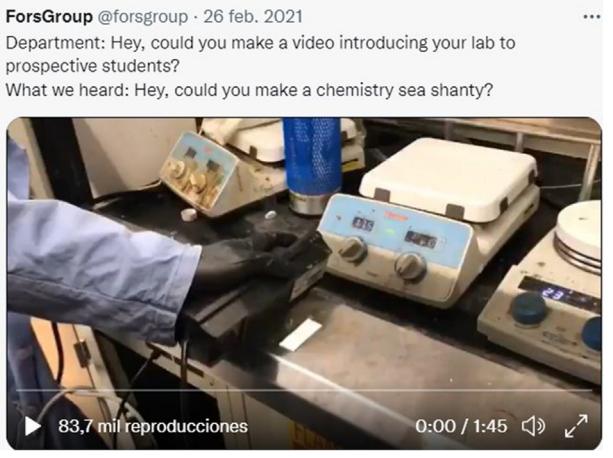


Figure 2. Tweet with a video of the researchers.

5.3.2. Attitude markers

Attitude markers were realised both through text and visually, through emoji (e.g. 4–6). Most attitude markers are used to evaluate research (or academic output) and researchers positively. Linguistic markers include: (i) positive adjectives or nouns which emphasise quality and excellence (e.g. "fascinating topic", "fantastic resource", "fantastic session", "super useful report", "interesting read", "excellent work", "best talk", "great paper", "incredibly talented", "masters", "such a legend"), or novelty ("newest", "latest"); (ii) expressions of positive feelings or emotional reactions (e.g. "very proud of the boss", "is delighting us", "I'm thrilled to", "super excited"); (iii) expressions of congratulations (e.g. "props to", "clap, clap and double clap", "Congrats to [Craig and Rosie]", "#Kudos to [Dr. Martín]", "shout out to", "Go, [Micaela]", "A hat trick to", "Let's go king!") and thanks (e.g. "We are so grateful to [@WestminsterFdn]"). The latter are considered here attitude markers because they involve a positive evaluation, expressed in front or an audience, of the person who is congratulated or thanked.

(4) 🤩 *Super excited* about joining this *amazing* research group to do some *cool* #nickel chemistry (MG)
(5) *#Kudos* to Dr. Bafaluy (@GroupMuniz & @MartinlabJClQ) our *freshly-minted* #Doctor for his thesis defence 🎓 🍾 (MG)
(6) *Congratulations* to @rachelsnyderrr for receiving the Tunis Wentink Prize! Such a legend!!! 🐐🐐🐐 (FG)

Attitude was also realised through various types of emoji. Following Logi and Zappavigna (2021) they can be classified into: (i) emblems, i.e. "culturally established gestures" (Gawne & McCulloch, 2019) (👍, 👏); (ii) ideational entities with

attitudinal connotations, mainly celebration emoji to express congratulations (🍾, 🎉, 🥂), but also the trophy emoji 🏆, the crown emoji 👑 and the goat emoji 🐐, a visual shorthand for the slang expression "the Greatest of All Time"; and (iii) iconic representations of facial expressions (😍, 😉, 😀, 😎, 🤗, 🤩, 😘, 🤓). The last type of emoji are illocutionary force markers (Gawne & McCulloch, 2019), used in the corpus to indicate a pro-social intention on the part of the user. Most of these face emoji are context-sensitive and their meaning is to varying degrees dependent on the accompanying text (see Gawne & McCulloch, 2019). That is, the text and the emoji interact to construct the positive attitude, forming what Logi and Zappavigna (2021) call "an intermodal coupling" (e.g. "Such a legend" and the 🐐🐐🐐 emoji in example 6). As can be seen in example (6), emoji were sometimes repeated for emphasis or reinforcement. In examples (4–6) we also see that, as pointed out by Logi and Zappavigna (2021), interpersonal meaning is cumulative and the emoji intensify the positive attitude conveyed by the lexical attitude markers. Figure 3 shows part of a tweet which also illustrates how groups harness the context-sensitive nature of emoji to use them creatively for interpersonal meaning. The shushing emoji helps to express positive attitude by conveying a sense of secrecy and anticipation of good news and to create solidarity by suggesting an exclusive sneak peek.

