Judging Smiles - Stylized Faces

Wesley Pang
Sai Harshita Neti

Paul G. Allen School of Computer Science and Engineering
University of Washington

ABSTRACT

In this paper, we attempt to determine what makes a smile genuine. We focus specifically on still images of a stylized character. We generated several images of smiles with different "parameters" to determine the impacts of different aspects of a smile. With these images, we conducted a user study to help us determine the optimal settings of a realistic smile versus a fake one. Our study proved to be a success, and we now have a better understanding of what makes a smile more genuine. This knowledge has applications in much of the animation industry as it heavily contributes to realistic character animation.

Key Words and Phrases: Stylized faces, Smiles, Realistic

1   INTRODUCTION

Creating realistic stylized faces is one of the most difficult problems in the animation industry. The task of generating an animated face seems simple, but making the face convey emotion naturally is a challenge. This includes generating genuine smiles. Currently, many stylized smiles are still deemed "fake" by audiences, and this diminishes the overall quality of the animation. In their study, Hossain and Gedeon observed that only one of eight virtual avatar smiles was considered to be real [Hossain and Gedeon 2017]. This study gives us an understanding of how smiles are perceived on stylized characters in general. We hope to improve upon this and animation as a whole by helping animators determine what makes a smile genuine, which in turn allows them to create genuine smiles.

To this extent, we begin by analyzing various stylized faces and isolating features we deem important in the creation of a realistic smile. We have access to the University of Washington's Facial Expression Research Group Database (FERG-DB), which allowed us to simply use their pre-existing images. We present several key features of a genuine smile that serve as a preliminary stepping point in creating more realistic smiles.

2   RELATED WORK

There are a number of other papers that attempt to tackle the same problem as us. This is good as it indicates that the problem

we are tackling is a real issue that has an impact on the animation industry.

In a paper titled "Recognition of Genuine Smiles", a group of researchers also attempt to figure out what separates genuine smiles from fakes ones [Dibeklioğlu et al. 2015]. They analyze full videos of smiles, meaning that they are looking at every part in a smile sequence, from start to finish. This is interesting because while we are looking at still images of smiles, they are analyzing every part. This gives them more data to work with, but our method has much more specific applications. For example, the results that we determine would be much more applicable for a stylized comic book. Still, we were able to learn a lot from this study. It gave us a general idea of what we should be doing and a direction to head in. While they experimented on movements of facial features, we were still able to glean valuable information. The specific facial features that they looked at were the eyelids, cheek, and lips, and this helped us in our selection of important features.

Another paper title "Dynamic properties of successful smiles" used a 3D computer-animated facial tool to measure how changing features of a smile are perceived, and had users rate smiles created using this tool based on their genuineness and effectiveness [Helwig et al. 2017]. Similar to our work, this paper focuses mainly on the mouth. However, this paper creates and utilizes animated smiles while we focus on still images of smiles.

3   OUR APPROACH

We utilized University of Washington's Facial Expression Research Group Database (FERG-DB) [Aneja et al. 2016], which consists of a pre existing set of stylized characters, for our research. We chose the character Mery and focused specifically on images that convey an emotion of joy. We decided to focus specifically on the mouth as one of the major features that determines a smile, and based on prior research, we selected the following features to experiment on: mouth shape - wideness and crookedness teeth - no teeth visible, only upper teeth visible, both sets of teeth visible.

Once we decided on which features we would be testing on, we generated images that would allow us to isolate and test on these features. We carefully selected image pairs from the FERG-DB that differed only in the specific attribute that we would be experimenting on in that instance. However, many of the images differed at multiple points, so we had to do some additional preprocessing before our user study could be conducted. In particular, the eyes of the stylized characters differed in almost every image. As this difference could be a major confounding factor, we decided to Photoshop the same pair of eyes onto every single image, and thus keep others factor apart from the focused area around the mouth constant. We chose a relatively neutral set of eyes to minimize any impact the eyes may have on the perceived genuine happiness of the characters. So, we were able to generate image pairs that differed

only in one specific attribute, with the attribute differing among different pairs.

4   PRELIMINARY USER STUDY

We conducted a user study to get a direct understanding of how people perceive smiles, in particular smiles on a stylized face, and to determine key aspects that contribute to the genuineness of smiles on stylized faces through direct feedback.

4.1   Participants and Methodology

We conducted the user study through Amazon Mechanical Turk and required that we receive at least 50 responses. In the Mechanical Turk study, we placed a link to SurveyMonkey where the main portion of the study is located.

The survey consists of 9 questions. Each question is an AB Test that presents the user with two smiles on a stylized character with a variation in the two smiles and asks the user to select which smile they think appears more genuine. At the end of the survey we asked the user to briefly explain their thought process and the features they considered when selecting the images.

