Image-Based Memes as Sentiment Predictors

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Abstract - **This paper explores the correlation between the implied semantic meaning of image-based memes and the textual content of discussions in social media. The behavior of a meme is also distinctive as memes replicate and mutate, similar to genes in human evolution, during propagation in social media networks. This research focuses on the use of sentiment analysis to discover affective meanings of textual comments in social media that are emphasized by the use of memes. Social media provides an interesting challenge in the field of semantic textual analysis due to the prevalence of slang within casual communications. The research supports that the affective nature of a topic in social media can be emphasized by the type of meme applied to the communication. It is the relationship between the unusual multimedia element – the meme – and social media textual communications at motivate the research. In addition to identifying correlations between text and memes, trends in the use of popular memes are also identified. This research successfully demonstrated that memes are used to emphasize the semantic content in social media communications and that the meanings of memes correlate to the topics of the discussion threads.**

Keywords- Multimedia, social media, meme, affect, semantic

I. INTRODUCTION

This paper focuses on identifying relationships between the semantic meaning of textual content and the corresponding usage of image-based memes in social media. In the context of this paper, a meme is "a cultural item in the form of an image… that is spread via the Internet and often altered in a creative or humorous way [1]." The act of including image-based memes in social media is to provide emphasis to the semantic meaning of textual conversations. According to [2], semantic content identification "is one of the most important techniques in multimedia applications…."

A meme is uniquely multimodal because a meme can be both a textual representation and a visual representation. It can also be used in a multimodal context where the meme (whether with text or not) is used in conjunction with textual comments and conversations to provide emphasis, additional meaning, or an affective response.

This multimodal relationship between textual and multimedia elements is explained by [3] using an example of the term *apple*. By itself, the term might represent a computer company, but it might also represent fruit. With the addition of an image of an apple to accompany the text, the meaning of the word can be discovered through the relationship of the two entities. In the context of this paper, the meme is analogous to the image of the apple where the word *apple* represents social media communications. The meme provides additional details about the meaning of or reaction to the text.

The foundation of this research examines content that is affective in nature. The word *affective* is synonymous with the term *emotional* and identifying such content is of importance in multimedia research [4]. An early exploration of affective content in multimedia was performed by [5] in an effort to emphasize the significance of identifying affective content in image and video data. The research contrasted the differences between cognitive and affective multimedia retrieval which provided a platform for future researchers in the field. Multimedia image retrieval was originally thought to be based on actual or objective information, while the affective level was subjective [5]. Further development of affective multimedia discovery indicated that affective content could also be objective, rather than subjective, in nature if the affect was an expected result from intended actions of the designer or if the multimedia content evoked a generally similar affective response in society [6].

Affective multimedia retrieval research, which can be directly applied to the unique characteristics of image-based memes in the research presented herein, were later contributed by [7]. Though memes are described in detail in Section II of this work, memes often contain textual elements to provide context to the meme image or textual elements can be assigned to memes that provide information about the image. In [7], the emotional meaning of movie script segments were evaluated by comparing the words in the script segments to an affective dictionary. Similarly, the textual content of a meme can be used in information retrieval by comparing the relationship between the words in the meme and an affective dictionary. The implementation of this process is described in Section IV-B.

The targeted semantic content of this study focuses on the use of image-based memes to emphasize emotion in reaction to Facebook comments that contain semantically negative content. The research focuses on three main areas: semantic analysis of Facebook textual comments, analysis of image-based memes, and discovering a correlation between image-based memes and social media content. The relationship between memes and the affective nature of the textual content is also explored.

In Section II of this paper, the image-based meme is identified and various implementations of memes in social media are examined. Section III describes social media

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networks with a focus on the Facebook social media network. Sections IV and V provide the details of the research and results. Section VI concludes the findings and contributions to the field.

