Detecting Sarcasm in Communication on Twitter

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Abstract

Sarcasm is a complex multimodal phenomenon that can be difficult to detect even in face-to-face communication, meaning it may be even harder to recognize in communication on social media, considering the absence of intonational and gestural cues. This thesis deals with the ways in which sarcasm is delivered and recognized on Twitter. A manual qualitative analysis of 31 tweets showed that Twitter users try to replicate the same principles that are used in oral communication, firstly, by using the same fixed lexical expressions, interjections and intensifiers, and secondly, by substituting intonational cues with punctuation, word and phrase capitalization and letter duplication, and gestural cues with emojis, images and GIFs. Although the presence of most of these cues by itself does not necessarily indicate sarcastic intent, the results showed that most Twitter users combine multiple multimodal cues, which makes sarcasm detection easier.

Key words: sarcasm, sarcasm detection, Twitter, cues, multimodality

1. Introduction

Although Twitter has been one of the most popular social media outlets for many years, its popularity skyrocketed during the pandemic as its conversational style was exactly what people needed during that time[1]. It allowed its users to freely express their opinions, thoughts and views on people, products and events, as well as engage in conversation with other users around the globe. These features make Twitter a valuable source of information for sentiment analysis and opinion mining, which turned out to be especially useful for companies, as it helps them understand their customers' opinions about their products and their competition (Giachanou and Crestani 2016). The challenge that sentiment analysis is faced with is the usage of sarcasm, as sarcasm is "a type of sentiment where people express their negative feelings using positive or intensified positive words in the text" (Bharti et al 2016, 108). Furthermore, sarcasm detection on social media is a challenging task by itself, as cues that are used in face-to-face communication such as tone of voice, facial expressions and gestures are absent, with sarcasm detection on Twitter being even more difficult as the brevity of tweets allows more ambiguity and the language used is informal, containing slang, abbreviations and typos (Sarsam et al 2020).

Most research that deals with the topic of sarcasm detection on Twitter has focused only on the linguistic features of sarcasm with the data collected and analysed computationally. In regard to that, the aim of this thesis is to manually identify how Twitter users convey sarcasm and provide a systematized overview of the cues that indicate sarcastic intent in communication on Twitter. The first two chapters give a brief introduction to sarcasm and sarcasm detection on Twitter, as well as the overview of previous research dealing with this topic, while the fourth chapter introduces the method, examples and results of the research.

2. Sarcasm

The word sarcasm originates from the Greek verb "sarkazein", meaning of which was originally "to tear flesh like a dog", but eventually became "to sneer"[2]. While on the receiving end of a sarcastic comment, one may in fact feel like being torn apart, since sarcasm can be

[1] https://www.thedrum.com/opinion/2021/09/06/why-twitter-making-comeback-one-the-most-popular-social-channels

[2] https://www.merriam-webster.com/dictionary/sarcasm

defined as a “meaner form of irony that tends to be offensive and directed towards other people or products” and irony implies some kind of incongruity between what is said and meant (Barbieri et al 2014) or the situation in which it is used (Skalicky and Crossley 2018). But why do people use sarcasm? Functions of sarcasm include “increasing the perceived politeness of the criticism, decreasing the perceived threat and aggressiveness of the criticism and creating a humorous atmosphere” (Shamay-Tsoory et al 2005). By using sarcasm, people mostly want to express their negative opinions by using positive sentiment words, which help conceal speaker’s hostility, and, at the same time, increase the humorous effect on the listener (Wang et al 2022). Most adults have no issues in deciphering if an utterance is sarcastic or not, however, it can be challenging for young children and individuals with autism or brain damage (Pexman 2018). Research has shown that difficulties in understanding sarcasm may indicate lack of ability to recognize and understand social cues as intentions, beliefs, and emotions. In addition, sarcasm interpretation requires knowledge of its situational relevance, as well as shared knowledge between the interlocutors and the possession of a cognitive mechanism known as the theory of mind, i.e., the ability to understand our own and other people’s mental states, emotions, beliefs, opinions (Shamay-Tsoory et al 2005). If the hearer fails to recognize the disparity between what is said and the reality of a situation, sarcasm will not be recognized or appreciated. To avoid that, speakers often tacitly emphasize “the contrast between the semantic content of the utterance and what they intend to communicate” by using implicit clues such as their facial expressions, gestures and the tone and rhythm of their voice (Matsui et al 2016, 75). Sarcasm detection has been a topic of interest across many disciplines, such as linguistics, computational science, psychology, and social sciences, and while they all deal with the same subject matter, they vary in their objectives. For example, psychology and social sciences focus on the “why” and “when”, i.e., situations in which people use sarcasm and the reasons behind it, while linguistics and computational science concentrate on the “how”, i.e., the ways in which sarcasm is communicated and in which it can be recognized. However, linguists mostly deal with the ways humans convey and detect sarcasm, whilst computational scientists concern themselves with automatic sarcasm detection and developing models and algorithms for sarcasm detection (Das 2019). One thing is certain, sarcasm is a multimodal phenomenon, detection of which involves finding contextual or linguistic discrepancies, which in turn would be impossible without information obtained from shared knowledge/context history or multimodal cues (Castro et al 2019). Due to the rise of the Internet, a vast amount of people’s everyday communication has been taking place on the social media and sarcasm is a major part of it. However, communication online largely differs from the face-to-face

communication, which makes sarcasm detection on the Internet more difficult and dependent on other factors, as tonal and gestural clues are absent.

3. Sarcasm detection on Twitter

According to Britannica, Twitter is an "online microblogging service for distributing short messages among groups of recipients via personal computer or mobile telephone"[3]. Users communicate through brief messages called "tweets", which can be on any subject, but are limited to 280 characters. Multimodal attachments such as URLs, images and videos can be added to them. Users can choose to follow other users, as well as specific topics. Due to its specific features which affect how language is used, language on Twitter is much different from languages on other social media. Its most distinct feature is its brevity. Twitter posts are limited to 280 characters and thus much shorter and more concise than those of social media outlets such as blogs, magazines, Facebook or Reddit. On the other hand, although tweets may be similar to text messages and online chat in relation to their shortness, they allow any other user on the platform to comment, which provides opportunities for discussion on a wide variety of topics (Hu et al 2013). These features also act as an encouragement for using slang, shortened lingo, emoticons, hashtags, and other expressions present in the informal lexicon (Davidov et al 2010). Research has shown that "Twitter users bonded over expressing sympathy, worry and frustration", and the tool that is often used for expressing frustration, simultaneously boosting group solidarity, is sarcasm (Sykora et al 2020, 3). However, detection of sarcasm in communication on Twitter can be difficult, considering the absence of tonal and gestural clues which make sarcasm more easily detectable in face-to-face communication.

