



Deliverable: D4.1 part b

Identification, evaluation and design of guide robot personality and behaviours: Contextual Analysis of Effective (non-verbal) Human Tour Guide Behaviour

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1. Summary

A study was carried out into the effective guide behavior of human tour guides at outdoor (exhibition) sites. The study involved the observation of four experienced tour guides while they gave guided tours to various groups. We observed two tour guides at the Lisbon City Zoo and two at the Royal Alcázar in Seville. The behaviors and personality aspects the tour guides showed were analyzed and the most effective behaviors will be used as inspiration for the design of the behavior and personality aspects of the FROG robot.

From analysis, we found that a guided tour consists of three main concepts that interact and influence each other. These concepts are navigating the visitors around the site, giving information and engaging the visitors. In these concepts several behaviors, personalities aspects and strategies can be found that are necessary for a good tour given by humans and that might be translated to robot behavior for robotic tour guides. This deliverable will focus on the aspect 'engagement'. For the FROG robot, partners from Universidad Pablo de Olavide will work on the navigation and YDreams will work on the content. However, any of our findings on behavior that may influence the navigation or the content will be discussed with them.

Attention, interaction, adaptation and interest are the categories that have most influence on the engagement of visitors during a guided tour. It is understandable that a human tour guide can stop their presentation if none of the visitors is paying attention. Capturing and keeping the attention of the visitors was easiest for guides when they made the tour interactive, allowing visitors to ask questions, and focusing on what the visitors liked. During tours the guides tried to adapt the tour to the interests of the visitors, because listening to something of their interest was easier than listening to something that the visitors were not familiar with. Guides could adapt the tour en route by changing the speed, route or content of the tour. However, beforehand guides also adapted their tours, as it made a difference whether they were giving a tour to, for example, primary school children or to graduate students of history.

The most effective tour guide behaviors identified involved specific behavior displayed at the beginning and end of a story at an exhibit: for example, starting with an unimportant sentence, and making a move in the direction of the next exhibit during the last sentence. The most effective strategy to ensure visitor engagement was to make the tour interactive and not a tour guide monologue. To make the tour more interactive, the guides let the visitors experience (feel/smell) the environment, showed pictures and objects, and so on. The most effective strategy to attract several people at once was to introduce a curiosity - an interesting fact that is special for that site/exhibit. Furthermore, when guiding adults guides were not paying attention to the visitors that did not want to listen. When guiding children, the guide could shift to the subject that was distracting the children, then capture their attention again and then shift back to the initial subject.

Behaviors such as moving in the direction of the next point of interest during the last sentence at an exhibit can be copied in the FROG robot. However, behaviors such as pointing into the exhibit to direct the visitors attention needs translation to robot specific behavior because the FROG robot will not have human-like arms. The robot is not a human and therefore should display robot specific behavior, which can be based on behavior human tour guides display, because visitors understand human tour guide behavior intuitively. Also, personality aspects that human tour guides show, such as making many and wide gestures, are important to study for the design of a tour guide robot. The behaviors of human tour guides might not be copied to the robot one-on-one, however, the interactional outcome of these behaviors is important to achieve with the robot as well.

2. Introduction

The FROG (Fun Robotic Outdoor Guide) project is developing a robot to guide visitors through outdoor exhibition sites such as zoos, historic sites or cultural heritage sites. At these sites there are usually some boards with information about the exhibits but visitors like to obtain more information and especially to hear curiosities. To meet the request for information books, audio guides and guided tours are often available for sale to the visitors. However, not all visitors can or want to use these options. In the FROG project we propose a robotic guide that will guide people through predefined parts of the site. When a robot guides visitors in these sites, apart from giving the information people are searching for, it needs to show the right guiding personality and behaviors to attract, educate and engage the visitors. In order for the robot to guide, as well as it being a Point of Interest, the robot's personality aspects and behaviors need to be intuitively understandable and should feel natural to the visitors.

Up to now there have been several robots developed to guide visitors through museums but none of them show exactly the right behavior to give fun, engaging and interesting, short guided tours. Therefore, to identify requirements and constraints for the FROG robot's personality and behaviors, we investigated the outdoor sites in which the robots will operate in a few years time. To design effective personality and behaviors for FROG, we need to carefully study the needs of visitors, the human tour guide behaviors, and the responses of the visitors in the actual environment in order to understand the future functions of the robot. The sites that were selected to investigate visitor and guide behaviors are the Lisbon City Zoo (Portugal) and the Royal Alcázar in Seville (Spain). These sites are also the locations in which the FROG robot will be tested and deployed in the future. Results of the investigation into the visitor experiences in the sites and the needs of visitors have been presented in Deliverable 1.1 in section 2.2. That section of the deliverable reports on the study on visitor experience executed in the Lisbon City Zoo and the Royal Alcázar in March 2012. The current deliverable reports on the study to identify effective human tour guide behaviors. Several manners of data collection, such as a literature review and a contextual analysis at the sites, were used to identify effective behaviors (including strategies) and personality aspects of human tour guides. This deliverable mainly reports on the contextual analysis, for which four guides, two at each location, were observed while they gave guided tours. Two researchers carried out the observations.

The results show that the four guides displayed similar behavior and used similar strategies for capturing and keeping the visitors' attention and guiding a group from one exhibit to the next. Several factors influenced the quality of a guided tour; for example, the interaction between visitors and guide and the enthusiasm of the tour guide while telling the story. Other relevant factors for a good tour were the content given during the tour and in what ways guides clarified the content, for example by methods of pointing, depicting and showing visuals. The combination of explicit behavior (strategies) used by guides should match their subconscious behavior (personality aspects) in order to present a convincing and inspiring story to the visitors. Factors that influence the tour influence each other as well, which means there are probably several ways of giving a good/engaging/inspiring guided tour. All tour guides are different and behave in a way that fits their own personality. Therefore, all factors found in the analysis are input and inspiration for the design of robot behaviour. For the design of the FROG robot it is important that the factors that influence the tour can be subdivided into verbal and non-verbal aspects. It is especially important to learn from non-verbal communication between tour guide and visitor for the design of the behavior and personality of the FROG robot, because the robot will not have natural speech or speech recognition systems. However, in this study on human tour guide behavior, the verbal aspects of guiding should not be neglected, as the outcome of verbal interaction can be an outcome that we want to obtain with the FROG robot as well. In that case the verbal behavior needs to be translated to non-verbal robot specific behavior.

The consortium does not aim to develop a human-like robot. A robot is a machine and will therefore show machine specific behavior. However, specific behavior might be taken from human behavior. The observed strategies of human tour guides require translation into robot specific behavior and personality before applying them to the FROG robot. The main human tour guide behaviors that the FROG project wants to focus on are: capturing the attention of visitors, directing their attention, and engaging visitors during a short tour. First, cues or strategies for capturing the attention of the visitors used by human tour guides may act as inspiration in the development of the FROG robot because humans react to these cues intuitively. Second, the behavior that human tour guides display when directing the attention of the visitors to a specific point is important to

identify, because human tour guides use several ways of pointing and these methods can inspire the behaviors of the FROG robot. The specific content of the tours is not described in this deliverable.

This deliverable will start, the structure of tours given by human tour guides, and human tour guide behavior that has been published previously. In section 4 the methodology of the contextual analysis at the Lisbon City Zoo and the Royal Alcázar will be given, also, the four tours observed by the researchers will be described to give a feeling of the process of the tours. Results will be given in section 5 and design implications due to the results will be given in section 6. The deliverable will finish with conclusions and future work.

In this deliverable, several references will be made to the paper *“Contextual analysis of Human Non-Verbal Guide Behaviors to Inform the Development of FROG, the Fun Robotic Outdoor Guide”* (D.E. Karreman, Van Dijk, & Evers, 2012a). This paper was published in “Human Behavior Understanding,” a Workshop at IROS 2012. The focus of the paper is mainly on non-verbal human tour guide behavior, while in this deliverable a more comprehensive overview of effective human tour guide behavior is given on non-verbal as well as on verbal aspects. Parts of the paper have been expanded in this deliverable. When sections of the paper are reported, it will be clearly mentioned.

3. Related work

As most behaviors of existing robots are based on human behavior, for designing a tour guide robot it might be useful to analyze some specific behavior that human tour guides use. Human tour guide behavior, and the structure and procedure of human guided tours will be discussed. In addition, theories about applying human-like behavior to robots will also be shortly discussed here.

Should all feedback given by guide robots be humanlike? In human to human interaction humans intuitively use and understand non-verbal (feedback) behavior of others (Ambady & Rosenthal, 1992). Human tour guides intuitively use effective guide behavior, so looking at the behavior of human tour guides may help to set the behavior of robotic tour guides. As Duffy states: using anthropomorphism and anthropomorphic communication cues can be powerful and intuitive to make humans understand and naturally interact with robots (Duffy, 2003). However, a robot is a machine and not a human and we should not aim for developing the perfect human-copy. The aim is to develop a robot that is good at its own task and only shows human appearance and behavior if that supports the task.

In previous work the authors found that originally tours were like lectures and were more or less a monologue of the tour guide (Uyen Tran & King, 2007), but nowadays tours have become more adjusted to the interests of the visitors which has the advantage that visitors are more involved in the tour and like the tour better (Best, 2012). To be this flexible, and to adapt the tour to the interest of the visitors, the guide needs to be able to tell flexibly about everything they encounter, so visitors do not notice the change in the tour when the guide makes changes in content, for example in the case of some places of the trip not being available (Wynn, 2010). To give an engaging tour, guides use several strategies to attract and keep the attention of the visitors. One of these strategies is to interact with them (Uyen Tran & King, 2007). Interaction with visitors (e.g. verbal interaction) is important to keep the visitors' attention. And as well as giving cues to the visitors, the guides also obtain a lot of non-verbal feedback about involvement of the visitors by looking at them. Visitors that are gazing at the guide or the object of interest and who are nodding or smiling are interested, the ones looking away or talking to each other may not be interested anymore (Best, 2012).

