

The Difference in Emoji Interpretation and Use by College Students Based on Extroversion and Introversion

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Abstract

We conduct research into human emoji interpretation to collect quantitative data that can be utilized for AI emoji use to promote the development of AI communication. Because the topic is so vast and many papers have already explored the general interpretation and use of emojis, we choose to focus on the difference in emoji use between introverts and extroverts. We use a survey to gain data on individuals' ability to interpret and use emojis which we then compare with their percent extroversion. We had participants rate their likelihood of using an emoji on a scale of 1 to 7 and their level of agreement with statements of extroversion and introversion on the same scale. We then graphed this data to illustrate the relationship between a person's percent extroversion and average emoji emotional intensity. We found that users in general are more likely to use emojis of a higher emotional intensity than emojis of lower emotional intensity, and that more extroverted users are more likely to use emojis of a lesser emotional intensity than more introverted users. To the best of our knowledge this is the first work to compare emoji use with a person's introversion and extroversion specifically. Our resource is useful for analyzing a person's emoji usage based on personality traits and can be used to help train AI in online communication.

1 Introduction

At the turn of the century in 1999, emojis were created. This signified a new age in communication. Texts and Instant Messaging (IM) was no longer just for necessary communications. The expression of emotions in picture form allowed texters and emailers to share their emotions along with their words. This advance evolved texting into a more informal and casual mode of communication.

Today emojis allow us to communicate in more complex ways. By using these pictures with our

text to show emotion, feeling, or an image, we can better express the meaning of our words over text (Krekhov et al., 2022). While this has proved a positive addition to communication for those who grew up with emojis, they can often be confusing for older generations. Despite their convenience, older people tend to understand (Weiß et al., 2020) and use emojis less than their younger counterparts (Memon and Ansari, 2021). Furthermore, interpretation and use of emojis varies, not only between age, but also gender (Wirza et al., 2020) and personality type (Marengo et al., 2017). The meaning of emojis also tends to change based on context. This combination of factors results in emojis interpretation varying a lot from person to person.

Despite this, researchers have continuously found ways to organize and identify emoji interpretation. Many have assumed, since their creation, an emotional association with different emojis, some (😊) clearer than others (😬). Through studies, however, researchers have found that with facial emojis, there is a general sense of one or more emotions related with each emoji (Krekhov et al., 2022) (Bai et al., 2019). We will build upon this research to look into emoji interpretation and how it differs between introverts and extroverts.

Introverts and Extroverts are defined by a person's interactions and relationships with other people and groups. Carl Jung defines extroversion as a person whose psychic energy and libido flow outward to other people and introversion as a person whose psychic energy and libido flow inward to themselves. However, these two terms are conclusively defined as the "primary direction for mental functioning" (Carlson, 1985) where extroverts are oriented to attach themselves to the outside world and introverts are oriented inwards, detaching themselves from the outside world (Carlyn, 1977). Extroverts are often seen as energetic,

friendly, and outgoing. Introverts are commonly seen as quiet, contemplative, and shy.

One common way to test a person's introversion or extroversion is the Myers Briggs Type Indicator (MBTI). This test asks a series of questions testing 4 definitions of personality. One of these definitions is a person's percent introversion and extroversion. Because this test is so well known, we incorporate the questions and statements from this test in our research. According to the Myers Briggs Type Indicator official website, 16personalities.com, there are differences in communication between introverts and extroverts in both in-person conversation and online communications. Because of this, we believe there will be a natural difference in the use of emojis between introverts and extroverts as it is a distinct method of expression.

The goal of our paper is to analyze the general difference in emoji use between introverts and extroverts. Through a survey, we want to compare the surveyed emotional intensity of different emojis (found by [Krekhov et al. \(2022\)](#)) with the likelihood of a person to use that emoji based on their percent extroversion. Emotional intensity is a number recorded by [Krekhov et al. \(2022\)](#) through intense surveys between 1 and 7 that reports to what extent an emoji expresses its associated emotion. An emotional intensity of 7 would report a very high intensity of that emotion whereas a lower score of 1 would report a low expression of that emotion by the associated emoji. With this data, we can map the likelihood of extroverts and introverts to use emojis of different intensities. We hope these results will help us to conclude how extroverts and introverts communicate differently in regard to emojis.

2 Related Work

Various papers have already been written on the topic of emojis by researchers. Some write a general review of emoji interpretation and report on the current societal consideration of emoji use and function, however, the majority of papers written on emojis largely follow a slightly different pattern. Each does a general study concerning emoji interpretation but incorporates one niche aspect that allow us to analyze emojis from a different perspective. These themes include the study of the intensity of emotion expressed by each emoji or the emotion the emoji indicates that user is feeling.

Some also look into how different genders or ages interpret emojis. These papers combine to give us many niche versions of the same topic: examining how emojis are interpreted.

In papers like [Weiß et al. \(2020\)](#), [Shah and Tewari \(2021\)](#), and [Memon and Ansari \(2021\)](#), we see how much work has been done into difference in emoji interpretation based on age. In [Weiß et al. \(2020\)](#), the authors look into how different ages interpret emojis. They surveyed 170 people and used their results to create a set of data that shows us how different age groups use and interpret emojis. [Shah and Tewari \(2021\)](#) performed a similar experiment but with college students. [Shah and Tewari \(2021\)](#) holds a focus group with college students to determine a proper questionnaire to analyze emoji usage among college students. The questionnaire makes statements about emoji usage that students would agree or disagree with. They then gave this survey to 250 college students and found that students tend to use emojis in a lighthearted way. They are given little emphasis and generally do reflect an association between the user's emotion and the emotion of the emoji used ([Shah and Tewari, 2021](#)). Lastly we see works like [Memon and Ansari \(2021\)](#) who analyzes what ages use what emojis and why through a questionnaire. They found that younger people tend to use emojis more frequently in text and better understand their meanings ([Memon and Ansari, 2021](#)). These papers are integral to research in the field of emojis and use methodology that we can draw upon for our paper. They also help us when drawing upon what pool of participants we will want to use for our paper.

