university of groningen / faculty of arts

Laughing our way to success

A study about the impact and causes of laughter in a communication game

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Bachelor thesis
Information Science
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January 4, 2021

ABSTRACT

Laughter is a phenomenon that is a crucial part of communication. But it can also be hard to understand. Research has shown the diverse meaning and placement that laughter can have and the factors that influence on it. Yet we still don't have a full understanding of it. This thesis studies the impact of laughter on the task success of a communication game. As well as the possible factors that influence on the laughter itself. The game we study is a virtual collaborative communication game played by two participants. The possible factors we study in this thesis are alcohol, gender and relationship. The laughter in our research is the laughter produced as a pair. We don't analyze individual laughter. To find answers for our research questions we analyze the data provided with the communication task. This data consist of audio files and text files which describe the output of the participants. We have to extract the laughter from the audio files and the possible factors that influence on the amount of laughter from the text files. With this data we create new data sets which describe the laughter of the pairs and possible factors that influence on this. Linear mixed effects regression models of the data enabled us to state significance of the results. We found significant results regarding the impact of laughter on task success. As well as significant factors that impact the amount of laughter produced by the pairs. These results indicate the different causes of laughter and the importance of it in communication.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

PREFACE

First of all I want to say that I created an interest for these communication tasks early on in my Bachelor program. I study Information Science at the University of Groningen and I'm writing this thesis to finish this Bachelor. Early on in the program I was faced with courses that study communication between people. These courses where given by Mr. Gregory Mills, Phd. Who is also my supervisor for this Bachelor thesis. In these courses we, as students, also participated in the communication tasks provided and/or made by Mr. Gregory Mills. I think this is a very good way of teaching students because you get involved in the whole process. Performing the task, looking at the data and then drawing conclusions on the data. This process made me realize that there is so much more to communication between people than I first thought. This is were I have to thank Mr. Gregory Mills. Who made me understand the difficult underlying processes that form the basis of human communication. The circumstances in which this thesis has been written were not great to be honest. With the Corona virus taking away the opportunity to meet face to face with my supervisor and fellow students, it was more difficult to make progress. But having a virtual meeting every Friday helped me to push on every week which resulted in a Bachelor thesis that I'm happy with. And that is were I again have to thank Mr. Gregory Mills for doing the best he could under the difficult circumstances. And not to be forgotten my fellow students who were there to brainstorm with.

1 INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

Laughter is a type of behavior that is researched by many people. From ordinary people to philosophers and scientists. Yet there is no behavior that remains more unexplained (Freud, 1960). It is a frequently and important used tool in communication. Unlike written language, laughter is an universal part of language which everyone is familiar with. Laughter is way more than just finding something funny. It has a special placement and meaning in communication. Studying the role of laughter is essential in the understanding of communication. If we want to create artificial intelligence that can communicate with us like a human we need this understanding. Laughter is an important part of this. We are going to look at the impact of laughter on the success of a communication task. The task being the 'kakikoe' task. We will explain this task in more detail later. We will also study possible factors that influences on the amount of laughter produced by participants of the task. First we will discuss the research which is already done in this topic. After this we will define the research questions. Followed by an overview of the data, the hypothesis, how we analyzed this data, the results, and finally discussing the results and concluding our research.

1.2 BACKGROUND

In this section we will look at the work that already has been done in this field. To give a good view of how broad the topic of laughter is we will look at the placement and meaning of laughter. With placement we mean where laughter occurs in communication. After this we will look at previous work regarding stimulating factors of laughter. This is the topic that we will focus most of our research on in this thesis. After we have discussed this we can formulate our research questions.

1.3 PLACEMENT AND MEANING OF LAUGHTER

Laughter is seen as an individual phenomenon that a person produces as a result of finding something funny. But as we will explain in this section research has showed that laughter occurs significantly more in groups of people than alone. The social setting in which the laughter occurs determines the placement and meaning of laughter. Research in laughter of anonymous young adults in public places showed the following: Laughter of both speaker and audience occurred during pauses at the end of phrases or sentences in over 99% of the sample of 1200 episodes of laughter (Provine, 1993). Nearly all cases of laughter had a special placement in this social setting. The outcome of Provine (1993) his work clearly suggests that laughter actually has a special placement and meaning in conversation. Humans think about if to laugh, when to laugh, where to laugh and how to laugh. The important fact about laughter is that it is mainly a joint action, not an individual action. The main cause of laughter is not a joke, but another person (Provine, 2004). In the study of Devereux and Ginsburg (2001) people watched a humorous videoclip in one of three conditions: alone, same sex pair with a stranger or same sex pair with a friend. The study showed that pairs produced significantly more laughter than people who were alone. The fact that laughing is more a joint action brings in a lot

more meaning to it. It can be a sarcastic reaction, a comforting mechanism and a tool to cut the tension. Also not laughing as Billig (2005) calls it 'unlaughter' can have a function. This is not laughing when laughter might otherwise be expected, hoped for or demanded. For instance this can be used to indirectly let someone in a group know that he or she is not being accepted in the group. Study of (Marci et al., 2004) showed interesting results when analyzing ten unique session of psychodynamic psychotherapy with digital videotape. Observers identified a total of 167 laugh responses. The patient laughed 119 times, where 76.5% occurred as speaker and 23,4% as non-speaker. The therapist however laughed 48 times, where only 10.4% occurred as speaker and 90.3% as non-speaker. This difference was highly significant. This substantiates the difference in the effect laughter can have. In the research of Marci et al. (2004) the effect of laughter is that the patient becomes more at ease. Which helps trying to find a solution for the problem that the patient is having. So why is laughing so important in communication? According to Cowie et al. (2001) there are two types of channels in human interaction: one that transmits the explicit message, for instance the words that someone says. And one that transmits the implicit message, like the emotion of the messenger. To understand the full message you need to understand both channels. A lot of work has been done on the explicit side but not on the implicit side. Fully understanding the role of laughter in communication is crucial for understanding human communication as a whole. Which is necessary for creating the interaction between humans and computers for instance.

1.4 STIMULATING FACTORS OF LAUGHTER

1.4.1 Alcohol

Laughter has also found to be stimulated by certain factors, like alcohol. You have probably experienced this yourself. You and your friends are drinking alcoholic beverages. As time progresses and the amount of alcohol in your system increases the atmosphere becomes cozier. Which results in more laughing between you and your friends. Study also has proven this. Like the study of Lowe and Taylor (1997), which showed that the frequency of laughter was significantly greater after consuming alcohol while watching a humorous film. A significant correlation of 0.27 was found between units of alcohol consumed and laughter scores.

1.4.2 Gender

Gender also has been found to have an impact on laughter. Study of Provine (1993) showed that women laughed 126% more than men. These results were based on 1200 episodes of laughter in public places, where there was a speaker and an audience. The study of Robinson and Smith-Lovin (2001) showed that groups consisting entirely of women had a significantly higher rate of humor, compared to mixed gender groups and all male groups. Where humor was measured on the basis of laughter. In this study the amount of humor in spoken conversation was measured during conversations in 29 six-person discussion groups in which they had to solve a collectively-oriented task. The task here was trying to make other participants laugh. The task was labelled successful when laughter was produced by others.

1.4.3 Relationship

Study of Grammer (1990) showed that the interest of the female in the male was greater when the female produced more laughter. This result was based on situations where two students of the opposite sex met for the first time. Laughter was measured during ten minute conversations that took place while the pair thought they were waiting for the experimenter to return from an 'urgent phone-call'. This suggests that relationship between two persons also has a impact on the amount of laughter produced. And the study of Smoski and Bachorowski (2003) showed that friend dyads produced significantly more laughs than stranger dyads. In this study friends or strangers were seated in a room and had to solve a problem together. As we can see in these studies the relationship between people is also an important factor that influences on the amount of laughter they produce.