Figure 3. Tweet with shushing emoji to create solidarity.

The attitude markers deployed in these tweets are different from those in traditional genres used by academics. First, they can be both verbal and visual (or a combination of both). Second, while in other formal genres written by academics (e.g. research papers) attitude markers can be used to evaluate negatively others' research (Afros & Schryer, 2009), no occurrence of markers of negative attitude was found in the dataset, which reflects the highly interpersonal nature of the genre. Third, many attitude markers are informal and typical of spoken discourse (e.g. "Go + name", "cool", "awesome", "Let's go king! 👑"), which also contributes to conveying intimacy and familiarity. Some of them are also unconventional expressions of attitude, which reflect the writers' creativity when composing these tweets (e.g. the onomatopoeia "clap, clap and double clap").

Attitude markers are very frequent in tweets intended for self-promotion, where the groups tend to inform of members' achievements (e.g. a new publication, PhD defenses, awards, invited talks) by evaluating the research output positively and/or congratulating these members (see example (5) above). They are also displayed in tweets intended to share the groups' resources, to persuade the readers to access these resources (e.g. "An interesting read on Yoga … by one of our Research Assistants"). Attitude markers also contribute to the networking purpose of tweets. They can help to create bonds with other researchers, by evaluating their contribution to knowledge positively in front of the disciplinary discourse community. This is frequent in conference tweets (i.e. tweets that are produced in the context of a conference; see Luzón & Albero-Posac, 2020; Puschmann, 2014), which only occurred in the SOLTI dataset (see examples 7–8).

(7) *Very nice* data PADA-1 @GroupeUNICANCER Dr. Bidard (SG)
(8) *Great* discussion Dr. Chien! (SG)

5.4. Engagement features in tweets by research groups

Table 3 presents the types of engagement features in the corpus, the different resources to achieve engagement, and the number of occurrences in each Twitter dataset.

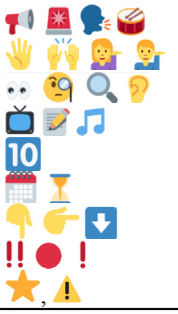
Table 3
Semiotic resources to achieve engagement in the corpus.

Engagement features	Resources to express engagement	Number of occurrences				
		Martin Group	Fors Group	TOPIC Group	SOLTI Group	Total
Attention-getting resources	Emoji (e.g. 🗣️).	20	1	81	63	165
	Graphical abstracts/graphics from papers	11/2	9/2	0	0	24
	Conference slides	0	0	0	10/2	12
	Academic flyers	4	2	15	6	27
	Quote cards	3	2	4	2	11
	Infographics	0	0	5	1	6
	Banners	0	0	7	5	12
	GIFs	0	1	5	0	6
	Group-created templates	3	0	14	0	17
	Self-playing videos	0	2	4	2	8
	Other visuals	2	2	1	0	5
	Exclamations	26	38	13	15	92
	Capital letters	0	0	0	6	6
	Total attention-getting resources	**71**	**59**	**149**	**112**	**391**
Appeals to shared interest	Questions	7	3	10	10	30
	Thinking emoji 🤔	1	0	3	2	6
	Hashtags	25	5	29	30	89
	Emoji: community specific (e.g. 🛸)	10	2	2	10	24
	Total shared interest	**43**	**10**	**44**	**52**	**149**
Reader mentions	Reader pronouns	21	4	13	10	48
	Names of others	5	5	0	6	16
	@mentions (other)	5	15	22	17	59
	Photographs of others	0	9	1	7	17
	Total reader mentions	**31**	**33**	**36**	**40**	**140**
Directives	Imperatives	32	20	30	14	96
	Other	0	0	4	0	4
	Total directives	**32**	**20**	**34**	**14**	**100**
Discipline-related humour	Memes	0	9	0	0	9
	Text (and picture)	0	9	0	0	9
	Video	0	1	0	0	1
	Picture	1	0	0	0	1
	Total humour	**1**	**19**	**0**	**0**	**20**
	TOTAL	**178**	**141**	**263**	**218**	**800**

5.4.1. Attention-getting resources

The most frequent category of engagement resources is *attention-getting resources*, i.e., resources that are intended to draw the readers' attention to the content of the tweet. It should be noted that Twitter is based on a "push" rather than "pull" model of science dissemination, i.e. a model that does not require people to actively search for information, but enables researchers to "push" the information more directly to potentially interested audiences, and therefore it is important to attract the reader's attention (Klar et al., 2020). The tweets in the corpus display different types of attention-getting emoji (see Table 4).