4. Methodology

This section explains the methods used for data collection and analysis of the data. The main focus of the research is on human tour guide behaviour and personality. However, not only the guide behaviour is important in this case, the interaction with and the reactions of the visitors to the guide also need to be studied to understand what makes the interaction during a guided tour natural/intuitive. The following part about the methodology and data analysis is partly taken from D.E. Karreman et al. (2012a).

Aim and research questions

The goal of this contextual analysis is to observe and assess the effective guide behaviours human tour guides used during the tours they gave. The final goal is to translate effective human tour guide behaviour to robot-specific behaviour for a tour guide robot.

Research question:

What are effective behaviours and personality aspects human tour guides use and how can we translate these to robot-specific guide behaviour?

The results of this analysis will be an overview of effective human tour guide behaviour. Later, controlled experiments will be carried out and design guidelines proposed in parts D4.1c and D4.1d.

Research context

Both the Lisbon City Zoo and the Royal Alcázar offer interesting and challenging opportunities for having robot guides guiding visitors. In these sites the amount of information that is available for visitors visiting the site without a tour guide is not satisfying them (Daphne E. Karreman, Van Dijk, & Evers, 2012b), therefore developing a robot that can give additional information to the visitors, might improve the visitor experience.

The Lisbon City Zoo is a park with several wild animals and one of the Zoo's goals is to educate visitors about nature and animals. Besides that, the Zoo also provides access to scientific (zoological) research and participates in conservation programs for species. The guides who give tours in the Lisbon City Zoo are trained and employed by the Zoo. Visitors to the Zoo are mainly families with one or two (young) children, couples, school classes and groups of friends. People come to the Zoo mostly to have a day out together.

The Royal Alcázar is a royal home, the first building was built in the ninth century and during the ages Christians and Muslims built, destroyed and rebuilt site. The guides in the Royal Alcázar are trained and employed by various agencies or enterprises. All guides must be certified by a recognised authority but the board of the Royal Alcázar does not check if all guides have a permit. The guides that contributed to this research were certificated. Visitors to the Royal Alcázar are mostly couples (with older children), groups of tourists and school classes.

The guides and the visitors

For the research, four guides were observed, videotaped and interviewed. In the Lisbon City Zoo two guides participated. The first guide (male, ten years of experience) guided a group of seven adult visitors, who were all members of the FROG project; however, they took the guided tour through the Zoo for the first time. The second guide (female, some years of experience) guided a school class of 19 children aged 9-10 years. The children, accompanied by their teacher, visited the Zoo as part of their education, and during the tour they learned about animals in the wild. In the Royal Alcázar two guides participated, both were female. The first guide (ten years of experience) guided a group of eight adult persons, including project members; six of them followed the tour at the Lisbon City Zoo as well. The last guide (several years of experience) guided a group of twelve adults (and two small children), this group consisted of project members (four, of whom three joined the other tour in the Royal Alcázar) and their family members, and students and staff of the Universidad Pablo de Olavide in Seville who were invited to the guided tour.

Procedure

At the start of each tour all visitors and the guide were informed about the research and they gave spoken consent for observation and recording. At the end of the tour the group was led to a room and all adults completed a consent form. Two researchers, who observed the guides, joined all four tours. One of the

researchers videotaped the tours. The second researcher was part of the guided group and took notes on the story the guide told, and seemingly effective guide behaviour, and observed the incidents that occurred during the tour. After each tour the researchers interviewed the guide and both of the researchers made notes. After the interview, the researchers completed and compared the notes of the observation of the tour and the interview.

Experience the tours!

In this part of the deliverable we chose to insert the description of the process of the four tours. These descriptions will help the reader to understand the procedure events during the tour. A short description and some figures are given for each of the four guides observed. In these stories some coding of strategies is given. *[coding]* This is an example of how coding is done. The information presented here will increase the understanding of the results of the guiding strategies.

Tiago

Tiago was the first guide that guided a group of seven adults through the Lisbon City Zoo; one of the visitors was also one of the observers. Tiago took the group of visitors for a two-hour tour and still he had to rush to give all of his information. *[flexibility]* He was able to tell freely about everything in the Zoo.

The tour started at the exhibit of tigers. Tiago put down his bottle of water and *[orientation]* stood with his back towards a large glass wall separating the tigers from the visitors. He was orientated towards the visitors and talking to the visitors that were closest. *[gaze]* While telling he was looking a lot into the exhibit and *[gestures]* made many wide arm gestures. The funniest part was when he told that tigers are good at jumping and that they could jump over the glass wall, however, there was a net placed over the exhibition. *[depict]* When he said that the tigers would be able to jump over, he pretended to be the tiger jumping over the wall, to scare the visitors. *[ending at exhibit]* Then he picked up his bottle of water and he took the group to the next exhibit of another species of tigers, but the tigers were not there, *[flexibility]* so he made jokes with the visitors that the tigers were out for a walk.

As well as information about the different species, Tiago told a lot about the design of the exhibits. For example, *[curiosity]* the penguins had plants in front of their exhibit, so they had the feeling of having some privacy. And small monkeys were in an exhibit separated from the visitors by some water, so the monkeys could not get out and the visitors could not get in or give food to the monkeys. The area of the monkeys was small, measured in square meters, but the exhibit was high, as in the wild these monkeys prefer to live in high trees.

The gorillas were special; Tiago told that people like to look at the primates, but that the primates also focused on the visitors. The group experienced that, because a male gorilla was already showing off his dominance by beating his breast, and later on it followed the group when they walked along the exhibit, jumping against a window to show his dominance again. *[time schedule]* Tiago wanted to go on, because he has seen this behaviour more often, *[distraction]* but the gorilla impressed the visitors. Therefore, Tiago just told parts of the story to the three visitors that were in front, waited for the others and went on to the next exhibit. This can be seen in figure 1, where some visitors still have to arrive, however Tiago had already started the story. *[visuals]* In the house of primates were large information boards that Tiago used for his explanation. *[distraction]* After a while some visitors were not listening anymore, but Tiago finished the story for the interested visitors as is visible in figure 2.

[time schedule] In a rush, he took the group from the primates to the cheetahs, where he had a short stop to tell about the stripes on the cheetah's face. During this explanation, *[depict]* he was pointing at his own face to indicate where the cheetahs have the stripes. Also, *[depict]* he explained about the claws of the cheetah using his own hand to indicate what the claws of the cheetahs look like.

Then he took the group to the okapis *[curiosity]* that, in the Lisbon City Zoo, have the best exhibit of the whole world, with soothing music and privacy. Next, the tour led to the elephants and the lions. Back again to a window at the chimpanzee exhibit, then along the lemur island. *[curiosity]* Lemurs are famous animals at the moment, because of the film Penguins of Madagascar, in which the king is a lemur. However with lemurs the females are dominant. A small hippo, to the giraffes. *[time schedule]* At some animal exhibits, Tiago only made a very short stop and some exhibits of animals were just passed without any explanation. *[walking]* When he

walked from one exhibition to the next, he always walked slightly in front of the group, most of the time talking to one of the visitors close to him.

At the exhibits of the giraffes, he made a longer stop giving some information about the giraffes and *[curiosity]* he told the names of the individual giraffes. Then he explained he did not do so for the gorillas, because they do react to their names and giraffes do not, but visitors like to know the names of the animals. *[distraction/interest]* Part of the group was still watching the giraffes, but Tiago and some visitors went on and stopped at a toxic tree, and Tiago told that *[curiosity]* eating leaves of the tree could kill dogs or small children, and that adults would get stomachache. Then the rest arrived and asked about the tree, so Tiago had to tell again that adults would have a stomachache, and that children or dogs could be killed by eating the leaves of the tree, because the tree is toxic.

Then he took the group into the reptile house. *[time schedule]* In a rush he went past snakes, Komodo dragons, reptiles, turtles, and crocodiles. When the group came outside again they thought the tour was finished, but Tiago led them past the bison, kangaroos, koalas and bongos before the interesting, long, varied tour was over.



Figure 1: Tiago while not all visitors are have arrived



Figure 2: Tiago not paying attention to distracted visitors

Sylvia

Sylvia guided a school class of Portuguese 6 year olds through the Lisbon City Zoo. She spoke in Portuguese to the children. Tiago walked with the observer close to the group, to explain what Sylvia was telling the children.

[purpose] The tour for the children started at a point where no animals were visible yet. The guide put the children in a semicircle and gave a general introduction, explaining the rules (not allowed to touch or feed the animals, stay behind the fences), *[story]* but also tried to link new knowledge to things the children already knew about domestic animals. During the introduction, *[adaptation]* Sylvia tried to take what the children were saying, and build the new knowledge on that basis.

The first animal the children went to was the zebra. *[orientation]* Sylvia stood at right angles to the exhibit and the children stood in a semicircle around the exhibit. *[authority]* The teacher kept the children in the right place, so all children were able to see the zebra. *[story]* Sylvia told about the stripes of zebras: that they are all different, just like the fingerprints of people.

Then they went to the tigers and *[orientation]* the orientation of the guide and the children was the same. Unlike Tiago, Sylvia seldom looked into the exhibits, *[gestures]* however, just like Tiago, Sylvia made many arm movements. *[story/adaptation]* Sylvia wanted to tell something complicated about the tigers and therefore she had to introduce a new difficult word. To have the children understand the word, she introduced it and then the whole group had to repeat the word loud. *[visuals]* Then Sylvia walked into the Temple of Tigers to use the rich wall paintings to explain more about the tigers.

Next they came to the area of birds and Sylvia told the children something about parrots. This was difficult to hear for some children because all the birds were making a lot of noise together. *[distraction]* Then a few children got distracted by a peacock. Sylvia noticed, and soon all children were looking at the peacock. *[flexibility]* Therefore Sylvia changed her story and started to tell something about the peacock, until she had captured the attention of all children again. Then she changed the subject back to the story she had been telling about the parrots.

The following exhibit was the exhibit of kangaroos. *[orientation]* Sylvia asked all children to stand close to the fence and look into the exhibit. She was standing behind the children and *[gaze]* was also looking at the exhibit while giving information about the kangaroos. This is visible in figure 3. Then one by one the children turned towards Sylvia and looked at her while she was asking the children questions about the kangaroos. *[children game]* At the end of the story Sylvia asked the children to jump like a kangaroo to the next exhibit. *[time schedule]* At that exhibit, Sylvia noticed she had to hurry a bit. *[time schedule]* To win some time at the exhibit of the bison she walked slowly backwards while the group of children was following her.