1.4.4 Task success

So we discussed possible factors that stimulate the amount of laughter people produce. But is laughter itself also a stimulating factor? In our case of task success. Study of Beckman et al. (2007) showed that employees of a company had a significant higher self-efficacy after participating in 15-minute sessions of non-humor dependent laughter over the time span of 15 consecutive days. Different aspects of this self-efficacy where: self-regulation, optimism, positive emotions and social identification. These aspects are important in creating a good work atmosphere which is crucial for success.

Some research has been done on factors that influences on laughter. But like the studies of Lowe and Taylor (1997); Provine (1993); Robinson and Smith-Lovin (2001); Beckman et al. (2007); Devereux and Ginsburg (2001) the method of these researches is showing a group of people something, like a movie, and then measuring the amount of laughter. Like the studies of Smoski and Bachorowski (2003); Marci et al. (2004) our study differs from this because the laughter in our study is measured whilst the participants perform a communication task. It is not the goal of the task. In this thesis we will investigate all the potential stimulating factors of laughter mentioned above. As well as looking at the impact of laughter on the success of the 'kakikoe' task.

2 RESEARCH QUESTIONS

With the background on this topic discussed we are now able to formulate our research questions. These questions form the basis of our thesis. The impact of laughter on the success of the communication task at hand. As well as studying possible stimulating factors of laughter.

2.1 RESEARCH QUESTION 1

As mentioned in section 1.4.1, study of Lowe and Taylor (1997) showed that the frequency of laughter was significantly higher after the consumption of alcohol. This study revolved around laughter of a group of people while watching a humorous movie. But will alcohol also make pairs laugh more while performing the 'kakikoe' task. This leads us to our first research question: **Do pairs laugh more while being under the influence of alcohol?**

2.2 RESEARCH QUESTION 2

Significance in the amount of laughter produced by different gender has been found, as we mentioned in section 1.4.2 (Provine, 1993; Robinson and Smith-Lovin, 2001). In these studies women laughed more than men during communication where the goal of the task was laughter. But will women also laugh more than men while performing the 'kakikoe' task. This leads us to our second research question: **Will women laugh more than men?**

2.3 RESEARCH QUESTION 3

Acquaintances have been found to produce significantly more laughter than strangers, as mentioned in section 1.4.3 Smoski and Bachorowski (2003). This study corresponds to our research because of the fact that here, laughter of pairs was also measured while solving a task. It will be interesting to see if the same outcome applies to our study. This leads us to our third research question: **Will acquaintances laugh more than strangers?**

2.4 RESEARCH QUESTION 4

Females turned out to have more interest in males when they produced more laughter, as mentioned in section 1.4.3 (Grammer, 1990). This study was only based on strangers. In our study we want to investigate if this is not only the case for strangers. So do male-female partners produce more laughter compared to others because they're interested in each other. Because we have such a broad selection of relationships we are also interested in seeing if there are any other relationships that result in pairs producing significantly more laughter than others. This leads us to our fourth research question: **Does the relationship between pairs play a significant role on the amount of laughter a pair produces?**

2.5 RESEARCH QUESTION 5

Studies of Marci et al. (2004); Beckman et al. (2007) revolved around laughter being a tool that helps reaching a successive outcome. The difference in our study is that the 'kakikoe' task requires pairs to coordinate with each other. As we mentioned in section 1.3, laughter can be a tool that makes people more relaxed. This may improve the coordination of the pair which results in better performance of the task. This leads us to our final research question: **Does laughter result in higher task success of a communication task between pairs?**

3 METHOD

3.1 KAKIKOE TASK

For our research we will use the results of the 'kakikoe' task which was conducted by Mills (2019). This is a game inspired by collaborative computer games, like Guitar Hero. The two participants both sit behind a separate screen with headphones on as you can see in (Figure 1). Just like Guitar Hero they see notes that they have to play. The difference is instead of playing notes participants say consonant-vowel pairs. One participant can say 'ka' and 'ki'. While the other participant can say 'ka' and 'koe'. These consonant-vowel pairs trigger the notes on the screen. Only one participant can see the notes both participants have to say and has to make this clear to the other participant while only using consonant-vowel pairs 'ka', 'ki' or 'koe'. The participants communicate via an audio link and can't see each other. The experiment was executed at the Lowlands festival in the Netherlands.

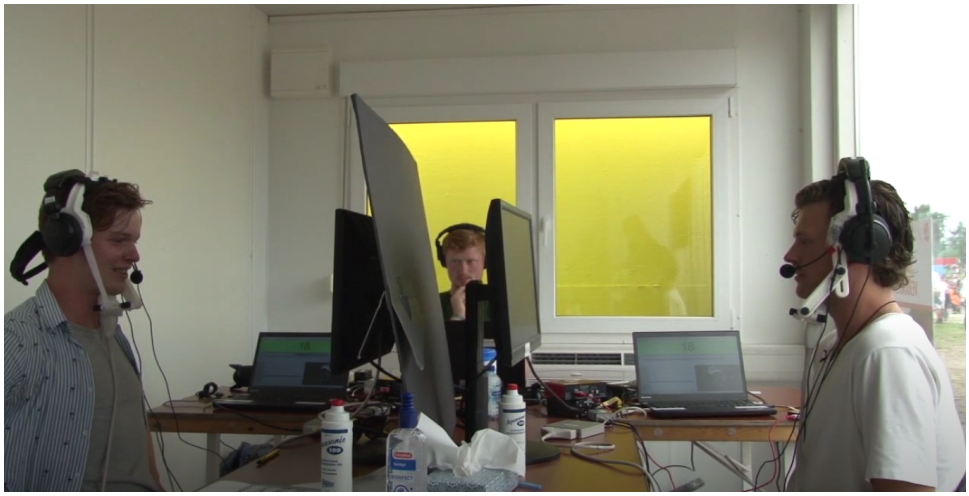

Figure 1: A pair performing the 'kakikoe' task.

3.2 DATA

The data set collected by Mills (2019) consist of game data of 78 pairs. For each pair there is one text file and multiple audio files containing the output of the participants. There are also questionnaire files in which the answers of all participants are included. We will explain these files in detail in this section. The games played by the pairs range from 29 to 44. This is because some pairs completed games faster than others. Which meant that they were able to complete more games.

3.2.1 Questionnaires

Before the games started participants filled in a questionnaire where different type of questions were asked. These questions were about personal characteristics, education, drug use, alcohol use and experience in music. One file contains all the answers of participants 1 and the other file of participants 2. Participants also filled

in a questionnaire after the experiment. These questions were about their game partner and experience. The answers of both participants of this questionnaire are collected in one file.

3.2.2 Text files

The output of all games played by a pair were collected in one .txt file. This file contains rows and columns. Each column is separated by '|' and each row is an event. An event is triggered when the participants say 'ka', 'ki' or 'koe'. We were only interested in one column of this file. This column indicated if the pair successfully completed a game or not. When the column in a row of a game consisted of 'TIMEOUT' the game was labelled as unsuccessful and otherwise successful.

3.2.3 Audio files

The data set contains one audio file for each game played by the participants. The audio file is in .wav format and contains the voices of both participants. The left channel is one participant and the right channel the other participant.

3.3 PROCESSING

In this section we will explain how we extracted the important data for us out of the collection, excluded certain data and created new data sets. This so that we were able to analyze the data and answer our research questions.