Table 4
Attention-getting emoji in academic tweets.

Types of emoji	Examples in the corpus
Emoji representing sound-producing objects used in real life to warn or draw attention	
Gesture emoji	
"Looking" or "hearing" emoji	
Emoji representing the object of attention	
Number emoji	
Time emoji	
Pointing emoji	
Punctuation emoji	
Other (less frequent)	

As can be seen in examples (9–13 below) below, these emoji draw attention to something that is supposed to be of interest for the reader. Some of them may be used for paralinguistic emphasis (e.g. 9) and/or to reinforce the meaning of other interpersonal resources (e.g. 13).

(9) 📢 WE ARE HIRING 📢 (SG)
(10) 👋 If you're having a hard time managing your feelings, it's really important to talk to someone about it (TG)
(11) For #InternationalStressAwarenessWeek, trauma expert @DrJenWild & her team have created 4 fantastic, 1-min videos (…). Check out all the videos below. 👇👇 (TG)
(12) LAST CHANCE TO REGISTER ‼️ (SG)
(13) A really nice little video from ICIQ and Chris! Give it a watch 📺 😃 (MG)

In addition to emoji, the tweets in the corpus deploy many other types of visuals intended to attract the readers' attention:

- graphical abstracts and graphics from research articles
- conference slides
- academic flyers, i.e. flyers advertising academic events, reports, webinars, blogs, podcasts.
- quote-cards, i.e. combinations of pictures and fragments of texts taken from other sources, used to attract the readers to those sources.
- infographics
- banners, which inform about the content of the tweet, repeat a fragment of the text in the tweet (e.g. "We are looking for a senior data manager") or include directives ("Link up with mental health researchers") (see Figure 4)
- GIFs
- templates created by the group for specific purposes, e.g. to announce a new paper/podcast, to introduce the researchers.
- self-playing videos
- other

Figure 4. Tweet with an attention-getting visual.

The key role of visuals is related to how tweets are read: when readers scroll their Twitter feeds, visuals may act as eye-catching devices that make them stop and read the tweet. Therefore, all the other visuals discussed as part of other categories (e.g. pictures of the researchers) also serve the purpose of attracting the readers' attention. Videos, in particular, are a powerful resource, used to attract the reader, provide information on an event or a summary of a resource, and persuade the reader to find further information elsewhere.

As can be seen in Table 3, groups differ in their use of attention-getting resources, which can be explained taking into account differences in their imagined audiences. Attention-getting emoji are much more frequent in the Medicine dataset, probably because of the need to attract non-expert audiences. This may also explain the fact that banners and infographics are only present in this dataset, and particularly in tweets by the TOPIC group. By contrast, graphical abstracts, graphics from papers, and quote-cards from research papers only occur in tweets posted by the Chemistry groups to promote a new publication.

5.4.2. Markers of shared interests and concerns

Several resources are intended to appeal *to shared interests and concerns*: questions, thinking face emoji, hashtags, and discipline related emoji. Questions are "the strategy of dialogic involvement par excellence" (Hyland, 2005b: 185), and

assume that the reader has an interest in the topic. In the corpus of tweets they were mostly used to raise the audience's interest before asking them to find the answer (in a paper, in a video) (e.g. 14–15), but they also served to encourage the reader to do something (usually in combination with "you") (e.g. 16). Many topic related questions were preceded by the thinking emoji (e.g. 15), which seems to encourage the reader to consider the question and explore it with the writer, thus reinforcing dialogicity and involvement. Gawne and McCulloch (2019) state that this emoji "often marks disingenuous or sarcastic questions, or a skeptical stance". However, it seems that in these convivial tweets, where there is no room for sarcasm, scholars have adapted the meaning of the emoji to meet their interpersonal needs.