There are other papers focusing on other differences in interpretation like gender ([Wirza et al., 2020](#)), however because our participant pool is limited, the papers debating interpretation discrepancy based on age are more relevant to our paper.

Other papers focus less on age and more on the emojis themselves. [Krekhov et al. \(2022\)](#) has performed an intensive study on the interpretation of emojis. In this study through surveys, [Krekhov et al. \(2022\)](#) analyzed which emojis were associated with an emotion. They then conducted a second survey with analyzed out of all emojis associated with some emotion, how intense were each of these emotions based on the emoji. They found that there were 46 emojis directly associated with one emotion and mapped to what intensity that

emotion was felt by each emoji. [Bai et al. \(2019\)](#) has also done a systematic review of the overall research that has been done on emojis. In their paper, [Bai et al. \(2019\)](#) selects databases and then papers from those databases concerning emoji usage. They compiled their research and present conclusions on the use and functions of emojis in society as well as to the individual. Papers like these gather data that stand to serve the larger community of research on emoji usage.

Among these papers I have found only one that comes closest to our experiment. [Marengo et al. \(2017\)](#) uses questionnaires to determine a correlation between emoji use and a person's score on the Big Five Personality Test, which is a personality test gauging the presence of five traits within one's personality. These traits are extroversion, agreeableness, conscientiousness, neuroticism, and openness. To accomplish this, [Marengo et al. \(2017\)](#) isolated 91 emojis and gave each participant a questionnaire asking how the participant identified with the listed emoji. They answered on a scale of 1 to 5. They then administered the Ten-Item Personality Inventory which measures the Big-Five traits. They found that 36 out of the 91 emojis used were associated with one of 3 of the 5 traits they tested: extroversion, agreeableness, and neuroticism. This study proved that emojis are sometimes correlated with personality traits and provides a basis for our research.

Our paper differs from those written previously because to the best of our knowledge it is the first paper to look into the interpretation of emojis based on the introversion and extroversion of the user and how that correlates with the reported emotional intensity of each emoji. The paper of [Marengo et al. \(2017\)](#) borders on the subject of our paper, however we differ in many ways. [Marengo et al. \(2017\)](#)'s paper was written in 2017. In the five year period since then, many new emojis have come out and we consider and use some of those new emojis in our study like 🤔🤔. [Marengo et al. \(2017\)](#) also uses the Big-Five personality test where we focus solely on extroversion and introversion as tested by the Myers-Briggs Type Indicator. This trait isolation allows us to zero in on and be more specific in our results than [Marengo et al. \(2017\)](#) regarding these traits. We also focus largely on the intensity of the emojis. As reported by [Krekhov et al. \(2022\)](#) we will compare emotional intensity of each emoji with a person's ex-

troversion and introversion rather than just a general self-identification with each emoji. To the best of our knowledge no researchers have written on the correlation between emotional intensity of emojis and their use by extroverts and introverts. We hope that our research will provide greater insight into the use of emojis and their relation to different personality traits in people.

3 Survey Outline and Methods

We want to administer a survey to a number of college-age students with the goal of learning more about the connection between emoji use and introversion/extroversion. We hypothesize that people with higher scores of extroversion will more often use emojis with a higher reported emotional intensity than those who score higher on introversion and also that people who score lower percentages of extroversion will be more likely to use emojis of a lower intensity.

To test these hypotheses, we survey college and graduate students. The survey has three identifying aspects: target participants, emoji use, and extroversion/introversion. Because we have limited resources, our target participant pool is limited to a certain age range. Despite this, our experiment maintains validity due to the age range we are targeting. The chosen participants will complete a series of questions about their personal emoji use. After completion of questions on emoji usage we then ask them questions regarding their level of extroversion or introversion. For the purpose of this experiment all extroversion and introversion questions are given an equal weight and participants will be given a percentage of extroversion to introversion. The results of their emoji usage are then cross-referenced with their percent extroversion. The survey also begins with a reminder to the participant. This reminder will ask them to reflect on their general, recent emoji usage to encourage accuracy among the answers. For encouragement of a higher number of participants, this survey has been sent out online to a number of students to be completed.

We hope to reach around 100 participants with our survey and from that pool, we hope to find 50 or more valid responses. We will use QuestionPro, a survey website, to create our survey and distribute it by link sharing. QuestionPro will save the data from the participants' answers for us. We will then transfer this data to a google sheets doc-

ument where we can analyze it and draw conclusions. In determining the method of data collection, we considered conducting a focus group like [Shah and Tewari \(2021\)](#), however we felt that our intention and area of research was clear enough to comfortably create a set of questions that would allow the user to understand the goal of our research. We believe that if we conducted focus groups rather than a questionnaire, we would receive less data as well as data that was influenced by the people in the group. Our chosen method of a questionnaire allows the individuals to think about their personal emoji use as well as allows us to reach a wider audience.

3.1 Target Participants

The subjects of this study are people ages 18 to 25 with no other qualifications. Due to a lack of resources, there is a limited pool of subjects to take the survey. As such our focus will be on the available pool of participants this being the range of people 18 to 25.

However, according to [Memon and Ansari \(2021\)](#) people ages 10 to 25 are more likely to use emojis than those ages 25 to 40. Furthermore, [Weiß et al. \(2020\)](#) states that younger people (18 and above) are more likely to understand a wider range of emojis. In this way this age exclusivity benefits our study as the emojis used in the survey are more likely to be known and understood by our participants. [Weiß et al. \(2020\)](#) also concludes that younger people are more likely to use emojis expressing emotions (facial emojis) than older people. In our survey, our focus will be on some of the most common facial emojis. This will help determine a link from expression of emotion to extroversion and introversion. Since [Weiß et al. \(2020\)](#) and [\(Memon and Ansari, 2021\)](#) tell us that a younger population will be more familiar with these emojis and more likely to use them, our participant pool does accurately represent the population that uses and understands emojis the most.

