Smoothened emotions

The effect of (digital) Botox on communication

Sophie Rust

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Media Technology MSc program, Leiden University
Supervisors: Max van Duijn & Maikel Scheer
Sophie@ontwerpkliniek.nl

Abstract. Using Botox is an increasingly popular way to prevent facial wrinkles. An effect of Botox, however, is that one's face becomes less expressive. The aim of this research is to investigate if this effect influences communication. In an experiment two stories were communicated by a series of video messages. One group was shown video footage that had been digitally manipulated to remove the frown wrinkles, simulating the facial expressions of Botox users. The other group was shown the non-manipulated video footage. Using a 'Chinese whisper'-setup, the stories were passed on over two generations of test subjects. Both generations were analyzed in terms of communication loss related to the original story. For story 1 no significant differences between the Botox and non-Botox conditions were found. For story 2 there are statistically significant differences between these conditions, in particular regarding the variables 'intended meaning' and 'emotion'. This may indicate that weakened facial expression due to Botox usage can lead to decreased communicative ability, in particular of emotionally-laden content.

1 Introduction and objectives

A large part of our communication is non-verbal. When non-verbal communication does not match verbal communication it will cause a lot of confusion at the receivers' end (Mehrabian & Wiener 1967). Non-verbal communication consists of, among other things, body language and facial expressions. Facial expressions are not just non-verbal, but also linked to verbal communication. To pronounce words it is needed to form one's mouth in certain positions using facial muscles (for example, when people are forced to smile by saying the word cheese out loud when a picture is taken). Facial expressions, for an important part, reveal our emotional and physical states and our intentions (Horstmann 2003).

It is commonly thought that facial expressions emerge from the experience of emotions but the *facial feedback hypothesis* states that it could be the other way around, or at least partially. The facial feedback hypothesis stems from the idea that facial movement can influence emotional experience. For example, someone who is forced to smile will have a more enjoyable experience.

Darwin was the first known to philosophize about this theory (1872). William James (1894) suggested that muscle actions contribute to experiencing emotions. It was Silvan Tomkings (1962) who eventually focussed his research on the facial muscles, leading to what is now known as the facial feedback hypothesis. The facial feedback hypothesis has proved difficult to test because most research was highly dependent on self-reporting (Flack et al. 1999). Experiments have also been conducted, for example in a study where researchers asked participants to hold a pen between their teeth or lips to create facial expressions without experiencing the matching emotions, while using the same muscles as those matching emotions (Strack, Martin, Stepper 1988). This research supported the facial feedback hypothesis. When researching the facial feedback hypothesis, a problem remained: it was impossible to distinguish between whether the emotions caused the expressions or vice versa. -That is, not until there was Botox. If facial expressions can initiate experienced inner emotions, it also means that the use of Botox, affects the experience of emotions.

Botox is a trademark (among other trademarks) of the company Allergran. The word is created out of the combination of the two words Botulinum and Toxin. Botulinum toxin is a neurotoxic protein produced by bacteria of the Clostridium botulinum family. In this paper the word Botox is used as a general term, and represents all types or brands of Botulum Toxin.

Before the discovery of medical and later cosmetic use, Botulinum toxin was a very dangerous toxic found in improperly prepared food. When it was hypothesized the toxin could be useful as a drug in a very diluted form for medical purposes (Erbguth 2004), dermatologists (Carruthers & Carruthers 1992) quickly discovered its cosmetic potential. Nowadays Botox is used for treating a wide spectrum of diseases in which overly active muscles form a problem and need to be controlled, ranging from Parkinson and overactive sweating to migraine. Besides that, it is a popular cosmetic drug that can be injected in different facial muscles. The injections, mostly used in the forehead area, temporarily paralyze the muscles that are treated. Therefore, locally the skin cannot make contractions, which will stop or slow down the process of wrinkling. As a side-effect, users of Botox cannot actively contract the affected facial muscles for three till six months after treatment. This results in a decreased ability to display facial expressions.

The current research is focussed on this cosmetic effect of Botox usage. The aim of this research is to find an answer to the question “Does Botox affect communication?”.

- This study focusses on Botox treatment used in the forehead area associated with the wrinkles that are prevented by Botox in this area.
- Because the Botox treatment of migraine is also located in the forehead area its results are similar to those for cosmetic treatment.