Then the tour continued to the reptiles, but they did not go into the reptile house, because the areas are too narrow and it is difficult for the children to focus. Outside the reptile house was also an exhibit of snakes. *[visual]* There Sylvia told about the snakes and she took a snake egg out of the bag she was carrying. For children the guides always took bags with materials to use during explanations. The children were focused when the hand of the guide went into the bag, because they were curious what would come out. When Sylvia was showing the snake egg, the children stood really close to her.

The slender-tailed meerkats are small animals that dig tunnels. They live in an exhibit with glass walls and the children were standing against the walls and looking into the exhibit. *[orientation]* Sylvia was again standing behind the children. *[story]* When a child asked a question, Sylvia first continued her story before answering the question. Often the question was already answered by the story she was telling, but she also continued to keep the structure of the story. Extra information came after that.

[distraction] When they reached to the giraffes the tour was almost over and it was difficult to keep the children's attention. The teacher still tried to make sure all the children were listening, however *[authority]* Sylvia also needed to clap her hands to capture their attention. *[children games]* Also at the exhibit of giraffes the children were asked to imitate how giraffes reach the ground. The children found out that the giraffes had to spread their front legs to reach the ground to eat the grass, see figure 4.

The last stop on the tour was at the exhibit of seals and sea lions where the children learned to differentiate between these two. To finish the tour, Sylvia proposed a sort of quiz. *[children games]* The boys were against the girls and both groups had to think of a question about what they had learned during the tour. However, the question should not be so easy that the other group could easily answer it. The group with a question (and answer) that the other group could not answer won the quiz. In this way Sylvia and the teacher could get an impression of what the children had learned during the tour.



Figure 3: Sylvia standing behind the group of children



Figure 4: Children reaching the ground like a giraffe

Paloma

Paloma guided a group of eight adults through the Royal Alcázar. The observer was one of the persons joining the tour.

[route] Paloma took the group to a small room close to the main entrance of the Royal Alcázar and introduced herself. *[orientation]* The group was standing around her in a semicircle and *[gaze]* Paloma was alternating her gaze to all of the visitors during her first explanations. Paloma was speaking clearly and loudly, so the small group of visitors had no problems in understanding her. Also, *[gestures]* she used a lot of arm gestures while telling the story. In this place, *[story]* she told some of the basic knowledge you should obtain when visiting the

Royal Alcázar. The information was not specific for the room they were standing in, but to understand what the visitors would see in the tour.

When moving to the next stop, Paloma really was aware of where she stopped and *[orientation]* where the visitors had to stand to see exactly what she wanted to show and which parts were not visible yet. *[interaction]* She tried to have the group experience the Royal Alcázar in different ways, for example, she let people feel and smell the plants (arayan – the aromatic (myrtle)) that grew close to the entrance, see figure 5. Also, *[visual]* sometimes she showed pictures, such as a small picture of the tower in Alhambra. *[orientation]* The group had to come really close to the guide to have a good view of the papers, but it helped her to tell the story.

The next stop was at the main square, which was only a few steps from the previous stop. She waited until the group was complete and *[orientation]* oriented in a semi-circle around her. Often when the group was standing in the semicircle formation, Paloma stepped slightly closer to the group, reducing the proximity between her and the visitors. *[distraction]* One of the visitors was not listening to the story most of the time, because he was taking pictures. Paloma did not pay any attention to him.

[route] Then the tour led through some of the richly decorated rooms of the Royal Alcázar. *[story]* Paloma knew exactly what to tell at each place and repeated the most important information more often. *[pointing]* While she was telling she was pointing a lot to where the group should look, and she described what they should see. *[interaction]* In these rooms she gave the visitors plenty of opportunity to discuss their thoughts. Some information she gave to one person in particular, because that visitor was asking questions about that. *[questions]* She even answered questions in the middle of her own story. When a visitor had a question, *[orientation]* Paloma took a step towards that person, so she was standing closer to the visitor to answer the question personally.

[curiosity] In the Courtyard of the Maidens she told about the Arabic text on the wall. *[interaction]* One of the visitors was able of reading Arabic and Paloma could not, so she encouraged him to read the text on the wall. Paloma and the visitor are both pointing to text on the wall in figure 6. However, the visitor was puzzled and could not really tell what was written. It seems that he felt a bit embarrassed, but Paloma helped him. The fact that he could not read the text was because it was based on Arabic, probably not real Arabic, because it was made by Muslims who worked for a Christian king, and the king might have liked the form of the text, but not the Muslim meaning, and therefore the builders only used some sort of Arabic-like decorations. *[distraction]* During these explanations some visitors were distracted by their mobile phones, *[attention]* Paloma just ignored them and talked to the people who were still listening.

[pointing] In the rooms Paloma was telling about and pointing to exhibits that were visible on different walls, *[orientation]* and so she was sometimes standing in the middle of the group. *[gaze]* But she still tried to alternate her gaze between the visitors who were interested in the story. During her explanation, *[story]* Paloma tried to make connections to details she had told before by saying sentences such as “do you remember?” *[flexibility]* Also, she tried to give personal attention to the visitors who had asked questions earlier by mentioning details that fit their interests.

[route] After visiting the rooms inside the building, Paloma took the group outside to a part of the gardens, here the distances became larger, therefore she often mentioned where she wanted to go next. However, she often made an extra stop in the middle of the walk to tell something extra. *[walking]* She walked in front of the group to show the direction and *[time schedule]* to keep a certain pace in the tour.

When the group was walking through a small corridor, *[walking]* Paloma walked in front and was talking to the visitors close to her. At some point she stopped and told something to one of the visitors. It was loud enough for the other visitors to listen as well. However, *[gaze]* Paloma was not addressing them. During her explanation in the corridor she switched to another person, because that person asked a question. The tour was finished in the Halls of Charles V. *[curiosity]* First Paloma explained about the pointed chins of Charles V and all the other kings of that time. And in the hall of tapestries, *[curiosity]* there was one tapestry that had the map of Europe upside down. This was the final exhibit of the tour. Paloma took the group back to the point where they had started the tour.



Figure 5: Paloma asking the visitors to smell the leaves

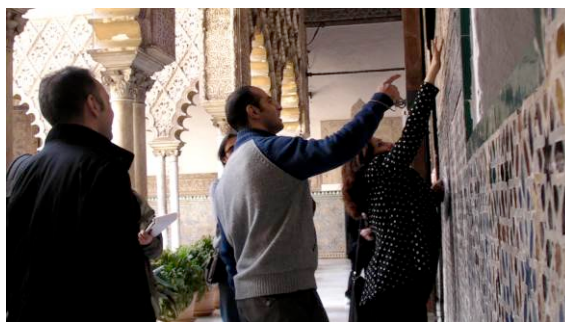


Figure 6: Paloma giving personal attention to the visitors

Mariana

Mariana, guiding a group of 12 adults (and two small children) through the Royal Alcázar.

Mariana started the tour in the main square. *[orientation]* The visitors were standing in a large semicircle around her and *[story]* she first introduced herself and the exhibits she wanted to show the group during the tour. Also, she gave a very short introduction into the history of Seville and the Royal Alcázar. Mariana, like the other guides, *[gestures]* moved her arms while talking, in one hand she held her sunglasses. She talked clearly, slowly but not particularly loudly. *[gaze]* She alternated her gaze between all participants of the group. Mariana told the visitors where they were going next, and asked them if they were ready. *[walking]* Only when the visitors started to move, did Mariana also walk in the direction of the door. She walked slightly in front of the group. Halfway between the place they stood and the door Mariana was asked a question by one of the visitors. She stopped walking, and so did the whole group. She answered the question. The other visitors were waiting.

[route] On entering the palace Mariana took the group through some small corridors directly to the Courtyard of the Maidens. *[orientation]* Here Mariana stood in front of the group of visitors with her back towards the garden of the patio. She started to explain what was visible; *[gestures/pointing]* she spoke slowly and used a lot of arm gestures and pointing gestures. *[orientation]* When she turned to talk about the patio, she had her back towards one of her visitors, however, later in her explanation she turned towards them to continue the story. Often other visitors had to pass through the formation of the group.

As Mariana was telling the group where they were going to go next, *[walking]* she already started walking and passed the semicircle of the group. She walked slowly and the visitors followed her slowly with a small gap between them. During the walk Mariana walked in front of the group and *[time schedule]* checked the time (see figure 7) and whether the next exhibit she wanted to visit was free. Then she gave some information to the first visitor in the group, before talking to the whole group again. *[orientation]* The group was still in the formation of walking, in a few rows. Mariana was not talking that loudly and *[pointing]* pointing a lot into the space, indicating where people should look. *[distraction]* Some of the visitors at the back were not paying attention to Mariana anymore. *[walking]* She walked further, and again she was some meters in front of the group.

[story] Mariana started to explain about an Arabic text on the wall, and *[orientation]* the group was standing in a semicircle around her. As she stood at right angles to the wall, Mariana could point to the text as well as address all the visitors. *[interaction]* At the moment one of the visitors asked a question about the text, she focused on that person and directed her answer to him.

[depict] In one of the rooms Mariana told a long story that she partly depicted with her hands (stones that would fall down if an earthquake should occur), see figure 8, and *[pointing]* she pointed a lot at the elements the visitors should focus on. When she wanted to go to the next room, she first focused on an element that she walked towards and that the visitors could only see when they reordered. *[walking]* In that way the visitors were already moving and it was easy for Mariana to take them to the next room.

[adaptation] After a while Mariana took the group to the gardens and started to explain about the plants growing there. *[walking]* When walking from one exhibit to the next she walked slowly in front of the group

and the group followed slowly. There was always some space between Mariana and the group. In front of the pavilion made for Charles V she stopped to explain about the building. *[orientation]* In that place was a small fountain and the path was a bit wider so all visitors of the group could stand around Mariana. Mariana could easily address all visitors and *[pointing]* point to the pavilion. At a certain moment, *[interaction]* she got a question in Spanish from one of the visitors, that she also answered in Spanish. The group consisted of different nationalities, so the explanation was not understandable for everyone. Also, some information *[curiosity]* about the bitter orange trees she only gave to a few visitors of the group that were still standing close to her, while the others were already moving on to the next exhibit. The tour continued through the gardens, where sometimes Mariana told something about the plants, *[walking]* but most of the time walked in front, or told something to the visitors in front.