Furthermore, we release this survey by sharing it in an online group chat used by students of Emory University. The members are asked to take this survey if they are between the ages of 18 and 25. By sharing our survey online, we are ensuring that those who take the survey are also people who use online chats. This makes it more likely for the survey takers to be more familiar with emojis and their use thus eliminating a section of participants

that do not use online chats and therefore are less likely to be familiar with emojis. This also ensures that the group taking the survey will be randomized in terms of gender, race, nationality, degree, and other aspects of identity. This is because the group chat of university students used has only one requirement for joining: you must be a student at Emory University. This leads us to the reasonable expectation that the group taking the survey will be evenly distributed across demographics of race, gender, etc. More information on our participant pool can be found in section [A Appendix](#).

3.2 Questions on Emoji Use

There are many ways to go about asking about emoji use. To keep the survey as uninfluenced by knowledge of the testing subject as possible, we decided to first ask questions about emoji usage and then following, questions on extroversion/introversion. To do this, we will frame questions on emoji usage as "What is the likelihood you would use this emoji in an online conversation if you were feeling **happy**?" The emotion "happy" will changed based on the emoji being asked about and a photo of the discussed emoji will be shown at the same time.

This question was chosen as it will determine how comfortable the user would feel using emojis. We did not, however, choose to ask directly about the comfortability the participant would have using each emoji because that would not tell us anything about the actual use of emojis by the user, just their feelings around using it. This question is framed in such a way that encourages the user to accurately report how often they use different emojis.

In determining the emotion associated with each emoji, we use the method and results of [Krekhov et al. \(2022\)](#)'s study into the intensity of emoji emotions. In this study [Krekhov et al. \(2022\)](#) uses seven core emotions to categorize the facial emojis. These emotions are happiness, love, anger, annoyance, sadness, shock, and disgust. We use the same seven emotions to represent emojis in our survey. The emotion we will ask about in each question is the same as the emotion that [Krekhov et al. \(2022\)](#) reports as the most associated with each emoji. For example if [Krekhov et al. \(2022\)](#) reports that 😊 was associated with happiness 70% of the time and associated with no other emotions, then when asking about this emoji

we will used "happy" in the our question: "What is the likelihood you would use this emoji in an online conversation if you were feeling **happy**?" In this way we can regulate the emotions we associate with emojis and ensure that the user is receiving an emoji associated with the emotion they would most likely have meant to express in using the emoji in a chat.

In his study, [Krekhov et al. \(2022\)](#) first surveys people to discover which emojis are and are not associated with emotions. After this, he takes each emoji that was in any way associated with any emotion and surveys people on which emotions they identify with each emoji and to what intensity that emoji expresses that emotion. We will use every emoji [Krekhov et al. \(2022\)](#) reports as directly associated with one emotion. Out of the 68 emojis [Krekhov et al. \(2022\)](#) tested for intensity, 46 were directly linked with only one emotion. We will test these 46 emojis and their associated emotions as shown in Figure 1.

Happiness:



Love:



Anger:



Sadness:



Annoyance:



Shock:



Disgust:



Figure 1: Emojis and their associated emotion.

In the survey the emojis are randomized by their intensity and all emojis are shown per emotional category. For example, a question may state "What is the likelihood you would use any of the following emojis in an online conversation if you were feeling anger?" and all subsequent anger emojis will show on the screen. This encourages decisions to not be made based on the relation of emojis seen and unseen. A sample question is shown in Figure 2.

What is the likelihood you would use any of the following emojis in an online conversation if you were feeling happy? You can answer the same rating for multiple questions.

Figure 2: Sample Question from the survey. The line on the right is a sliding scale that participants will use the express to what degree they would use each emoji.

We be using the 7-Point Likert Scale to measure the likelihood of people using this emoji. This is the scale used by [Krekhov et al. \(2022\)](#) and since we are using his data on emoji interpretation, we will also use the same scale as him. It has been contested that a scale of 1 to 10 is too large in general and as such, a scale of 1 to 7 is able to more accurately determine our participants' true feelings about the emojis. This also allows our data to better match that of [Krekhov et al. \(2022\)](#). It also fits well with our extroversion/introversion section of the survey as the Myers-Briggs Type Indicator (MBTI) also uses a scale of 1 to 7 in their questions. In our survey we attribute the feelings expressed in Table 1 to each number on our scale.

Emoji Relation Scale
1: I would never use this emoji to express this emotion
2: I very rarely use this emoji to express this emotion
3: I rarely use this emoji to express this emotion
4: I occasionally use this emoji to express this emotion
5: I frequently use this emoji to express this emotion
6: I very frequently use this emoji to express this emotion
7: I would definitely use this emoji to express this emotion

Table 1: These phrases are used to identify to what degree the participant would use different emojis. The scale definitions are included in the initial caption to the survey, not each individual question.

3.3 Questions on Extroversion and Introversion

To determine a person's level of extroversion/introversion we use statements from the Myers-Briggs Type Indicator. There has been some controversy over the validity of the Myers Briggs test. Most articles addressing this validity are from 1960 to 1990. We have conducted a brief review of as many of these papers as we could find.

Based of the work of [Carlyn \(1977\)](#) we have determined the MBTI test to be "reasonably valid" for testing individual personality traits. Based off the work of [Carlson \(1985\)](#) we have to determined the MBTI to be reliable as well. Combining reliability and validity, we conclude that the MBTI is a valid source material to draw upon when choosing questions and statements to determine introversion and extroversion.

The participant reads a series of statements and chooses their level of agreement with the statement from 1 to 7. These statements have been pulled from the The Myers Briggs Foundation website which adapted them from Looking at Type: The Fundamentals by Charles R. Martin (CAPT 1997). The statements included are listed in Table 2.

Extroversion and Introversion Statements
I am seen as "outgoing" or as a "people person."
I feel comfortable in groups and like working in them.
I have a wide range of friends and know lots of people.
I sometimes jump too quickly into an activity and don't allow enough time to think it over.
Before I start a project, I sometimes forget to stop and get clear on what I want to do and why.
I am seen as "reflective" or "reserved."
I feel comfortable being alone and like things I can do on my own.
I sometimes forget to check with the outside world to see if my ideas really fit the experience.
I sometimes spend too much time reflecting and don't move into action quickly enough.
I prefer to know just a few people well.