II. IMAGE-BASED MEMES

The term meme was originally introduced by [8]. The origin of meme comes from the Greek, *mimema*, which represents the most basic form [9] of the cultural item described by [1]. The spreading of "…often altered" [1] copies of a meme via the Internet is borrowed from human genetics and the replication of memes embodies the idea of a cultural evolution. Researchers find this behavior analogous to genes in human genetics where copies of original genes [9] pass through the human lineage. In genetics, genes both replicate and mutate and memes mimic this behavior.

The general format of a meme is generally an image with two lines of text (one at the top and another at the bottom). In the broader sense, a meme can also be an image (with no text) that is representative of an emotion, such as shock or surprise. A meme can originate from the author using photo-editing software, but the Internet has a vast array of "meme generators" that provide user-friendly interfaces for creating unique memes. A Google search for "meme generator" resulted in approximately 1,250,000 results. Users either select an existing image via the meme generator or upload their own. The generator allows the addition of the text and the image is then saved as a new image that includes the text embedded in the image.

A. Replication and Mutation

Collective attention can influence the propagation of the spread and replication of memes across social media [10] sites like Reddit, Facebook, and Twitter. For example, the death of Michael Jackson prompted elevations in collective attention [10]. Internet traffic increased by 11% upon the death of Michael Jackson [11]. A series of Michael Jackson popcorn memes is used to demonstrate replication.

The popcorn meme in popular culture shows someone eating popcorn as a reactionary image "to indicate a feeling of amusement while witnessing drama or [an] argument unfold [13]." While Michael Jackson popcorn memes existed as far back as 2007, the Michael Jackson popcorn meme was finally established as the pillar of memes in this drama-fueled category in 2011, and Reddit created the *popcorngif* sub-community in 2012 to support the popcorn meme popularity [13].

A comparison of the "I'm just here for the comments" Michael Jackson Popcorn meme shows minor mutations of the meme in the first row of Figure 1. Additional replications with minor mutations featuring Michael Jackson then emerged with additional phrases related to popcorn as shown row two of Figure 1. Further mutations with replication can be found paying homage to the original meme, some featuring other famous celebrities, referencing Michael Jackson and popcorn as shown in the last row of Figure 1.

B. The Humor of Memes

This section focuses on the portion of the definition of a meme where the meme is "…often altered in a creative or humorous way [1]." Altercation of memes was covered in Section II-A where replication and mutation were defined. This section focuses on humor. Humor is a complex emotion that is unique to humans because it is based on social interactions [13]. Humor is an interesting emotional category that contains a vast array of sub-categories. The work of [13] and [14] further break down the emotional categories associated with affective content and highlight the characteristics of humor.

In [13], the research was not in the field of multimedia, but in psychology. The researched focused on using brain scans to measure brain activity while subjects were exposed to audio files containing jokes. The researchers found that the central reward section of the brain is associated with the emotion of humor [13]. Their studies of humor provide a basis for understanding this particular emotion.

The research of [14] also focused on the nature of humor and found that humor is a complicated emotion which develops with age. Their research allowed them to create a typology of humor that could be used as a guide in identifying which groups of individuals respond to which types of humor [14].

Because the intent of evoking humor is the purpose of the meme, this usage represents the idea that affective content when using a meme is objective, rather than subjective, because of the intended affect as described in [6] and referenced in Section I.

III. THE ROLE OF SOCIAL MEDIA

This section targets the portion of the definition of a meme in [1] where the meme "…is spread via the Internet …" on social media networks such as Reddit, Facebook, and Twitter.