[route] Mariana took the group through the Halls of Charles V and the hall of the tapestries and finished the tour at the Alighting Area with a view on the Cathedral of Seville.



Figure 7: Mariana in front and checking the time



Figure 8: Mariana depicting stones falling down

Data collection

Two researchers followed all four tours. One of the researchers was videorecording the tours, the other researcher joined the visitors and took notes of events that happened during the tour.

Videos of all tours were made to assess the guide behaviour and his/her expressions as well as reactions of some visitors or the whole group of visitors. The quality of the audio is good when filmed from a close distance to the guide, but not informative when the whole group of visitors was filmed. However, non-verbal behaviour of the guide and the visitors' responses are very well visible in both cases. The interviews were semi-structured (duration was approx. 15 minutes) asking the guides about the tour they had just given, their experiences guiding different kinds of groups, use of strategies to gain and keep the attention of the group and how they would like to improve the visitor experience at the sites. The questions for the interviews were based on factors that might influence the tour a robot can give, an overview of these factors and the questions for the guides are presented in the table below.

Table 1: Factors that might influence the tour given by a robot and questions based on these factors.

Factors that might influence the robot tour.	Question to human tour guide.
Purpose of the tour	What is the purpose of your tour?
Main exhibit in the site.	What is the main exhibit in the site you are guiding?
(Predictable) differences between various groups.	Do you notice differences between groups? How do you deal with that?
Difference in guiding children and adults.	Is guiding children different from guiding adults? If yes, in what way?
Gaining and keeping attention of visitors.	How do you gain and keep the attention of the visitors? Do you use strategies for that?
Improve visitor experience.	What do you want to change of improve the visitor experience?

Data analysis

The data gathered from the different data collection moments were combined in the analysis using an affinity diagram. This method is based on the Grounded Theory method (Corbin & Strauss, 1990); a method in which themes and results emerge from the data such as notes and recordings. An affinity diagram is very useful when large amounts of qualitative data have to be analyzed, from which the results are complex and not easy to grab (Courage & Baxter, 2005). The affinity diagram helps to order the information and to find logic and natural relationships between the parts of the data. The method using an affinity diagram roughly follows three steps. First, short statements of the notes have to be written on cards (post-its or index-cards). When writing down these statements, no attention should be given to duplications of text or solitary cards. For interpretation of the data colour coding of the statements could be useful. Second, all statements have to be shuffled and stuck to a wall. Cards with similar statements are placed close to each other, but also other relations between statements can be made clear by using arrows or signs (such as *). In this phase, clusters of similar subjects and relations between subjects appear. It is important that a statement can be in more than one cluster (by duplicating the card) and relations can be of all kinds (e.g. cause, opposite, similar). In the third step, the clusters have to be named and the relations between the clusters are given meaning by describing the way they influence each other. Some extra cards with the main findings per cluster will be stuck to the wall to make the affinity diagram more easily readable. When the number of clusters is high, some can be combined into larger clusters with some sub clusters. But also the other way around, when a cluster is very large, it can be split into two or more clusters.

For the research on human tour guide behaviours, from all data types (observation, interview, video analysis and literature) notes were taken and written as statements on small cards. From observation the notes of both researchers on guide behaviour, personality and events that happened during a tour were written on statement cards. These observations were complemented with notes taken during review of the video recordings. For a more detailed analysis of the guide behaviour, two film fragments (approx. 2-4 minutes) were taken from all guides. These fragments were chosen, because they show the guide telling a story at one exhibit, from arriving at the exhibit and starting the explanation until ending at the exhibit. In these fragments, the guides are filmed from close by, so the story they are telling about the exhibit is understandable. This gave the researchers the opportunity to study the guides' movements and gestures timing in the story they told. The answers from the guides to the interview questions were also noted on statement cards. These remarks gave us more insight into the strategies the guides used. The set of statement cards was made complete by taking some outstanding citations from literature on tour guiding.

The statements were colour coded by resource (e.g. all statements taken from the direct observation of the tours were written in blue and statements taken from the interviews were written in purple). When all cards were completed, the researcher started to cluster the statements on a large wall. During this clustering the placement of the cards was not fixed and cards were removed and replaced if necessary. Finally, all cards were on the wall and names for the clusters were invented, some clusters with sub-clusters were invented. The main statements per cluster were added on yellow notes. The final affinity diagram contained over one hundred statement cards, which made it complex to read. To improve the readability of the diagram a less complex

version was made. In this version duplicate information was left out, statements with the same meaning were combined and everything was written in short terms.

Please note that the analysis of data sources and the elaboration of the affinity diagram were done by one of the researchers. However, the researchers discussed the notes on the observations and the video analysis before writing the statement cards. Also, after making the affinity diagram and the final connection diagram the researchers discussed the results and added relations, connections and changed names for the clusters to get the best overview of the results.

5. Results

In this section, the results of the data analysis are presented. To begin we will give a short overview of the terms used in this section. The terms also explain what is visible in the diagram “tour guiding.” First, all **events** (e.g. “Tiago depicted the stripes of the cheetahs face in his own face” or “Paloma showed a picture of another building in Mudejar style”), written on the statement cards, were categorized in **categories** of the same kind of events (e.g. “depicting” or “visual”). Then the categories were put into meaningful **groups** that belonged to a larger concept (e.g. “gestures” or “information”). Last, from these clusters three **core aspects** of guided tours were found (e.g. “content”). Also, the lines in the diagram symbolize **relations** between two categories (e.g. the connection between depicting and visual is “the subject the guide wants to show is not available at that moment, therefore the guide uses other means to clarify the story”). In the appendix an earlier, more comprehensive version of the tour guiding diagram is given. In this diagram most relations between categories are named. To make sure the reader will not be overloaded by information of the tour-guiding diagram, only an abstracted version is used in the deliverable. In addition to explain the information in the diagram, several versions showing different information are used. The coding terms as already used in section 4 were derived from the categories in the tour-guiding diagram.

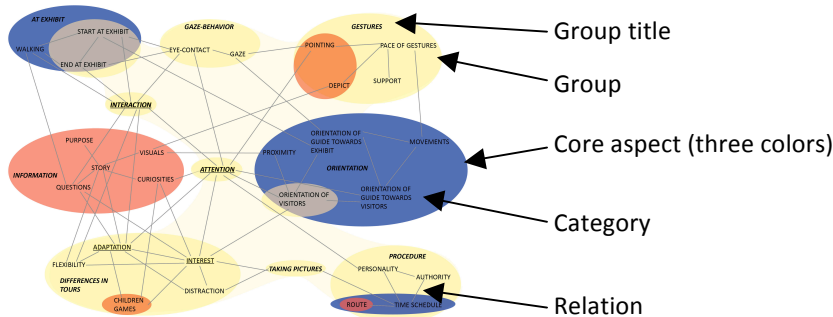


Figure 9: Explanation of guiding diagram

This section starts with an overview of the core aspects of a guided tour. These core aspects are navigation, content and engagement. In this deliverable the main focus will be on engagement, however, navigation, content and engagement overlap in some cases. Second, an overview of the meaningful groups, their categories and the relations between them is given. Categories with most relations are of main importance for engaging people during a guided tour; therefore these will be described first. The events that form the categories are not mentioned. However, many events that occurred are used as examples for the categories. Last, an overview of the effective behaviour of human tour guides is given. The effective behaviour of the tour guide is separated in strategies, behaviours tour guides use on purpose, and implicit behaviours, or personality aspects that guides use subconsciously. The behaviour is visitor behaviour, because understanding visitor behaviour influences the behaviour of the tour guide.

Core aspects of a guided tour

From the affinity diagram it became visible that a guided tour consists of three core aspects that partly overlap and influence each other. For a guided tour in a tourist site it is important to navigate the visitors through the site, to convey information and to engage the visitors in the tour. In figure 10 these three aspects are presented in three colours/grey scales. In the following sections guidance (blue/darkest grey scale), content (red/middle grey scale) and engagement (yellow/lightest grey scale) are explained per core aspect.

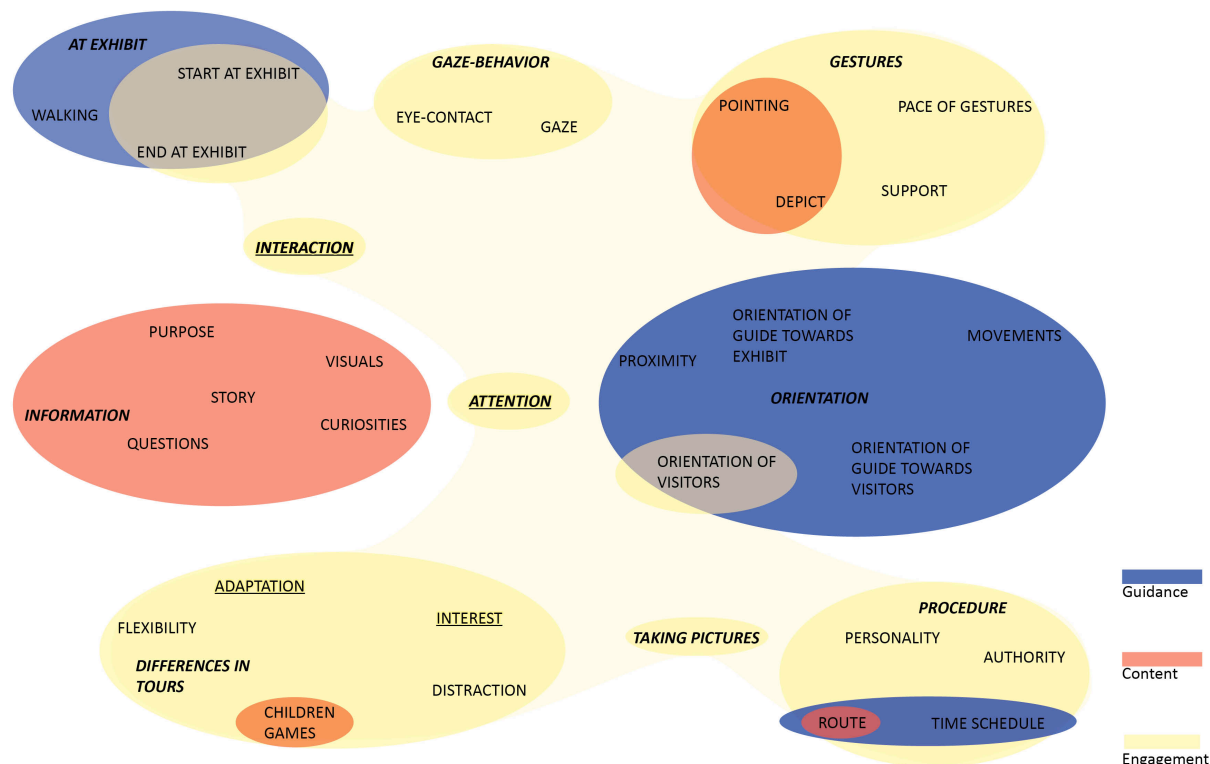


Figure 10: core aspects in tour guiding diagram

Guidance (blue core aspect)