Table 2: Statements taken from The Myers Briggs Foundation on determining extroversion and introversion. The first five statements are those extroverts tend to agree with. The second five statements are those introverts tend to agree with.

We will use a scale of 1 to 7 for agreement and disagreement. This is the scale used by the Myers Briggs Type Indicator. We will be using the same scale labels as well where 1 will equate to "Strongly Disagree" and 7 will equate to "Strongly Agree. 4 will remain "neutral." The numbers in between 1 and 4 and 4 and 7 are not defined by a state of agreement or disagreement on the MBTI test so we will also leave them undefined.

3.4 Data Development

By combining the work of [Krehov et al. \(2022\)](#) and the Myers Briggs Type Indicator, we have created a survey testing the use of emojis by 18 to 25-year-olds. The survey also tests their introversion and extroversion. After concluding the test, the participants are scored based on their extroversion and introversion in the form of a percentage (i.e. if you are 70% extroverted then you are likewise 30% introverted).

$$[E_1 + E_2 + \dots + E_5 + (\frac{7}{7} - I_1) + (\frac{7}{7} - I_2) + \dots + (\frac{7}{7} - I_5)] * 10 = P \quad (1)$$

In equation 1, E represents the amount one agrees with an extroverted statement (their self-reported agreement with the statement out of seven). The variables are labeled E_1 through E_5 to represent the five statements on extroversion. Similarly, I represents the amount one agrees with an introverted statement. The variables are labeled I_1 through I_5 to represent the five statements on introversion. P represents the percent of extroversion that the participant will be given. $100 - P = R$ will return the percent introversion the user scores, where R represents this percentage.

Equation 1 was found through simplification of our process. First the fractions are added together. To average them we divide by 10 and then we multiply by 100 to receive the integer of our percentage.

For each emoji, the participant ranks the likelihood of their use of this emoji when expressing the associated emotion from 1 to 7. We then isolate the emojis that the participant identifies they have a higher tendency to use as defined in Table 3.

Emoji Use Rating	Interpretation of Values
1-3	Not Frequently Used
3.1-4.9	Fluctuating Use
5-7	Frequently Used

Table 3: This table represents our interpretations of users' reported emoji use. We will only use emojis that each participant ranked in our "Frequently Used" category when graphing their most used emoji intensities with their percent extroversion. This will ensure we attribute only the emoji intensities that each participant uses frequently.

We've chosen to separate emojis with a scale rather than a simple yes or no, because we feel a yes or no response would not accurately indicate a user's tendency to use an emoji. The provided scale allows users to contemplate and report their emoji use in a more detailed way and accounts for users who may use an emoji, but very rarely, versus another user who may use an emoji very

frequently. If we were to use the yes-no model, these users may both say yes to one emoji when we only want to consider users that frequently use that emoji. Equation 2 represents this process.

$$\frac{(M_1 + M_2 + \dots + M_N)}{N} \quad (2)$$

In equation 2 M represents the intensity of one emoji. So, within a single emotional category for one participant, we will consider only the emojis the participant ranked somewhere between four and seven. We will then average the intensity of these considered emojis and plot that point on a graph with the participants percent extroversion.

We will also find the average use score of each emoji. This will help us identify outliers that may not be affected by extroversion or introversion. For example if there is an emoji that every participant has ranked 7, or very frequently used, then this emoji is shown to not waver between participants and therefore would not be affected by extroversion or introversion. Any emoji that presents an average use above 6 or below 2 will be removed from the data analysis process.

In the interest of maintaining validity, we will remove any survey results where only part of the survey is filled out, as well as surveys that took under one minute to complete. Our survey should take around four minutes on average and we feel that participants who take less than one minute to complete it likely did not properly think through all of their answers. We hope that the short length of our survey will encourage participants to fill it out thoughtfully.

4 Experiments

Total Responses	Incomplete Responses	Usable Responses
47	13	34

Table 4: This table represents the responses we received after 10 days after releasing the survey link. Surveys listed as incomplete were left partially empty or were completed in under 20 seconds.

We received 34 usable responses to collect data on. We can see the distribution of country of origin in Table 5, but we are not separating or isolating responses based on this data.

By taking the average of every rank given to every emoji by every user, we found the number 3.44. This number represents the average likeli-

Country of Origin	Participant Percent Distribution
America	78.72
Great Britain	14.89
Denmark	2.13
Spain	2.13
Puerto Rico	2.13

Table 5: This table represents the distribution of our participants by country of origin. We believe the country of origin should not largely affect our results as we are not looking into the difference in emoji use by country. More work on emoji interpretation by culture or country has been done by [Krekhev et al. \(2022\)](#).

hood of use of any given emoji by any given participant. Originally we had hoped that this number would be 4 as that would represent an evenly distributed emoji usage over all of our participants. We considered scaling this number and the attributed rankings so that our average would be 4, but decided against this as we did not want to misrepresent our data and agreed that 3.44 was close enough to our goal of 4. Because of this, our data is evenly distributed and represented truly as the users report.

We also averaged the rank that each emoji was given over all participants. This number represents the average use of this emoji by all of our participants. In doing this, we found two emoji's had an average rank of less than two: 🤔, with the former having a rank of 1.88 and the latter having a rank of 1.82. This told us that the average use of these emojis is between very rare and rare across all participants. Because of this we are excluding these two emojis from the results and data analysis leaving us with 44 emojis to analyze.