So, how can one recognize if a tweet is sarcastic? Many researchers dealt with features of sarcasm on Twitter, for example, Cai et al (2019) and Das (2019) developed models for sarcasm detection that included features like text, image, and image attribute features or reactions/emojis and found that multimodal approach showed superiority over the unimodal approach (text only). Barbieri et al (2014) mention seven groups of features important for detecting sarcasm on Twitter – frequency, written-spoken, intensity, structure, sentiments, synonyms, and ambiguity. Frequency refers to the disparity between common and uncommon words, with the assumption that irony, as well as sarcasm, is closely connected to unexpectedness and the surprise that stems from it. Their opinion is that the use of different registers within a tweet, i.e., the use of many words of high frequency (words that are commonly used in English) and

[3] https://www.britannica.com/topic/Twitter

the use of only few low frequency words (words that are rarely used in English) in a single tweet, results in a lack of balance that can cause unexpectedness. Written-spoken feature involves unexpectedness resulting from the usage of informal spoken style words in a formal written style tweet, or formal written style words in an informal spoken style context. Intensity relates to the usage of adjectives and adverbs and to the degree in which those words are exaggerated in order to convey a statement opposite of what is said, i.e., sarcastic. Furthermore, structure refers to the length of the tweet (the number of characters that make a tweet), the length of the words that are used (as well as the frequency of each part of speech), punctuation (the sum of all commas, full stops, exclamation marks, quotation marks, ellipsis) and the usage of emoticons. Sentiment feature involves assigning each tweet a sentiment score of positivity or negativity and examining sentiment imbalances between words. The next feature deals with the frequency of the synonyms - since sarcastic tweets convey two meanings at the same time, the choice of a word instead of one of its synonyms is crucial. Last, but not least, ambiguity relates to the usage of the words with many meanings rather than the ones with only a few meanings, which makes it easier to convey both literal and intended meaning at the same time.

While the focus of research by Barbieri et al was mostly on lexical features, Bamman and Smith (2015) argue that including extra-linguistic data derived from the context of a tweet (author/audience features) helps in achieving better accuracy in sarcasm detection. In their research, they included four types of features: tweet features, author features, audience features and environment features (response) and found that author, audience, and environment features show statistical significance in bettering of the sarcasm detection accuracy. Bharti et al (2016) mention different types of features used to identify sarcasm, as well as seven different types of sarcastic posts that appear most often. Features that help in sarcasm detection can be divided into lexical, pragmatic and hyperbole. Lexical features of a text include text properties such as unigrams, bigrams, n-grams, while pragmatic features refer to figurative text such as emoticons, hashtags, @user, replies, etc. and are considered to be some of the most powerful features in sarcasm detection. Finally, hyperbolic text involves intensifiers such as adjectives or adverbs, interjections, punctuation, quotation marks, etc., and the tweets containing it have a higher chance of being sarcastic. For example, it is much easier for people to detect that the utterance “fantastic weather” while it is raining is sarcastic, than the utterance without the hyperbole “the weather is good”. As for the types of sarcastic posts that appear most often on Twitter, Bharti et al (2016, 111) point out “T1 – sarcasm as contradiction between positive sentiment and negative situation, T2 – sarcasm as a contradiction between negative sentiment and positive

situation, T3 – tweets that start with interjection word, T4 – sarcasm as a contradiction between likes and dislikes, T5 – sarcasm as a contradiction between tweet and the universal facts and T6 – sarcasm as a contradiction between tweet and its temporal facts". The first type of sarcastic posts that refers to the contradiction between positive sentiment and negative situation arises from the contrast between a positive sentiment word (love, adore, enjoy, etc.), and a stereotypically negative activity or state (cleaning, waiting at the doctor, being ignored, etc.) (Riloff et al 2013), as in the sentence "I just love being woken up early on my day off" and it is the most common type of sarcasm. The second type of sarcastic posts is based on the contrast between a negative sentiment and a positive situation, as in the following example, "I hate being right all the time". The third type of sarcastic posts are tweets that start with interjection words such as wow, aha, yay, nah, etc., and are usually followed by an adverb or adjective, as in the sentence "Yay, more rain today". Likes and dislikes contradiction and sarcastic posts based on it refer to the user's behavioural features, i.e., sarcasm detection is dependent on user's tweet history that is analysed, and their tweets are categorized according to the post's sentiment. For example, if a Twitter user who is a fan of a football club Arsenal and often posts about it suddenly tweets "I love it when Arsenal is losing", the tweet should be sarcastic. The next type of sarcastic posts are the ones in contradiction to facts or universal truths. For example, if someone posted that "The Sun is revolving around the Earth", there is a strong possibility that the tweet is sarcastic, since it is a well-known fact that the Earth revolves around the Sun. Last, but not least, posts that are based on the contradiction to temporal facts work in the same way, with the exception of the facts or truths mentioned not being universal, but time dependent, i.e., they might change over time. For example, the tweet "I love living in Ukraine" would probably not be considered sarcastic in 2021 or will not be a few years from now, but right now, considering that there is a war going on between Russia and Ukraine, there is a high chance that this post would be considered sarcastic.

4. Research

4.1. Method

For the purposes of this master's thesis, a manual qualitative analysis of Twitter posts was conducted. Since Twitter is a social media platform much different from Facebook, Reddit or similar platforms that allow users to form groups/subreddits according to their similar interests, searching for sarcastic tweets was a challenging task. Based on some examples of sarcastic tweets and previous research that dealt with similar topics, a list of cues for sarcasm detection on Twitter was compiled, which then acted as a springboard for compiling more

sarcastic tweets. Originally, the cues included positive/negative sentiment words, lexical expressions (interjections, intensifiers), hashtags, and multimodal cues such as emojis, GIFs and images, but as the research progressed, the focus shifted towards the entirety of multimodal cues within a post, as all multimodal cues as a whole assist sarcasm detection and the analysis of those cues in isolation would be partial. The final sample consisted of 31 Twitter posts.

4.2. Results and discussion

4.2.1. Sarcasm as incongruity between sentiments

One of the ways most used to express sarcasm is the juxtaposition of a positive/negative sentiment word and usually a verb denoting an unenjoyable/enjoyable activity or situation. According to Maynard and Greenwood (2014), sarcasm stemming from this type of contrast is particularly likely if the sentiment word is a strong one (e.g., adore rather than like), if there is a swear word preceding a positive sentiment word (e.g., Fucking brilliant!) and if the activity or situation in question is stereotypically and universally considered to be positive (e.g., having a day off) or negative (e.g., going to the dentist).

Figure 1.

Figure 2.