As the words “guided tour” already imply, something or someone is conducting a tour; this can be a tour guide, an audio guide, guide books or in the case of this project a robotic guide. Conducting a tour means that the route will be chosen, as well as the places where people stop to have a look at a point of interest. At several places the guide will give information about the exhibits. The guidance in a tour may vary between all tours, based on the time schedule, the level of crowdedness, and the exhibits chosen to present.

Content (red core aspect)

Content is of main importance for a guided tour. Without content, there is nothing to guide the visitors through and definitely nothing to talk about. The guides told an overall story divided into small chunks at the different exhibits. The tour was given in a special order that supported the story and made it easy to follow (e.g. based on history in the case of the Royal Alcázar). The content of the tour was not fixed, the guides knew what visitors liked to hear, or what they needed to know to understand what they were seeing. As guides adapted the tours to the specific groups of visitors, the content differed a bit each time. Curiosities, which are interesting facts, were always part of the story. Visitors liked to hear them because they were mostly remarkable facts visitors could not learn anywhere else than in that site.

Engagement (yellow core aspect)

Apart from leading the visitors through a site and giving information about what was to be seen, the guides wanted to capture the attention of the visitors and keep them engaged during the tour. Guides achieved engagement of the visitors by making the tour interactive and not a monologue of the guide. The guides adapted the tour to the interest of the visitors; for example, they had a few games for children. Visitors were encouraged to ask questions, experience the site (feel, smell), to look around and to talk about their interests. Also, the guides used various strategies to keep the visitors engaged; these will be described in the following sections.

The connections

In the relations tour-guiding diagram (figure 9) all meaningful groups are given a descriptive title (black, bold, italic, and in capitals). Ten groups, of which seven contain several categories (black and in capitals), were identified with the affinity diagram method. The groups and categories all contain several events, strategies or

guide/visitor behaviours that are not all named in the tour-guiding diagram. The groups and categories are connected with lines that indicate relationships between them. See figure 11 for an explanation of the terms used in the description of the tour-guiding diagram. Categories with the largest number of connections (attention, interaction, interest and adaptation) represent the main aspects of engagement during a tour. Guides tried to do everything to influence these four main factors positively, for example by asking the visitors questions.

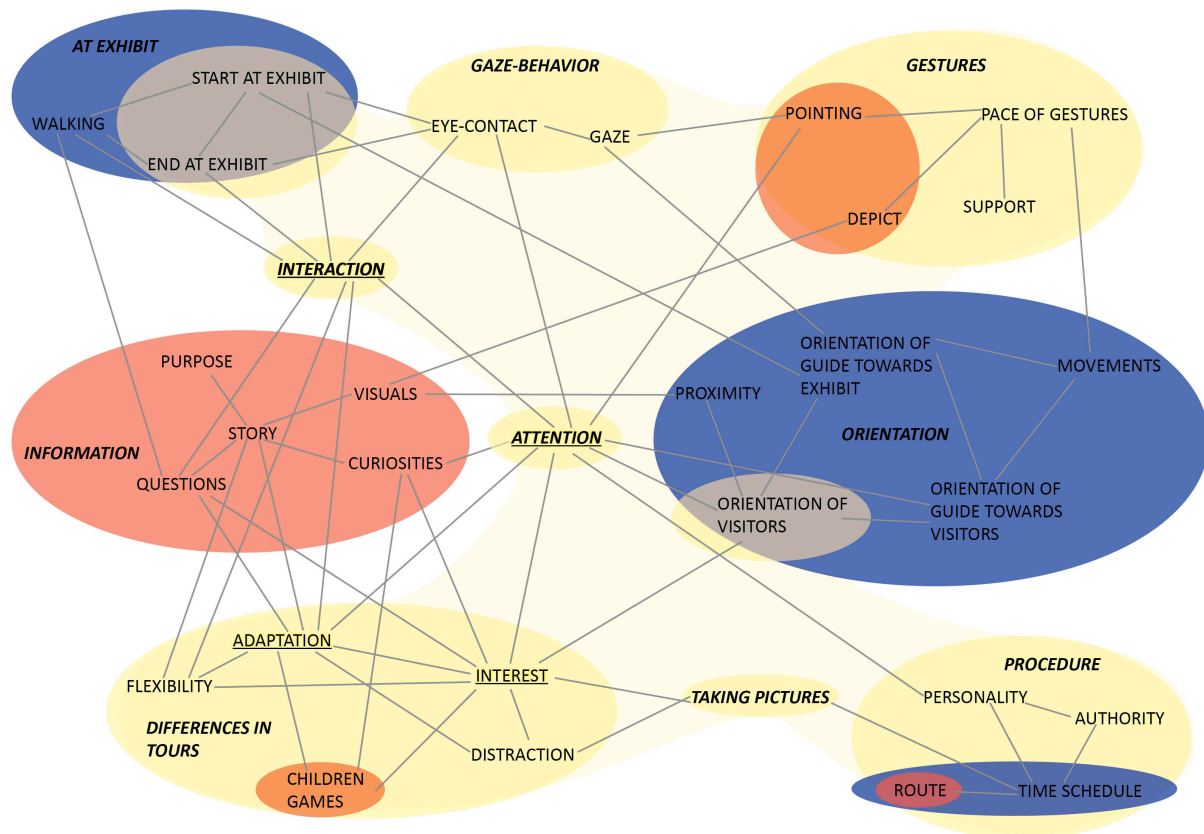


Figure 11: categories, groups and relations in tour guiding diagram

Groups and categories

In this part, the identified groups and their categories will be described. First, the categories that are of main importance for the engagement in guided tours will be described, to start with attention, interaction, adaptation, interest. Afterwards the four main categories, all other categories that influence the engagement during the guided tour are described organized together with the other categories in their group.

Attention

The category **attention** has the most relations with other categories, this means that this category is of main importance for the engagement in the guided tour. When thinking about guiding visitors in a site, the guides did everything to capture and hold the attention of the visitors. Because if there are no visitors giving their attention to the tour guide, the guide can stop the guided tour. The guides used several strategies to gain and keep the attention of the visitors, which are all about addressing the visitors and engaging them in the tour. The strategies (such as, telling curiosities, keeping eye-contact and alternating gaze between the visitors, having interactive tours) will be explained in detail in the following sections.

Interaction

The category **interaction** concerns the contact a guide made with the visitors. The guides stated in the interviews that interaction during a tour is important, because their experience is that visitors listening for two hours to a monologue of the tour guide will get distracted. During the tours we observed that interactivity was of importance to create a good tour. If visitors were involved in the story, they started to ask questions and

show their interests, so the guide was able to adapt the tour to the interests of the visitors. The more room for interaction in the tour, the more active the visitors were in listening to and discussing with the guide.

Guides addressed the visitors by asking and answering questions, showing visuals, allowing and encouraging visitors to experience (touch, smell) the site, pointing at objects, searching for special occurrences in the exhibit together, asking for personal interests and referring to that later on in the tour. Also during walks from one exhibit to the next, the guides often talked to the visitors. Sometimes these visitors had questions for the guide and sometimes the guides just took part in conversations the visitors had. Figure 12 shows the guide involved in the talk of the visitors during the walk to the next exhibit. Especially for children, special attention to a particular child or a small group of children was needed at times, because they were not listening or they were answering questions very well. By giving personal attention to visitors, guides developed a relationship with their visitors, which improved the engagement of the visitors during the tour.



Figure 12: Tiago talking to the visitors during the walk

Differences in tours

The comments about **adaptation** indicated that tours were made different for different groups, and adjusted to the visitors' interests. For example, for children the guides had a less scientific story than for adults. The story for children was linked to knowledge and experiences that they had from daily life, for example when talking about tigers in the Zoo, the guide Sylvia asked the children if they knew what cats usually eat, and linked the information about the food of the tiger to that knowledge. Even during a tour, the guides kept checking whether visitors were engaged and changed the content, speed or route of the tour based on questions or feedback they received from the visitors. For **children** many visuals were brought and some **games** were done, for example, imitation games such as jumping like a kangaroo or reaching to the ground like a giraffe (see figure 13 for an impression).

Interest of the visitors was obtained when the guide had a striking story and a lot interaction with the group. The guides in the Zoo knew most visitors liked stories about the elephants, giraffes, tigers, lions and primates a lot, therefore the guides took more time at the exhibits of the favourite animals, and did not elaborate on less exiting species (such as earthworms), even when they could tell a lot about them. To keep children engaged the guides often made analogies with daily life knowledge and experiences to keep the story close to a child's perception.

As Best also stated, nowadays a tour is not a pre-written speech learned by heart by the guide (Best, 2012). The tours were shaped to the visitors' interests, and therefore the visitors paid more attention, asked questions, and interacted with the guides. This interaction made it easier for the visitors to follow a two-hour tour. Also, guides spent most time at exhibits that visitors' were interested in, because it was easy to keep them engaged. If a guide noticed that visitors had other interests than the story told, the guides adapted the tour to keep the visitors' interest. The guides recognized loss of interest by the implicit feedback of the visitors, such as distraction showed by visitors and the kind of questions they asked.