4.1 Data Organization

Emotion Expressed	Average Likelihood of Emoji Use
Happiness	3.070
Love	4.544
Anger	3.041
Sadness	3.654
Annoyance	4.245
Shock	3.045
Disgust	4.735

Table 6: The right column is expressing the likelihood of any given participant to use an emoji within the emotional category listed. This table shows us that people are more likely to use emojis to express love, annoyance, and disgust than any other emotion. They are least likely to use emojis to express happiness, anger, and shock

Next we isolated each section of the survey. First we looked at the results of the emoji section of the survey. For each participant we removed the emojis they rated less than 5. This left us with their frequently used emojis and we averaged the intensities of these emojis for our y-value. We also found the average intensity of the emojis we considered per emotional category, which we will refer to as the Average Reported Intensity (ARI), and the average of the average intensities per participant per emotion, which we will refer to as the Average Emotion Intensity (AEI). The ARI is a value calculated from the intensities reported by Krekhov et al. (2022). The AEI is a value calculated from the intensity of our participants reported emoji use. We will use the ARI of each emotion to compare to the calculated AEI. If the $AEI > ARI$, then we will have determined that users tend to use emojis of a higher than average intensity when expressing the emotion those emojis are associated with. If $AEI < ARI$, then we will likewise determine that users tend to use emojis of a lower than average intensity when expressing the emotion those emojis are associated with. If AEI is roughly equal to ARI, then user use an evenly distributed spread of emojis to express the associated emotion. We will discuss these further in each section for each emotion.

The y-axis of each of our graphs was adjusted to leave out excess white space but it did not remove any reported scores. This allows us to better see the data's distribution relative to itself. If a participant for any given emotion did not rank any emojis between 5 and 7 (inclusive), then we left out their score entirely for that emotion from the graphs.

Percent Extroversion	Number of Participants
0.000-25.000	0
25.001-50.000	17
50.001-75.000	17
75.001-100.000	0

Table 7: Number of participants per category of percent extroversion. All participants fell within the range of 25.001 to 75.000.

Next we looked at the section on introversion and extroversion. As explained through equation 1 in Section 3.4, we compiled the data for each participant based on their self reported association with our 10 statements. After finding the percentage of extroversion for each participant, we

calculated the average of these percentages. We found that the average participant's extroversion was 48.99. To maintain an evenly distributed network of data, we would hope for this average to be 50%. The closeness of our expected average to our calculated average shows us that our participants are evenly distributed between extroverts and introverts and adds validity to our results. We also found that none of our participants scored below 25% or over 75% for their level of extroversion, and were evenly distributed between the groups of 25.001 to 50.000 and 50.001 to 75.000 as shown in Table 7. Because of this, all graphs' x-axis have been made to fit this range of 25 to 75.

4.2 Data Representation

Finally, we graphed the average intensities per participant on the y-axis and the participants matching percent extroversion on the x-axis. We did this separately for each emotion and the graphs used were scatter plots as the data collected per participant was not related to the other participants' collected data. We then found a trend line for each graph and it's associated equation. Our hypotheses remain that participants with a higher percent extroversion will have a higher tendency to use emojis with higher emotional intensities and that participants with a lower percent extroversion will have a higher tendency to use emojis of a lower intensity. The slope of the equation of the trend line relates to our hypothesis and identifies if it is supported or not. Trend lines with a positive slope support our hypotheses and trend lines with a slope of 0 or a negative slope will support the opposite of our hypotheses: People with a higher percent extroversion will use emojis of a lower intensity than people with a higher percent introversion and/or people with a lower percent extroversion will use emojis of a higher intensity. We also calculated the Pearson Correlation Coefficient (PCC) for each graph. The PCC calculates the correlation between two arrays of continuous variables. The coefficients can range from a scale of -1 to 1 and they tell us how correlated our data is. A further breakdown of the PCC associated interpreted correlations by value is provided in Table 8.

Lastly, we added error bars to our graphs. These bars represent the standard deviation of a data set. Lastly, for each emotional category, we calculated the average emotional intensity used to convey different emotions. This number was found by aver-

PCC	Array Correlation
-1 - -0.5	High Correlation
-0.49 - -0.3	Moderate Correlation
-2.9 - 0	Low Correlation
0-0.29	Low Correlation
0.3-0.49	Moderate Correlation
0.5-1	High Correlation

Table 8: This table represents what PCC values are associated with which correlations. We will use these to determine the correlation of our data.

aging the intensities of the most frequently used emojis for each participant and then averaging those scores across all participants per emotion. We will refer to this number as the Average Emotional Intensity or AEI. General interpretations of these values are included in Table 9.

AEI value	Interpretation of Values
1-3	Low Average Emoji Intensity
3.1-4.9	Average Emoji Intensity
5-7	High Average Emoji Intensity

Table 9: This table represents our interpretations of users' reported emoji use. We will only use emojis that each participant ranked in our "Frequently Used" category when graphing their most used emoji intensities with their percent extroversion. This will ensure we attribute only the emoji intensities that each participant uses frequently.

4.2.1 Happiness

In isolating the data gathered for the emojis associated with happiness, we found AEI to be 5.525. It is important to note that the average emotional intensity expressed by any given happiness emoji was found to be 4.922 by averaging the emojis [Krekhov et al. \(2022\)](#) reported as associated with happiness. This shows us that on average, participants tend to use the happiness emojis that express a higher intensity of happiness than average.

Here in Figure 3 we can see a slight positive trend in our graph. Though small, the positive slope of our trend line indicates that on average people who are more extroverted will tend to use emojis with a slightly higher emotional intensity when attempting to express happiness. These results fall in conjunction with our hypotheses. The standard deviation is 0.639, which is on the higher end of our standard deviations (values ranging from 0.8 for our data). The Pearson Correlation Coefficient for this data was found to be 0.027.

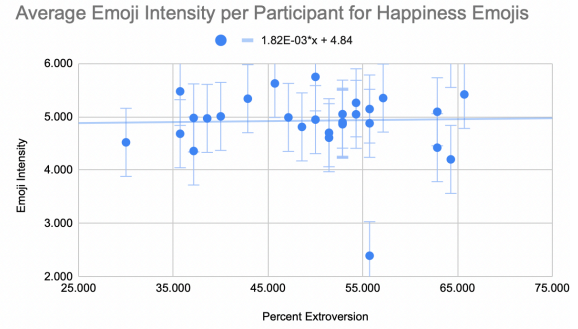


Figure 3: Graph mapping a participant's percent extroversion and the average emotional intensity of the emojis they most frequently use that are associated with happiness.