3.3.1 Excluded data

The first ten games of the task were left out. Because these games were just there to get familiar with the task. We also disregarded the data of pairs with relation O (other). Because this is such a broad description on which we can't draw any conclusions. And some data was left out of participants who didn't finish the task for some reason. In the end we were left with the data of 72 pairs out of the 78 pairs.

3.3.2 Questionnaires

From the questionnaires we needed some personal data. This was needed for analyzing the possible stimulating factors of laughter. An overview of the questions and answers which were in the file is shown in (Table 1). There were a few pairs who both filled in a different relation. One filled in friends and the other partners. We labelled these as friends.

Question	Answer(s)
Alcohol level	Amount of alcohol indicated by an alcohol tester
Have you smoked or ingested cannabis today?	Y(yes) or N(no)
Have you taken other recreational drugs today?	Y(yes, if so what) or N(no)
Gender	M(male) or F(female)
How is your game partner related to you?	PA(partner), FR(friends), FA(family), LEFT EMPTY(strangers) or O(other)

Table 1: Questions and answers of the questionnaires.

3.3.3 Audio files

Because there was no measure of laughter in the data set we needed a way to extract the laughter from the audio files. For this we used the Python library of Ryokai et al. (2018). This laughter detection algorithm uses a neural network that predicts, for every 10ms audio frame in a file, an estimated probability that this frame is part of a laugh. The model is trained on the Switchboard corpus which contains approximately 260 hours of speech from around 2400 telephone conversations. It achieved 88% accuracy at identifying laughter on a held out validation set. When using the algorithm it identifies laughter in audio files, cuts these parts and saves them to new audio files. Timestamps of the laughter parts are also saved to a .TextGrid file which enabled us to get the amount of laughing time per game. The command for using the laugh detector looked like this:

```
$ python3 segment_laughter.py my_audio_file.wav models/model.h5 my_folder 0.5 1 True
```

Where 'my_audio_file.wav' is the input file and 'my_folder' is the output folder. There are also three parameters that are given to the detector: first one being the minimum probability threshold, second one being the minimum length in seconds that a laugh needs to be in order to be identified and the last one saves the results to a .TextGrid file if set to True. For the first and second parameter we tried different values. We listened to the output that the detector created so we could confirm which parameters worked the best. We created a bash script called 'run_laughter.sh' so the detector ran over a whole directory instead of one file Janssen (2020). After

running the command over the input directories we had one output directory for every pair containing the .TextGrid files of each audio file. An example for both an output and input directory are in a GitHub repository Janssen (2020). Because we were interested in the amount of laughter relative to the total game time we also needed a way to get the time per audio file. For this we used the librosa library. This Python library has a function '.get_duration' which takes an audio file as input and returns the length in seconds. We first ran a Python script called 'total_time.py' on the input directory, containing the audio files, of every pair Janssen (2020). This Python script wrote the results to a .csv file. Each time the script ran over the input of a pair, lines were added to the then already existing .csv file. An overview of this .csv file is shown in (Table 2). After this the only thing we needed was the laughing

Column	Description
participants	the id's of both participants
game	number of the game
time	length of the game in seconds
total_time	cumulative time in seconds
alcohol	N(both no alcohol), NY(one alcohol) or Y(both alcohol)
drugs	N(both no drugs), NY(one drugs) or Y(both drugs)
relationship	consists of two parts separated by a '-': part one: PA(partner), FR(friends), FA(family) or NR(strangers) part two: male(both male), mf(male and female) or female(both female)

Table 2: Columns and description of the first .csv file.

time of each game. For this we also wrote a Python script called 'laughing_time.py' that extracted the timestamps from the .TextGrid files in the output directory of the pairs Janssen (2020). This Python script also wrote the results to a .csv file. For this file it was also the case that lines of each pair were added to the already existing .csv file. An overview of this .csv file is shown in (Table 3). At this point we had all

Column	Description
participants	the id's of both participants
game	number of the game
laughing_time	length of laughter per game in seconds
laughing_time_tot	cumulative laughing_time

Table 3: Columns and description of the second .csv file.

the data but it was in two separate files. So, again, we made a Python script called 'merge_files.py' that merged these two files into the final data set Janssen (2020).

3.3.4 Text files

The only thing we needed from the text files was the result of a game. For this we looked for every game if there was a row which contained 'TIMEOUT'. If this was the case the game was labelled with a 0, which meant unsuccessful. Otherwise the game was labelled with a 1, which meant successful. We added a column to the merged .csv file representing this called 'success'.

3.3.5 Final data sets

Because game times differed a lot we needed to add a variable called 'laugh_perc' to our data set. This column represents, per game, the laughing time divided by the total time. And because the column 'relationship' contains both gender and relationship we created two extra columns. The column 'gender' which indicates if the participants are both male, female or mixed ('mf'). And the column 'acq_str' which indicates if participants knew each other ('acquaintance') or not ('stranger').

We now extracted all the data we needed to create our final data sets. One data set containing all games of the participants with all the variables that were important to us. An example line can be seen in (Figure 2). The other data set which is a

participants	game	success	time	total_time	alcohol	drugs	relationship	laughing_time	laughing_time_tot	laugh_perc	acq_str	gender
06104873220647518670	11	1	15	15	Y	N	PA-mf	2	2	13.3333333333333	acquaintance	mf

Figure 2: Example line from the final data set containing all games of each pair.

summary of all participants. One line for each pair containing the total times and the success as a percentage. The success was calculated by dividing the 1's, which indicated success, by the total games played and multiplying this by 100 to make it a percentage. To get a good view of this data set an example line of two pairs can be seen in (Figure 3).

participants	success	time	laughing_time	relationship	alcohol	drugs	laugh_perc	acq_str	gender
06104873220647518670	93.75	816	132	PA-mf	Y	N	16.1764705882353	acquaintance	mf
06105747340637377404	95.83	848	100	FR-female	N	N	11.7924528301887	acquaintance	male

Figure 3: Example line from the final data set containing a summary of all pairs.

4 HYPOTHESIS

In this section we will formulate our hypothesis for each research questions stated in chapter 2. We will evaluate these answers later after we obtain the results.

4.1 HYPOTHESIS – RESEARCH QUESTION 1

Do pairs laugh more while being under the influence of alcohol? We think that the consumption of alcohol will result in a significantly higher amount of laughter. We expect to find a significantly higher percentage of laughter for pairs who both consumed alcohol. Compared to pairs where only one participant consumed alcohol and pairs where both participants didn't consume alcohol.

4.2 HYPOTHESIS – RESEARCH QUESTION 2

Will women laugh more than men? We think that women will laugh significantly more than men. We expect to find significantly higher laughing times per game for female pairs than for male and mixed pairs.

4.3 HYPOTHESIS – RESEARCH QUESTION 3

Will acquaintances laugh more than strangers? We think that acquaintances will laugh significantly more than strangers. We expect to find significantly higher laughing times per game for acquaintance pairs than for stranger pairs.

4.4 HYPOTHESIS – RESEARCH QUESTION 4

Does the relationship between pairs play a significant role on the amount of laughter a pair produces? We think that certain relationships will result in a significantly higher amount of laughter than others. We expect to find significantly higher laughing times per game for male-female partners compared to others. There are also a lot of other relationship but we are not sure what to expect from these. So it will be interesting to see if there are other relationship that result in significant amount of laughter compared to others.

4.5 HYPOTHESIS – RESEARCH QUESTION 5

Does laughter result in higher task success of a communication task between pairs? We think that laughter will result in a significantly higher task success. We expect that pairs who laugh more during a game will have a significantly higher change of completing the game successfully.

