Virtual animal characters in future communication: Exploratory study on character choice and agency

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Abstract

People need efficient means to communicate at a distance, but the available means to message can be inadequate. Any sent message might be perceived too little, fail to convey the intended emotion, or be received in a place, time or fashion that the sender would not prefer. There is room for new types of Computer-mediated communication.

The thesis is an exploratory, mixed-methods study on a futuristic concept, where augmented-reality technology is used to send a lively and intelligent virtual animal character to enrich a message. The study goals are to find if the concept is acceptable, recognize common use cases for the messaging-characters, and to recognize if participants can identify different levels of independence to act, i.e. agency, for characters.

To accomplish the goals, I conducted 12 interviews where I showed a low-fidelity prototype of the concept and designed animal character animations to the interviewees and had them first invent their own use scenarios and then select which characters they would use in predefined scenarios. To accomplish the agency goal, I had the interviewees order four animal animations by the level of independence to act shown by the animal.

Overall, the results suggest the concept is acceptable. Augmented-reality animal messaging-characters could be used to enhance commonly send messages, and their strength is that they could be sent to act in a specific way to support the message. On types of interaction wished for, I found that most of the interviewees wished for more than animated statues, and many wished for the animals to act humanlike. However, they did not seem to wish for futuristic believable artificial intelligence. Concerning agency, the study brought into question the feasibility of defining a character's level of agency. The results show that determining the level of agency shown in interacting animal character GIFs is either more difficult to do than I expected or outright impossible.

Key words and terms: Augmented Reality, Mediated-Communication, Agency.

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1. Introduction

One of the major challenges of sending text messages with a mobile device is that the messages can lack the intended meaning because of their lack of richness and limitations of the medium (Bubas, 2001). Text messages are a poor and unnatural form of communication compared to face-to-face communication (Kock, 2004). For example, convincing a person can be problematic: the message asking a friend to come over may not say "pleaaaase" convincingly enough, because nothing looks them into the eyes. The lack of richness and limitations of the medium are a challenge present in practically every message people send. A common text message, "I love you [heart]" probably does not convey the hoped amount of emotion, because it too is no match for meeting face-to-face, and the message appears in a tiny box in a tiny screen area. I often seem to need something 'heavier'.

The second major challenge in messaging may be the difficulty to make the message intent specific and clear (Bubas, 2001). Today, people try to use emoji to make their messages' intents clearer and more specific, but often they fail to understand how the recipient can interpret the emoji or it can even look entirely different to them (see Figure 1). Moreover, one cannot show complex expressions, such as "first I smiled, but then I grinned" with an emoji. To try to solve the problem of vagueness, one may use animated GIFs or stickers instead. However, the GIFs are collected for users from all over the Internet (GIPHY, 2017), and the only thing they can find may be a smiling Batman; and stickers' expressions can be too ambiguous (Cha, Kim, Park, Yi, and Lee, 2018).

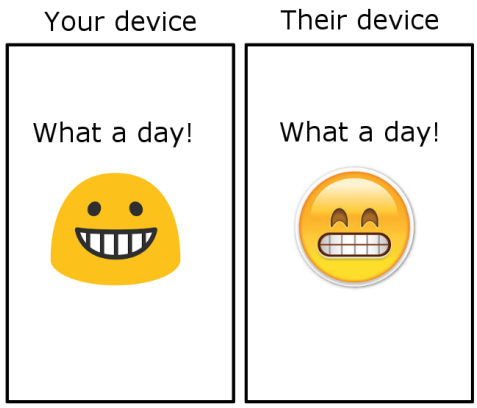

Figure 1: What looks like a smiling emoji on one device, can look like a teeth grinding emoji on other device, as pointed out by (Miller, 2016).

The third major problem the thesis may address is lack of control over the circumstances the messages are received in. The circumstances can influence the interpretation of a message (Bateson, 2000). I believe that people hope their messages will be received and

read in an appropriate place, time, mood and fashion. However, the recipients are often busy doing something somewhere, have an unknown mood, and when the message arrives, they may notice only the alert sounds and lights of their device, but not open the message. People do not have this problem in a face-to-face conversation where they know and control the circumstances.

These three problems reveal that there is room to criticize Computer-mediated communication solutions and the way they are presently used. Future communication is worth of design and study.