Figure 1. illustrates an example of sarcasm that emerges from the disparity between a positive sentiment word "love" and an unenjoyable state of feeling overwhelmed by one's own mess. The example also features intensifiers "just" and "so" which make sarcastic intent more obvious, but are not necessary for sarcasm detection and will be elaborated later on (see chapter 4.2.2.). Similarly in Figure 2., it can be observed that the sarcastic intent of this tweet stems from the contrast between a positive sentiment word "love" and a situation that is evidently racist. The two do not usually go together, especially since the author emphasizes the fact that

it is white people who make assumptions when the author stands by their car, making it clear that the author is not white and that they would not view this situation as positive. The following sentence “my favorite type of racism” also includes a positive sentiment word “favorite” paired with a universally negative concept of racism, making it clear that it is sarcastic as well.

Figure 3.

Figure 4.

On the other hand, Figures 3. and 4. show examples of sarcasm stemming from the contrast between a negative sentiment word “hate” and universally positive traits such as being rich, pretty, smart, funny, etc.

Sarcastic intent can also be conveyed if the mentioned situation is not universally positive or negative, but if the author of the tweet and their audience share mutual knowledge and opinions (Muresan et al 2015). For example, if a person who just moved to a new town for work was to tweet “I love living here, I have so many friends”, people that do not know that person would probably think that the statement is true and not sarcastic, while the friends of the said person that share some knowledge of this person’s recent life events would probably recognize the tweet as sarcastic since the person just moved to a new town and it is unlikely that they have already made a lot of friends.

4.2.2. Lexical expressions as cues for sarcasm

Previous research has also shown that the usage of certain lexical expressions contributes to deciphering sarcastic intent. For example, Kreuz and Caucci (2007) found that the use of interjections (gee, gosh, oh, ah, yes, wow, etc.) was a reliable cue for sarcasm detection, while certain lexical expressions (thanks a lot, good job, not sure if, right, so, such, etc.), rhetorical questions, repetitions, and foreign phrases were also common in sarcastic utterances.

Figure 5.

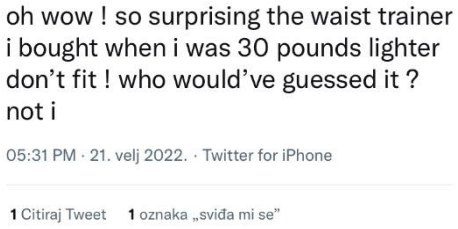

Figure 6.

Figure 5. depicts the usage of interjections "ah" and "yes" which in this case play a similar role as positive sentiment words mentioned before (like, love, adore, etc.) and the sarcasm stems from the contrast between the positive sentiment interjections and the negative situation following them ("the sound of the ambulances every 5 minutes"). If the interjections were removed, the statement "the sound of the ambulances every 5 minutes" could be understood as just that, a statement, as sarcastic intent would not have been obvious. Figure 6. represents a tweet expressing the feeling of "surprise" that the waist trainer which author bought when they were lighter does not fit anymore. The interjections "oh" and "wow", along with the adverb "so" in the phrase "so surprising" and the fixed lexical expression "who would've guessed it" make it obvious that the tweet is sarcastic.

Figure 7.

Figure 8.

Figure 7. contains the lexical expression "not sure if you know this", which in this case acts as an intensifier, since the statement "the Vikings actually invented Invisalign and tooth whitening" would most likely be deemed sarcastic by itself because it contradicts common knowledge. Furthermore, figure 8. is a tweet containing a fixed lexical expression "thanks a lot" which would usually imply a positive sentiment since the author is being grateful to somebody/something for something, but the fact that the author claims to be grateful to covid for having a negative impact on their mental health makes it clear that there is a sarcastic intent present in this tweet.

Sarcastic statements are also often strengthened by the usage of intensifiers, linguistic elements that "that can be removed or replaced while respecting the linguistic correctness of the sentence and context, but resulting in a weaker evaluation" (Van Mulken and Schellens 2012, in Liebrecht et al 2013, 31). Intensifiers usually appear in the form of adjectives or adverbs (e.g., so, too, very, really, simply, absolutely, etc.), and according to Utsumi (2000) are used to implicitly show negative attitudes through sarcasm.

Figure 9.

Figure 10.

Figure 9. is an example of the usage of intensifiers "absolutely" and "amazing" in order to convey sarcastic intent. The phrase "absolutely LOVE" paired with a negative statement "framing being held accountable for abuse as an assault on women everywhere" makes it clear that the tweet is meant to be sarcastic. In addition, the usage of caps lock in this phrase is also a cue for sarcasm, as it marks intonational focus that would be present in oral communication (see Chapter 2.4.2.1.). Additionally, adjective "amazing" in the final sentence of the tweet again combined with a statement that would usually be considered negative "how predictable the elite have become" just intensifies the negative attitude and makes sarcasm more obvious. Similarly, Figure 10. also contains a positive sentiment phrase "absolutely love" in contrast to the negative feeling of "being called racist for saying chili shouldn't have beans". The author then characterizes this behaviour as "totally cool and normal". It is apparent that the tweet is sarcastic, as being called racist for a banal thing is not something one would appreciate, and that situation would not be considered cool and normal. Intensifiers "absolutely" and "totally" act as additional cues for sarcasm detection as they strengthen the negative attitudes that the author is implicitly trying to express.

4.2.3. Hashtags as cues for sarcasm

Hashtags are words prefixed by a # symbol, used on Twitter for various purposes, such as marking and categorizing keywords and topics, promoting content, or providing extra

information about the intended context of a tweet (Scott 2015). According to Bamman and Smith (2015), if Twitter users are not familiar with their audience, they are more likely to explicitly mark their sarcastic tweets with a hashtag #sarcasm and #sarcastic. However, the aim of this thesis is to determine the implicit cues that can be used to detect sarcasm on Twitter, so tweets marked with hashtags #sarcasm and #sarcastic were not included in the research. Hashtags that are relevant to this topic are the ones that provide extra context and make sarcasm detection easier. It is important to note that hashtags that are relevant for sarcasm detection as a matter of fact provide information that is in opposition to the text of the tweet. So, the sarcasm that manifests through the usage of hashtags is actually the result of the incongruity between the sentiments of the hashtag and the rest of the text of the tweet.

Figure 11.

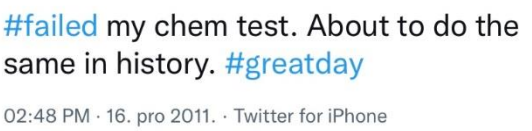

Figure 12.