4.6 ANALYSIS

In this section we will explain what analysis we will use to answer each research question. We will also explain which variables of our data set we use to answer the different research questions. We performed all the analysis in the programming language R.

4.6.1 Analysis - Research Question 1 & 2 & 3

For the research questions: **Do pairs laugh more while being under the influence of alcohol?**, **Will women laugh more than men?** and **Will acquaintances laugh more than than strangers?** We used linear mixed effects regression to answer these questions. We used the data set containing a summary of all pairs for this regression (Figure 3). Mixed effect because we want different random effects for the different pairs. Here the response variable is 'laugh_perc' and the explanatory variables are 'alcohol', 'gender' and 'acq_str'.

4.6.2 Analysis - Research Question 4

For the research question **Does the relationship between pairs play a significant role on the amount of laughter they produce?** We will again use liner mixed effects regression. With the same reasons and data as for research question 1. Here the response variable is 'laugh_perc' and the explanatory variable is 'relationship' A different model because 'gender' and 'acq_str' are also a part 'relationship'. This means that we can't add this variable to the first model.

4.6.3 Analysis - Research Question 5

Does laughter result in higher task success of a communication task between pairs? For the final research question we used generalized linear mixed effects regression to investigate significance. We used the data set containing the games of all pairs for this regression (Figure 2). Generalized because we are dealing with a binomial response. And mixed because we want to add a random effect for participants.

In all our models the threshold for significance will be set at a p-value of 0.05 or a t-value of 2. If the models result in a p-value which is below the threshold or if the models result in a t-value which is bigger than the threshold. We will state the result as significant

5 RESULTS

In this section we will, for each research question, first look at the distributions of our data to give a good view of the results. After this we will show the outcome of the models we created. The code for all the figures and models can be found in a R Notebook Janssen (2020).

5.1 LAUGHTER AND ALCOHOL

5.1.1 Distribution

Our first research question revolves around laughter and alcohol so we will show how both variables are distributed over the participants. Because our model looks at the laughter as a percentage of game time we will first of all look at the game time of the participants (Figure 4). In this figure we can see the total game time on the y-axis and all pairs on the x-axis. As we can see the game time is distributed fairly

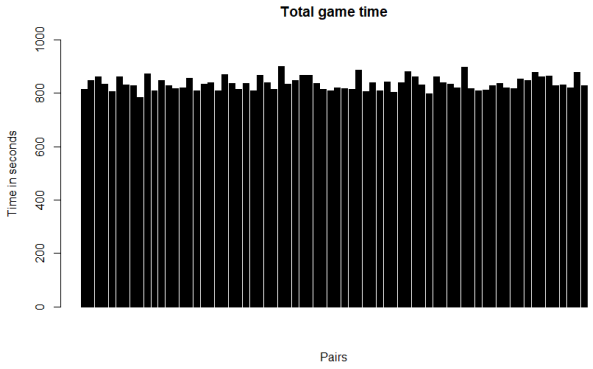

Figure 4: Total game time of all pairs.

even with a mean game time of 836.9 seconds. The different game times are not a problem for us because we account for this by looking at laughter, in green, relative to the game time, in black. You can see this in (Figure 5). Laughter is distributed less fairly with a mean laughing time of 34.0 seconds. Now that we have a good

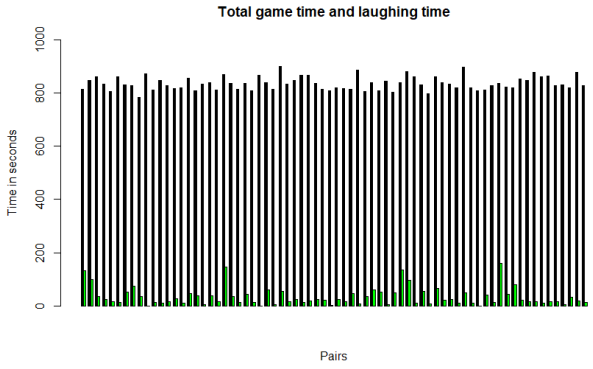

Figure 5: Total game time and laughing time of all pairs.

view of how the laughter is distributed among all the pairs lets look at how alcohol groups are distributed. A pair can belong to one of three different alcohol groups: both participants have consumed alcohol (Y), both participants have not consumed alcohol (N) or one participant has consumed alcohol and the other has not (NY). As we can see in (Figure 6) the largest group 'N' consist of 32 pairs. Followed by the group 'NY' with 23 pairs. And the group 'Y' has 17 pairs, which is the lowest. As

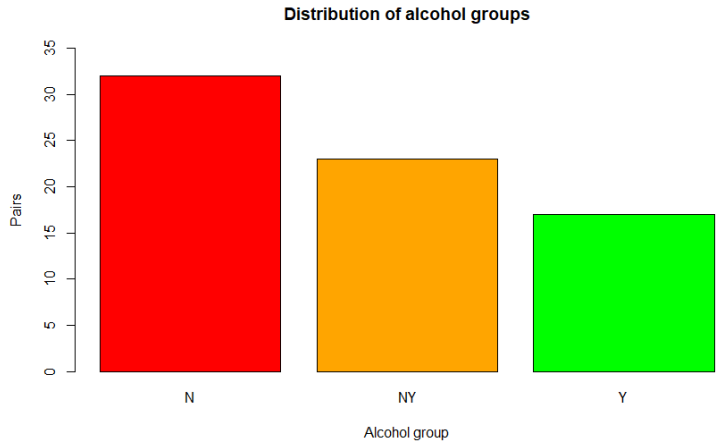

Figure 6: Distribution of alcohol groups.

we are interested in difference of laughter between the alcohol groups we created a barplot in which you can see the average laughter per alcohol group (Figure 7). We can see that there are differences in laughter between the three groups. The 'NY' group produces a lot less laughter than the other two groups on average.

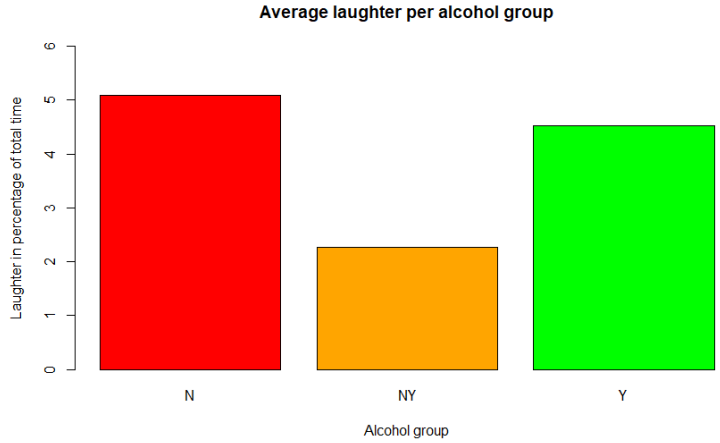

Figure 7: Average laughter per alcohol group.