The facial expressions that are most affected by Botox are those associated with negative emotions, e.g. anger, sadness or disgust (Finzi 2013). All of these involve contraction of muscles in the forehead area, the so-called corrugators (frown muscles). Injections in these muscles are also the most commonly chosen Botox treatment (Maikel Scheer, p.c.). Therefore, research in this thesis concentrates on loss of expressivity in the forehead area specifically. People who use Botox to prevent migraine attacks have this cosmetic side-effect, and are taken into account in this study.

2 Scientific Context and Related Work

Previous research concerning Botox and facial expressions is concentrated mainly on the experience of emotions by the user of Botox and mostly to test the facial feedback hypothesis. In one of the first studies regarding Botox use and emotions, researchers compared the mood of participants who got Botox injected in the corrugator (frown) muscles with participants who had other cosmetic treatments (Lewis & Bowler 2009). Negative moods of the participants who were injected with Botox in the frown muscles were reduced, supporting the facial feedback hypothesis.

A similar study (Davis et al. 2010) compared Botox with Restylane (non paralyzing) injections. Self-reported emotional experience responses to positive and negative video clips were collected. A significant decrease was found in the experiences of emotion in the Botox group compared to the Restylane group. From this the authors concluded that the changes in experienced emotions were not induced by (possible reactions to) undergoing cosmetic treatment as such, but arose from the disability to frown, since this was the only difference between the two treatments.

Combining the use of Botox and fMRI[1] made it possible to compare brain activity related to facial expression, to brain activity without facial expression by asking participants to imitate facial expressions, and comparing it with the neural activity found without using facial expressions. (Hennenlotter et al. 2008). Findings of this study demonstrate that facial feedback modulates neural activity during intentional imitations of facial expressions.

Recently it has been suggested (Baumeister, Papa and Foroni 2016) that subjects who have had Botox injections have more difficulties recognizing emotions. The effect was bigger in subtle emotions than in very obvious emotions and the effect was also larger under time pressure. If Botox leads to a decrease of neural activity when mimicking emotional expressions (as suggested by the fMRI study cited above), this can indeed explain why subjects also have difficulties

[1] fMRI (Functional magnetic resonance imaging) is a teqnique to scan the brain on activity by detecting changes associated with blood flow.

recognizing emotions. The mechanism of recognising emotions in human beings possibly works by the automatic, unconscious mirroring of those emotions, leading to the experience of empathy and thereby knowing the matching emotion. Less subtle emotions contain more visual clues, and perhaps that is why Botox users still recognise those emotions. It could be as well that there is a decrease of empathy but not a total loss of empathy and for full negative emotions there is still enough to experience and thus recognise that emotion.

All related studies are focussed on the experience of the users of Botox rather than the people to whom Botox users communicate. Since the former group is significantly larger but was not been taken into account in previous studies, it is important to shift focus to this new perspective. This research is therefore focussed on the question: does Botox affect communication? Or, more precisely: does decreased facial expressiveness, as found in Botox users, affect their ability to communicate a particular message to non-Botox users? In an experimental setting, subjects with smoothened facial expressions ('Botox users') communicate two stories to a set of subjects with normal facial expression ('non-Botox users') in a one-way direction. Received information and emotions of the non-Botox users are measured using four parameters. The findings will be discussed in the context of the framework set out in the sections 1 and 2.

3 Method

In the experiment two stories are communicated through video messages. One group is shown video footage that has been digitally manipulated. The frown lines between the eyes are digitally removed, to simulate Botox usage; see fig. 1 below. The control group watched the original versions of the same videos. To test what is conveyed, the receiver was asked to retell the story via a recording of a webcam to some one else. To amplify the effect, the story was retold another time, following the 'Chinese-whisper paradigm' (cf. Mesoudi et al. 2006). Those stories are also recorded via webcam and then analyzed and compared to the original story; see fig. 2.

It has thus been decided to use manipulated video footage in a way that it seems as if people have used Botox, rather than record real Botox users and let them retell the stories. This decision is motivated in the following way.

Practical reasons:

1. Financial limitations; it would be a large investment to inject Botox for a before-and-after recording.
2. Using Botox still is a taboo to some extent. It is necessary for participants to admit they are Botox users, which they might not be willing to share openly.
3. Needed approval from the ethical committee would unnecessarily delay the research.