Firstly, the example above (Figure 11.) shows that sarcastic intent is demonstrated through the incongruity between the hashtag #lateforwork and the text of the tweet, meaning that if the hashtag was removed from the tweet, the tweet would not be considered sarcastic, and the readers would assume that the author just had a great start of the day. However, the hashtag reveals that the author was in fact late for work that day, which would be perceived as something negative by most people and which implies that the day, or at least the beginning of that day, was not that great for them. Figure 12. shows two different ways of using hashtags in the same tweet. The first hashtag #failed is used to mark the word failed and increase tweet visibility, but it is not relevant for sarcasm detection. The second hashtag #greatday carries positive sentiment and is in contrast with the text of the tweet preceding it, as exam failure is considered to be something universally negative, making the tweet obviously sarcastic. These two examples (Figure 11. and Figure 12.) exhibit how hashtags can be used as cues for sarcasm while carrying different sentiments, as the hashtag in Figure 11. carries negative sentiment and serves to expose the sarcastic nature of the seemingly positive text, while the hashtag in Figure 12. carries positive sentiment which is in contrast with the negative situation described. In other words, the hashtag in Figure 11. makes the text sarcastic, while the sarcasm in Figure 12. lies in the actual hashtag.

Although the examples mentioned show that the cues that were originally chosen for this analysis serve as a way for the author to convey the sarcastic message and as a way for the audience to detect the sarcastic intent, the research has shown that this type of Twitter posts that contain only one of the mentioned cues (lexical expressions, interjections, intensifiers, hashtags) are in the minority. Most of the tweets that were analysed consisted of the combination of said cues (with the addition of images, gifs, emojis, punctuation), so those were the tweets that ended up being the focal point of the research.

4.2.4. Multimodal cues for sarcasm detection

Multimodality is a term used for the "interplay between different representational modes, for instance, between images and written/spoken word" (Kress and Van Leeuwen 2001, 20), or in other words, acknowledging that people produce meaning using multiple means or modes, for example image with writing or gestures with speaking (Bezemer and Jewitt 2018). In terms of digital message transmission, modern social media have shifted messages being generated and transmitted in purely textual form to multimodal form, making it richer through the addition of images, videos, gifs, emojis, different fonts, colours, etc. (Law 2020). Multimodality is especially useful in conveying and deciphering sarcasm on social media, since, as it was already mentioned in this paper, sarcasm in face-to-face communication relies hugely on gestural and tonal clues. As those clues are unavailable in communication on social media, they are substituted with images, gifs, emoticons, punctuation and quotation marks, interjections, etc., which proves that communication on social media is trying to imitate communication in person (Razali et al 2017). This is not unusual, considering that neuropsychologists indicate that in order to recognize and understand sarcasm, human brain needs multiple modalities (Yao et al 2021). Different modalities within a tweet can serve two roles in sarcasm detection. They can either provide information complementary to the text or they can provide conflicting information, which then makes sarcasm detection easier, since there is an obvious incongruity between the text and the other modalities (Castro et al 2019). Even though most research in the past dealt with text only sarcasm detection, recent studies have started to incorporate other aspects into their research, as online communication nowadays is enriched by multiple modalities. For example, Das (2019) compared performances of unimodal and multimodal approaches to sarcasm detection and found that the multimodal approach achieved higher accuracy (93.11%) in sarcasm detection than both text-based approach (82.5%) and image-based approach (84%). Furthermore, Castro et al (2019) researched if multimodal cues help automatic detection and classification of sarcasm and found

that the relative error rate of sarcasm detection was reduced by up to 12.9% when multimodal information was used instead of unimodal information. In their paper, Cai et al (2019) proposed a multimodal hierarchical fusion model for sarcasm detection that included three modalities – images, text and image attributes, and the results have shown the model to be effective, with all three of the modalities very useful. Yao et al (2021), on the other hand, took into account neuropsychology and neuroanatomy findings on sarcasm cognition and proposed a multimodal, multi-interactive and multihierarchical neural network and found that the model performance increased with the increase of modalities. Their model also proved to exceed previous optimal models for sarcasm detection. According to Liang et al (2022, 1767), "the key of effective multi-modal sarcasm detection is to accurately extract the incongruent sentiment cues from different modalities, allowing the detection of the true sentiment conveyed in the message".

4.2.4.1. Prosodic cues for sarcasm

According to Wennerstrom (2001), prosody refers to the aspect of language involving intonation, rhythm, tempo, loudness and pauses. In speech, prosody and contextual information interact and influence how the listener is going to interpret the utterance, which is especially important in sarcasm, as many speakers deliberately change the prosody to alter the message of the utterance. Detection of sarcasm in English depends mostly on these aspects of prosody: slower tempo (speech rate), greater intensity (amplitude) and lower pitch level. Research has shown that these cues are picked up easily in childhood, even earlier than the contextual cues, with the intensity appearing to be the most important prosodic cue for sarcasm identification (Peters et al 2015). On the other hand, Attardo et al (2003) found that different pitch patterns appear in sarcastic utterances: flat intonation (neither rising nor falling); pattern involving the initial phrase with a high or extreme pitch range (seemingly genuine and consistent with what is said), followed by a phrase with extremely low, flat pitch range (sarcastic intent) or vice versa; and a pattern with exaggerated pitch accents throughout the entire utterance, indicating fake enthusiasm. The authors conclude that no prosodic aspect by itself is a cue for sarcasm, but that prosodic cues for sarcasm will present themselves as an "incongruity between the pitch contour and what is said, or the pitch contour and what is meant, or perhaps even both" (Attardo et al 2003, 253).

However, the prosodic cues are DEFINITELY NOOOOT RELEVANT for written sarcasm detection…Or are they? “It is generally accepted that when reading, many (though not all) people experience a “voice in their head” which applies a default prosody to the text” (Heath 2018, 3). One of the orthographic features that trigger that “voice” is punctuation, “with full stops, question marks, exclamation marks, commas, colons, semi-colons, dashes and brackets having the potential of marking (certain) intonation unit boundaries in written language read aloud as well as signalling rhythmic pauses” (James 2017, 141). Rajadesingan et al (2015) note that most used punctuation in written sarcasm are ellipsis “…” (indicating pause), multiple exclamation marks “!!!” and asterisk “*” (indicating emphasis). They also claim that users use other prosodic variations to express sarcasm, such as capitalization of certain words or phrases to point out changes in tone, exaggerate or express their frustration, or repetition of letters (usually vowels) in words in order to highlight certain parts of the tweet to make it clear they mean the opposite of what is said. Similarly, according to Heath (2018), single-word capitalization is used to mark intonational focus in speech, which occurs as a result of the change in the emotional state of the speaker, but can be manipulated, as in acting or using sarcasm, and capitalization of a large portion or the entirety of a tweet is used to indicate heightened emotion.

Figure 13.

Figure 14.

Figure 15.

