Julia Krammling
julia.krammling@hs-augsburg.de
954077

Teresa Kendel
teresa.kendel@hs-augsburg.de
954076

Gesture Research:

Exploring how enjoyable different gestures are perceived in a gesture-controlled game.

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Prof. Dr. Michael Kipp
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Abstract

It is proven that a user perceives gestures more convenient when they are easier to perform, especially in terms of effort that has to be put into the movement [Liu, Thomas: "Gesture Interfaces: Minor Change in Effort, Major Impact on Appeal", 2017]. On the other hand, movement leads to a release of serotonin and other happiness hormones, which is why we assume that big gestures could be preferred by users when performed in the context of a game and in front of a big screen—and when fatigue doesn't play a too important role.

We compared effortful (big) gestures with easy (small) gestures to find out, which gestures are perceived more convenient by users. The participants of our study had to play three different gesture-controlled games that address three different gesture pairs (easy and effortful: tap, swipe and circle gesture). The small gestures had to be used in front of a small screen using a Leap Motion to track the hands, the large ones in front of a big screen using the Kinect to track the body position.

With our investigations we could verify our hypothesis that bigger gestures were preferred when played in front of a big screen and in the context of a game.

Furthermore, there were differences concerning the perception of the different gestures. Especially the circle gesture was liked more as a small gesture. It is important to mention that our data needs to be treated carefully because system reliability influenced our outcome. That is why there can be seen an obvious tendency looking at the results, but further research needs to be done to make reliable statements.

Keywords: Gesture interaction, user experience, effort

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1 Related work

The experiment builds upon the paper "Gesture Interfaces: Minor Change in Effort, Major Impact on Appeal" of Xiaoxing Liu and Geb W. Thomas in which pairs of similar gestures that differ in size and effort, are compared. In their investigations they found out that effort plays an important role in the development of gesture interfaces. Users prefer gestures which are less effortful and consider them to be more appealing.

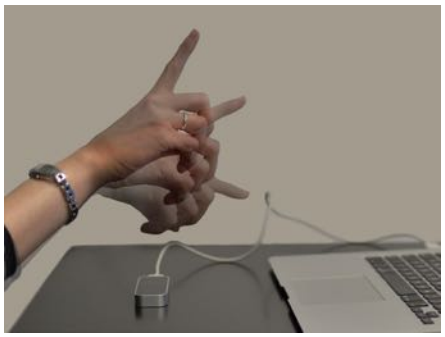
In our experiment we wanted to build on their thoughts and conducted some further research. We assumed that big gestures could be perceived more enjoyable when performed in the context of a game and that—besides system reliability and effort of a gesture—especially the screen size influences the user in feeling a gesture more or less appealing.

Research questions:
Can bigger gestures be perceived more enjoyable than smaller ones depending on the context?
Are there differences between different gestures?

2 Methods and gestures

To conduct our investigation, we developed three different gesture controlled games. Each game covers one special gesture, which can be performed either big, using the whole arm or small, using only one hand respectively the index finger. There were three gesture pairs, each pair was employed to control one game. Those pairs were taken from the paper ("Gesture Interfaces: Minor Change in Effort, Major Impact on Appeal") and should be common to the users.
The gestures consisted of the following gesture pairs:

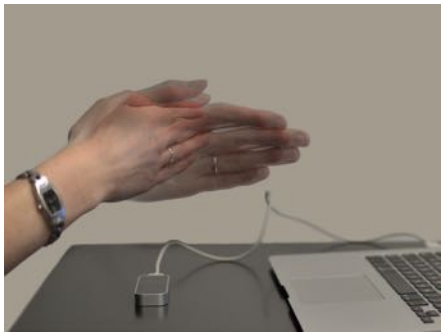
2.1 Tap gesture



tap gesture performed with the index finger in a less effortful way

or using the whole arm in a more effortful way respectively.

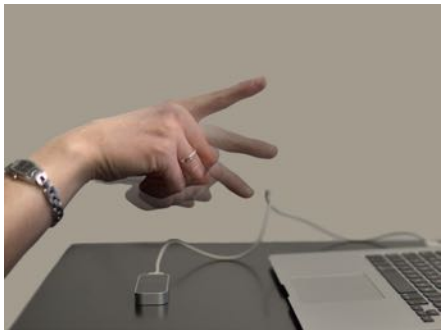
2.2 Swipe gesture



The second pair was the swipe gesture, either performed with one hand

or with the whole arm.