Substantive reasons:

4. Ethical conduct of the study would involve the knowledge and approval from the participants to use Botox. This foreknowledge would possibly influence the behaviour during the experiment and could thus affect results.
5. To have the stories told twice the exact same way before and after getting Botox injections is very complicated. To get the exact word match participants would have to read the story from paper or using an auto-cue system, but either would make the telling look less natural. Even if all the words are the same, it is impossible to have one's head in the same (natural) position as the first time, let alone all the facial muscles that are not affected by Botox.
6. Studies using Botox to research facial feedback hypothesis show that using Botox can lead to a decrease of empathy (Baumeister, Papa and Foroni 2016). When an emotional message is transported to a receiver face to face, it stays unknown if the lack of emotional received information comes from the fact that the emotions are not readable from the sender's face or if the whole emotion was never intended in the message because of the lack of empathy of the Botox user. Separating the empathy from the visible cues makes it more clear that if (emotional) information is lost, it is due to change in visible appearances of the face.

3.1 Stories

Each participant is asked to watch video recordings of the telling of two stories. After that they are asked to retell the stories in front of the camera, for a next participant to see. The first story is a Dutch fable, written by the Dutch writer Toon Tellegen about a snail and an elephant. It has a third-person narrator. The story is only adapted a little to add at least one strong negative emotion to the story. There are minor differences between the text and the spoken story because the storyteller is asked to learn the subplots by heart to create a more natural atmosphere in the source video. The second story is a first-person narrative about a scam at the gym; the participants in line (the first, second and third generations) are asked to retell the story also from a first-person perspective, as if the events in the story were experienced by themselves.

The reason to use two stories from different narrative perspectives is that the first way of storytelling could feel more natural since it is just a story about two animals, as if people tell the story to a child. Participants do not need to pretend to be in a situation they are unknown with. The downside of this type of communication is that a story about someone-else's emotions does not per se activate individual emotions, and could therefore be a weaker form of emotion in the first place. The second way of story telling stimulates individual emotions, depending on the empathy level of the storytellers, but could make people uncomfortable because they might be embarrassed by telling the story.

The stories are selected on content. Each story needed some subplots with different sorts of emotions and different levels of emotional affection (slightly emotional versus highly emotional) because of possible expected outcome according to the recent study of Baumeister, Papa and Foroni (2016) (section 2).

Both story types are spread in all human cultures. The first one is a fable, a fictional story about animals with human characteristics. The second story can be seen as a gossip about the storyteller. In our culture gossip is more commonly communicated (by adults) than fables or fiction. For human beings, conversation often consists of social topics, that can be seen as gossip (Dunbar 2004). While gossip often has a bad image it is of great evolutionary importance. It contains important social information and can for example warn people for dangerous situations or non trustworthy persons.

The second story used in the experiment is a story like this that could spread naturally through people with the purpose to warn others for this gym where they are only interested in your money and not in your muscles. The first story gives information about the characteristics of the animals, who are in fact very humanlike features. An example to illustrate how this information could be useful is the following: From the first story we can learn that the elephant can be a little rough. With this information, one would be careful using the good china when the elephant would come over for dinner.

3.2 Chinese whispers

In order to measure how well information is conveyed in communication it is necessary to pass information through different people. This method makes use of the transmission chain often used in children's games around the world (known under various titles, for example 'Chinese whisper game', 'telephone game', 'whisper down the lane', etc.) where a story or gossip is whispered in the ears of children who form a line. One by one they listen to and then retell the story or gossip. By the end of each round, the initial story or gossip is revealed together with the resulting story after it has been passed on along the line. The game is often used as an example of the unreliability of transmitted information or gossips. In science this method is used in the context of cultural evolution research (Mesoudi & Whiten 2008), where the question is how cultural information travels through generations. Barlett (1932) used this method to study the process of remembering. He found out that remembering is more a process of reconstruction than exact replication. In this research it is interesting to see if people reconstruct stories differently when a part of the facial expression is missing, and how this travels through generations. The research in this paper focusses on the communication from Botox users to non-Botox users in a chain of listening and retelling.

3.3 Digital manipulation

Daan Krijnen (a fellow media technology student) developed, specially for this research, software to manipulate videos in such a way that particular facial expressions are smoothened.

The software is programmed[2] in Open Frameworks and it makes use of the OFX Face Tracker add on and the clone class from the Face Substitution project. The OFX Face Tracker from Jason Saragih is adapted for OpenFrameWorks by Kyle McDonald[3]. The Face Substitution project is created by Kyle McDonnald and Arturo Castro.