(14) *Do you like β-amino acids*?? well, we have just the paper for you! (MG)
(15) 🤔 *Are psychological therapies targeting #anxiety disorders in adolescents more effective than controls?* Holy J Baker, @notthefirstpete, Jessica Karalus@Cathy_Creswell & @pollywaite explore that in their new meta analysis. Have a read 👇 (TG)
(16) *Have you added yourselves to #MHRmap yet?* (TG)

Hashtags such as #postdoc, #cancerresearch, #WomenInScience, or conference hashtags such as #SABCS21, help to express shared research interests with a particular disciplinary group, or to align with the values and interests of a wider community. Hashtags serve to create ambient affiliation with a potential audience (Zappavigna, 2015) and thus researchers use them to connect with readers within and beyond their disciplinary community.

Shared interests and values are also expressed with emoji which signal belonging to the academic community (e.g. 🎓) or to a specific disciplinary community (e.g. 🧠 in tweets by the TOPIC group or emoji related to Chemistry ⚗️, 👨‍🔬 or Medicine 🧪, 💉, 🩸, 🧬, 💊). In example (17) the three discipline-related emoji, which create bonds with the disciplinary community, are combined with attitude markers ("new", "excellent"), the directive "click" and the graphical abstract to persuade the audience to access the new publication.

(17) We have a *new* carboxylation perspective in Chem! *Excellent* work from all involved. 🏭⚗️ *Click* the link before the 31st of December. No fees, no registration, just Chemistry 👨‍🔬
[+ embedded graphical abstract] (MG)

5.4.3. *Reader mentions*

Reader mentions, which address and acknowledge the readers as participants in the discourse, take various forms: name of other researchers (or groups), @mentions of other researchers, second person pronoun, including inclusive we, and images of the other researchers (usually with members of the group, to show their links with them). In the corpus analysed, @mentions of other researchers had an important networking function. @mentions were used to refer to other researchers, and thus show their relation with the group (e.g. 18), and, more frequently, to direct the message to them, usually to congratulate them, to ask them to share information and/or bring them into the conversation (e.g. 19–20). In conference tweets, @mentions were often used to interact with presenters (e.g. 19), or to indicate that they are replying to another participant. As can be seen in example (20), @mentions can be used to address the tweet simultaneously at several users, including both expert and non-expert users. Some tweets include a list of @mentions at the end of the tweet, as a way to share and "push" it to imagined audiences who may be interested in the content of the tweet and make the tweet part of several conversations.

(18) A new collaborative publication with the *@Pericas_Lab* in Synlett! (MG)
(19) *@MaggieCheang*, great work on paloma2 and pallet (SG)
(20) pls share *@STynesideAB @MrsFJ70 @EmergingMindsUK @mapyoungpeople @actagainstbully* (TG)

The references to the reader with "you" occurred frequently in combination with directives (e.g. 21–23), or with questions (see examples 14 and 16 above), to encourage or invite users to do something. The Chemistry groups used this resource in promotional tweets, so that users read their papers (e.g. 21). In the Medicine dataset (particularly in the tweets of the TOPIC Group, who does research on mental health) "you" referred mostly to the general audience or to practitioners, and was used in tweets calling for action or tweets for public outreach (e.g. 22–23). A common pattern was "if you", used to anticipate readers' interests/concerns, in order to persuade them to do something or access a resource.

(21) @ruthmaust's paper on the controlled polymerization of CPPs has been published in @ACSCentSci! If, like us, *you* like graphitic materials, aromatic hydrocarbons, fluorescence, and/or polymers, check it out (MG)
(22) If *you* are a parent or carer of a young person who self-harms, consider signing up for this study (TG)
(23) 👋 If *you*'re having a hard time managing your feelings, it's really important to talk to someone about it. This short @bbcbitesize video based on the findings of the @EmergingMindsUK Co-Ray Project will help *you* understand how *you* can get some support (TG)

There were also a few cases of inclusive "we", which served to create a sense of disciplinary community, or to establish a bonding with a group (e.g. "In 1977, we produced 50 million tons of plastics globally (…) @GCoatesCornell @CornellChem spoke to us about sustainable polymers & issues in plastic") or with a broader audience (e.g. "We've never been in a situation like this before. It's the first time any of us has been faced by a pandemic").