5   SECONDARY USER STUDY

After we reviewed the results for the first user study, we conducted a second user study to re-test specific features that stood out from the first study and to confirm our results for image pairs in which there was a considerable difference in the perceptions of the two smiles.

The format of the second survey closely resembles that of the first study with the exception of a few image pairs. We received 48 responses for the second survey.

We present all the image pairs for which there existed close to or greater than a 20% difference in the responses between the two choices and their descriptions on page 5. We refer to these figures in our discussion of the results.

6   RESULTS

We present the results from both studies as a comparison between the two images. Refer to Table 1 and Table 2.

We condense the results into a direct comparison of the smile variations as seen in Table 3 on the next page.

	Image (a)	Image (b)
Fig. 1	61.54%	38.46%
Fig. 2	57.69%	42.31%
Fig. 3	34.62%	65.38%
Fig. 4	59.62%	40.38%
Fig. 5	59.62%	40.38%
Fig. 6	65.38%	34.62%
Fig. 7	25.00%	75.00%

Table 1. Results from First Study

6.1   Discussion of Results

Looking at the results, we see that respondents tended to prefer smiles that had minimal to no teeth. We were greatly surprised by this result, as we hypothesized that open smiles with the upper teeth visible would have a higher preference over closed smiles. Furthermore, when we look up

	Image (a)	Image (b)
Fig. 2	65.31%	34.69%
Fig. 3	30.61%	69.39%
Fig. 4	71.43%	28.57%
Fig. 5	59.18%	40.82%
Fig. 7	22.45%	77.55%
Fig. 8	16.33%	83.67%
Fig. 9	63.27%	36.73%

Table 2. Results from Second Study

smiles online, we see a great number of images in which people are smiling with their upper teeth visible.

With respect to the width of a smile, respondents tended to prefer smiles that are wider when compared with shorter smiles. This result is unsurprising due to the fact that when a person smiles, the corners of their mouth turn up on the sides, and this motion elongates the smile. However, according to the feedback from some respondents we discovered that there is a limit to how wide the smile should be. That is, a smile that is too wide is also deemed as not genuine.

With respect to the crookedness of a smile, respondents tended to prefer smiles that are not crooked. A reason for this result is that a crooked smile may appear "mocking", as one corner of the mouth is turned up more than the other corner, and thus prevent the smile from appearing genuine.

No Teeth	✔	Top Teeth	
No Teeth	✔	All Teeth	
Top Teeth	✔	All Teeth	
Not Crooked	✔	Crooked	
Wider	✔	Narrower	
Not Crooked, No Teeth	✔	Crooked, Upper Teeth	

Table 3. Smile characteristics that were preferred by study participants

7   CONCLUSION

We were able to determine specific facial characteristics that contribute to the genuineness of a smile. Our method of testing allowed us to determine what users preferred in a genuine smile, and from there we were able to see general trends of what made a smile realistic.

Although our results were not exactly what we predicted, they make sense. We hypothesized that smiles with only the top teeth showing would be the most genuine, but our results show that the less teeth the better. The rest of our predictions were as expected though. Wider smiles and smiles that were not crooked always won out over their counterparts.

So, when it comes to the parameters that we tested, the optimal stylized smile is wide, has no teeth, and is not crooked.

8   LIMITATIONS AND FUTURE WORK

In this work, we only tested variations in the area directly around and including the mouth. A further study would be to also test variations in eye shape, as eye shape is another critical factor in judging smiles. The two features, mouth and eyes, could then be combined to test a wide range of variations in smiles.

Another limitation in our work is that we only tested smile variations on one character. A further study would present users with smiles on different stylized characters and determine if smiles are perceived differently on different characters. This discussion leads into yet another possible extension of our work, which is to observe if users of different genders or different cultures respond differently when asked which of two smiles is more genuine.

The ultimate goal would be to accumulate and apply all the parameters deemed necessary to create genuine stylized smiles to an automated filter that would accept a still image of a smiling stylized character and modify the smile such that the smile is at its optimal genuineness.

Importantly, we must acknowledge that the perception of smiles is certainly subjective.