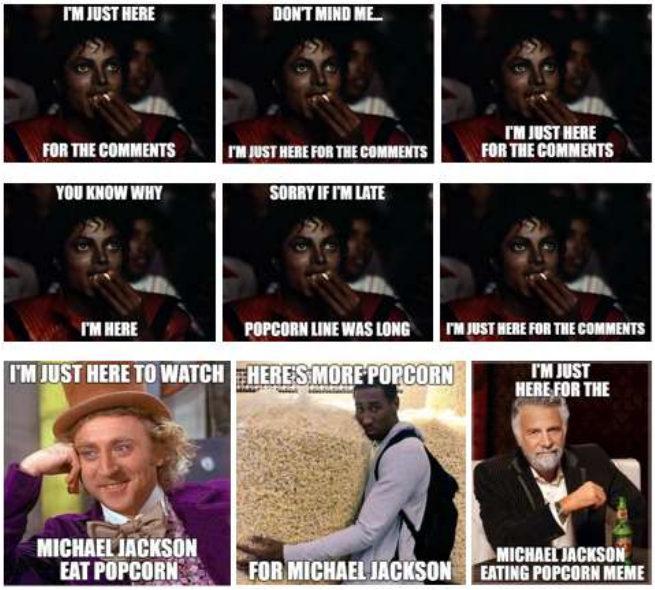

Figure 1. Meme Replication and Mutation

Reddit has an open-sharing platform unlike Twitter and Facebook where sharing is via some established connection [15]. Twitter and Facebook users make connections by establishing "followers" and "friends," respectively. In addition, Facebook connections are also recognized via groups or pages where participants in a group or users who like a page may or may not be connected as "friends."

The research herein focuses on communications via Facebook, a social media network that has billions of active users and is currently the most popular social media network [16]. Communication takes place in several formats. The most basic method of communication on Facebook is on an individual's profile page in the form of a status update. A status update by an individual is visible on the news feed of friends [8]. In addition to status updates for individual users, Facebook includes pages which are for celebrities or organizations to communicate with Facebook users [17].

Facebook also features groups, which can be open, closed, or secret. Secret groups are not searchable and require new users to be invited by an existing member, who is also a friend. Closed groups require new members to ask permission to join. New members are added by existing members. Open groups allow users to join without permission. While the he activity of an individual status update is rather limited in relation to the number of friends and/or privacy settings, groups provide a rich source of communication due to their capacity for large numbers of users. There are Facebook groups with over one million members [18].

This research uses the general term *comments* to identify a complete unit of thought, or individual post, regardless of whether the content was in the form of a status update or comment within a group discussion or on a page. Comments are textual submissions with a minimum of one character and may include several words or phrases. Images may or may not accompany a comment.

IV. Methodology

Because of the multimodal nature of the content, the methodology included analysis of the textual content in conjunction with the image-based memes.

The textual content analysis included: (1) word analysis, (2) phrase analysis, (3) comment analysis, and (4) discussion analysis. In addition, a frequency analysis provided the most used negative word in the Facebook comment. A discussion is an initial comment or post including additional responses to the initial post. When discussion comments referenced arguments, it was noted. The most used meme (by category tag) was identified. Discussion threads that included the popular popcorn memes were identified.

Meme analysis involved studying both the textual and image content of memes. The images were categorized by the picture used. The pictorial content was necessary to categorize which meme was used. In addition, if textual messages were embedded in the memes, they were identified and evaluated.

A. Textual Analysis of Facebook Discussions

Textual semantic analysis began by collecting a series of Facebook communications from both status updates, with associated comments, and group discussions.

For this study, ten individual discussions were evaluated. The ten discussions were comprised of 997 unique comments, which included 27,260 words and 103 memes. Facebook discussion selection was at random and discussions were required to contain at least one meme.

Semantic analysis began with preprocessing in preparation of the textual analysis. Preprocessing included removing Facebook social links such as "like" and "remove" so that the text would not be counted as a user-generated comment. Timestamps were removed as well as other navigational elements included in each discussion.

Four levels of analysis were performed on textual comments. A discussion sentiment score was calculated for an entire discussion thread. The discussion sentiment score was derived from lower-level scores. The next level of analysis assigned comment sentiment scores, which provided sentiment scores for each comment in a discussion thread. The comment score was derived by averaging phrase sentiment scores. Phase scores were scores assigned to phrases in a comment. Finally, scores to individual words in the comments were assigned and are termed word sentiment scores. Discussion sentiment scores based on phrase analysis and word analysis (explained in Section IV-A-1) were also compared.