Figure 13: Children jumping like kangaroos

The guides tried to keep the visitors engaged during the whole tour, however, some visitors just did not like the tour. So sometimes, visitors got **distracted**. When this happened and the guides noticed it, they did not pay much attention to these visitors anymore. From the interviews it became clear that the guides did not want to use their authority, as adult visitors can decide for themselves whether they want to listen or not. The guides also indicated that when the visitors were engaged again, they were not treated differently from others because they had not paid attention earlier.

Visitors showed specific behaviour when they were distracted: looking away, talking to others, walking away and taking pictures (other than of the exhibit the guide was talking about). Especially when children took pictures this was a sign that they were distracted. Children were easily distracted, as Tiago said about guiding children in the interview, therefore he switched subject when he found out that the interest of the children was somewhere else. For example, we observed Sylvia in the Zoo. The children were distracted by peacocks walking around them so they were not paying attention to the story about parrots anymore. Then Sylvia started to tell about the peacock, so she captured the attention of the children again. In this way the guide made sure that she and the children had a mutual subject again and then she shifted back to the original subject.

Information

As stated earlier, the **story** the guides told was not pre-defined. Each of the guides adapted the story to the interest of the visitors and answered questions. All guides told about the purpose of the site (e.g. about species or keeping history alive) and gave curiosities about the site. Visuals were used to clarify the story. All guides had clear **goals** for their tour. They wanted to educate their visitors, because there is so much information available about the site, but little is shown on information boards. In the Royal Alcázar, there was not even one board available in every room was. In the Zoo all species had their own information boards, and some extra information close to the exhibits of the popular animals. However, visitors wanted to learn more about the animals.

Curiosities are interesting and not commonly known facts about the location or the exhibit on view (e.g. “the Portuguese brought the first Rhinoceros to Europe” or “last year the Royal Alcázar was partly closed for the public, because the royal family stayed there for a few days”). Tour guides stated in interviews that it was the curiosities that visitors remembered best afterwards, because they were extraordinary and special. Also from observation of the groups guided by one of the guides, this seemed obvious, because the visitors were discussing these facts. The curiosities were part of the story the guides told. Also, giving curiosities was used as a strategy to capture attention, as the curiosities helped to get visitors’ attention if some seem to get lost.

Visuals are pictures or objects the guides brought with them to support their story. The visuals were often small, so visitors needed to stand closer to the guide to have a proper look at them as can be seen in figure 14. The visuals on a tour for children were put in a bag, hence it was a real surprise for children what came out of the bag and they focused on it immediately. At the same time the children came really close to the guide to see the object. In figure 15 Sylvia is showing a feather to the children and they are standing very close to her. In the Zoo, the guides did not mention the animals that were not visible, because especially for children it could be confusing to talk about animals that are not there.



Figure 14: Paloma showing a picture to clarify



Figure 15: Sylvia showing a feather to the children

At the exhibit

The guides would **start and end** a story about **an exhibition** by telling less important information. This was done to wait for the group to assemble or to set off to the next exhibit. Guides often started with “well” “uhm” “so” or “here we see something very beautiful,” which was to get the visitors attention to the new spot. In the end guides concluded with a short summary, explaining where to go next or using words such as “ok” “so” “let’s go” to indicate they were finished at the exhibit.

In the interviews all guides indicated that when they arrived at the new exhibit, they only waited for the first few visitors before starting the explanation, and not for the whole group. Remarkably we observed that at the start of the tour of all four guides waited until the group was complete before starting to talk, but later on when the group was slower, the guides did not wait for all of them and just started the story. Tiago started to talk about the exhibit when only one visitor was close, as can be seen in figure 16. If the guide told something important, and not all visitors had arrived yet, the guide spoke louder, so everyone was able to hear the story. It happened in the Zoo with the tour of Tiago that he told a story about toxic leaves of a tree twice, because one of the visitors that came later asked questions about the information he had not heard, but that Tiago had already told.



Figure 16: Tiago starting the story to only one of the visitors

Verbal information was not needed to indicate that the story at an exhibit had ended. Another method that we observed in the tour of Paloma was changing the subject of the talk at the end of an explanation, and paying a little attention to somewhere else in the room, by just telling a short fact about it. She finished a long explanation in a room in the Royal Alcázar, and then shifted the subject of explanation to another exhibit in the room. Hence the visitors had to shift their attention and turn around to see the exhibit. This made the visitors move and so they were ready to go on to the next exhibit in another room. This made it is easier for a guide to have the visitors follow after a long time of standing and listening.

Also, at the end of the story, the guides obviously broke the eye contact. The visitors then reorganized and followed the guide when he/she started walking. The visitors knew in which direction they had to go, because the guide had already turned, pointed or had taken some steps in that direction. The action of the guide and the reaction of the visitors is visible in figure 17. When the guide started to walk the visitors followed in a chain reaction, first the visitors that were closest to the guide, and last the ones that were the farthest away.



Figure 17: Mariana already start walking during the last sentence of the story

When guiding a group from one exhibit to the next, guides usually **walked** slightly in front of their group. This was for three reasons; the guide was able to lead the way, keep the right pace in the tour, and the guide was able to prepare for the next exhibit (especially in the Zoo, the guides sometimes had to check where the animal was located). These short walks between the exhibits were also the times the guide was able to have more personal contact with the visitors and talk to individuals. Mariana especially walked slowly, so the visitors could easily follow her and had time to look around, see figure 17. The distances between the exhibits were short, so visitors were not too easily lost and the group stayed complete. For example one of the persons that was taking pictures during the tour of Paloma could easily find them, because they were still close.



Figure 18: Mariana walking in front of the group

Gaze behavior

Eye contact is very important for remembering the story visitors were listening to, and the guides are aware of that. Otteson also showed this in a study with children who remembered the story better when the teacher gazed at them (Otteson & Otteson, 1979). Guides alternated their gaze between each of the visitors. Another reason for looking at the visitors was to get implicit feedback of the involvement of the visitors. A guide could see whether visitors were engaged or not, whether they gazed at the exhibit or at the guide and if they nodded or smiled at the guide, they were engaged. If the visitors started to look away, talk to others or walked away a little, they were not engaged anymore.

Although the guides stated in the interviews that they try to alternate their gaze between the visitors, from the observations it seems that they pick one visitor in the group at each exhibit to tell the story to. They did alternate their attention to the others just sometimes and only briefly. The visitor who was addressed was often one of the nearby visitors and the guide shaped the story to his/her interests (because the guide reacted to the feedback that visitor gave). In figure 19 Tiago is focusing on one of the visitors, while the others are also interested. Generally, for each exhibit, a different visitor seemed to be addressed, depending on who was standing close by.

The guide **gazed** at the visitors and the exhibit. From our observations the most frequently found gaze-pattern of the guides was 'look at the visitors and alternate the gaze between them.' Second, when the guides were pointing somewhere in the exhibit, they gazed shortly into the exhibit to see where to point exactly. Third, when depicting the story with gestures the guide often looked at his/her own hands, to see if the depicting was done right and to indicate where the visitors had to look. Lastly, the guide scanned the environment to see where to go next and if that area was free.



Figure 19: Tiago focusing on one visitor

Gestures

All of the guides made lots of gestures with their arms, even though each had a personal style of gesturing. Overall, the **arm movements** that the guides made were wide. The intensity of gesticulation differed per person. Even when holding visuals, the guides used both arms to support or depict the story. Most of the guides ‘talked with their hands’ and used a lot of gestures to **support** their story. However these gestures seemed not to be necessary for communication, the guide needed them for telling the story, as Alibali et al. showed, people make gestures even if the listeners cannot see them (Alibali, Heath, & Myers, 2001).

Pointing was a very helpful gesture to focus the visitors’ attention on something in the exhibit. When the guide pointed, they often took a short look into the exhibit themselves, to see where to point exactly. This sometimes created mutual gaze, where the visitors started to look into the exhibit together with the guide, but most of the times the guides also needed a word or sentence such as “there” or “on the wall you can see” to direct the visitors’ attention towards a point of interest. When visitors were still looking into the exhibit, the guides usually turned their heads towards the visitors, so the guide was more audible, as is visible in figure 20. Visitors who were still looking at the exhibit would then one by one turn their heads back and start nodding, to suggest that they understood the story. The guide would not always wait for all people looking back before going on, to keep pace in the tour. This effect was also reported by Best in an analysis of museum tour guides (Best, 2012).



Figure 20: Paloma carefully chooses where to stand

The guides also made gestures to **depict** their stories. For example Tiago also showed on his own face where to find the stripes on the faces of cheetahs (see figure 21), or Mariana talking about stones falling down using her hands to show the stone rain. Depicting the story helped visitors to understand the story the guides were telling. A guide only depicted things that were not visible at that moment. This could be an object in a room visited earlier, a specialty or behaviour of an animal. Sometimes the subject was not visible and the guide was not able to depict it, then the guide showed a visual. For example, in the Royal Alcázar the guide talked about a comparable tower built in another city, the guide was not able to depict what the tower looked like, so showing a picture helped the visitors to understand the story. If the guide did not have a picture, the comparison with the other tower would be better left out the story, because visitors would not fully understand the point made by the guide.



Figure 21: Tiago explaining the stripes of the cheetah on his own face

Orientation

The orientation of the guide towards the visitors and towards the exhibit was well chosen. **The orientation of the visitors** was usually towards the exhibit, so they could easily look at the subject the guide was talking about. **The orientation of the guide towards the visitors** was in such a way that visitors could easily look at the exhibit and at the guide at the same time, or so that the angle between both was small. **The orientation of the guides towards the exhibits** was at right angles to the exhibit or they would stand with their back to the exhibit. The guides tried to look at the visitors, so they could see whether they were involved. For example, Tiago was standing in front of a pillar with his back towards the exhibit of tigers, so he could look at the visitors and the visitors had a free view of the exhibit. The guides looked towards or turned towards the exhibit to see where to point, but looked back at the visitors immediately afterwards. In figure 22 we can see how Tiago oriented towards the visitors, however, he still can easily point into the exhibit. For children, who are much smaller than the guide, Sylvia would often stand behind them. The guide and the children would look into the exhibit together, the guide would keep an eye on the children as she told her story, but the children did not look to the guide.