REFERENCES

H. Dibeklioğlu, A. A. Salah and T. Gevers, "Recognition of Genuine Smiles," in *IEEE Transactions on Multimedia*, vol. 17, no. 3, pp. 279-294, March 2015. doi:10.1109/TMM.2015.2394777

Helwig NE, Sohre NE, Ruprecht MR, Guy SJ, Lyford-Pike S (2017) Dynamic properties of successful smiles. PLoS ONE 12(6): e0179708. https://doi.org/10.1371/journal.pone.0179708

Md Zakir Hossain and Tom Gedeon. 2017. Discriminating real and posed smiles: human and avatar smiles. In Proceedings of the 29th Australian Conference on Computer-Human Interaction (OZCHI '17), Alessandro Soro, Dhaval Vyas, Bernd Ploderer, Ann Morrison, Jenny Waycott, and Margot Brereton (Eds.). ACM, New York, NY, USA, 581-586. DOI: https://doi.org/10.1145/3152771.3156179

Aneja, Deepali, Alex Colburn, Gary Faigin, Linda Shapiro, and Barbara Mones. "Modeling Stylized Character Expressions via Deep Learning." In *Asian Conference on Computer Vision*, 2016, pp. 136-53., Springer.
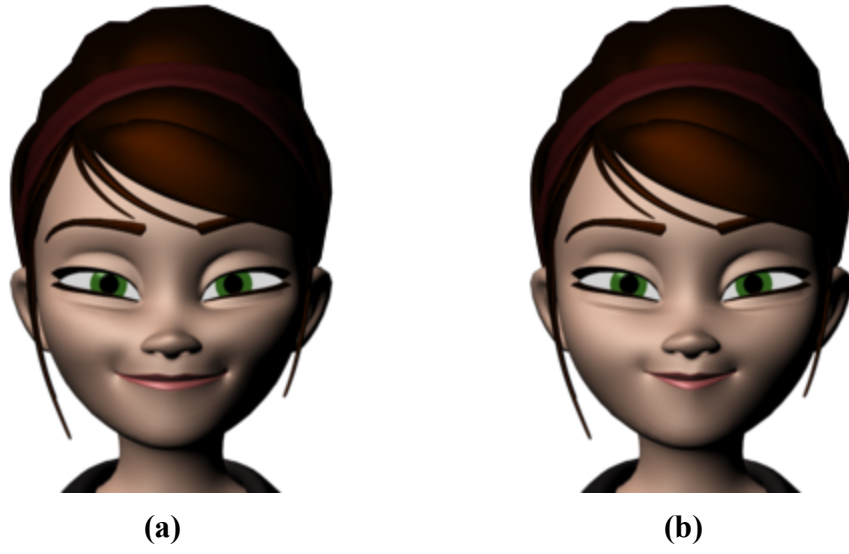
(a)   (b)
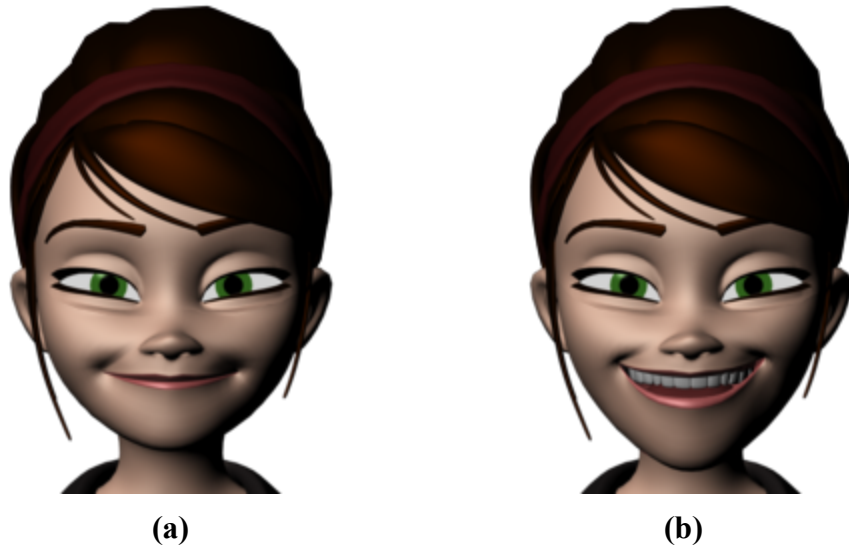
Fig. 1 Wider smile vs. Shorter smile

(a)   (b)

Fig. 2 No teeth vs. Upper teeth

(a)   **(b)**

Fig. 3 Both sets of teeth vs. No teeth

(a)   **(b)**

Fig. 4 Upper teeth vs. Both sets of teeth

(a)   (b)