The program works as follows:

- It first detects the faces on every frame.
- The position of the forehead is calculated related to the eyebrows.
- The moving forehead is replaced with a mixture of textures and colors of a neutral forehead of the same person and the original forehead, using the clone class from the Face Substitution project.
- Its output is the collection of all manipulated frames, which can be stitched together in video editing software to create a video again.

Sound is used from the original video. An example of the result, a still from a video versus a still from a manipulated video is displayed in fig. 1.

Fig. 1: left the original capture, right the digitally manipulated version.

[2] Source code of the project: https://github.com/Daankrn/Botoxinator
[3] http://facetracker.net/

3.4 Setup

Participants

The study involved 25 participants, divided into three groups that represent the three generations of the research, plus one original storyteller. The original storyteller is an actor and voice actor. His two stories are passed on to five persons. Those five persons are the first generation. Their stories, captured by webcam recordings are manipulated into almost exact the same videos. The only difference in these manipulated videos (in relation to the original videos) are the missing forehead expressions. See fig. 2.

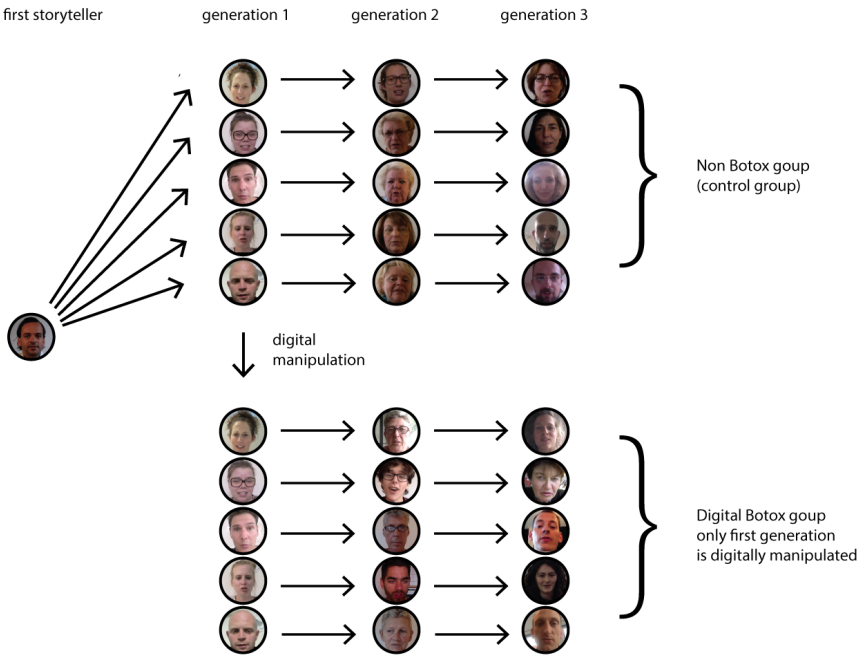

Fig. 2: Schematic overview of the story transitions

Procedure

A small cover-up story was told if participants asked for information about the research, to keep them from being influenced by foreknowledge. Those who asked were told the study was about storytelling.

Each participant was asked to watch the video from the person before in line (see fig. 2) and to retell the story directly afterwards recorded by a

webcam. When the recording was created the participant was asked to fill out a questionnaire with some questions regarding the storyteller they had seen before retelling the story themselves.

This procedure was repeated for the second story, with the difference in recording instructions that participants were asked to retell the story in a first-person narrative. After filling out the second questionnaire, they were asked to fill out a third one, together with the debriefing, where the real aim of the research was explained. Some control questions were asked to see if the participants had sensed that the research was different then explained. Finally questions were asked about their interests in cosmetic treatments or anti-aging.

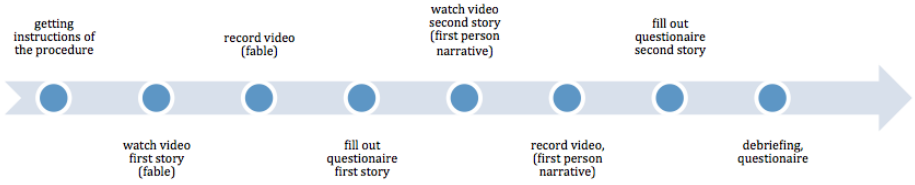

Fig. 3: Chronological flow of procedure for each participant

3.5 Data analyzes

After collecting the twenty videos of the third generation, the videos were analyzed by making transcripts of the texts and comparing them to the text of the first storyteller. Four parameters were compared: number of words, number of exact matching words, intended meaning of the storylines and matching emotions.