2.3 Circle gesture

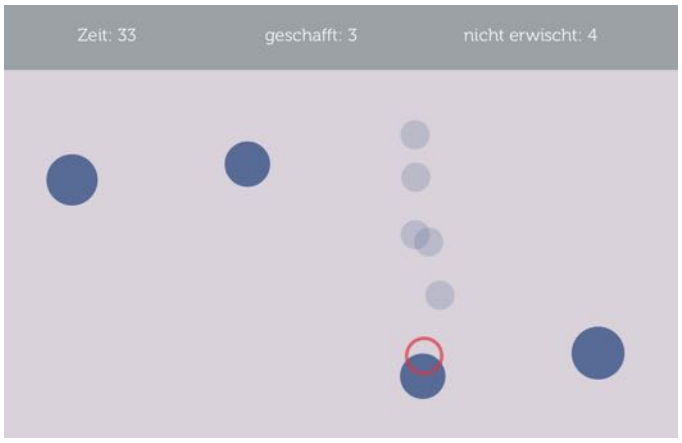


The third gesture pair was the circle gesture with the index finger as the easy gesture

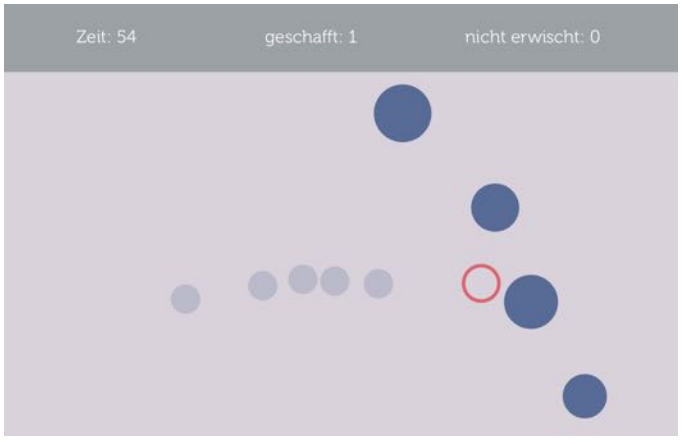
and with the whole arm as the more effortful gesture.

3 Games

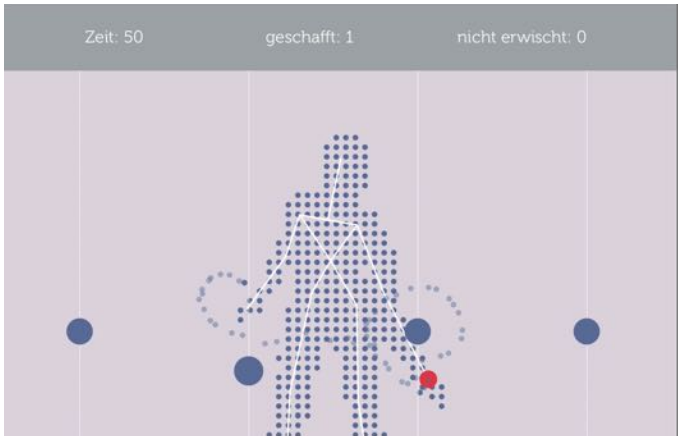
To be able to compare each game under the aspect of efficiency, each game lasted for one minute precisely—successful gestures were counted, as well as minus points, which represent the over all success of each game since they are an index for either system reliability or poorly performed gestures. The games used audi-visual feedback to confirm a successful gesture, and displayed the moving path of the arm respectively the index finger to provide further visual feedback over one's gestures.

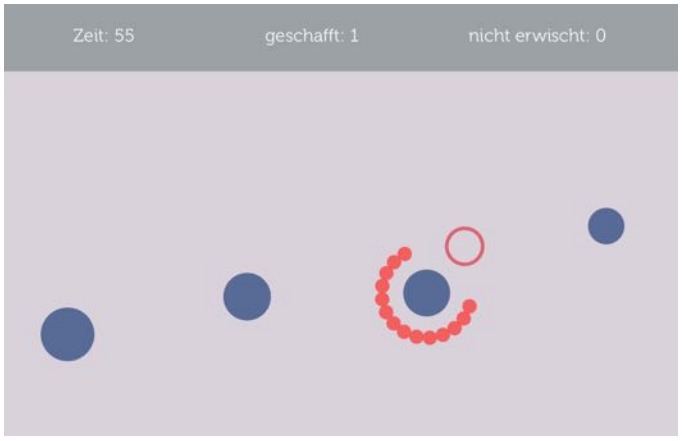


The game for the tap gesture showed four balls which moved from bottom to top. The player had to push them down again with the tap gesture. If the tap gesture was successful the user got one point but if one ball touched the upper rim the user got one minus point.



In the swipe gesture game the user had to push balls coming from the right side back to the right with the swipe gesture. Every successful gesture counted one point. If one ball touched the left side the user got one minus point.

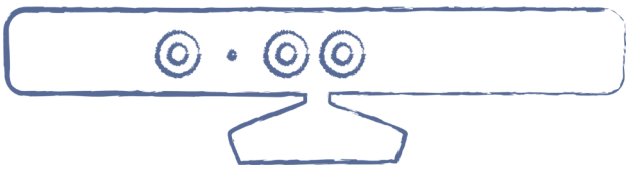




In the game for the circle gesture the balls moved from bottom to top again. The higher they got, the smaller they became. With the circle gesture the player let the ball grow again and it began to sink. The balls were not allowed to touch the upper rim. If they did, the user got one minus point, otherwise the user earned one point.