Figure 13. is an example of a tweet featuring both single-word capitalization and vowel repetition in the word "LOOOVE" in order to highlight the word, which makes the contrast between the positive sentiment word "love" and the seemingly negative rest of the tweet "when my mom gives me shitty relationship advice" even more apparent, making it obvious that the tweet is sarcastic. Intensifier "just" is another cue that makes sarcastic intent more apparent. Although emojis are about to be explained in the next chapter of this thesis, it is important to note that this tweet ends with three emojis, two heart eyes emojis carrying positive sentiment and the unamused face emoji (used to convey a variety of negative emotions[4]) carrying negative sentiment, making it even more clear that the overall sentiment of the tweet is not positive. Figure 14. follows the same sentence structure as Figure 13., with the tweet starting with the positive sentiment "I just looove", followed by the description of a situation that would be considered negative by most "being cat called by disguising [sic] men". The author also highlights the word "love" by using vowel repetition, and the sarcastic intent is ensured with the use of ellipsis "…" at the end of the sentence, which is used to mark omitted text or unfinished thought and has been proven to occur more often in sarcastic than in literal comments (Thompson and Filik 2016). The author also uses three negative sentiment emojis. Figure 15. is an example of a tweet featuring many of the mentioned cues for sarcasm. Sarcasm in the tweet is primarily based on the incongruity between the positive sentiment word "amazing" and the negative sentiment phrase "how much you all HATE me". The sarcastic

[4] https://emojipedia.org/unamused-face/

intent is made even more obvious by the author capitalizing many words in the tweet that they wish to emphasize, such as “SOOO”, “AMAZING”, “HATE”, etc. Furthermore, intensifier “so” is used with triple O’s and all of the sentences in the tweet end with an exclamation point, some even with multiple exclamation points. Their use is standard in sarcastic and ironic expressions, as they indicate emphasis (Kreuz and Caucci 2007). There is an image attached to the tweet, but is not relevant for the sarcasm detection.

4.2.4.2. Visual cues for sarcasm

In face-to-face communication, sarcasm delivery is followed by gestural cues such as raised or lowered eyebrows, rolling eyes, winking, nodding, tongue in cheek or simply a blank face (Attardo et al 2003). In online communication, those facial reactions are replaced by emojis, images, GIFs and videos. In terms of relevance for sarcasm detection on Twitter, these multimodal attachments either portray real life face expressions, or they serve to provide additional information for sarcasm detection and are mostly incongruous with the text of the tweet, making the sarcasm more obvious.

4.2.4.2.1. Emojis as cues for sarcasm

Emojis are “ideograms and smiles that can be considered the natural evolution of the emoticons (icons “typographically composed of keyboard symbols” (Tang and Hew 2019) like :) and :D)” (Barbieri et al 2016, 3967). They come in different shapes and sizes, representing different emotions, facial expressions, objects, animals, plants, weather conditions, places, etc. Na’aman et al (2017) point out three ways in which emojis are used – as stand-ins for function words (e.g. I 🍩 like you), as stand-ins for lexical words or phrases (e.g. He holds the 🔑 to my 💔) and as markers added to complete utterances in order to either express attitude (e.g. He won again 😠), emphasize the importance of the topic by reiterating it (e.g. Don’t tell anyone 😲) or to mimic the facial expression or gesture that would occur in face-to-face communication (e.g. Yeah, whatever, mom 🙄). It is important to note, though, that the annotators in this research had trouble with agreeing whether certain emojis belong in the attitude, topic or gesture category, as some of the emojis are inherently ambiguous and better labelling system might be needed. Similarly, Thompson and Filik (2016) indicate that a major function of emoticons is to ensure the correct message interpretation, whether by expressing a positive attitude or indicating sarcasm or humour. In their research, they studied how people used emoticons to ensure their intentions came across clear in written communication and found that participants used emoticons far more frequently while trying to convey a sarcastic message

than a literal one, and emoticons that were almost exclusively used in sarcastic contexts were a tongue face (:P) and wink face (;)) emoticons, while the basic smile face emoticon (:)) was mostly used in messages with literal meaning. Furthermore, Garcia et al. (2022) researched how emojis influence intergenerational sarcasm comprehension and the results have shown that older adults experience difficulties in perceiving and interpreting sarcastic intent in comparison to younger people, but that their performance significantly improved when a sarcastic message was accompanied by a winking face emoji. Another emoji used for conveying sarcasm (as well as irony, joking, a sense of goofiness or silliness), according to Emojipedia, is the upside-down face emoji (🙃)[5]. Mohd Noor and Abd Aziz (2021) in their article dealt with the challenges that ambiguous nature of emojis poses in the judicial system. They also stated that the upside-down face emoji can convey sarcasm, irony, or passive aggression. Their explanation was that the emoji looks opposite to the basic smiley face emoji, which is why its presence makes the statement appear opposite of what it says. According to Subramaniam et al (2019), five most frequently used emojis on Twitter are the face with tears of joy, the winking face, the face with stuck out tongue and winking eye, the unamused face, and the grinning face with smiling eyes. All five emojis often appear in sarcastic comments, with the last four being used almost exclusively in the sarcastic context, while the face with tears of joy is the most used emoji on Twitter, almost equally in sarcastic and non-sarcastic settings.

Figure 16.

Figure 17.

The example in Figure 16. features a statement followed by the upside-down face emoji. Despite the sentence "The misogyny has been fun." not being sarcastic by itself, the fact that the author of the tweet is a woman would make one believe that the tweet is in fact sarcastic, since it would be logical to assume that almost no woman would find hatred towards women fun. The addition of the upside-down face emoji makes the sarcastic intent of the tweet even more apparent. Figure 17. represents a response to the tweet saying that Donald Trump might be the most popular man in the world right now. The author of the tweet clearly disagrees with

[5] https://emojipedia.org/upside-down-face/

that statement as they posted a sarcastic response, basically saying that if Trump is the most popular man in the world right now, then "Elvis is alive, the Earth is flat and Jesus will be back next week". As it is universally known that all of those statements are false, it is clear that the author is being sarcastic, yet their sarcastic intent is made even more obvious by the usage of the crying face emoji.

4.2.4.2.2. Images and GIFs as cues for sarcasm

Even though Twitter is a predominantly textual social media platform, it still allows multimodal attachments, such as images and GIFs. Due to the character limit of 280 characters per tweet, many users utilize these multimodal attachments to provide extra information or to make their tweets more visually appealing. In sarcastic posts, these visual markers are used either to illustrate the literal meaning or, more often, to demonstrate the incongruity between the literal and the intended meaning. An image or GIF by itself is not considered sarcastic most of the time, but it can play a crucial role in determining whether the text or a tweet as a whole is sarcastic or not (Schifanella et al 2016). Das and Clark (2018, 56) claim that "images can be a good predictor of sarcasm in shared content on social media" because most of the time they include visual clues that provide the viewer with all the information and context needed for correct sarcasm detection. Schifanella et al (2016) emphasize that there are two types of images that appear within sarcastic tweets, an image that provides additional clues that make the comprehension of the intended meaning of the text easier, but is not necessary to find the post sarcastic, and an image that provides context or visual clues needed to interpret the post, because the intended meaning is not obvious when looking at the text on its own. The authors conducted two experiments to investigate the importance of images for sarcasm detection. They collected 1,000 sarcastic posts that originally consisted of text and a complimentary image (not necessary for sarcasm comprehension) and asked the annotators to mark the posts as sarcastic or not. Then they took all the posts that annotators deemed not sarcastic and presented them to the annotators again, this time with an image attached, and asked them to decide if the posts were sarcastic once again. The results have shown that more than half of the posts were misclassified as not sarcastic, which proves that although an image might not be necessary for sarcasm understanding, in some cases it provides crucial clues for the correct interpretation.