Figure 22: Orientation towards visitors and exhibit

The **distance** between the guide and the visitors differed between the tours. For one guide during a tour the proximity of the visitors to the guide stayed more or less constant. The approximate distance was 1.5-2 meters. Children stood much closer to the guide, in this case Sylvia, and often tapped the guide's arms to get her attention.

Taking pictures

We observed that visitors **took pictures** for several reasons: for example because they were very interested, or because they were distracted, because they want to keep memories from the site, or because they just enjoyed being there with the group. From observation during the tour we found that when visitors were interested they took pictures of the exhibit the guide was talking about, see figure 23. Sometimes these visitors waited a bit longer at the end of the story to get a nice picture without too many people in it. In that case they missed the

start of the explanation of the next exhibit. When visitors were distracted and started to take pictures, they took pictures of anything around them and did not pay attention to the guide anymore. Also resulting in getting lost and missing much of the story the guide was telling.

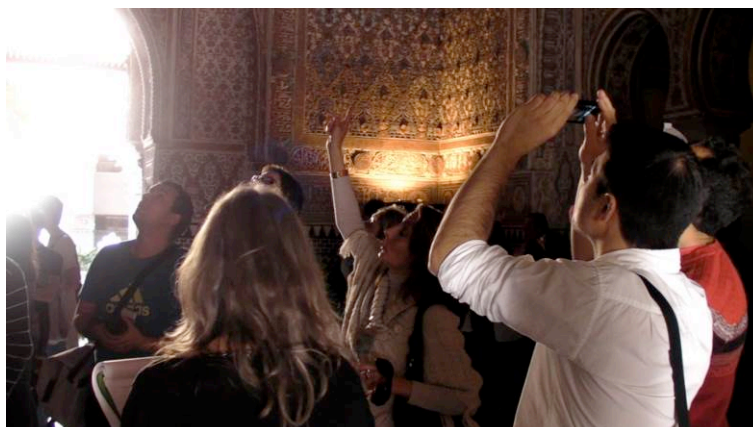


Figure 23: Visitor taking pictures of point of interest the guide is talking about

The procedure

The categories grouped in procedure concerns those aspects of the tour that influence the process of a guided tour. At both sites, the guides could talk freely and flexibly about everything they encountered. However, the length of the tour was limited, therefore the guides had to fit everything into a tight **time schedule**. Typically, a tour took 2-2.5 hours. To give the most interested visitors as much information as possible, the guides would start to talk to the visitors at the front of the group. Sometimes the guide skipped an exhibit, because the animals were inside or another group was in front of the exhibit, so nothing was visible. Sometimes the guide told just one or two facts while passing an exhibit to win some time. This is visible in figure 24, where Sylvia is walking backwards and during the walk she tells something about the animals.



Figure 24: Sylvia walking backwards along an exhibit to win some time

All guides decided the pace of the tour by not waiting for all visitors before starting to talk or walking to the next exhibit. Not waiting for all visitors to pay attention usually happened when arriving at an exhibit, or when a guide asked visitors to look at a point of interest. On the other hand, guides would also stretch time for visitors to look at something, by continuing their story with non-important sentences. Usually, guides did not wait for visitors who wanted to take pictures, so visitors that took pictures lagged behind. The guides walked slightly in front of the group. As the guides walked in front, the most interested visitors followed at the same pace, the others who followed a bit slower would often miss the start of a guide's story at a new exhibit. However, when a visitor was really interested, but wanted to take a picture without the whole group in front of the exhibit, he/she waited until the group was gone. This led to missing the start of the next exhibit, as the guides did not wait for these visitors.

For adult visitors, the guides did not use their **authority**, because visitors could choose for themselves if they wanted to hear the explanation of the guide. Guiding children was different from guiding adults. The guides used their authority for guiding children and the children needed to adhere to some rules (such as “not feeding the animals”). The guide usually teamed up with the teacher to keep the attention of the children. Usually, the guide would tell the story, while the teacher made sure the children were listening and paying attention. Even so, the guide still had to ask for silence and attention at times. Also, the guide gave plusses and minuses to certain children if they respectively knew the answer to a question or were annoying. To keep the children engaged during the tour, the guide played games with them and the guide often took some more materials to show the children to interest them in the explanation.

In the analysis the guides were not tested for their personality profile; however, we observed some personality aspects that seemed to be effective in guiding. We found that the observed guides were very different persons with different **personalities**. However, there were commonalities in their behaviours. For example, the guides were not afraid to talk to groups and all used wide gestures while talking, which both point to an extrovert personality (Digman, 1990). Also, we observed some differences, for example, Tiago often looked into exhibits, while Sylvia almost never looked in the exhibit. Another difference was that some of the guides made many of full body movements during the tour, they would turn their upper body and would even make small steps in front the visitors, while others only used their arms when talking. These are personal preferences of the guides (that they probably show subconsciously) that reflect some of the personality traits of the guides.

Moreover, the guides were aware of most of their behaviour and the consequences of specific behaviour; by using specific behaviour on purpose (e.g. starting to walk during the last sentence at an exhibit) they influenced the behaviour of the visitors (in this case, the visitors would know the story at the exhibit was ended and would follow in the right direction). The guides said in the interviews that they used a lot of strategies during the tours and that they tried to learn from every tour they give. The exact strategies they used were explained in this section and in the next section an overview of the effective behaviours (explicit behaviour as well as implicit behaviour) the guides showed will be given.

Clusters

To come to the “effective behaviour for tour guiding diagram,” which will be a useful tool for developing robot specific guide behaviours, we looked at the different categories and decided what were strategies the guides used, what was subconscious behaviour (the guides did not tell about these at all in the interviews) and what was visitor behaviour. These effective behaviours were grouped into three clusters; strategies/explicit behaviour, personality-aspects/ implicit behaviour, and visitor behaviour. In figure 25 the clusters are visible as coloured lines grouping some categories and groups to a larger cluster. As is visible in figure 25, a category can be in one or more clusters, as it can contribute to both (e.g. some events of gaze behaviour were strategies (alternating gaze), however some were subconscious behaviour of the guide (looking at one person for longer time)). These clusters give insight into the different effective behaviours in guiding.

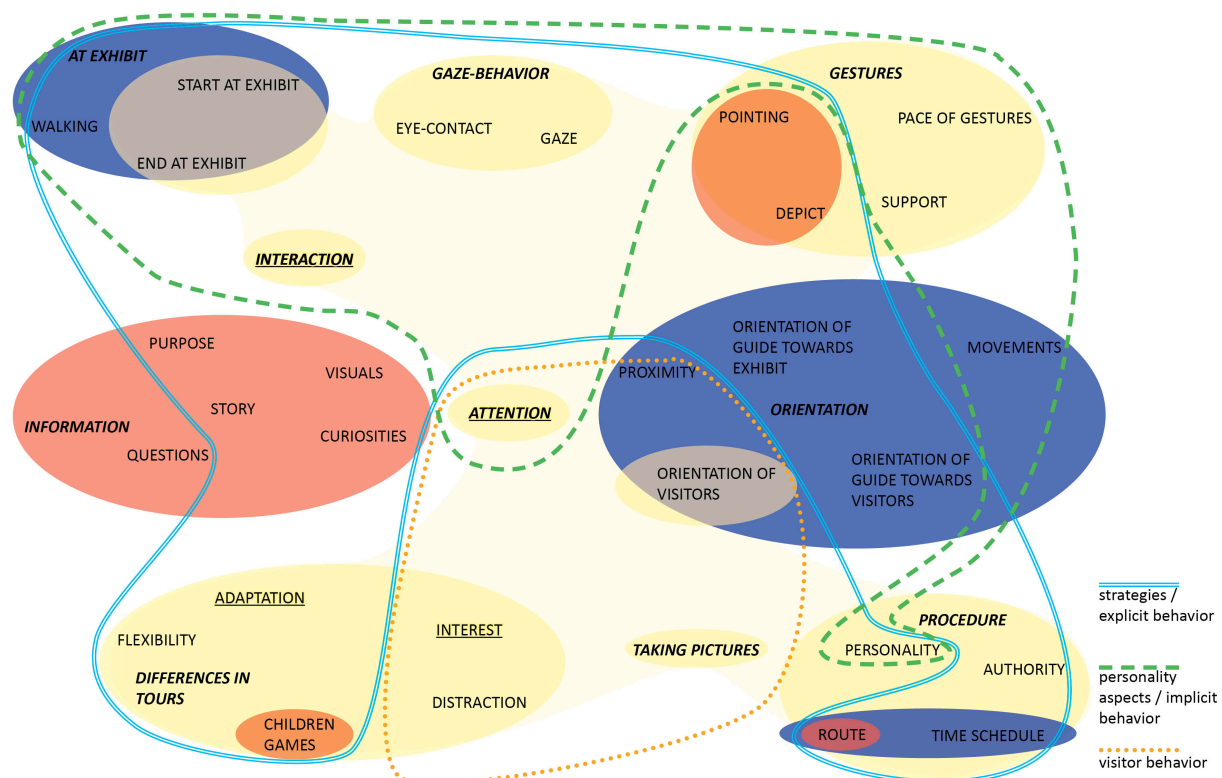


Figure 25: Behavior clusters in tour guiding diagram

Strategies/Explicit behaviour

A strategy is explicit behaviour of a tour guide that was used to gain and hold the visitors' attention; we observed the strategies being used by two or more guides. The guides were very different persons; however, the strategies they used showed several commonalities. Most of the strategies fitted naturally in their behaviour. Strategies used to shape the tour in a positive way were, for instance, keeping the tour interactive, alternate their gaze between the visitors, keeping a certain pace in the tour, adapting the tour to the visitors' interest, showing visuals, pointing into the exhibit, depicting the story and telling curiosities. Table 2 shows which behaviours are effective strategies.