4 Technical Requirements

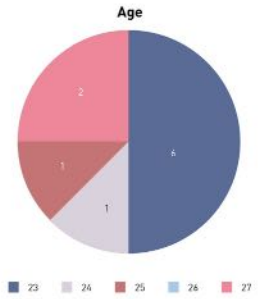
To track the small gestures, we used the Leap Motion. The big gestures were tracked by a Kinect, which allows detecting full body movements.
For programming the games we used Processing with the "SimpleOpenNI" (Max Rheiner) library for the Kinect and the library „Leap Motion for Processing" (Daniel Shiffman, Thomas Lengeling) to connect the Leap Motion with Processing.
Moreover, we used a laptop and a beamer for our test setup.



Kinect

Leap Motion

5 Testing



For the testing of our prototypes, we invited eight participants between 23 and 27 years. The group consisted of two women and six men, who all were familiar with computer interactions, half of them considered their experience with gesture interaction as high. Every participant had to play each game twice. One time in front of a small laptop screen using the Leap Motion and one time in front of a big screen which was a projection with a diagonal of around two meters using the Kinect. The participants had to perform the relevant gesture to control the game.

After every gesture pair they had to go through the following questionnaire and decide whether they preferred the Leap Motion (small gesture), the Kinect (big gesture) or if they were undecided.

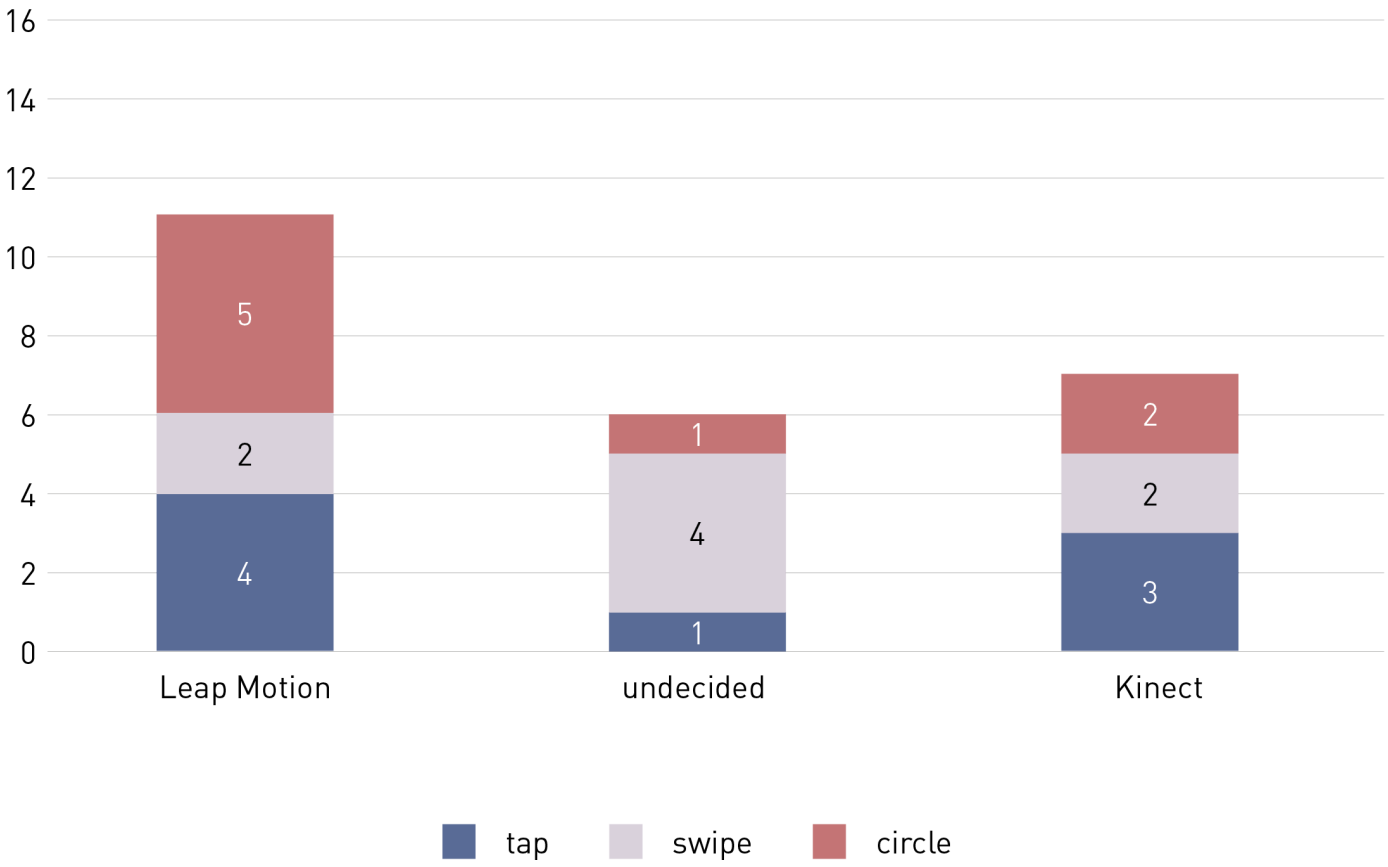
1. Which gesture was less effortful?
2. Which gesture fitted the game better?
3. Which game was more fun?
4. Which system did recognize you better?