Although the same roles that images have in sarcasm detection can be applied to GIFs, there are some characteristics of GIFs that distinguish them from images. A GIF or Graphic Interchange Format is a type of compressed digital image file that can be either a static image

or animated loop of image sequences, with the latter used more frequently on social media (Ash 2016). GIFs can be used as a representation of affect or the author's current embodied reaction that cannot be expressed through text or static multimodal attachments like emojis or images. GIFs can have many different meanings which makes them appealing to different audiences and applicable in multiple contexts. Furthermore, "the automatic looping of a GIF allows it to create meaning, provide layers of significance, highlight details and events, encourage and reward repeated viewing, and create seamless content through perfect loops where the beginning and the end are difficult—if not impossible—to identify". Since GIFs are usually snippets extracted from movies, tv shows, etc., in addition to providing additional information to the text, they allow the author to add their own personal touch by choosing a GIF that, for example, was extracted from a movie they like or featured a celebrity they are a fan of (Miltner and Highfield 2017). By using that type of GIF to convey a sarcastic intent in addition to the text that by itself is not sarcastic, the author can intentionally or unintentionally provide only the members of a certain community (people that watched a certain movie/TV show, fans of a certain celebrity) with the opportunity to detect and understand the sarcastic intent.

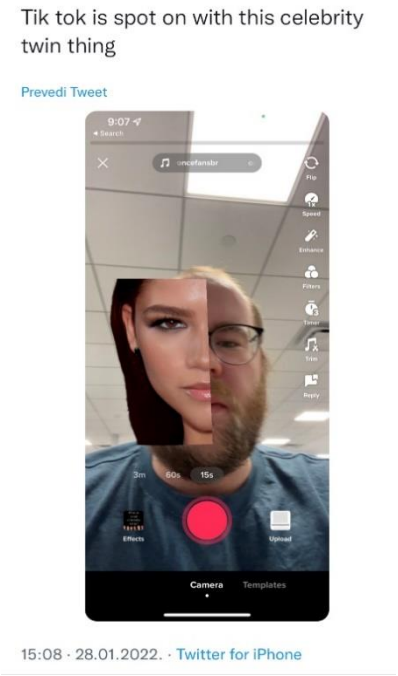

Figure 18.

Figure 19.

Figures 18. and 19. are examples of tweets that consist of a non-sarcastic utterance accompanied by the image which contains the visual clues needed to decipher the sarcastic message of the tweet. In Figure 18. the author is talking about the accuracy of a filter that supposedly matches one's face with a celebrity lookalike on a currently very popular social

media app called Tiktok. The sentence “Tik tok is spot on with this celebrity twin thing” would make one believe that the author was being literal and was in fact satisfied with the accuracy of the said filter. However, the presence of the image makes it clear that the sentence is in fact supposed to be sarcastic, since the image portrays the Tiktok filter pairing a white balding man with ginger/lightly coloured facial hair and glasses with Zendaya, a young mixed-race actress who has long dark brown hair and heavy makeup. The pair could not be any more different, so it is clear that Tiktok was not spot on with the celebrity twin thing and that the intended meaning is opposite of what was said, i.e., sarcastic. Similarly, Figure 19. features the text “Nice parking.” which by itself does not look sarcastic, but it is accompanied by the image picturing a FedEx truck hanging off a concrete wall or fence, making the tweet obviously sarcastic as the vehicle is certainly not parked nicely.

Figure 20.

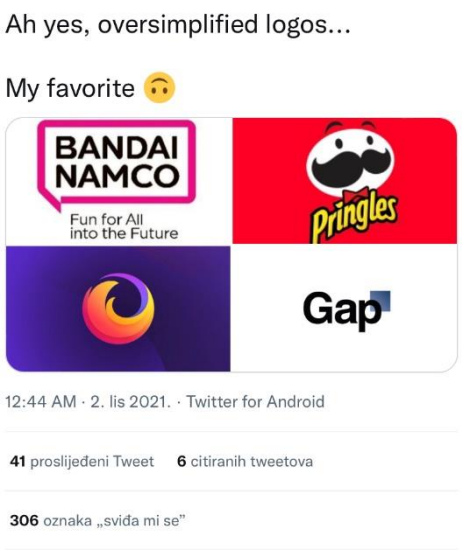

Figure 21.

Figures 20. and 21. represent tweets with an image in the complimentary role, meaning that the image is not necessary for sarcasm detection. In Figure 20. the sentence “Fantastic weather for the rest of the week” is not sarcastic by itself, but it is followed by the hashtags #london and #rain, making the sentence appear sarcastic. The sarcastic intent is confirmed by the addition of the image that shows the forecast for London, predicting rain for the most part of the following week. Without the image, one might think that the hashtag #rain describes current weather conditions and that the sentence “Fantastic weather for the rest of the week”

implies that the author is happy that great weather is forecast for the rest of the week after that current rainy day. Figure 21. features a tweet saying “Ah yes, oversimplified logos… My favorite 🙃” accompanied by the image showing examples of those logos. The text by itself would be enough to deem the tweet sarcastic as it contains other cues that are typically used in sarcastic statements, such as interjections “ah” and “yes”, ellipsis “…” and the upside-down face emoji. Thus, the image is not necessary, but serves to provide examples of what the author is talking about.

Figure 22.

Figure 23.