Table 2: Strategies of human tour guides

		Action guide	Reason action guide
Interaction		Guides encourage visitors to ask questions, experience (feel/smell) the site, discuss about the site, and search for differences in separate places in the site.	Listening to a monologue for 2 -2,5 hours is too long, but when the guide can involve them, visitors will listen for a longer time. Also, by discussing things, guides learn what are the interests of the visitors.
Differences in tours	Adaptation before starting the tour	If a guide knows before the tour what kind of group will join, the guide can prepare e.g. an easier tour for children and a more scientific tour for adults.	If the tour is very different from their previous gained knowledge, visitors will have difficulties to follow the tour; however, if the guide can build on existing knowledge, the tour will be easier to follow.
	Adaptation during tour	Change tour to interests of group of visitors.	When talking about what already have their interest, they keep engaged easier. The tour can be changed in speed, route or content. Differentiation can also be in the depth of the

			different topics, e.g. more on history or more on architecture.
	Children's games	Guide has some games for children, e.g. jump like a kangaroo, or bend like a giraffe.	To keep children engaged (only listening becomes boring) and to make them remember the story easier in a playful way the guides have assignments in which they can be active.
	Distraction	When visitors get distracted, the guide is not paying attention to these visitors anymore, but focusing on the others.	Guides do not want to use their authority to make visitors listen. They state that adults can choose for themselves whether they want to listen or not. If visitors later on are listening again, the guide will re-address them. For children the guide teams up with the teacher. The guide is telling the story, the teacher keeps the children quite, however, sometimes the guide has to ask for silence and attention.
	Flexibility	The guides had an impressive knowledge of the site, which made that they easily could change to another subject and they were able to talk freely about everything they encountered.	The guide told more about subjects that interested the visitors.
Information	Story	The guide knows exactly what to tell.	The guide has a lot of knowledge about the site and aspects visible in the site.
	Purpose	The guide has a clear purpose with giving the tour.	Most of the time the purpose of the guide is to create understanding about the importance of the site, however, this can also be more specific. If the guide does not have a clear purpose, the story of the tour will be hard to follow as it changes subject very often.
	Curiosities	The guides give facts that are special for the site or for the region.	Visitors like to hear curiosities and it can trigger the visitors to pay attention to the guide again.
	Visuals	The guides show pictures or objects.	These objects help to explain subjects that are not visible in the site, but help the visitors to understand the story.
At exhibit	Start	The guide starts with non-important words or sentences.	Making clear to visitors that the new story will begin and give them a chance to listen without missing the start of the story.
	Start	The guide starts with a bit louder voice when he/she want to say something important.	Visitors that are still hanging behind then can also follow the story.
	End	The guide makes a closing remark about the exhibit.	Visitors know the story at the exhibit is finished.
	End	The guide changes direction of focus to somewhere else in the room after a long talk at an exhibit.	The visitors have to change their position after a long time of standing in one place. By having them move a bit already, it is easier to take them for a longer walk afterwards.
	Walking	The guide is walking (slightly) in front of the group.	In this way the guide leads the way, makes the tempo of the tour and can check if the next exhibit is free.

Gaze behavior	Gaze	The guide is looking at all visitors and alternating gaze.	Check engagement.
	Eye contact	The guide is looking at all engaged visitors and alternating gaze between them.	Addressing the visitors that are listening.
Gestures	Pointing	The guide is pointing into an exhibit.	Focus attention of the visitors to the exhibit.
	Depicting	The guides use their hands/arms or whole body to show something that is not visible in the exhibit.	By using the own body, the visitors understand where to look in the exhibit. Also, showing something with the hands, clarifies the story of the guides.
Orientation	Towards visitors	The guide is standing in front or next to the exhibit.	In this orientation the visitors can look both to the guide and to the exhibit.
	Towards exhibit	The guide is standing so that he can easily point into the exhibit he wants to tell about.	The guide often stands at right angles to the exhibit, in this way the guide can easily address the visitors, but also point into the exhibit.
	Behind visitors	If visitors are children (small) the guide stands behind them to not block the sight	All children can see the exhibit, the guide can see where they are looking at and if they are still engaged
Procedure	Route	The guide is able to choose a route that corresponds to the story.	To keep the tour as close to the interests/ previous gained knowledge of the visitors as possible.
	Time schedule	The guide has to stick to a time schedule, as the visitors paid for or agreed to a tour of specific time span.	The visitors want to see the whole site in the agreed time planning, so the guide needs to check whether there is still time to visit the exhibits.
	Authority	The guide is the leader of the group, leads the way and decides on the time schedule. However, the guide does not make the visitors listen.	The guide is the one in the group who has most knowledge about the site. However, especially adults can choose for their self if they want to listen.

Personality-aspects

Next to explicit behaviour, the guides showed (non-verbal) behaviour they were not consciously aware of. Still these subconsciously given cues could be very helpful in communication, as others read them intuitively. Implicit behaviour that shaped the tour were for example: making eye-contact to ask for questions of the visitors, choosing one person to look at more to obtain feedback of the listeners while alternating to the others sometimes, and the behaviour when finishing at an exhibit and walking during the last sentence to the next exhibit already. Table 3 shows which behaviours belong to the implicit behaviour/personality-aspects.

Table 3: Strategies of human tour guides

		Action guide	Reason action guide
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Attention		The guide receives all kind of feedback of the visitors about their engagement in the tour.	The guide chooses how to go on with the story and to focus to which visitor, mostly the most interested visitor.
Interaction		The guides react to (small) actions of visitors.	It is part of the personality to react to other people and give them tips, make jokes etc. (extrovert).
At exhibit	Start	The guide turns towards the visitors.	The visitors know they are supposed to stop in that place and focus to the guide after talking to each other.
	End	The guide is already walking into the direction of the new exhibit during the last sentence of the current exhibit.	Visitors know what direction to go next and follow the guide in a chain reaction. Visitors that were closest to the guide will follow first.
	Walking	The guide is talking to visitors during the walk.	In this way the guide is creating a relationship with the visitors, that makes it easier for the visitors to ask questions and discuss things.
Gaze behaviour	Eye contact	The guides focus on one visitor that is close while telling a story, while just sometimes alternating gaze.	Receive implicit feedback and base story on interests of one close person.
	Eye contact	The guides look away from the visitors (mainly to the ground).	Visitors understand the story is over and can start asking questions, or follow in the determined direction.
	Gaze	The guides look (and point) into an exhibit.	To point to the exact right place and to make visitors look into the exhibit (creating mutual gaze).
Gestures	Pace of gestures	Guides make large gestures	If the movements are small, it will be unclear to the visitors, however, it also indicates that guides have extrovert personality profile.
	Supporting gestures	The guide makes a lot of gestures while they are talking.	These gestures help the guide to tell the story, as most people need gestures while talking, also the visitors stay focused to the guide.
Orientation	Movements	Some guides make more full-body movements than others.	Indicating personality profile.
Procedure	Personality	All guides have different personality, but show some commonalities in guide behaviour.	Some of the personality aspects of human tour guides are helpful for creating an interesting tour.

Visitor behaviour

Visitor behaviour is a special collection, because the visitors shaped this collection. The guide was able to influence some behaviour of the visitors, but it was never certain that the visitors would behave as the guide expected. The guides oriented themselves half towards the visitors and half towards the exhibit, hence the visitors oriented themselves in half circles around the guide, towards the exhibit. The orientation and location of the guide had some influence on this. The guide could also change his/her position a bit after the visitors had oriented themselves. The guides tried to keep all visitors interested, but distraction (and the expression of it)

was not always preventable. Sometimes visitors started to take pictures (showing interest or distraction), resulting in hanging back and missing parts of the story.

From previously performed research we have seen that visitors liked the information they obtained from the guide, especially the curiosities the guide told. Also visitors liked the way the guide was taking them through the site and the order in which the information was given. Visitors did not like the length of the tour, the overflow of information, the fast pace of the tour, passing the exhibits too quickly and not having time for the details they liked, or not having time to take pictures. Also when joining a guided tour, visitors did not have time for social talk in their own group (Daphne E. Karreman et al., 2012b). More information about visitor behaviour and visitor experience can also be found in D1.1.

6. Conclusions and Future work

Our study results show that guiding visitors through a touristic place is not a trivial matter and requires expertise and experience. Human tour guides adopt several strategies and are consciously aware of the way their behaviour will shape the visitors' reactions. Tour guides explicitly choose their behaviours to realise a smooth and convincing tour-experience so that the visitor's experience of the site is enhanced.

The tour guides we observed in the study reported in this deliverable were different in their gender, background, personality, behaviours and approach; however, we found specific commonalities in the guide behaviours they displayed. An important observation is that each of the guides consciously adapted their behaviour and adopted several strategies to influence the visitors' experience in a positive way. Similarly, each of the guides was very well informed, they knew many details about the history and content of the sites and they could inform visitors about anything the tour encountered in the sites. When visitors had specific questions, the guide's knowledge was extensive enough to be able to give information about any topic of interest.

We identified the most effective explicit strategies adopted by the tour guides:

Tell interesting details (curiosities) to gain and keep the attention of the visitors.

Start a new story even though not all the members of the tour are there yet so that they gather quickly and, therefore, manage the pace of the tour.

Orient yourself in a position so that visitors can easily look at you and at the exhibit simultaneously.

The guides also showed some implicit behaviour patterns. These were behaviours they were unaware of adopting but which proved effective in delivering a smooth tour. Many of these behaviours helped the guides in telling their story and for visitors to understand the story. Also, the behaviours were mostly spatial/proximity behaviours. An example of such behaviours is to break eye contact with visitors at the end of a story and already start moving in the direction of the next exhibit of interest so that visitors understand the story is about to finish and which direction they will go next.

To continue with this research, we will use the results found about human tour guide behaviour as inspiration to investigate the way people respond to robot guide behaviours. We will at first translate the observed human tour guide behaviours, gaze, gestures, movements, proximity and orientation to robot-specific behaviour and apply it to the FROG robot. In controlled lab experiments, and real-world explorations we will assess the appropriateness and effectiveness of possible behaviours for robot gaze, movement, proximity and orientation.

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