This indicates a very low level of correlation between our two data sets of emotional intensity of happy emojis and percent extroversion of participants.

4.2.2 Love

Next we isolated the data on emojis used to express love. The average intensity of these emojis is found to be 4.625 according to [Krekhov et al. \(2022\)](#)'s results. We found that the average participant uses an AEI of 4.883 to express love by their emojis. This indicates that emoji users tend to use slightly more intense emojis when expressing love.

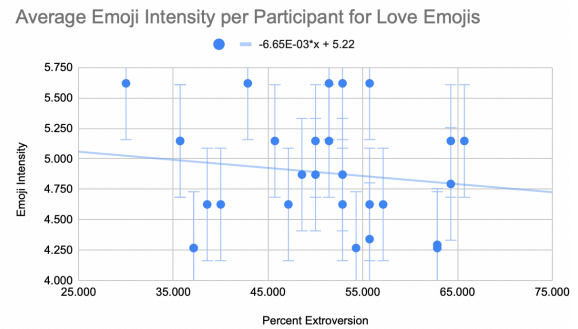


Figure 4: Graph mapping a participant's percent extroversion and the average emotional intensity of the emojis they most frequently use that are associated with love.

From our graph (Figure 4), we can clearly see that the higher percent extroversion of a participant, the less intense emojis they used for love. Our trend line has a slope of $-6.65E-03$. The data collected from our survey on this emotion is more scattered than some of our other graphs such as figure 6. This tells us that the expression of

love in emoji form is varied for many users across the board. Despite this general variant, there is, however, a downward trend associated with these points. Because of this, these findings do not support our hypotheses. The standard deviation is 0.462 which is fairly average for our standard deviations overall, however because our reported emotional intensities for love were all between the range of 4 to 5.75, this value appears to show larger error than is actually accurate. For our data on love, we found the PCC to be -0.1419422135. This indicates a very low level of correlation.

4.2.3 Anger

In averaging the given emotional intensity from Krekhov et al. (2022)'s study, we find the average emotional intensity of an emoji associated with anger is 5.164. The AEI used in expressing anger with emojis by our participants was found to be 5.718. With this number being slightly higher than the average intensity of these emojis, this tells us that people in general tend to use emojis expressing anger of a higher intensity rather than a lower intensity anger emoji.

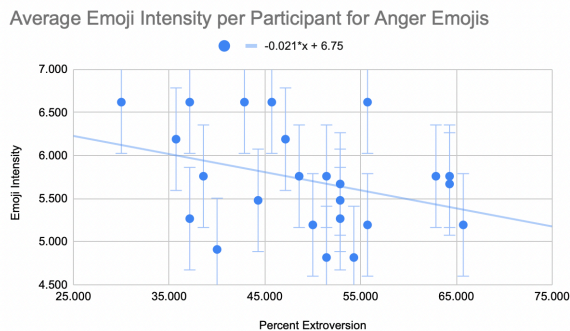


Figure 5: Graph mapping a participant's percent extroversion and the average emotional intensity of the emojis they most frequently use that are associated with anger.

Like our model for the emoji's expressing love, our anger emoji data was also fairly scattered as shown in Figure 5. This contributes to our findings with the love emojis that when also using angry emojis, a users expressed intensity can be varied. Despite this as we increase in percent extroversion in our participants, there is a noticeable decline in intensity of emoji used. This downward trend results in a negative slope that does not support our hypotheses. The standard deviation is 0.595 which, like happiness, is slightly higher than our average standard deviation (0.45). This

indicates slightly more variation in emoji use for emojis representing anger. The PCC for anger is -0.3449440664. This coefficient is between 0.29 and 0.49, so it is considered to show a moderate correlation between our data sets.

4.2.4 Sadness

Like with our other emoji emotion sections, we again averaged the intensity of the emojis Krekhov et al. (2022) associates with sadness. This number was found to be 4.108. In congruency with our previous findings, we once again conclude that users tend to use emojis of a slightly higher intensity to express sadness. This was found based on a calculated AEI of 4.263 used by any given participant to express sadness with an emoji.

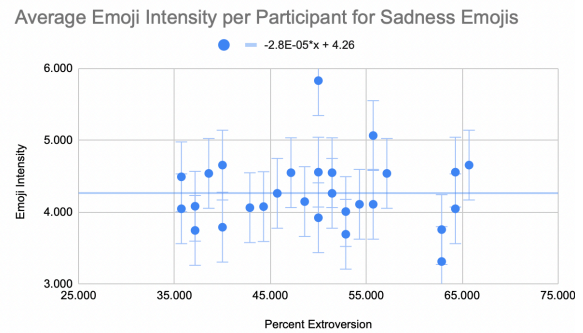


Figure 6: Graph mapping a participant's percent extroversion and the average emotional intensity of the emojis they most frequently use that are associated with sadness.

In graphing the data that we found on the emotional intensity of emojis participants use when expressing sadness, we found a trend line that had a small, but negative, slope as shown in Figure 6. This slope is -2.8E-05. Because this number is so small, we conclude that regardless of percent extroversion, participants use emojis to express sadness of an equal emotional intensity. We can also see by our plot points that there was little variation in average emotional intensity by each participant as most of the points' y-values are very close together. We found the standard deviation to be 0.486. While our points varied slightly more than average, they all stayed within the same realm of data indicating a lack of true variance in emoji usage for emojis representing sadness. The Pearson Correlation Coefficient for sadness is -0.0005335853906. This is a very low number and indicates a very low level of correlation.

4.2.5 Annoyance

In averaging the emojis associated with annoyance, we found the average emotional intensity for an emoji expressing annoyance to be 4.703. Our participants had an AEI of 4.760 when using emojis to express annoyance. These numbers are very close together but once again there is a very slight increase in intensity from our participants indicating that the emojis they tend to use are ones that are slightly more intense when attempting to express annoyance with emojis.