5.4.4. Directives

Directives are used for various purposes. In tweets intended to encourage the reader to access a new publication or a resource by the group, directives were used to direct the reader to the hyperlinked paper or resource (e.g. "check out/read our paper", "watch the video", "access it"). They were also used in tweets intended to encourage various audiences (students, researchers, practitioners, general public) to carry out different actions, such as register for a course, conference or workshop organised by the group, apply for a PhD position, participate in a study ("don't miss", "register", "retweet"). While in the Chemistry dataset the most frequent directives were "check out" and "read", to direct the reader to the group's new publications, the directives occurring in the Medicine dataset suggested a more general audience and a disseminating purpose (e.g. "learn more", "find out more", "see video below for full information"). In addition to imperatives, the TOPIC account also included other types of directives ("let's", "it's important"), used to connect with a wider audience.

5.4.5. Discipline related humour

Discipline related humour also serves to signal belonging to a disciplinary community and to create bonds with this community. Humour was only used in tweets by the Fors group (19 tweets) and in one tweet by the Martin group. Interestingly, these are the Twitter accounts run by students. The dataset of the Fors group included different resources for humour. The most common one is memes (see Figure 5). In most of these memes, in order to obtain the intended humorous

Figure 5. Tweet with discipline-related meme.

effect, users need two types of knowledge: knowledge of the meme (which usually makes reference to popular culture) and disciplinary knowledge. Solidarity is constructed because only members of an exclusive group (discipline members, PhD students) can get the full humorous effect. In other tweets, humour was created through linguistic means (e.g. wordplay), such as the rhyme in the tweet in Figure 6, which serves to present informally and creatively the group's newly published research. Humour can also be created through a combination of text and pictures. For instance, one of the tweets displays the text "A good PI can be hard to find", together with a picture of the group, where the Principal Investigator is difficult to spot and recognise, because he is behind a glass. The "Chemistry sea shanty" video (see Figure 2) is another example of the variety of resources used by the group to engage the audience through humour.

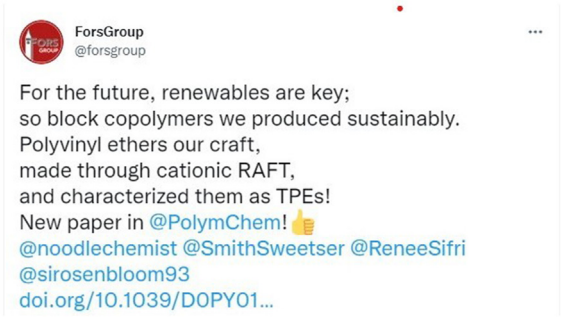


Figure 6. Tweet with discipline-related humour.

5.5. Interaction between interpersonal markers to achieve the tweet's purposes

Various semiotic resources are orchestrated in the tweets to construct interpersonal meaning and thus achieve networking and persuasive purposes. Research groups promote their work and show that they are competent researchers by deploying and combining various types of resources in their tweets: (i) self-mentions, to project their academic identity, enhance their visibility, present their research and inform of their achievements; (ii) attitude markers, to evaluate their own research positively, seeking a similar positive response from readers; (iii) attention-getting visuals, to draw attention to their research and academic activity; and (iv) directives, to encourage the readers to access their publications or other research outputs. The tweet in Figure 7 shows how several semiotic resources are combined to draw the readers' attention to a new publication and persuade them to access it: directives ("Check out", "delve into"), self-mentions (@MartinLab_ICIQ, Craig Day, @RosieSomervill3), the attention-getting emoji ⚠️ related to the propositional content ("undesired"), and the graphical abstract.