6 Results

6.1 Which gesture was less effortful?

Hypothesis: Small gestures (Leap Motion games) are less effortful.

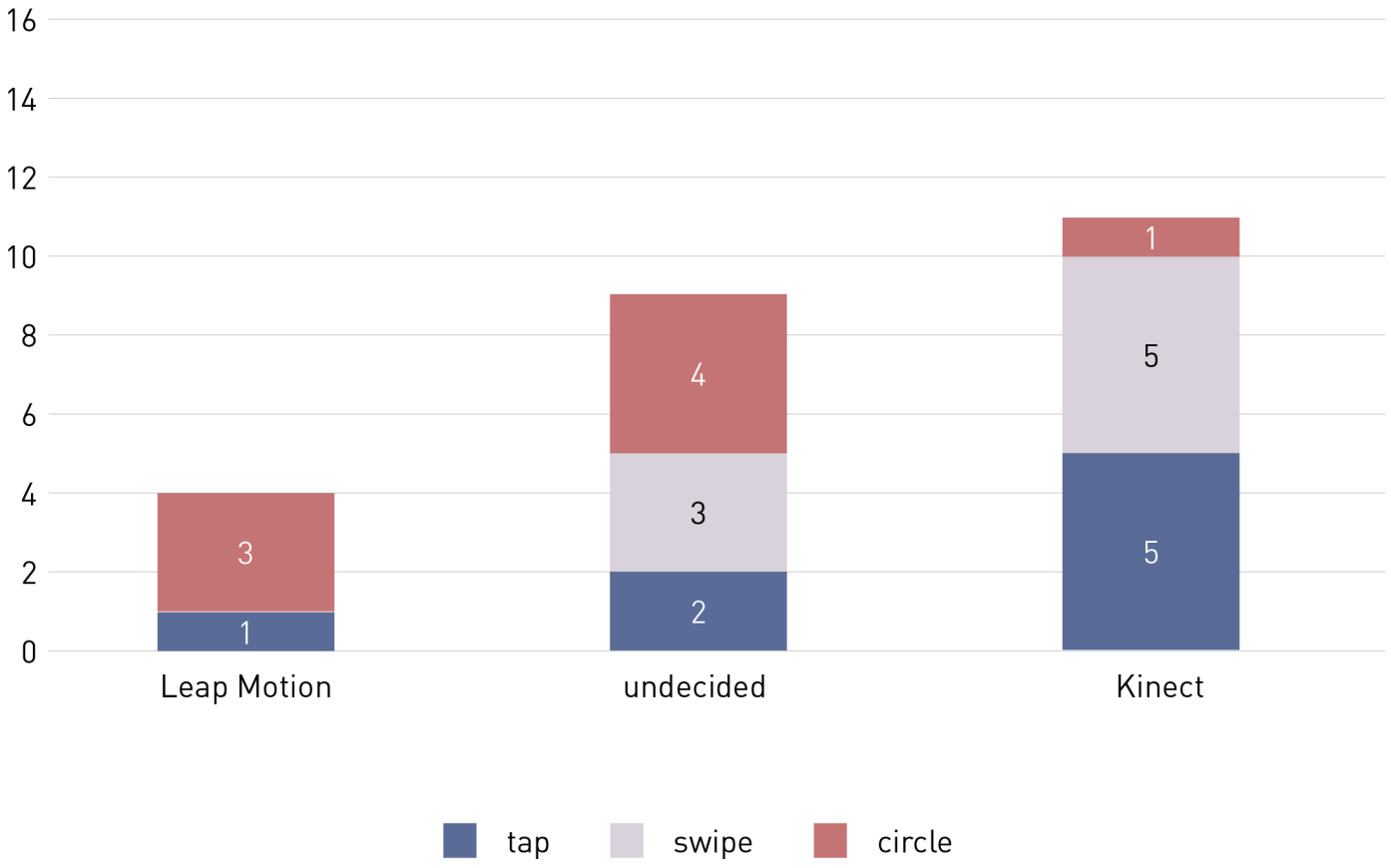
From the paper "Gesture Interfaces: Minor Change in Effort, Major Impact on Appeal" of Liu and Thomas we knew that people perceive small gestures to be less effortful. To verify that for our study, we asked the same question and got a similar result. Especially the tap and the circle gesture were felt to be less effortful. The swipe movement was felt to be equally effortful in both systems. Due to the low number of test persons our results were not significant in all cases.