1) Word Analysis

A sentiment score was calculated for individual words in a discussion. This score was determined by using a matching algorithm to a sentiment dictionary. The sentiment dictionary of [19] was used and based on the work of [20] which focused on identifying online opinions and classifying them as positive or negative using natural language processing. The sentiment score was derived from the sentiment dictionary of [19] with slight modifications to include missing words and slang terms that were not included in the original dictionary by [19]. Any word not in the dictionary was considered neutral.

2) Phrase Analysis

The Semantria Sentiment Analysis tool by Lexalytics [21] was used to assign sentiment scores to individual phrases in comments. The default Semantria sentiment library was used in addition to the previously identified dictionary from Section IV-A-1. The Lexalytics tool provided more fine-tuned sentiment scores using weights. In order to use the custom dictionary with the Lexalytics dictionary, simple weights (1 for positive) and (-1 for negative) were added to each additional word.

Phrase analysis also included phrase intensifiers and negators in scoring. Words such as *always* or *never* were considered intensifiers or negators when used in conjunction with identified words with a sentiment score.

3) Comment Analysis

The Lexalytics tool calculated scores for each Facebook comment in a discussion thread. Each comment score was

based on averaging all phrase scores determined in the phrase analysis phase for each individual comment in the discussion.

4) Discussion Analysis

An overall sentiment score for the entire thread of discussion comments was calculated based on individual word scores as well as phrase scores. The scores from the word analysis as well as the phrase analysis were recorded and sums and averages were compared. Discussion analysis included additional details. Frequency analysis was used to determine the most-used negative word in a discussion.

In addition, to determine if a discussion referenced an argument, an argument score (1 for true and 0 for false) was assigned. Argument scores were determined in the same manner as the word analysis in Section IV-A-1. Instead of a sentiment dictionary, a dictionary using synonyms for the word "argument" was utilized. Each word in the discussion was compared to the words in the argument dictionary to determine the presence of such words.

B. Meme Analysis

The main focus for meme analysis was to identify the meaning of the meme using both the images and text (if present). Individual memes were identified in each discussion thread. Meme counts were also performed for each discussion. Memes were also categorized for use in frequency analysis.

1) Meme Textual Descriptions

A majority of memes in the study (84%) included textual content. For memes including textual content, the text was transcribed for each meme. When no embedded textual phrase was present, a meme's visual content was manually described. For example, a picture of someone performing a "facepalm" (a physical action demonstrating astonishment or disbelief) was identified with a textual description of "facepalm." Likewise, a picture of a crying llama (the image is from a cartoon) was described as "crying llama." Other descriptive text for non-textual memes included "surprise face" and "crying baby."

2) Meme Categories

Memes were provided a categorical tag based on visual content. This tag provided a textual representation of the image even if the image had no embedded textual phrases. There were 35 unique meme categories using descriptive tags such as popcorn, teeth, crying, annoyed, and facepalm. Textual tags were manually assigned. The tags were used to identify the main action or point of the meme. When the categories were created and each meme labeled, the categories could be used for identifying which memes were associated with the textual content. In addition, the categories allowed similar memes, such as multiple versions of the popcorn meme, to be identified with a single label. The categories were then used to determine the popularity of memes in each discussion.

3) Meme Popularity

Frequency analysis of the most common meme category was performed to determine which meme types were used the most. The count is represented as the *meme score*. In addition, any discussion comments that contained the popular popcorn meme were identified.

V. Results

The results support that memes are not only used to provide emphasis to Facebook discussions, but they also correlate to the content of the discussion thread.

A. Discussion Scores

Discussion sentiment scores generally followed the same pattern for each thread as shown in Figure 2 whether based on word- or phase- analysis.

As shown in Figure 2, all discussion sentiment scores were negative for discussion sentiment scores that were derived from the word analysis. All, save two, discussion sentiment scores were negative for the phrase analysis. The conflicting discussion semantic scores are identified in Figure 2 with markers at Discussions 3 and 10. For both instances of discrepancy, the discussion semantic score based on word analysis was negative, but the discussion semantic score derived from the phrase analysis was positive.