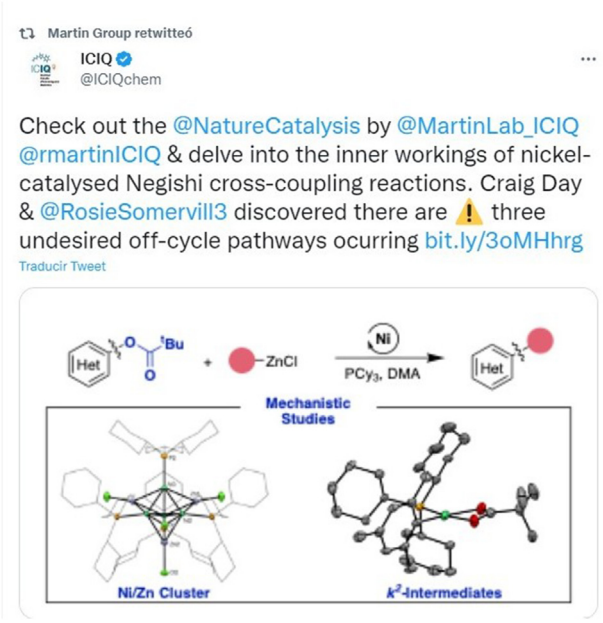


Figure 7. Tweet to promote a new publication.

Pictures of the members smiling and gazing at the camera or pictures of the whole group that suggest a friendly working environment contribute both to promoting the group and engaging the readers. An interesting practice of two of these groups (Martin Group and TOPIC Group) is to use their Twitter account to introduce the members of the group, by displaying a picture of the member smiling at the camera and some information, both professional and personal (e.g. field of research, hobbies, motivations) (see Figure 8). In these tweets, pictures are combined with other resources, such as first-person pronouns ("In high school, *I* dreamt about being…"), or proper names, to create proximity, maybe with the intention of attracting other members to the group.

Tweets which seek to strengthen the group's relations within the disciplinary community tend to combine several of the following interpersonal resources: (i) reader mentions (both linguistic and visual), which help to make other researchers visible, validate them as members of the disciplinary community, display the group's connections with them, and invite them to engage in the conversation; (ii) attitude markers, to express a positive stance towards other researchers or their output; (iii) appeals to shared interests and concerns, which help to claim solidarity; (iv) directives, to invite others to access shared resources; and (v) disciplinary humour, through memes or other resources.

The high frequency of directives in the corpus shows that many tweets are intended to call the reader to different types of material actions. In addition to directives, these tweets usually include other interpersonal resources that contribute to this persuasive goal, such as attitude markers conveying positive evaluation (e.g. "useful resource"), reader pronouns which address specific audiences directly and show the interest of performing the action for them, or emoji that reinforce the

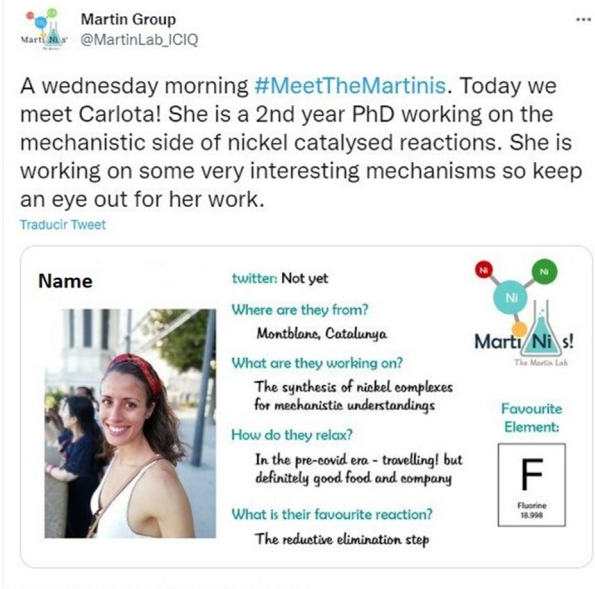


Figure 8. #MeettheMartinis tweet.

directive. Tweets intended to disseminate knowledge to a wider audience tend to display resources that help to connect with this audience, such us reader pronouns, which narrow the social distance with the audience, questions to raise their interest, and a high variety of visuals to attract their attention.