6.2 Which gesture fitted the game better?

Hypothesis: Big gestures (Kinect game) fit the game better.

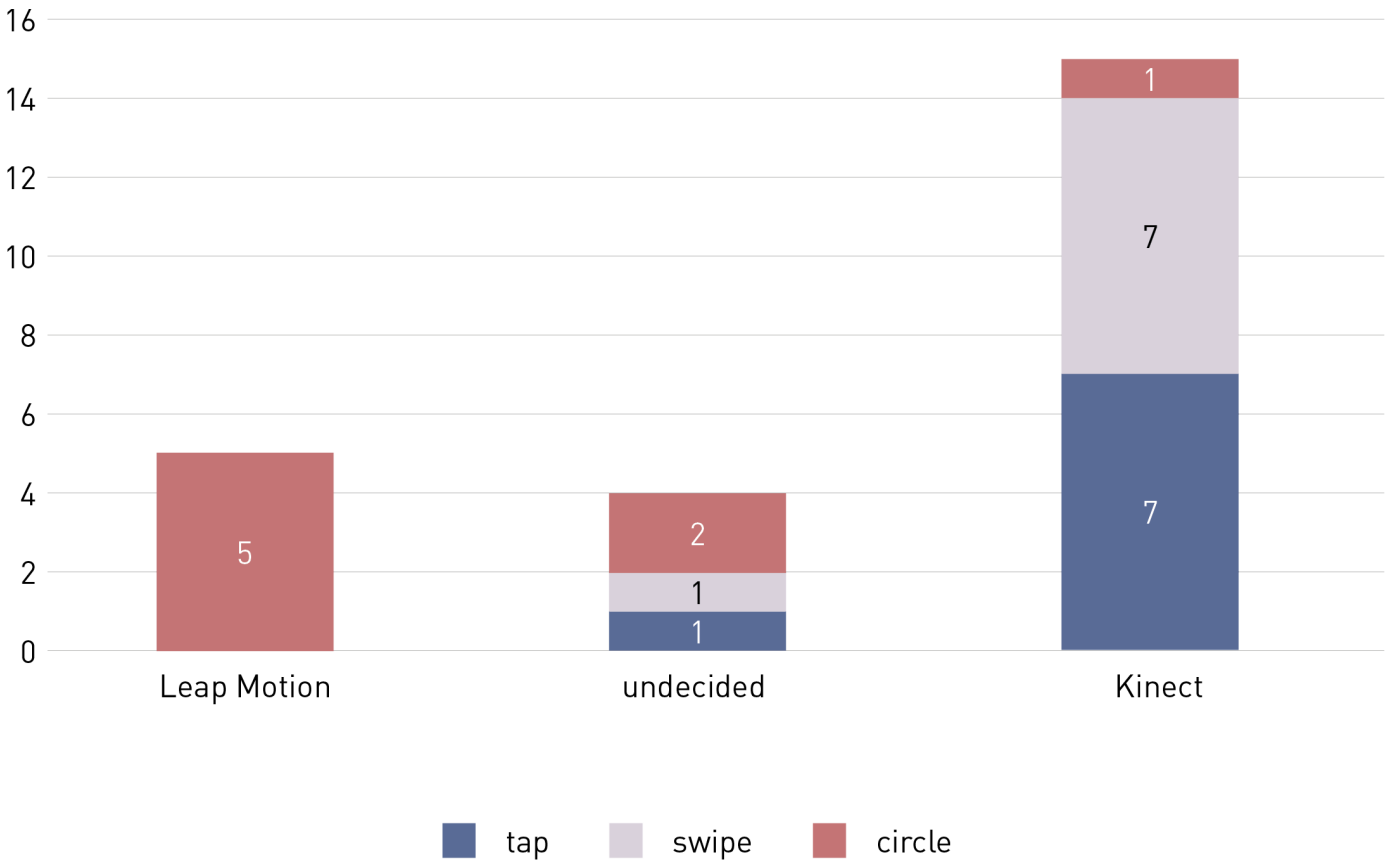
Particularly the tap and the swipe gesture were preferred significantly for the games with the bigger movements. For the circle gesture our assumptions were not true. This gesture tended to fit the Leap Motion games with the small gestures better, which was probably due to the system reliability of both prototypes. The Kinect game for the circle gesture was more difficult to play because the circle gesture was not recognized reliable every time by the Kinect.