Figure 22. is a representation of a sarcastic tweet accompanied by a GIF. The text of the tweet bears positive sentiment, but the sarcastic intent can be suspected because the author keeps repeating how much they love going to the dentist and how much fun it was, and going to the dentist is one of those situations universally deemed as negative. It is possible that some people simply enjoy going to the dentist, however, the repetition of the statement that going to the dentist is great serves to intensify the text, and intensifiers are often used to indirectly express negative attitudes. Additionally, the GIF attached displays an old man visibly shaken, on the verge of tears, with his hand covering his mouth and then waving goodbye. The GIF is in contradiction with the positive sentiment of the text of the tweet, which makes it even more clear that the tweet is sarcastic. Moreover, the GIF was extracted from the TV series Doctor Who, and although it is possible that the author chose this particular GIF simply because it matched the sentiment that the author wanted to portray, it could also be that the author is a fan of the show who wanted to express that and provide the members of the same community with

more context to the tweet. Figure 23. features a tweet containing the text “oh no, poor Carlton”, followed by the GIF of a little girl looking serious, then turning to the camera with a sneaky smile, looking like she is plotting something. Even though the context is not really needed to recognize the sarcastic intent, the text most likely refers to the Australian football club that lost their latest match to Melbourne, and while it contains the cue for sarcasm in terms of interjections “oh” and “no”, without the GIF it would not be possible to discern whether the tweet is meant to be taken literally (expressing sympathy or pity) or sarcastically. However, the GIF of the little girl with an evil sneaky smile makes it clear that the text of the tweet and the sentiment of the GIF are incongruous and that the tweet is actually sarcastic.

Many authors believe that prosodic cues seem to provide more information than the semantic cues, while behavioural cues such as laughing supersede both intonational and semantic cues (Attardo et al 2003). In terms of sarcasm detection online, that would mean that prosodic cues such as punctuation, capitalization and letter duplication make sarcasm detection easier than just lexical cues, while the visual cues, i.e., emojis, images and GIFs provide more information relevant for sarcasm detection than the prosodic and lexical cues. It is logical to assume then that if there are more multimodal cues in a tweet, sarcasm detection is easier. The proposed multimodality scale/hierarchy for sarcasm detection would then be:

Lexical cues < prosodic cues < emojis < images < GIFs

4.2.5. Examples of posts containing multimodal cues for sarcasm detection

Previous examples showed posts in which sarcasm was exposed mostly by using only one of the cues for sarcasm detection that were mentioned before in this thesis, when in reality most Twitter posts contain a combination of those cues, which is not unusual as more cues equal easier sarcasm detection. The following examples feature a combination of the cues for sarcasm detection that were analysed in this thesis.

Figure 24.

Figure 24. displays a tweet that was posted in response to another tweet ("a jedi's weapon deserves more respect"). A jedi's weapon refers to the lightsaber, a fictional energy sword used in Star Wars movies. The response "Ah yes… the weapon that was used to murder a bunch of children deserves more respect 🙃" + GIF contains couple of cues for sarcasm. The first cue are the interjections "Ah yes" followed by ellipsis (triple dot indicating an omission of a word/sentence or an unfinished thought) which has been proven to appear more often in sarcastic than in literal comments (Thompson and Filik 2016). The sentence that appears next is clearly sarcastic, since there is a contrast between the positive sentiment of the phrase "deserves more respect" and the negative connotation of the utterance "the weapon that was used to murder a bunch of children". The tweet ends with an upside-down face emoji which was mentioned as one of the emojis which make the sarcastic intent more apparent. Finally, there is a GIF attached to the tweet featuring a scene from the Star Wars movie of a lightsaber igniting in front of children. The GIF by itself is not sarcastic and it would not be enough to detect that a tweet is sarcastic, but it serves to provide more context to the tweet.

Figure 25.

Figure 25. is a tweet ("I love getting stood up for a date… best feeling ever 🙃") that also exhibits multiple cues for sarcasm detection. First and most obvious is the incongruity between a positive sentiment verb "love" and universally negative situation "getting stood up for a date", followed by the ellipsis, which is another cue for sarcasm. Since nobody likes getting stood up for a date, "best feeling ever" is an exaggerated phrase, consisting of the intensifiers "best" and "ever", which are also common in sarcastic utterances. Again, there is an upside-down face emoji at the end of the sentence, frequently used emoji in sarcasm. As well as in the example before this one, there is a GIF attached to the tweet, but in this case the GIF offers a visual clue beneficial for sarcasm detection. The GIF features NeNe Leakes from the reality show The Real Housewives of Atlanta expressing her frustration and annoyance, which is in contrast with the overall positive sentiment of the whole tweet and makes the sarcastic intent clearer.

Figure 26.

Figure 26. represents a tweet saying "Dobermans are such an aggressive and dangerous breed 😂" followed by an image of a dog, a Doberman, cuddled up on the couch with a couple of young children. The sarcasm lies in the discrepancy between the textual part of the tweet which carries negative connotations and the image that opposes that statement since it clearly depicts a dog that is calm and friendly towards children. The face with tears of joy emoji at the end of the statement also signifies sarcastic intent, implying that the statement is funny and thus, not true.

Figure 27.

Figure 27. is a tweet saying “Everything is awesome ..”, followed by hashtags #laearthquake, #earthquake, #AfterShock, #shook, #thursdaymorning, #thursdayvibes, #shake and a GIF of a cartoon character SpongeBob SquarePants laying still in his bed with his eyes wide open, while everything around him is shaking. In this case, the text of the tweet is not sarcastic by itself, in fact, the overall sentiment of the textual part is positive. What makes the tweet sarcastic is the incongruity of the text and the hashtags, as well as the text and the GIF. The post would be considered sarcastic even if there was only GIF without hashtags, or only hashtags without the GIF. What hashtags do is provide the context, so the reader knows that there has been an earthquake in Los Angeles on a Thursday morning, which is enough to understand that the post is sarcastic, since earthquakes are one of those situations that are universally perceived as negative, so it would be safe to assume that not everything is awesome. If there were no hashtags, the GIF would be enough of a clue for sarcasm, since it bears negative sentiment (SpongeBob is visibly disturbed), however, it might not be clear that the author experienced an earthquake. It can also be seen that the author put two dots at the end of the sentence which in this case act in the same way as the triple dot, i.e., ellipsis, indicating an unfinished thought and being one of the cues for sarcasm detection, but not solid enough on its own.

Figure 28.

Figure 28. depicts a response (“My goodness. I feel so lucky been called an idiot. Such a gentleman. I am in love 🙃”) to an insulting tweet aimed at the author of said response. The response is clearly sarcastic, because the tone of it is very positive, yet the author is responding to the post that insulted them. The contrast between the two sentiments is the first and most obvious clue that there was a sarcastic intent. The response also features intensifiers that are

frequently used in sarcasm (so lucky, such a gentleman) and the upside-down face emoji. Attached to the response is the insulting tweet that the author is commenting on, which serves to provide more information on the subject matter, yet it does not have any role in sarcasm detection since the author already mentioned in the response that they were called an idiot.