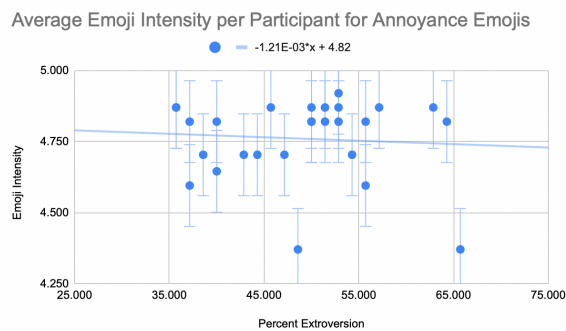


Figure 7: Graph mapping a participant's percent extroversion and the average emotional intensity of the emojis they most frequently use that are associated with annoyance.

The points here in Figure 7 are, like sadness, fairly close together across the board. The trend line has a small, but negative slope, indicating that for the most part participants used the same emotional intensity to express annoyance despite the percent extroversion, but there was a slightly downward trend. We can once again conclude that participants tend to use less intense emojis the more their percent extroversion increases. Our annoyance standard deviation is 0.143 which is significantly lower than our average standard deviation. This indicates that emojis conveying annoyance are generally used similarly between extroverts and introverts. The PCC for annoyance was found to be -0.0724163641. This number is below 0.29 so it shows us a low level of correlation.

4.2.6 Shock

The average emotional intensity of the emojis used to express shock as reported by Krekhov et al. (2022) was found to be 4.481. The AEI of the emojis our participants most frequently used to express shock was found to be 4.628. This again shows us that users are more likely to use emojis of a slightly higher intensity when attempting to ex-

press shock.

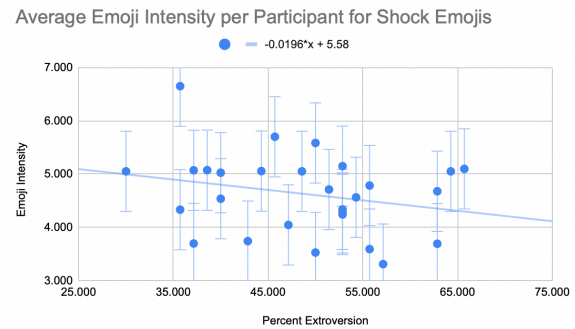


Figure 8: Graph mapping a participant's percent extroversion and the average emotional intensity of the emojis they most frequently use that are associated with shock.

Once again we see a graph (Figure 8) with points that are more varied. Despite this variance, we see a trend line with a negative slope. This indicates to us that the higher percent extroversion in a participant, the more likely they are to use emojis of a lesser emotional intensity to express shock. Our standard deviation here is 0.753 indicating a large variance in the use of emojis depicting shock. Shock was one of the emotional categories with the largest amount of emojis, so this variance could be due to an increase in emoji representation. This indicates that people use shock emojis very differently. The Pearson Correlation Coefficient is -0.249332152 and indicates a low level of correlation.

4.2.7 Disgust

The average emotional intensity for any given emoji that expresses disgust was found to be 6.300. The AEI any given participant will use to express disgust with an emoji was found to be 6.328. These averages are very close to each other, but once again there is a slight increase in the intensity that our participants used to express emotions. We see this and conclude that participants have a slightly more likely to use emojis of higher intensity when attempting to express disgust.

It's important to note that there were only two emojis found to express disgust by Krekhov et al. (2022). Our graph in Figure 9 modeling the emotional intensity of our disgust emojis as they are used by our participants is fairly linear. These points are very close together and form a distinct line for which the slope is slightly negative. Because the slope is once again so small ($-8.37E-04$),

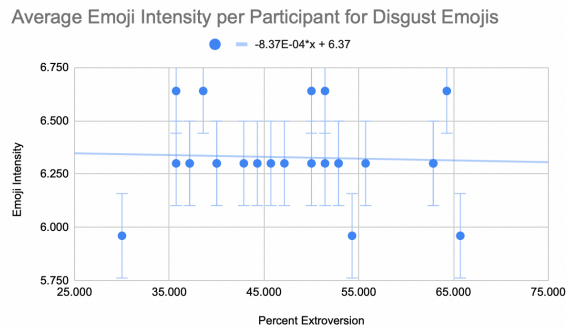


Figure 9: Graph mapping a participant's percent extroversion and the average emotional intensity of the emojis they most frequently use that are associated with disgust.

we conclude from this graph that, in general, participants use emojis of the same emotional intensity to express disgust. Furthermore, because we only have two of these represented in our survey, it is likely that our users are using these two emojis fairly evenly to express this emotion. Our standard deviation for disgust is 0.198. This low number indicates that the two emojis representing disgust are used fairly similarly throughout participants. Our PCC is -0.04 and indicates a low level of correlation.

4.2.8 Putting Our Data Together

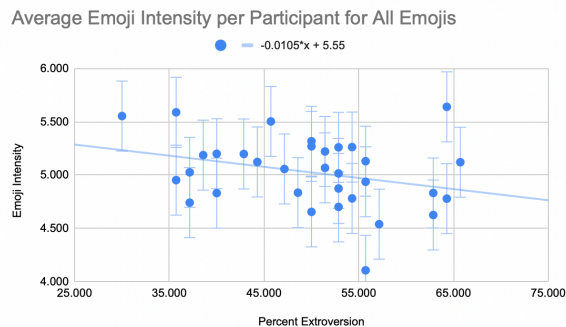


Figure 10: Graph mapping a participant's percent extroversion and the average emotional intensity of the emojis they most frequently use regardless of emotion.

Our standard deviation over all emojis is 0.328 which represents an average variation of roughly 5% between users in how they use emojis of different emotional intensities. Our Pearson Correlation Coefficient is -0.30 and therefore our data is moderately correlated. When graphing the average emotional intensity expressed by any given emoji to express any given emotion by any given participant, we see a direct downward trend.

As illustrated in Figure 10, there is a clear negative slope to our graph. This leads us to conclude that the greater percent extroversion a person presents, the more likely they are to use emojis of a lower intensity. This conclusion is in direct contrast with our hypotheses.