6.3 Which game was more fun?

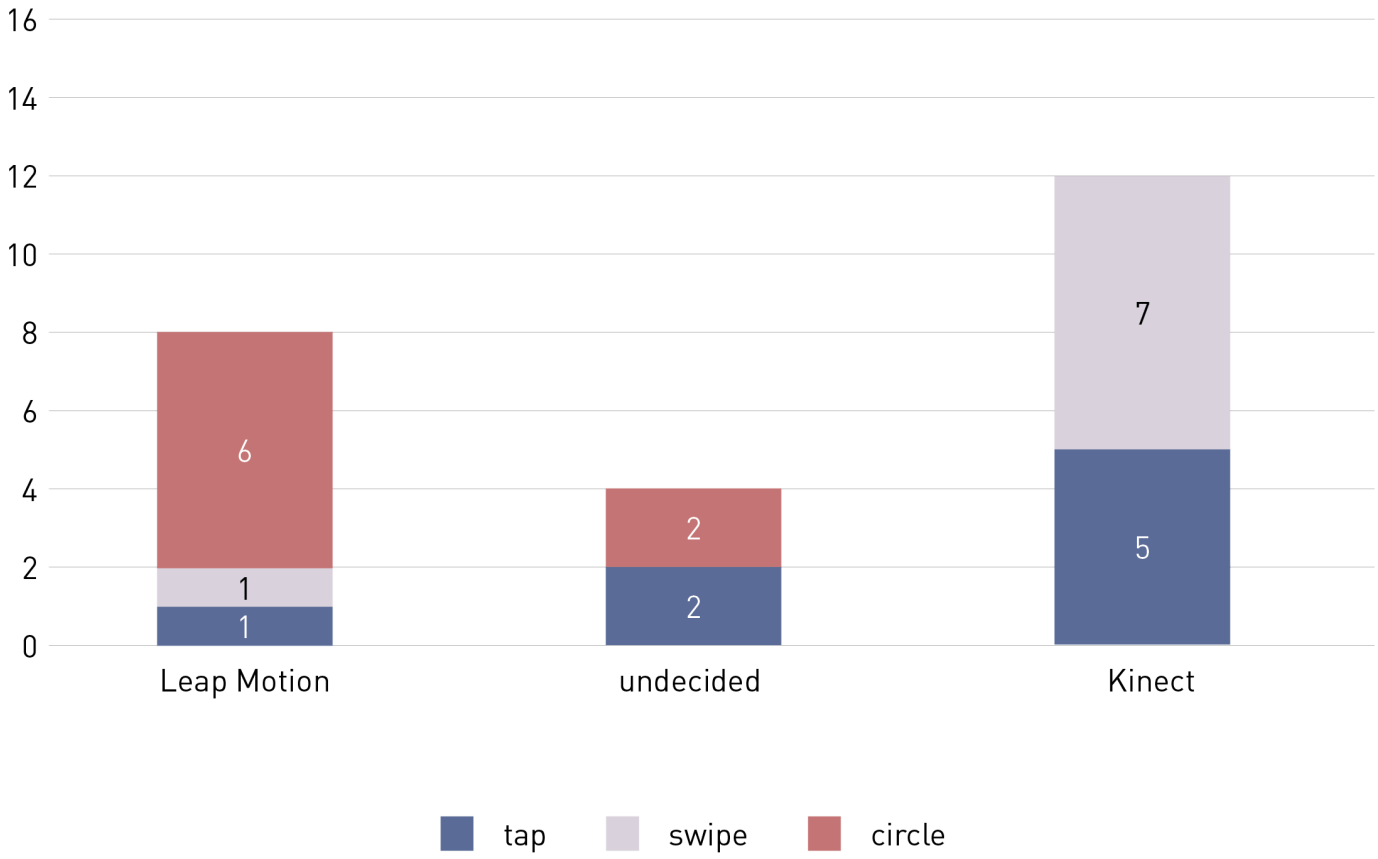
Hypothesis: Big gestures (Kinect game) are more fun.