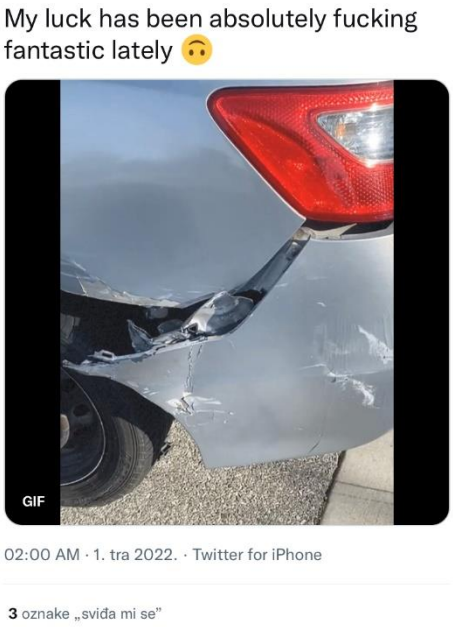

Figure 29.

Figure 29. is another example of a tweet with the attachment of a GIF. The sarcastic intent is made obvious through the contrast of the textual part of the tweet and the GIF. The text by itself ("My luck has been absolutely fucking fantastic lately 🙃") cannot be undoubtedly classified as sarcastic, even though it contains cues that help in deciphering the sarcastic intent, such as the intensifiers "absolutely", "fucking" and "fantastic", as well as the upside-down face emoji. What makes the tweet obviously sarcastic is the presence of the GIF that exhibits a damaged car, which is in contradiction to the text of the tweet, since damaging your car is something that nobody would consider fantastic or lucky.

Figure 30.

Figure 30. depicts a tweet saying “I love having covid honestly it’s great” and the image portraying a grinning Marvel character called Venom. It can be assumed that the text of the tweet is sarcastic by itself, as having covid would be considered as something negative by most people, yet the author is describing it in a positive light. However, it is possible that the author would consider having covid great in case they were fed up with work or school and being home for a while would have been helpful. The addition of the image by itself does not make the sarcastic intent clearer since the character in it, although creepy, looks happy. Nevertheless, the image contains the embedded text “I AM IN IN ABSOLUTE AGONY” which is in contrast to the image itself and the text of the tweet, indicating sarcasm.

Figure 31.

Figure 31. is a tweet with the text “Gee Thanks Putin #gas” followed by the image showing Walmart’s gas prices. Even without the image it is quite obvious that the tweet is

sarcastic. The interjections “gee” and “thanks” are indicators that there is a sarcastic intent and the hashtag #gas makes it clear what the author is talking about. Since the gas prices around the world have gone up because of Russia invading Ukraine, it is clear that the statement is sarcastic. The image just provides more context, showing the current gas prices, so it would make the sarcastic intent clearer for someone that is not familiar with the current situation in the world, but knows that the gas was cheaper before.

To sum up, the present study revealed that although written communication and face-to-face communication differ, sarcasm delivery and detection online follow the same patterns as sarcasm delivery and detection in oral communication. First and foremost, both written and spoken sarcasm mostly stem from the contrast between what is said/written and what is actually meant (Skalicky and Crossley 2018). To signal that they mean the opposite from what is being said, speakers/writters use various cues.

Some of the cues used in both spoken and written sarcasm are certain fixed lexical expressions and interjections, such as thanks a lot, not sure if you know, oh, wow, ah, yes, gee, etc., as well as intensifiers so, many, very, absolutely, etc., all of which serve as way to implicitly express negative attitudes (Utsami 2000).

The main point of distinction between written and spoken sarcasm is the absence of prosodic and gestural cues in the written sarcasm. However, both of those types of cues are still exhibited in written sarcasm, prosodic through the usage of punctuation (mainly exclamations and ellipsis), capitalization of certain words or phrases and letter duplication (Rajadesingan et al 2015). As with gestural cues, authors on Twitter use multimodal tools such as emojis (mainly upside-down face emoji and emoji with the tears of joy), images and GIFs, which allow them to mimic facial expressions and gestures they would use in face-to-face communication. Users on Twitter also use hashtags while conveying sarcasm to provide more context to the tweet and therefore make sarcasm more easily detectable.

However, the presence of any of those cues does not make the utterance sarcastic, it just exaggerates the incongruity between the literal and intended meaning, making the sarcasm easier to detect for the listener/reader. It can be assumed that most information relevant for sarcasm detection is provided by visual cues, mainly GIFs and images, followed by emojis, then prosodic cues and lastly lexical cues (Attardo et al 2003). It is also important to add that sarcasm, especially written considering it is more restrictive when it comes to non-linguistic modalities, can be quite difficult to recognize and interpret correctly for both humans and

computers (Mishra et al 2017), so most Twitter users tend to combine multiple cues within the same sarcastic statement to ensure their audience understood them, as it has been proven that utilizing multimodal cues as opposed to only one modality resulted in better accuracy in sarcasm detection (Rockwell 2005).

It is important to note the main limitation of this study. Sarcasm detection by an individual researcher may be viewed as a highly subjective process, and it is possible that the analysis would have been different if there were more annotators instead of one annotator who is also the author of this thesis, which could have resulted in a larger sample and more varied interpretation of sarcasm detection.

5. Conclusion

The purpose of this thesis was to analyse posts on Twitter in order to compile and systematize a list of cues that are being used in communication on Twitter to indicate sarcastic intent. After going through the existing literature and research on sarcasm detection, a list of initial cues was compiled, and the Twitter posts were searched by using those cues so that more sarcastic tweets could be found. A manual qualitative analysis was performed on the sample of 31 tweets and the results showed that users on Twitter try to replicate spoken sarcasm by using the same patterns and cues, or finding ways to translate those cues into the writing.

Most of the sarcastic utterances, both spoken and written, use the same principle of the contrasting sentiments (using positive words to indicate something negative and, although rarely, vice versa) and the cues that are used both in spoken and written sarcasm include fixed lexical expressions (thanks a lot, not sure if you know, good job), interjections (ah, yes, oh, wow, gee, gosh) and intensifiers (many, very, such, so, absolutely). Although these lexical cues make sarcasm detection easier, their presence on its own does not indicate sarcasm and they are considered to be "the weakest" cue of all the mentioned ones. Users on Twitter also use hashtags often in their sarcastic posts to provide additional information to their audience, making the sarcasm easier to detect. Sarcasm in face-to-face communication relies heavily on intonational and gestural cues and those cues cannot be directly mimicked in writing, but the prosodic cues are translated into written sarcasm by the usage of punctuation, word and phrase capitalization and letter duplication (signalling pauses, emphasis, exaggeration, change in tone) and visual cues are exhibited in terms of emojis, images and GIFs (simulating facial reactions, gestures, emotions). While the prosodic cues make sarcasm detection a lot more obvious, just like the lexical cues, they are not sufficient to deem an utterance sarcastic, however, they are considered

to be a “stronger” cue than lexical cues. However, images and GIFs can in some cases be essential for sarcasm recognition, so they are viewed as “the strongest” cue. As sarcasm can be hard to recognize even in face-to-face communication, the research proved that most Twitter users combine multiple multimodal cues to make the sarcasm more obvious to their audience.

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