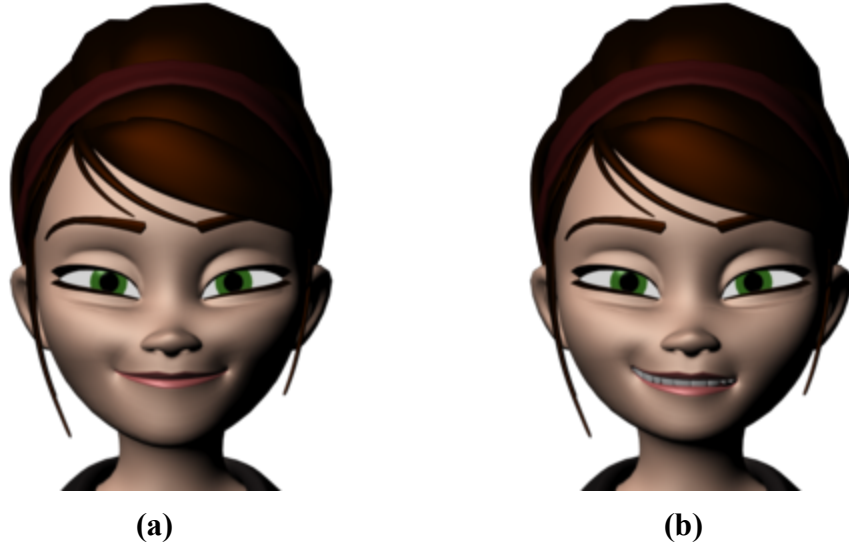**Fig. 5 Straight smile vs. Crooked smile with teeth**

(a)   (b)

Fig. 6 Straight smile vs. Crooked smile
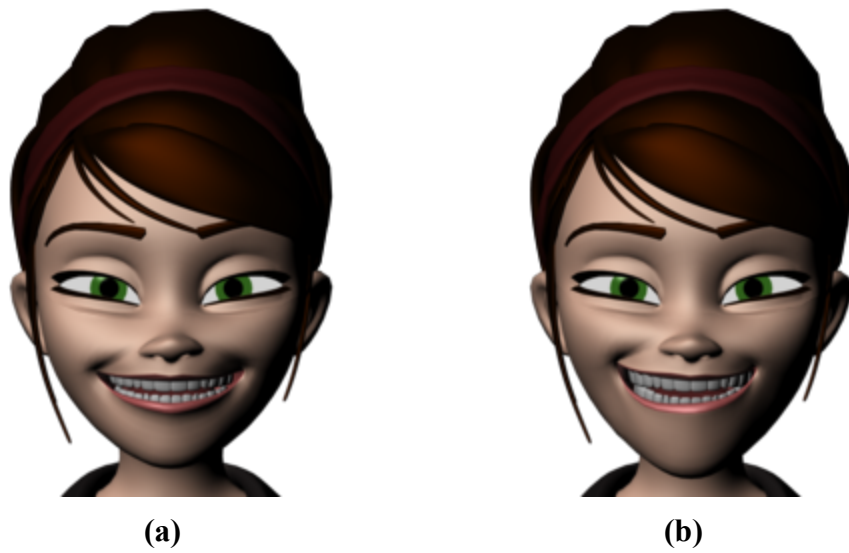
(a)   (b)

Fig. 7 Crooked smile with teeth vs. Closed, straight smile

(a)   (b)

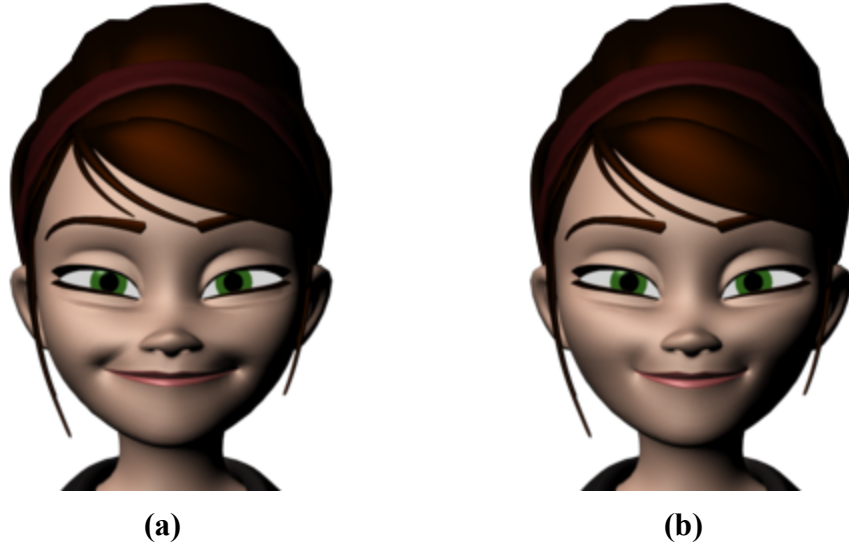**Fig. 8 Both sets of teeth vs. Upper teeth**

(a)   **(b)**

Fig. 9 Wider smile vs. Shorter smile