A manual investigation was performed to determine why there was a discrepancy in the sentiment scoring. In both cases, the phrase analysis scoring was far superior to that of the word scoring. This is expected as the phrase analysis is a more robust method of textual analysis. For example, in Discussion 3, there was a mention of "pixie dust" which is generally positive as "pixie dust" is associated with good luck. The word matching considered "dust" as a negative word, lowering the overall semantic score. Likewise, in Discussion 10, phrases such as "I've never laughed so hard" were not detected as positive when each word was scored using the word analysis.

While the phrase analysis scores were determined to be more accurate, Discussion 3 included several uses of "know it all," a phrase which may or may not have negative connotations. For example, the phrase "She will know it all after she reads the directions." Does not have the same semantic meaning as, "Don't be a know it all!" Technically, the term "know it all" in the second example should have the hyphen "-" between the words and correctly written as "know-it-all," a term defined in [22] as "a person who acts as though he or she knows everything and who dismisses the opinions, comments, or suggestions of others." The negative usage of *know-it-all* was manually identified in Discussion 3 as "know it all," skewing the results. For Discussion 10, a few semantically-negative phrases were unknown to the analyzer.

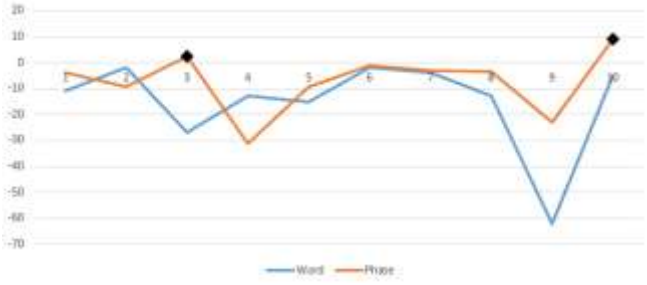

Figure 2. Discussion Sentiment Comparison

For example, *asinine* was incorrectly spelled and left as neutral.

Regardless of the discrepancies in Discussions 3 and 10 in terms of the sentiment scoring, the additional phases of the study were not negatively affected. The identification of discussions including arguments, in addition to which discussions included popcorn memes, was accomplished.

B. Frequency of Negative Words

As explained in Section IV-A-4, frequency analysis was performed on all negative words in a discussion. The most frequently noted words for the discussions were *attack*, *fight*, *sorry*, *bug*, *war*, *rude*, *block*, and *moron*. The word *attack* was the most frequently used negative word in three discussions. Overall, *attack* was the most frequently used negative word in the study.

C. Argument References

When a discussion thread included references to arguments, per the description in Section IV-A-4, an argument score was recorded. Nine of the ten Facebook discussions made reference to arguments. Discussion 7 was the only discussion that did not reference an argument. The most commonly used word in Discussion 7 was *moron* and the overall sentiment of the conversation demonstrated agreement among users, thus no argument ensued in the discussion.

D. Meme Scores

Frequency analysis was performed to determine the most used type of meme (indicated by category) for each discussion. The most frequently used categories of memes in the discussions were: *popcorn*, *stupidity*, *disbelief*, *teeth*, and *offend*. Other popular memes were those that were tagged with terms that included *unicorns*.

Popcorn was the most frequently used meme for three discussions. Including all discussions, the most frequent type of meme was the popular popcorn meme. As mentioned in Section II-A, the popcorn meme symbolizes amusement while watching an argument. All popcorn memes were included in discusses referencing arguments, but not all discussions referencing arguments included a popcorn meme.

The *stupidity* meme was the most frequent in the discussion where the frequency analysis of text determined that the word *moron* was used most frequently. For example, the word *moron* was the most popular textual term used in Discussion 7 (as explained in Section V-A-2). Of the twelve memes associated with Discussion 7, five were categorized as *stupid*.

The meme related to *teeth* was the most frequently used in a discussion that referenced a news report. The news report did not include a mention of teeth in the text, but the report was accompanied by a police mug shot where the accused had apparently neglected regular dental hygiene. This particular discussion thread is unique because the picture associated with the original story being discussed was the catalyst for the meme responses. Of the 22 memes that were posted in response to this discussion, seven were categorized using *teeth*. The categories of *disgust* and *disbelief* followed in popularity.