Number of words (1) and Exact matching words (2) The number of words was measured by counting the words of the original story (A), counting the words of the analyzed story (B), and by calculating the ratio by B/A. The same procedure was used to measure the words that matched exactly. To count the matching words in order to compare the two stories on this parameter, a script[4] to automate this task is created (by Wouter Beugelsdijk and Sophie Rust) and used.

[4] Code of the script can be found here: https://jsfiddle.net/wiedo/1bshxqtw/

Emotion (3) and Intended meaning (4) Labelling of the emotions and intended meaning was done manually by the researcher (Sophie Rust). In an ideal situation this should be done by a bigger panel to make it more objective. The choices of emotions of subplots were made by direct clues; for example, "I'm so angry that this happened" led to the label "angry" or by indirect clues like "It's a pity" led to "disappointment". Sometimes the facial expressions helped in deciding what emotion was appropriate for the subplot. This was possible because for analysis only the non-manipulated versions of the videos were used.

'Intended meaning' scores were attributed by making statements of the spoken sentences for each subplot, then a point was given for each statement that was still included in the story. If four out of six statements were still in the retold story (possibly in other words), 4/6 points were given. New statements that did not exist in the original version were ignored.

Those four measurements were taken for each subplot (six subplots for each story) and for the whole story. The two groups (digitally-manipulated Botox group and control group) were compared to each other using unpaired t-tests to search for significant changes with the statistical significance threshold set to 0.05.

The questionnaires were analyzed to see if the manipulated videos influenced the relation with the storyteller and to check if the participants noticed the manipulations. Furthermore, the questionnaires made it possible to look into a possible relation between interest in cosmetic treatments and attentiveness towards the manipulations.

Furthermore the filled-out forms were also used to check if differences in gender and age between groups could affect the results, to check if the native language is Dutch, and to confirm that the participants did not already know the story.

4 Results

To recapitulate: in order to answer the overall research question "Does Botox affect communication?" an experiment was set up in which two stories were passed on through two generations in two different settings. Five storytellers of the first generation all saw the same two videotaped stories told by an actor which they retold in front of a webcam. The resulting five videos were then digitally manipulated to simulate the use of Botox in one setting, and used in the original form in the other, non-Botox setting. In each condition, five new participants watched the videos and retold them in front of a webcam to the second generation. This was repeated and the videos produced by the third generation were then analyzed (see fig. 2), yielding the results reported in this section.

Of the 25 participants (N=25) 9 (36%) were male and 16 (64%) female. Age ranged between 21-70 (M = 42.44; SD = 15.248). analyzes were conducted to check whether groups significantly differed in gender and age. There were no significant differences between the groups regarding gender and age, which makes it unlikely that these factors influenced findings of this study.

First the four parameters were measured (number of words, exact word matches, intended meaning and emotion) for the third generation, and then compared to the source story (first story teller). To measure differences in scores between the digital Botox group and the control group the third generation was analyzed with N=10, 4 (40%) were male, 6 (60%) were female. Age ranged between 22 and 62 (M = 39,2; SD = 13,48).

Unpaired T-tests were conducted to check for significant differences in every subplot on the four parameters, for the two different stories and also for four parameters for the whole stories.

The following results were found in the third generation:

- No significant differences were found within the subplots of the first story or within the whole first story.
- No significant differences were found within the whole second story (table 1).
- Three significant differences were found in subplots (third and fifth) of the second story (first-person narrative story about the gym). See table 2 and table 3.
  - The third subplot had the emotion 'indignation' assigned to it and was significantly different on matching words ($t(8) = 0.0426$, $p = 0.0400$) and emotions ($t(8) = 2.4495$, $p = 0.0400$).
  - The fifth subplot, assigned by the emotion 'anger' had significant difference on the intended meaning parameter ($t(8) = 2.7380$, $p = 0.0255$).