5.2 LAUGHTER AND GENDER

5.2.1 Distribution

The second research question revolves around laughter and gender. In the last part we already showed how laughter is distributed among the pairs. In this section we will also look at how gender is distributed and how the laughter is distributed among different gender groups. A pair can belong to one of three different gender groups: both participants are male, both participants are female or one participant is male and the other female (mf). We can see the distribution of gender groups across all pairs in (Figure 8). Here we can see that there are 22 female, 21 male and 29 'mf' pairs. So as we are interested in difference of laughter between the gender

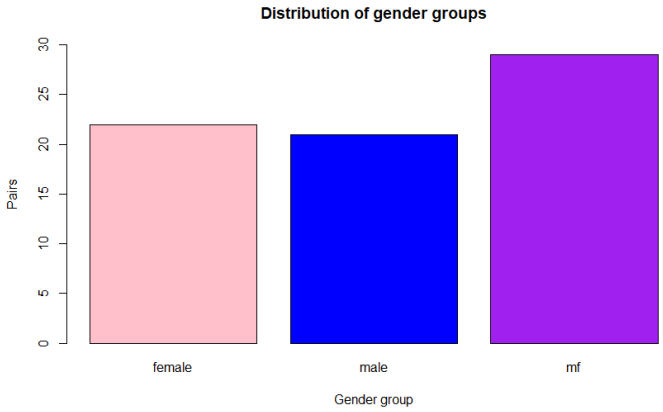

Figure 8: Distribution of gender groups.

compositions we created a barplot in which you can see the average laughter across the gender groups (Figure 9). We can see that there are differences in laughter between the three groups. Female groups produce more laughter than other groups on average.

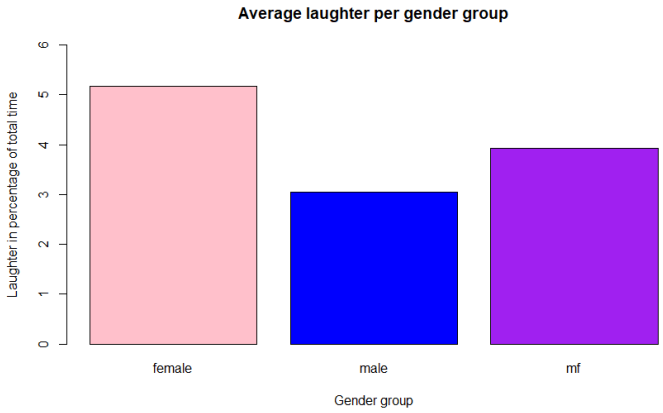

Figure 9: Average laughter per gender group.

5.3 LAUGHTER OF ACQUAINTANCES AND STRANGERS

5.3.1 Distribution

The third research question revolves around the difference in laughter for participants that know each other versus participants that don't know each other. So first of all lets look at the distribution of acquaintances and strangers. This can be seen in (Figure 10). Here we can see that there are a lot more pairs that know each other than pairs that don't know each other. There are 65 pairs in the 'acquaintance' group and 7 pairs in the 'stranger' group. As we are interested in the difference in laughter

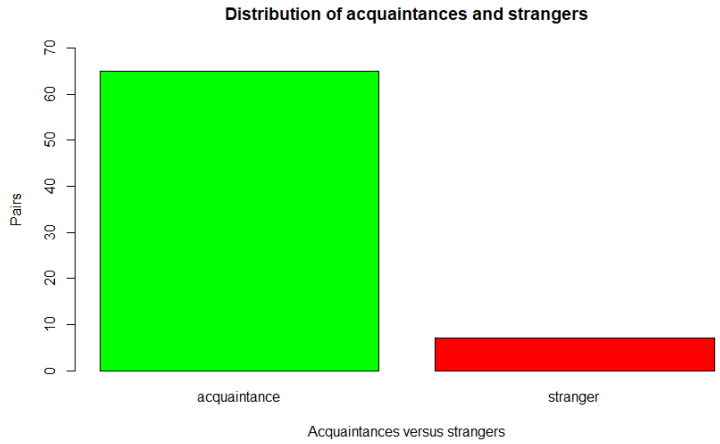

Figure 10: Distribution of acquaintances and strangers.

of these two groups we created a barplot where you can see the average laughter of the two groups (Figure 11). The plot shows a big difference in laughter between the two groups. Acquaintances laugh more than twice as much as strangers on average. Now that we showed how all the variables in our first model are distributed we are

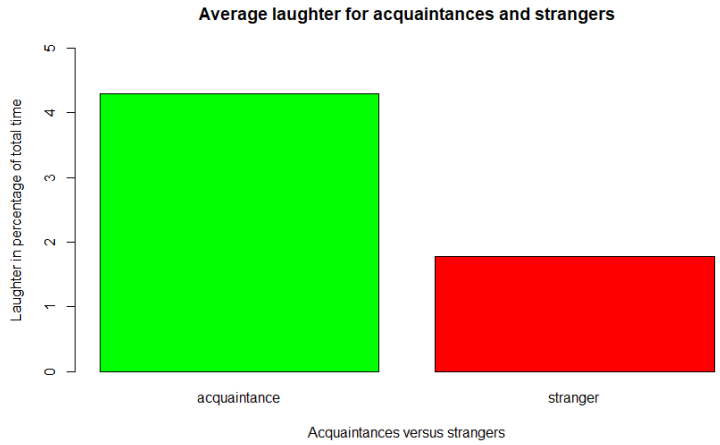

Figure 11: Average laughter of acquaintances and strangers.

ready to make the model and test significance.

5.3.2 Model

To investigate if there is significance we made a linear mixed effects regression model. Where the laughter percentage is modelled as a function of alcohol, gender and 'acq_str'. With a random effect for pairs. We used the package 'lme4' for this, which contains the function 'lmer'. The model looks like this:

```
lmer(laugh_perc_log ~ alcohol + gender + acq_str + (1|participants), data=data2)
```

In this model the dependent variable is 'laugh_perc_log', the independent variables are 'alcohol', 'gender' and 'acq_str'. And there is a random effect for 'participants', which are the pairs. Because the dependent variable is time laughed as a percentage of the total time the values will be distributed heavily towards 0. This will result in non-normality. We tried to fix this by transforming the 'laugh_perc' to the logarithm of 'laugh_perc'. We had two pairs who produced no laughter. Because of this their laughing percentage is 0. Transforming a 0 to the logarithm function of it results in an infinite negative number. So we first added a 1 to the laughing percentage of every pair and then transformed it to the logarithm. Now we were able to check the assumptions. We needed to check if the residuals are normally distributed and if there is homoscedasticity. These results are visualized in (Figure 12). A shapiro wilk test resulted in a p-value > 0.05, so the residuals are normally distributed. The differences on the x-axis of the left plot look equal. We performed a Levene Test which resulted in a p-value > 0.05. So the assumption of homoscedasticity is met. We also needed to check if there is no multicollinearity. VIF values of the fixed effects where below 5 so the data is not multicollinear. This means that the assumption of multicollinearity is also met. The results of the model can be seen in (Figure 22).

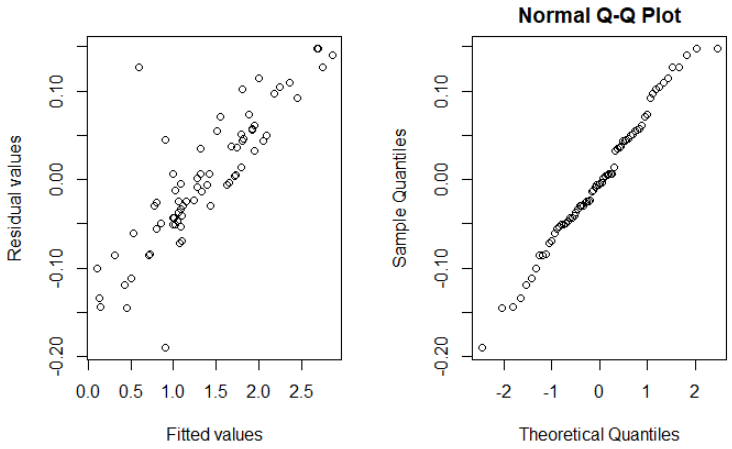

Figure 12: Plots for homoscedasticity and normality of the residuals.