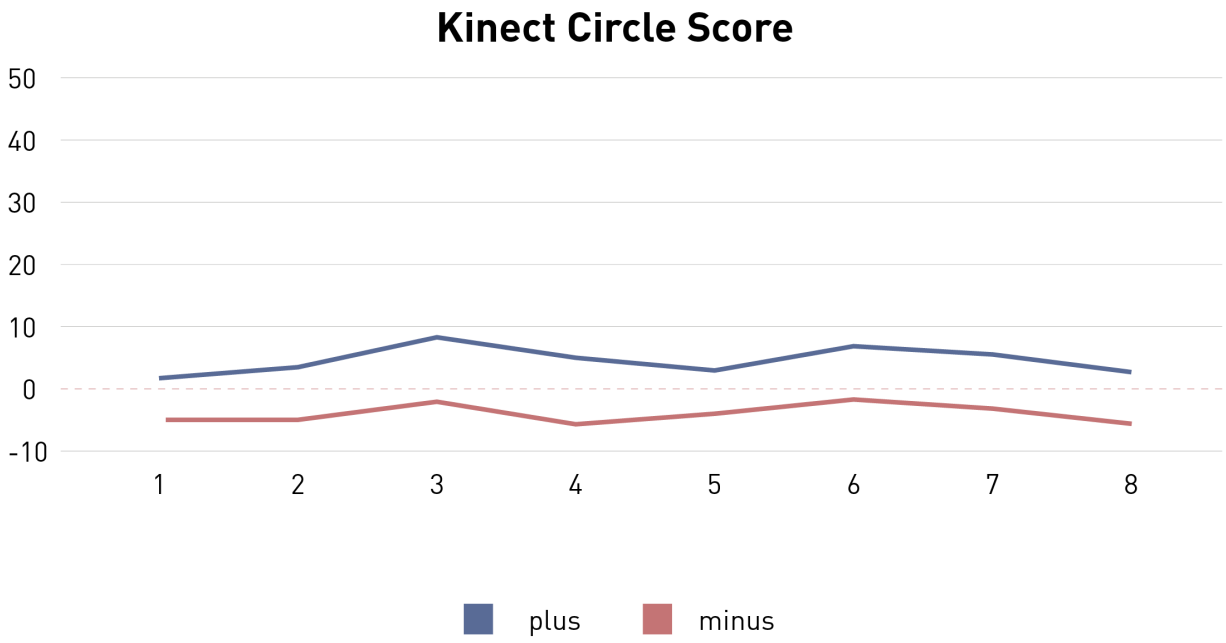
In this case, our assumptions could be partly confirmed. The big tap and swipe gestures in the Kinect games were significantly prefered over the small gestures in the Leap Motion games. In the context of a game pushing balls back an earning points the participants like the big gestures more where they had to move around to reach the balls. Controlling the game with the circle gesture, the participants preferred the small circle gesture which was probably due to system reliability.



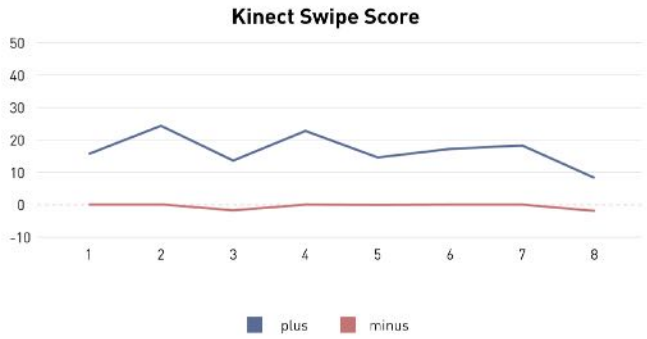
6.4 Which system did recognize you better?

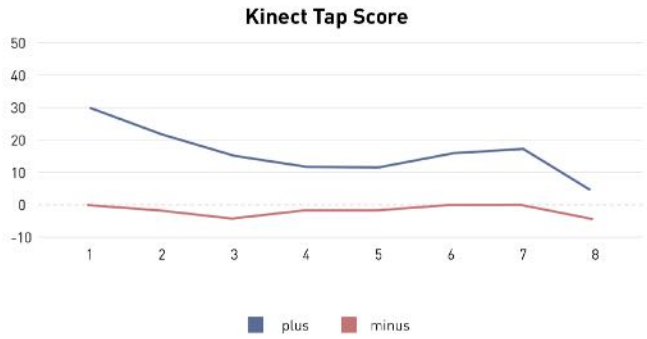
As the diagrams show, there had been quite a high variability how the systems detected the different gestures. The test persons felt the Kinect to recognize the tap and the swipe gesture better than the Leap Motion. In contrast the Leap Motion was felt to recognize the circle gesture better than the Kinect.