It is remarkable that those subplots were the only subplot in the second story that had merely negative emotions assigned to it. These findings may support the hypothesis that without seeing facial expressions, it is harder to transmit emotional content—see the discussion in the next section.

Table 1: Whole second story about the gym

Parameter	Non Botox		Digital Botox			
	$M(\%)$	SD	$M(\%)$	SD	t	p
Words	44.26	13.74	75.36	27.01	0.5018	0.6293
Matching words	25.96	7.52	36.17	13.17	1.4744	0.1786
Intended meaning	39.72	14.28	28.72	7.96	1.5050	0.1707
Emotions	66.67	30.84	56.67	14.79	0.0523	0.9596

M = mean, SD = standard deviation

Table 2: Subplot 3, second story about the gym **Indignation**

Parameter	Non Botox		Digital Botox			
	$M(\%)$	SD	$M(\%)$	SD	t	p
Words	57.82	24.40	122.18	79.67	1.7336	0.1212
Matching words	18.91	3.74	32.36	11.87	2.4083	0.0426*
Intended meaning	60.00	13.69	60.00	37.91	0	1
Emotions	100.00	0.00	40.00	54.77	2.4495	0.0400*

M = mean, SD = standard deviation, $*$ = significant differences

Table 3: Subplot 5, second story about the gym **Anger**

Parameter	Non Botox		Digital Botox			
	$M(\%)$	SD	$M(\%)$	SD	t	p
Words	526.67	39.76	43.53	64.59	0.5012	0.6297
Matching words	10.98	14.93	8.24	10.04	0.3231	0.7549
Intended meaning	33.33	16.50	10.00	9.31	2.7380	0.0255*
Emotions	40.00	54.77	60.00	54.77	0.5774	0.5796

M = mean, SD = standard deviation, $*$ = significant differences

To see if the changes found significant in the third generation of the second story could be tracked down through earlier generations, the second-generation stories were also analyzed on the same four parameters. No significant changes were found between the digital-Botox group and the control group within the second generation in the second story. Although trends were found that possibly could have led to the significant changes in the third generation.

This could mean that the changes in the second generation were too small to be significant but influenced the third generation in a way that the changes became bigger through the generations. This observation fits with the dynamics of a typical Chinese-whisper game or gossip, where stories become wilder, more extreme or less accurate each time the story is passed on.

Another explanation for the fact that no significant changes were found in the second generation but were found in the third generation could be that it is just a matter of chance. Given the small population and large number of t-tests performed on the data this could be the case. However, it must be noted that the significant changes were found on the exact locations where they were expected: in the subplots that were labelled with strong negative emotions (see section 3.5). This makes it unlikely that those findings are coincidences.

To explore if this so called "snowball effect" (effects getting bigger over generations) exists through generations, a fourth generation would have to be added and analyzed, to see if indeed significant changes will occur on the expected subplots in the fourth generation. This could be part of future work.

5 Discussion

As most of the current research on Botox specifically focusses on the effects of Botox on Botox users in *experiencing* emotions, the current research is an important addition to the existing literature because it takes into account those who are being communicated to by Botox users—an even larger group potentially affected by this popular cosmetic treatment. The outcome of this study is relevant for both sides of communication, the Botox user and the non-Botox user who communicates with the Botox user because negative communicated emotions can be disturbed and disturbed communication is unpleasant for both parties.

There are some limitations to this research, some more serious than others. The research was limited to 25 participants, and the final analyzes took place in a comparison of groups of 5. The validity of the research would increase if the test groups were bigger. Furthermore, digital Botox, rather than actual Botox was used, so it is hard to make conclusive remarks about whether the results are an indicator of actual Botox as well.

However, cosmetic specialist Maikel Scheer was consulted for advice and for verification of the realism of the digital Botox in relation to real Botox. Maikel Scheer was impressed by the closeness of the imitation but he stated that real Botox would have had even more effect on the movements in the forehead, indicating that the used videos were conservative in their smoothening rather than exaggerating of facial expressions. It was possible to make the effect stronger in the digital Botox but it was feared that the videos would look less natural and that the manipulations would stand out and would be noticed by the test candidates.

Most concerns and limitations of this research are the consequence of the choice for a high ecological validity in the design of this study. This has the advantage of having more reliable results than in a more laboratory set-up. The downside is that it could lead to fewer findings because working with extremes was avoided.