5 Results

We can learn a lot from the data we gather despite the results disproving our hypotheses. First we will analyze the results and identify what this means for emoji interpretation overall. Secondly, we will recognize the limitations of our work. Lastly we will discuss future directions that this experiment can take and applications in computer science.

5.1 Data Analysis

Our first conclusion is that people tend to use emojis that express higher emotional intensities rather than their average or lower counterparts for any emotion. For each of our emotions, the AEI was always found to be slightly higher or significantly higher than the overall average intensities of all those emojis expressing said emotion. This means that within a pool of emojis associated with an emotion, people across the board will tend to use just the emojis of a higher intensity.

We also found that, in general, the more extroverted a person is, the more likely they are to use emojis of a lower intensity. This finding varied from emotion to emotion. We can see in figure 3 that our results do not support this, however in figures 4, 5, 7, 8, 9, and 10, we do see results that support this. Most notably in 10, we see a very clear downward trend line.

Though we take this to be our overall conclusion, we can see in figures 6, 7, and 9 that in some cases, there was a fairly even use of emotional intensity regardless of extroversion or introversion despite their overall downward trends. This tells us that when expressing sadness, annoyance, or disgust, a person's extroversion or introversion is not highly applicable and does not generally dictate emoji usage.

We saw the least variance in our graphs for happiness, sadness, and disgust. This tells us that our results for these three emotions are more accurate to a larger population because most of our participants give similar answers. However, for annoyance, love, anger, and shock, we had much more

variance in our answers. This tells us that for these four emotions, there was a greater difference in emoji use person-to-person. For these four emotions, we are more likely to have outliers and our data is less significant.

As mentioned in the section above, we found two emojis to be used the least: 🙄👹. This tells us that these emojis are less likely to be used by any given user. Alternatively, we found two emojis to be used far more than the others: 😊🥰. Both emojis had an average ranking of above 5, with the former having a score of 5.382 and the latter having a score of 5.882. This tells us that these two emojis are more likely to be used by any given user.

5.2 Limitations

It is important to note that we had some limitations in our experimentation. Due to lack of resources and funding, we were limited to a small group of participants. This limitation not only led us to a smaller age range of applicants, but also a smaller amount in general. Because we were limited to one college and within that college, only the people the authors could reach out to, our participant pool was a lot smaller than we would have hoped. This affected both the amount of people surveyed and the target group of participants used.

Being undergraduate students, our original participant pool was of peers and teachers. From this pool we targeted the age range of 18 to 25 based on the work of [Weiß et al. \(2020\)](#) and [Memon and Ansari \(2021\)](#). While we do believe this accurately represents an age range that we both understand and uses emojis, we recognize that this comes as a limitation because we cannot represent a full spectrum of randomized data. It also means that the standard deviation is higher than normal resulting in a larger error bound and ultimately a lower significance of our results. We do believe that all other identity aspects are evenly randomized because our participants were all students. In this way their place of origin, interests, gender, sexuality, etc. were not in anyway standardized.

5.3 Future Work in Emoji Interpretation

5.3.1 Recommendations for Future Study

If this experiment were to be repeated in the future, we would hope it would be with a much larger and wider participant pool to address the main limitation of our study. Our participant lim-

itations largely affected our results and data. The repetition of this experiment with a much wider range of applicants as well as number of applicants would help solidify the data and add significance to the results.

Another recommendation we make to future researchers of emoji interpretation would be to create a more in-depth version of the extroversion and introversion testing that we did. We kept our test short to encourage participation. While we had participants agreeing and disagreeing with 10 given statements, we would recommend that a longer test section be given on introversion and extroversion with more specific statements. We would also recommend that future researchers consider using percentages rather than a 1 to 7 scale to represent emoji use. Though we did not employ it, percentages may better represent participant use and correlate more accurately to percent extroversion when graphed.

5.3.2 Future Directions

Emoji interpretation is a vast category of study. There are many different nuances to study as we have seen in our Related Works section. One direction that could take our work a step further would be to test how different personality tests (such as the big five test or the Myers-Briggs test) indicate extroversion and introversion, and how users use emojis as compared with their given score from each individual test. This could serve as a validity test to either of these personality tests or it could aid research on emoji interpretation as a whole.

5.3.3 Applications of Emoji Interpretation

While a seemingly small area of study, there are actually many applications of emoji interpretation. As the fields of artificial intelligence (AI) and human-computer interaction (HCI) grow, we are seeing the rise of AI communication. And as technology grows, online communication becomes a faster and easier resource to reach out to people. For humans, emojis are an integral part of online conversation and communication. Since its creation, emojis have been intimately involved with online communication and studies like the ones done here will be integral to teaching AI and chat bots better communication with human beings.

6 Conclusion

The work we have done in this paper gives us more insight into the difference of emoji interpretation between introverts and extroverts. This data helps us to learn how different people interpret emoticons and how they use this language. Our final analysis of our overall results conveys that extroverts tend to use emojis of a lesser intensity than introverts. We also discovered that users are more likely to use emojis that convey a greater emotional intensity. These results tell us a lot about human emoji interpretation, but there is still more work to be done in this field.

We believe a repetition of this experiment with a larger pool and variety of participants would add validity to our results. We also believe further research into the difference in interpretation and use of emojis based on personality traits would benefit the world of technology. Not only could we learn how to identify personality traits in emoji users by their communication, but we could also give technology more personality by programming it to use emojis in a way that conveys personable or more anthropomorphic personality traits.

As language develops over time, we must develop with it. Emojis have become an integral part of online communication and understanding their use and meaning in text these days is nearly as important as understanding the words we use. In creating and developing different types of AI, we must teach them how to communicate, which now includes emoji use. Understanding the nuances of emoji use will help elevate AI chat programs not only communicate well, but to communicate like humans do.

All our resources including the dataset, models, and survey link are available through our open source project link.¹

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¹<https://github.com/VelvetJumper/EmojiInterpretation.git>

A Appendix

None of our participants were paid for their time. They were informed before taking the survey that their participation was fully voluntary and no compensation would be provided. By taking the survey, participants were agreeing that their participation was voluntary.