The unicorn meme was a direct response to the original comment posted in the Facebook discussion using a slang phrase that included the word *unicorn*, thus the onslaught of unicorn memes. Of the eight memes associated with the text, six were categorized as *unicorn*.

E. Significance of the Popcorn Meme

In Section II-A, the well-known popcorn meme was explained. While the popcorn meme was the most frequently used meme in three discussion threads – and all discussion threads collectively – it was also found that the popcorn meme represented 56% of all memes identified the study.

As previously mentioned, every discussion thread that included a reference to an argument was also accompanied by the popcorn meme. The results show that the popcorn meme is a strong indicator of a discussion that includes disagreement, yet the popcorn meme is a humorous interjection in the discussion. This human behavior has been studied by Moore in [23] whose research on the subject of psychoanalyzing Reality TV demonstrated that viewers found enjoyment and even felt superior when watching Reality TV shows that portrayed characters being humiliated. In the social media discussion thread, the humor is demonstrated by the use of a meme. More specifically, the research shows that the humor of "watching" an argument unfold is most often represented with the popular popcorn meme.

VI. Conclusion

In this paper, an exploration of the correlation between image-based memes and textual contributions in social media – more specifically Facebook discussion threads – was performed. In order to accomplish this task, several methods were implemented.

The social media discussions included both textual comments and accompanying image-based memes. Textual comments underwent several stages of analysis, including sentiment analysis, to determine the affective nature of the discussions, as well as frequency analysis, to identify trends.

Memes injected into the Facebook discussions were transcribed and categorized. Memes were studied in relation to their associated discussion thread and frequency analysis was performed to determine trends. Correlations between textual discussions and meme categories were also discovered.

This research demonstrated that memes are used to emphasize the semantic content Facebook discussion threads. The research further supported that the meanings of the memes correlate to the topics of the discussion threads. The reactionary behavior of using memes to contribute to the affective nature of the discussion provides context to the sentiment of the discussion thread. Trends were discovered; support for future research is present.

There were three important findings. The first was not initially a targeted research focus and was discovered unexpectedly. Discussions that included an image associated with the text (such as a news story) showed interesting results. The image used to accompany an initial conversation had a higher correlation than the text (in terms of which memes were

included in the conversation). The memes were a reaction to the image, not the text. As explained in V-B, in one discussion, a majority of the memes were categorized as *teeth*, yet the word "teeth" or "tooth" was never included in the original text.

The second finding was that there was a positive correlation between the sentiment of the discussions and the memes used. The study included a focus on discussions that included arguments. As explained in Section V-2, 100% of the popular popcorn memes, which are traditionally used in relation to enjoyment in social media arguments, were associated with discussions pertaining to arguments.

Finally, the popcorn meme supports the idea in [6] that humor can be objective as explained in Section I. The very purpose of the popular popcorn meme is to invoke a feeling of humor, though the food popcorn is not necessarily humorous.

There were some limitations. The sentiment dictionaries required the addition of slang and uncommon uses of words. For example, the word "banned" was not a negative word in the sentiment dictionary, but in terms of Facebook group membership, banning a member is a negative action. Likewise, sentiment analysis of slang phrases was limited. Phrases such as "Bye, Felicia!" and "negative Nelly" were examples of where necessary improvements to the sentiment dictionary were needed. This refinement continues.

A. Future Research

The research demonstrated that some memes have such special connotations (the popcorn meme) that can be further examined for sentiment prediction. Additionally, the positive results of the study create a pathway for more enhanced multimodal exploration where automatic meme detection (performed via advances in image processing) is performed.

The conclusions were positive and the results support further development of the field. Questions arise such as "Can analyzing memes alone provide an accurate representation of social media sentiment?" or "Do textual and non-textual memes provide similar emphasis on discussion sentiment?"

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