An example of the ecological validity of this study is that some manipulated videos did not differ much from the original because some participants hardly frowned during the telling of the stories. Ones could have searched for persons with more facial expression, but this would not represent the 'real world' situation where obviously not everybody has an expressive face to begin with. It is not even true that only people with expressive faces are users of Botox because Botox is used to prevent getting wrinkles, and not only to erase existing wrinkles. There are people who use Botox for non-cosmetic reasons, like preventing the symptoms of migraine.

A lot of time and effort was put in all the details of the design of the study and the instructions for the participants. Unfortunately there was left room for other interpretations of instructions than intended. It can be concluded that the directions given to the participants in order to tell the second story in the first-person narrative were not clear enough. This can be deduced from the following observations:

- Participants focussed on remembering the story instead of telling a story convincingly to someone new.
- Some people tried to copy the voice or accents of the storyteller before them in line.
- Some people changed or added new elements to the story to fit their own experience or interests. For example, someone talked about going to a yoga studio instead of a gym, or people added information why they had chosen this particular gym where this was not part of the original story.
  Since the number of (matching) words were parts of the measures taken as comparisons, these parameters were affected by the misinterpretations and therefore not useful anymore.

One of the reasons digital manipulation was chosen over real Botox was to exclude the decrease of empathy that was found in studies about Botox users.

Reflecting on this experiment, it was impossible to exclude lack of empathy. In this setup there is still a dependency of the empathy people put into their roles as the 'victims of the gym scam'. Some people told afterwards that, during the debriefing, they could not feel empathy for the storyteller because they thought this would never occur to them. They saw the 'victim' not as a victim but more as "a consequence of stupidity". Therefore they felt ashamed repeating the story from the first-person perspective and were less convinced in their emotions.

Still significant changes were found in the third generation on the two subplots that were labelled with negative emotions. however, there were two other subplots that contained negative emotions and did not show significant changes. A closer analysis, however, shows that those subplots contained more than one emotion, or a more mixed emotion. Apart from this, it is difficult to find a solid explanation for the fact that digital Botox did not significantly affect those subplots. Maybe the emotions were subtler and therefore it could be less surprising to miss facial expressions during those subplots. Another explanation could be that they relied more on verbal content.

Lastly, the first story generally seemed less relatable than the second story, which may have influenced the outcome as well. In the first story, both in the digital Botox group and in the control group parameter 'anger' disappeared over almost all generations, probably indicating that this emotion (which was specifically added to the original story) did not match the story well. Typically hierarchical stories were found to be better remembered (Mesoudi & Whiten 2004). An addition to this could be that also the emotional content of those typical stories like fables or fairytales are stored inside the human memory, where it is very unnatural that in a sweet fable like this, an animal becomes angry. Another explanation could be that it is more of a socially desirable behaviour in our culture not to become angry (in public) and therefore was filtered out by the well-mannered participants.

6 Conclusion

Given the measures taken to enhance ecological validity, resulting in lower methodological rigidity, combined with the small population of test subjects, it is difficult to draw firm conclusions regarding the overall research question: "Does Botox affect communication?". The results, answering this question indicates that Botox can influence communication. Mostly strong negative emotional content was affected by the digital Botox in this study.

A trend was found in decreased information transfer of negative emotional content in the analyzes of the second generation of the digital Botox group. In the third generation, this trend is extended to significant measurable changes of a decrease in conveyed negative emotional content.

7 Future work

Recommendations for further research would include methodological improvements and/or expansion of this research. The following obstacles in this study should be avoided.

Improvements:

- Different interpretations of directions should be avoided. It should be stated emphatically that the test subjects should use their own voice and accent, no new elements of the story should be added and the participants should not change any part of the story. The text should be retold as clearly as possible.
- Labelling of emotions and intended meaning scores should be done as objectively as possible. A recommendation would be to use an objective panel of people or to use a computer algorithm to make (more) objective choices.

Extensions:

- A fourth generation could also be added in order to see if there is actually a so called "snow ball effect" to be found.
- It would be good to work with more test subjects. A variation in method could include dividing all participants in two groups and letting them all watch either the videos with digital Botox or the original videos and see if more differences can be found.
- It would be interesting to repeat the study using real Botox, to the extent in which this is possible.
- The hypothesis was focussed on information loss due to Botox, but it is also possible that Botox helps communicating with positive messages of people with very angry looking faces. This could also be an interesting view for further research.

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Appendix