The intercept contains alcohol is N, gender is female and 'acq_str' is acquaintances. These three predictors are all significant with a t-value(10.33) > 2. This means that that pairs who both didn't consume any alcohol produce significantly more laughter than pairs where one or both participants consumed alcohol. This result is not in line with our hypothesis which states that pairs who consumed alcohol produce a significantly higher amount of laughter. Pairs consisting of only females produce significantly more laughter than pairs with one male and one female or pairs with both males. This result is in line with our hypothesis which states that women will laugh significantly more than men. And acquaintances produce significantly more laughter than strangers. This is also inline with our hypothesis which states that acquaintances produce more laughter than strangers. The predictor alcohol is 'NY' is also significant with a t-value(-2.19) > -2. This means that pairs where one participant consumed alcohol and the other participant didn't, produced a significantly lower amount of laughter.

5.4 LAUGHTER AND RELATIONSHIP

5.4.1 Distribution

In this section we will take a look at the distribution of relationships between pairs. This is where our fourth research question revolves around. The distribution of all the relationship groups can be seen in (Figure 13). As you can see some relationships are a lot more common than others. The biggest group is female friends with 20 pairs. And the two smallest groups are female partners and female family members with only 1 pair. As we are interested in the difference in laughter between

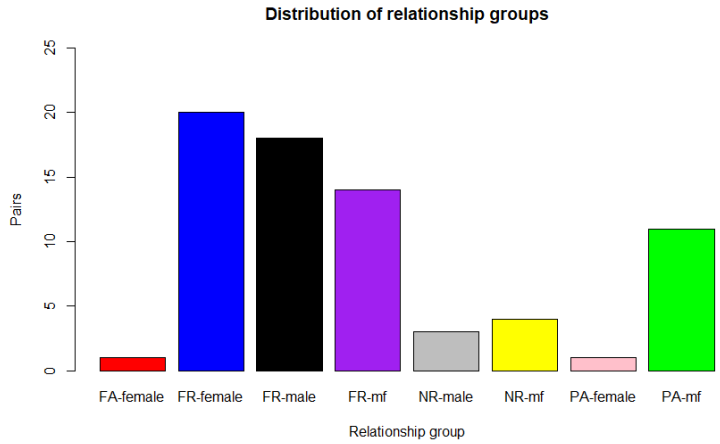

Figure 13: Distribution of relationship groups.

these groups we made a barplot containing the average laughter of all groups (Figure 14). We can see that there are three groups that, on average, produce a lot of laughter compared to the rest. These groups are female family members, female friends and male-female friends. The other groups produce about the same amount of laughter on average. Now that we have a good view of how relationships are distributed across pairs and laughter across the relationships we can define our model and test significance.

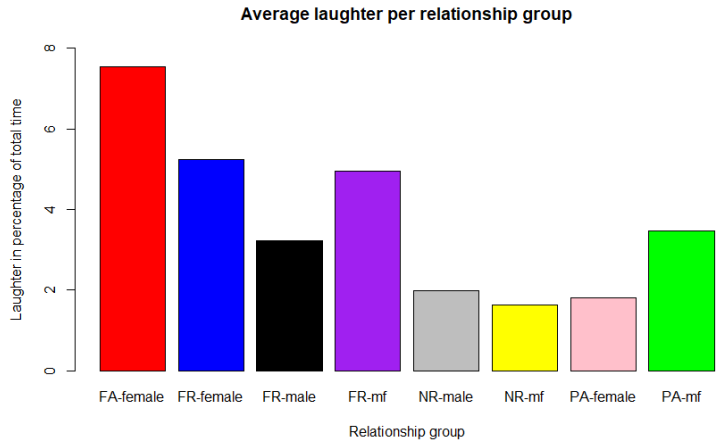

Figure 14: Average laughter per relationship group.

5.4.2 Model

To investigate if there is significance we made another linear mixed effects regression model. Where the laughter percentage is modelled as a function of relationship. With a random effect for pairs. The model looks like this:

```
lmer(laugh_perc_log ~ relationship + (1|participants), data=data2)
```

We use the dependent variable 'laugh_perc_log' for the same reasons as we explained in our first model. The independent variable here is 'relationship'. We now needed to check the assumptions. First of all we needed to check if the residuals are normally distributed and if there is homoscedasticity. These results are visualized in (Figure 15). A shapiro wilk test resulted in a p-value > 0.05, so the residuals are normally distributed. The differences on the x-axis of the left plot look equal. We performed a Levene Test which resulted in a p-value > 0.05. So the assumption of homoscedasticity is also met. The results of the model can be seen in (Figure 23).

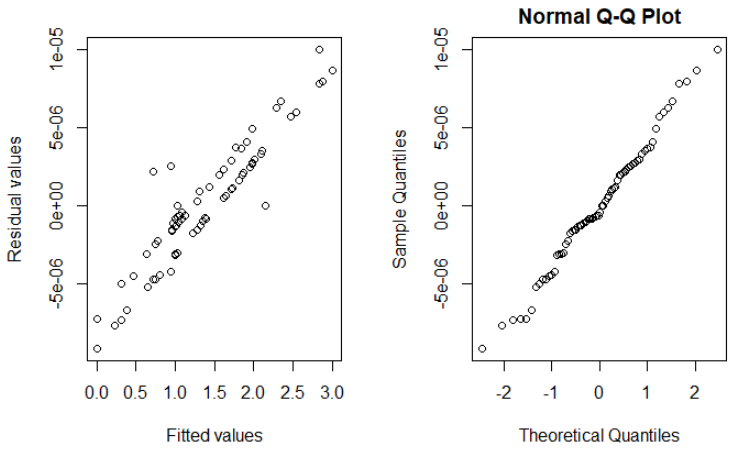

Figure 15: Plots for homoscedasticity and normality of the residuals.

The intercept here contains relationship is 'FA-female'. This is the only predictor that is significant with a t-value(3.0) > 2. This means that pairs that are both female and family produce significantly more laughter than other pairs. This result is in line with our hypothesis which states that certain relationships will result in a significantly higher amount of laughter than others. But we also expected that male-female partners would produce significantly more laughter than others. This is not the case.

5.5 SUCCESS AND LAUGHTER

5.5.1 Distribution

Our last research question revolves around success and laughter so we will show how both these variables are distributed over the participants. Because success is measured per game we will first of all look at the distribution of games played by the pairs. This can be seen in (Figure 16). In this figure we can see the games played

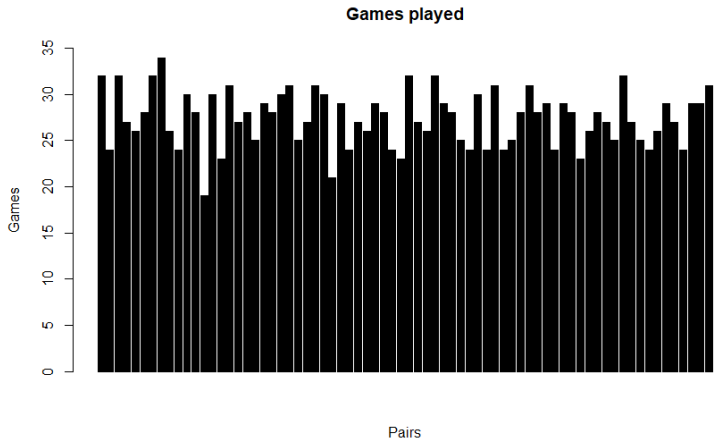

Figure 16: Games played by the pairs.