6. Conclusions

The aim of this study was to explore the multimodal practices of research groups when using Twitter, focusing on the ways various resources (linguistic and visual) are employed to project an identity, convey a stance and engage the audience in these space-constrained texts. This study has revealed that tweets written by research groups are highly interpersonal texts, displaying a large number of semiotic resources to express stance and engagement (4.69 instances of interpersonal devices per tweet). These tweets are particularly rich in resources that attract the readers' attention, highlight affect and solidarity, and create an egalitarian, personal and informal relation with the readers, i.e., self-mentions, attitude markers, attention-getting resources, reader mentions, appeals to shared interests, humour, directives. The specific categories of interpersonal resources displayed in these tweets and the high number of occurrences when compared with traditional genres of academic communication (e.g., research articles) can be explained by the highly promotional, interactive and persuasive nature of these texts. The length constraints of tweets may also account for the high number of stance and engagement devices and the use of non-linguistic resources: tweeters need to optimise the 280 characters of the tweet and harness the multimodal affordances of the medium to achieve their purposes.

The findings have demonstrated how visuals are co-deployed with linguistic resources to convey interpersonal meaning in the tweets in the corpus. Emoji help to express attitude and create intimacy and draw the readers' attention to important content, among other functions. Images of researchers are a powerful means of self-representation, which both help to visualise the researchers as competent members of the community and bring them closer to the reader. Other visuals attract the readers' attention to the content of the tweet. Conventions that are particular to social media, such as hashtags, @mentions or memes, are also prominent interpersonal resources in academic tweets, contributing to promoting the group and constructing solidarity and dialogicity.

The analysis has also revealed that the choice of specific stance and engagement resources and their orchestration in the tweet are guided by the purpose(s) of the tweet: self-promotion, community building, disseminating knowledge to wide audiences, and persuading various stakeholders to carry out particular actions. The results suggest that research groups employ multiple semiotic resources strategically; the differences in the type and frequency of interpersonal resources observed in the four Twitter accounts can be explained, at least in part, in terms of each group's communication agenda, specific purposes (e.g. advertise their research, attract members to the group, provide resources for the general public), their imagined audience(s) (members of the discipline vs. more diversified audience), and the type of relationship that they want to establish with these audiences.

Finally, the results shed light on the changes that digital genres are bringing to academic communication. Three salient feature of the expression of stance and engagement in the tweets in the corpus are informality, researcher's enhanced visibility and creativity. Informality is reflected not only linguistically (reader pronouns, questions, informal attitude markers), but also in the use of emoji and other visuals, and in the use of humour. These informal resources help to express familiarity

and establish a friendly and intimate relationship with the audience, which contributes to persuasiveness. Researchers are "visible" not only linguistically, but also visually, through pictures and videos, which contributes both to authority and proximity. Creativity is reflected, for instance, in the adaptation of semiotic resources which are frequent in tweets (emoji, memes) for the expression of stance and engagement in academic contexts.

To sum up, the present study adds to the still scarce research on how multimodal semiotic resources are co-articulated when composing digital genres for science communication. It seeks to contribute to the understanding of academic Twitter and of the important role of both linguistic and visual resources for the expression of interpersonal meaning in academic tweets. However, considering the scope of the research, which has focused on the Twitter accounts of research groups in two disciplines, further research is needed to determine the extent to which the results are applicable to tweets by individual researchers and to tweets in other disciplines.

The study will hopefully provide insights that could help to develop pedagogical approaches to academic tweeting. Researchers (and more particularly research groups) who want to use Twitter for self-promotion, networking or knowledge dissemination could benefit from instruction which makes them aware of how various semiotic resources can work together to achieve these purposes. This instruction could involve helping them develop skills for digital multimodal composing (Hafner, 2020), so that they can combine multiple semiotic resources effectively when composing their tweets. Instruction could also involve making researchers aware of the possibilities offered by Twitter features such as hashtags or mentions. It is also important to focus on the informality of this type of discourse, and on the features that are effective in this new rhetorical context to engage various types of audiences.

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