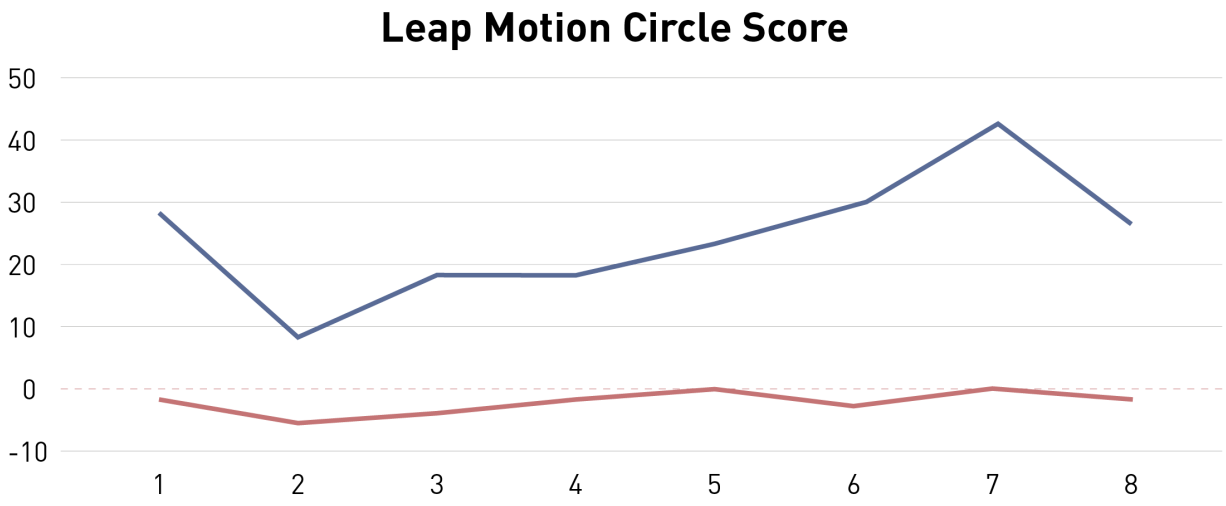


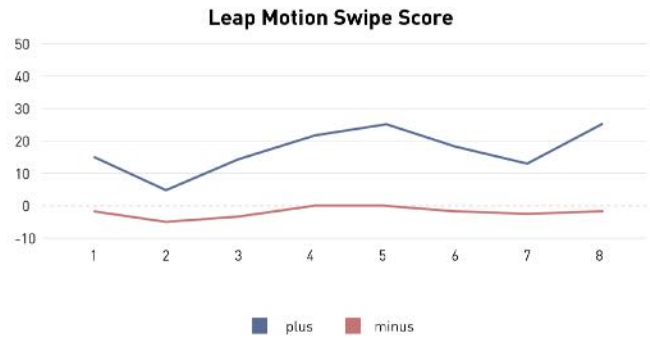
The highscore curves reflect those relations. With the big circle gesture at the Kinect the test persons could not get a higher score than 8 and had a quite high number of drawbacks.





With the big swipe and the big tap gesture, which were felt to be better recognized, the test persons reached a higher number of points and the distribution of drawbacks was better balanced.





The score curves of the Leap Motion show higher variability over all. System reliability was approximately the same in every gesture for the Leap Motion.

It is difficult to make a reliable statement regarding the high score, because it highly depended on the individual gaming style of each participant, for example whether they played very fast or not. The minus points—or balls that weren't reached, on the other hand, give an insight of how well the systems recognized the relevant gestures or how well the gestures were performed.

6.5 Relation between fun and effort

In matters of our research question, there is a tendency recognizable that the results confirm our assumptions. The research question was, whether bigger gestures (more effortful) could be perceived more enjoyable than smaller ones (less effortful) depending on the context and if there are differences between different gestures.

Our data suggests that both questions can be answered with yes. In the context of a game, people seem to prefer the more effortful gestures, because they apparently are more fun. Except the circle gesture, which seems to be more convenient as a small gesture.

	less effort	more fun
small gesture	11 persons	5 persons
big gesture	7 persons	15 persons

7 Discussion and improvement

The results must be treated carefully. Our testing group consisted of eight persons only, which is not a very high number. This is partly a reason why we sometimes did not get significant results. Probably more test persons could have counterbalanced this. A second reason why we did not get significant results was that we offered three possibilities to answer: Kinect, undecided and Leap Motion. To get reliable significant results it might have been better to give only two possibilities to answer, because undecided answers could not be considered related to significance. On the other hand, it may have manipulated the results if we forced our participants to decide for one device when someone was simply undecided.

Based upon the paper “Gesture Interfaces: Minor Change in Effort, Major Impact on Appeal” of Xiaoxing Liu and Geb W. Thomas we know that system reliability has a negative impact on how the effort of a gesture is perceived. This also has an influence on the fun factor.
To hold the influence of system reliability as small as possible both prototypes should have been working completely equal, which was not the case. The Leap Motion recognized the circle gesture better than the Kinect and got stuck sometimes. The Kinect recognized tap and swipe gestures better than the Leap Motion and had problems with the circle gesture.

That is why there can be seen an obvious tendency looking at the results, but further research needs to be done to make reliable statements.

8 Conclusion and future work

As far as it was possible with our know-how we could confirm our assumptions. The experiments show that the context affects a gesture´s or a system´s attractiveness. A tendency is recognizable that gestures are prefered in the context of a game, even when they are more effortful. Especially the tap and the swipe gestures are convenient for more effortful movements and bigger screens. The circle gesture needs to be further investigated to make reliable statements about.

In future work, the influence of system reliability will have to be reduced to get more reliable results. That means both prototypes of the Kinect games and the Leap Motion games need to work equally.

Consequently we want to emphasise how important it is to consider the influence of the context, system reliability, effort of a gesture and the screen size in order to make gesture interfaces easier and more enjoyable to use.