on the y-axis and all the pairs on the x-axis. Here we can see that there is variation in games played by each pair. The mean games played by a pair is 27. As we have said before the first ten introduction games are not included here. Because we are investigating the success of games we made a barplot in which you can see the successive games of all pairs as a fraction of total games played. This can be seen in (Figure 17). Here you can see all the pairs on the x-axis and the fraction of total

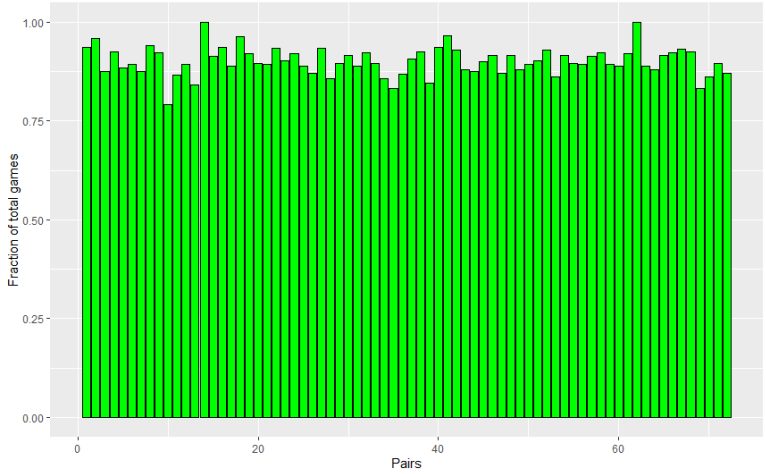

Figure 17: Successive games of all pairs as a fraction of total games played.

games on the y-axis. As you can see all pairs completed more than 75% of their games. There is not a lot of difference between the pairs with a mean percentage of completed games of 90.2%.

In section 5.1.1 we already showed how the laughter is distributed across the pairs. So now that you have a good view of how both variables laughter and success are distributed lets look at them relative to each other (Figure 18). If laughter would

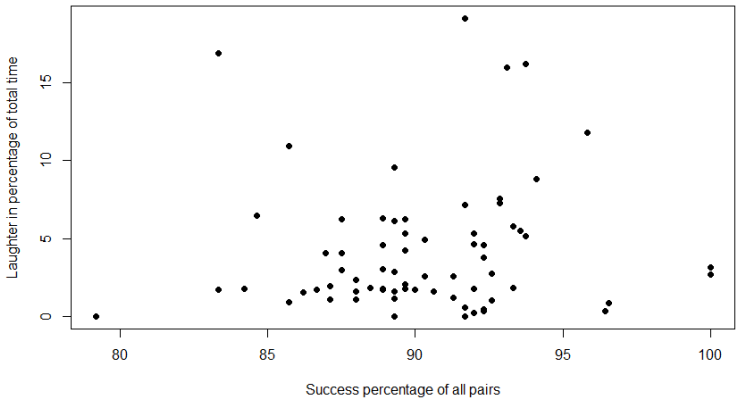

Figure 18: Success percentage vs laughter percentage of all pairs.

have a significant effect on the success there should be a linear relation between the two. The higher the laughter percentage the higher the success percentage. This doesn't seem to be the case. Because in the model we will be looking at the impact of laughter on the 'success' of the game it will be good to visualize the average laughter time of successful (1) versus unsuccessful (0) games. You can see this in (Figure 19). The average laughter is 5.69% for unsuccessful games and 2.63% for successful games. This suggests that laughter will not result in a higher task success. To test if this was the case we made a model.

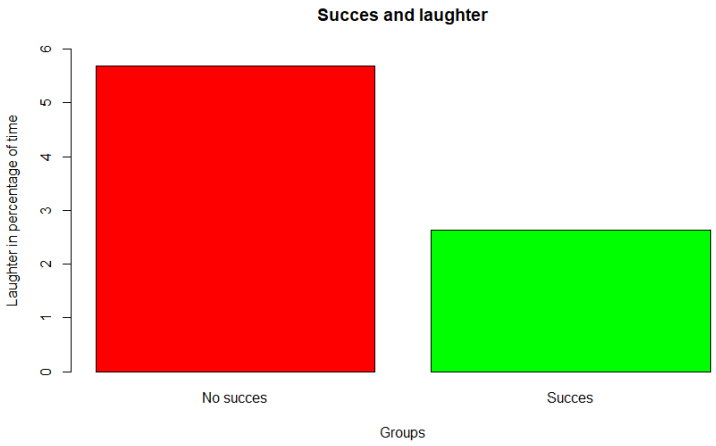

Figure 19: Average laughter unsuccessful vs successful games.

5.5.2 Model

To investigate if there is significance we made a generalized linear mixed effects regression model. Where the success is modelled as a function of the laughter. With a random effect for participants. We used the package 'lme4' for this, which contains the function 'glmer'. The model looks like this:

```
glmer(success ~ laugh_bin + (1|participants), family='binomial', data=data)
```

Because the laughing percentage is 0 most of the times (Figure 20) the assumption of linearity will not be met. So we decided to create a variable with laughter on a binary scale. If there was laughter this value was 1 and if there was no laughter the value was 0. In this model the dependent variable is 'success', the independent variable is 'laugh_bin', there is a random effect for 'participants' and binomial because 'success' is either 0 (unsuccessful) or 1 (successful). Now lets check if the model meets the assumptions. The games played are independent of each other and the dependent variable is on a binary scale. No further assumptions need to be checked because our independent variable is also on a binary scale. The results

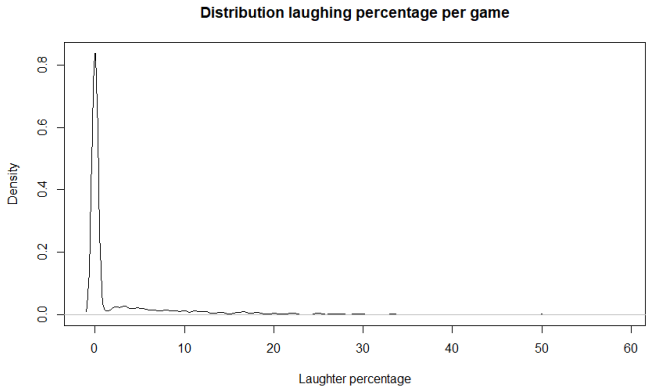

Figure 20: Distribution of laughter percentage throughout all games.

of the model can be seen in (Figure 24). It shows a p-value of 2e-16, which is lower than our threshold of 0.05. This indicates that the laughter in a game significantly influences whether a game is completed successfully or not. But not how we expected. If laughter increases the probability of success decreases (Figure 21). So laughter results in a significantly lower task success. This result is not in line with our hypothesis which states that laughter results in a significantly higher task success.

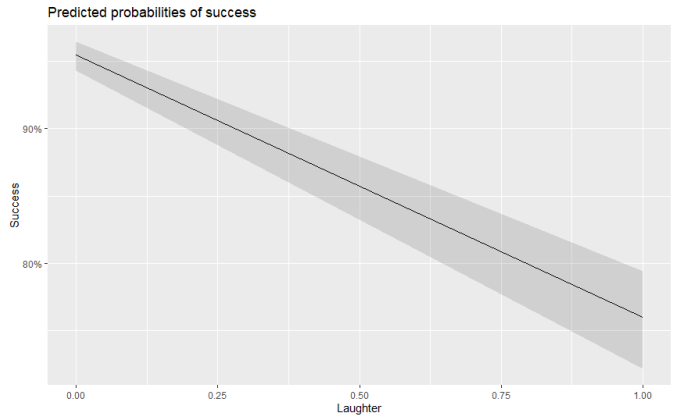

Figure 21: Laughter as fixed effect predictor of game success.

6 DISCUSSION

In this section we will discuss the results and form conclusions by answering our research questions. We will also discuss future work in this area.

6.1 DISCUSSION – RESEARCH QUESTION 1

Do pairs laugh more while being under the influence of alcohol? Our results showed that there was significance, but not how we expected. We expected that pairs where both participants consumed alcohol would produce significantly more laughter than other pairs. But the exact opposite was the case. Pairs where both participants didn't consume alcohol laughed significantly more than pairs where one or both participants consumed alcohol. Which leads us to the conclusion that pairs do not produce more laughter while being under the influence of alcohol. This might be because of our measure of alcohol. We put participants who had very little alcohol in their blood in the same category as participants who had a lot of alcohol in their blood. A little alcohol in your blood might not be enough to have a significant effect on the amount of laughter produced. We also found that pairs where one participant consumed alcohol and the other didn't, produced significantly less laughter than other pairs. We think this could be because the two participants are in different states. Because laughter is mainly a joint action it depends highly on the reaction of the other participant. When one participant has consumed alcohol he or she might produce laughter whilst the other participant doesn't see a reason to respond with laughter. When one participant notices that the other participant is not responding with laughter to their laughter it is likely that he or she will be less likely to laugh in the future.

6.2 DISCUSSION – RESEARCH QUESTION 2

Will women laugh more than men? Our results showed that gender has a significant impact on the amount of laughter produced by the pairs. As we expected, groups only containing female participants produced significantly more laughter than male and mixed gender groups. We can conclude that women laugh significantly more than men whilst performing a communication task.

6.3 DISCUSSION – RESEARCH QUESTION 3

Will acquaintances laugh more than strangers? Our results showed that if two participants knew each other before the task they produced significantly more laughter throughout the task. So we can conclude that acquaintances laugh significantly more than strangers.

6.4 DISCUSSION – RESEARCH QUESTION 4

Does the relationship between pairs play a significant role on the amount of laughter they produce? Our results showed that female family members produced significantly more laughter than other pairs. So we conclude that the relationship of a pair does play a significant role in the amount of laughter they produce. A remark on this is that this group only contained the observations of one group. We also expected male-female partners to produce more laughter because they find each other attractive, but we didn't find significance. We think this could be because both participants know that they're in love with each other. They are both past the stage that they have to make this overly clear by laughing more often.

6.5 DISCUSSION – RESEARCH QUESTION 5

Does laughter result in higher task success of a communication task between pairs? Our results showed that laughter did not result in a higher task success of the 'kakikoe' task performed by pairs. Laughter did turn out to have a significant impact on the task success. But instead of it resulting in a higher task success it actually resulted in a lower task success. We can conclude that laughter results in a significantly lower task success whilst performing a communication task. We think that this is the case because of the fact that there is a time limit for each game. Valuable time is being wasted whilst the pairs are laughing. The effect that laughter may have on the perseverance of successfully completing the task is outweighed by the time wasted whilst laughing.

6.6 FUTURE WORK

Our research showed interesting results of studying possible factors that influence on the amount of laughter a pair produces. Because we measured laughter from data which contained the output of both participants the laughter was a measure of the pair. For future work it would be interesting to measure the laughter from the pairs separately. We could then take a more in depth look at the distribution of laughter between the two participants. We concluded that women produced more laughter than men. But with a separate measure of laughter we could also be able to investigate if women also had the biggest contribution to laughter in the mixed groups. The same goes for the alcohol groups. A separate measure would also facilitate looking at the overlap of laughter between the participants. Because laughter is mainly a joint action this would be a very interesting part to look at. For future work on the impact of alcohol on laughter we think it would be better to use the amount of alcohol in the blood as a measure, not putting all participants in one group. For the relationship groups it would be better to have data of more pairs. Because we had quite a lot of groups compared to the amount of pairs some groups only were the measure of one pair. Our research also showed that in our case laughter results in less success of the communication task. For future work it would be better to look at the impact of laughter on a communication task that has no time limit.

7 ACKNOWLEDGEMENTS

I would like to thank Mr. Gregory Mills, PhD and my thesis group for the help during the process of writing this thesis.

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```
Linear mixed model fit by REML ['lmerMod']
Formula: laugh_perc_log ~ alcohol + gender + acq_str + (1 | participants)
   Data: data2

REML criterion at convergence: 152.3

Scaled residuals:
     Min       1Q   Median       3Q      Max
-0.84405 -0.21129 -0.02282  0.22190  0.66063

Random effects:
 Groups       Name        Variance Std.Dev.
 participants (Intercept) 0.42604  0.6527
 Residual                 0.05043  0.2246
Number of obs: 72, groups:  participants, 70

Fixed effects:
                 Estimate Std. Error t value
(Intercept)      1.679150   0.162603  10.327
alcoholNY       -0.411591   0.188220  -2.187
alcoholY         0.004491   0.218574   0.021
gendermale      -0.318645   0.228770  -1.393
gendermf        -0.241798   0.200347  -1.207
acq_strstranger  0.095649   0.206689   0.463

Correlation of Fixed Effects:
            (Intr) alchNY alchlY gndrml gndrmf
alcoholNY   -0.409
alcoholY    -0.246  0.336
gendermale  -0.506 -0.092 -0.348
gendermf    -0.673  0.059 -0.115  0.527
acq_strstrn  0.167 -0.445 -0.025 -0.093 -0.147
```

Figure 22: Model of laughter as a function of alcohol, gender and 'acq_str'.

```
Linear mixed model fit by REML ['lmerMod']
Formula: laugh_perc_log ~ relationship + (1 | participants)
   Data: data2

REML criterion at convergence: 149.9

Scaled residuals:
       Min         1Q     Median         3Q        Max
-0.0052640 -0.0013265 -0.0003227  0.0014683  0.0057409

Random effects:
 Groups       Name        Variance  Std.Dev.
 participants (Intercept) 5.106e-01 0.71458
 Residual                 3.028e-06 0.00174
Number of obs: 72, groups:  participants, 70

Fixed effects:
                      Estimate Std. Error t value
(Intercept)             2.1448     0.7146   3.002
relationshipFR-female  -0.6001     0.7322  -0.820
relationshipFR-male    -0.9143     0.7322  -1.249
relationshipFR-mf      -0.6214     0.7397  -0.840
relationshipNR-male    -0.9143     0.7322  -1.249
relationshipNR-mf      -0.9860     0.7397  -1.333
relationshipPA-female  -1.1157     1.0106  -1.104
relationshipPA-mf      -0.9860     0.7397  -1.333
```

Figure 23: Model of laughter as a function of relationship.

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
 Family: binomial  ( logit )
Formula: success ~ laugh_bin + (1 | participants)
   Data: data

     AIC      BIC   logLik deviance df.resid
  1119.4   1136.1   -556.7   1113.4     1971

Scaled residuals:
    Min      1Q  Median      3Q     Max
-4.6077  0.2170  0.2170  0.2170  0.5621

Random effects:
 Groups       Name        Variance Std.Dev.
 participants (Intercept) 0        0
Number of obs: 1974, groups:  participants, 72

Fixed effects:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)   3.0555     0.1269   24.07   <2e-16 ***
laugh_bin    -1.9032     0.1627  -11.70   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:
          (Intr)
laugh_bin -0.780
optimizer (Nelder_Mead) convergence code: 0 (OK)
```

Figure 24: Model of success as a function of laughter.