1.1. The thesis studies and builds upon my design concept

The foundation of the thesis is a design concept created in a University of Tampere project for Nokia Technologies. The concept is to use augmented-reality technology (glasses or lenses) to send a lively virtual animal character to deliver a message (see Figure 2 below). I call the design concept ARimal (augmented reality intelligent messaging animal) in the thesis.

Figure 2: The basic idea of the ARimal concept, an augmented reality messenger animal.

Animal characters were chosen in the project instead of imaginary characters, because of belief that virtual animals would be more acceptable than virtual imaginary characters and human characters. Augmented-reality glasses were chosen to be the medium, so that the animals and messages could be received with little interruption, in physical space and in large-size. Moreover, the virtual animals were chosen in the project to be lively, to have some degree of capacity to act independently, in order that they would be believable as animals and not appear as entirely ‘soul-less’.

The thesis contributes the design concept and an exploratory study of the concept. The thesis takes a so-called speculative design approach (Gonsher, 2016) to the challenges in Computer-mediated communication. In this speculative design approach, fiction is used to study the impact of the ARimal concept; and this enables dialogue with the future users (Auger, 2013). In the thesis, I take the novel ARimal concept and associated ideas with the goal of finding problems it can solve. By doing this, I move the knowledge space forward. I seek to answer the following questions:

- Is the concept acceptable?
- What is the desired level of character's ability to act independently (agency) for different scenarios?
- What presented animal characters participants would prefer in different scenarios?
- How participants describe potentially uncanny looking characters?

The two questions that I particularly focus on are the agency question and the question of what presented animal characters participants would prefer in different scenarios. I believe they are the most essential to the concept and the most valuable of the questions, because they should reveal whether the concept would have a broad or niche market (compare: heart emoji vs. some rarely used emoji). Moreover, they should reveal whether people are interested in sending artificially intelligent animals (which are probably hard to develop) or 'animated animal statues' (which are comparatively easy to develop).

To answer these questions, I conduct an exploratory mixed-methods study (see Figure 3), where I present interviewees with the concept fiction, a fictional augmented-reality messaging app, and animated GIFs, representing augmented reality characters in the app. I have the interviewees come up with their own messaging scenarios and then I have them go through scenarios I have designed, asking them questions on the go. This is how I answer all the research questions, except the question about character agency level.

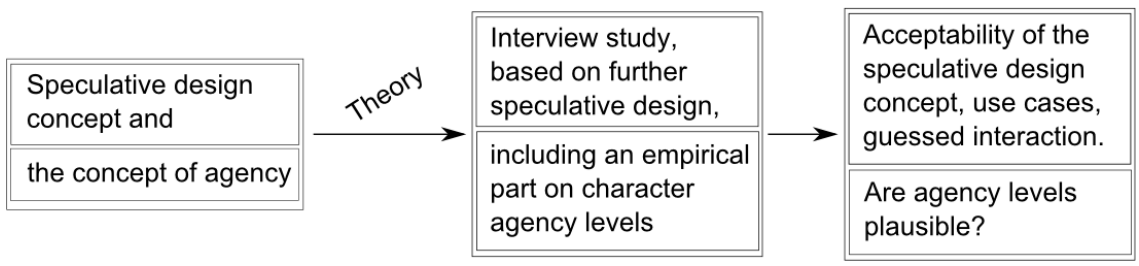

Figure 3: The thesis study as a simplified process diagram, goals in the end.

I have a particular focus on the research question about the level of agency, because the ARimal is an intelligent virtual animal messenger, and I am interested in whether it is

reasonable to include the concept of agency levels in a character design process. The agency question has two parts in practice: *(1)* what designed category of agency the character should display; and *(2)* whether perception of agency can be divided into levels by using criteria of action or not. For example, does a sitting corgi dog display less agency than a begging dalmatian dog? However, the relation of the second part to the first part is such that even if interviewees disagree on the amount of agency displayed by, say a begging dog, it may still be accurate to say that an interviewee wanted to send the dog that displayed agency by begging. It is unlikely that thinking about character agency would be a waste of time.

The thesis starts with an explanation of the ARimal concept and the speculative design approach. Then the thesis presents computer-mediated communication theory and concepts related to the ARimal. Next, the thesis presents theory on how humans perceive objects from a designer's point of view; how humans perceive different animals, real and digital; and human perception of agency. In the last part, the thesis has the interview study methodology, its results, discussion, and conclusion. The thesis belongs in Human Technology Interaction and Communication Sciences.

2. The speculative design concept: ARimal

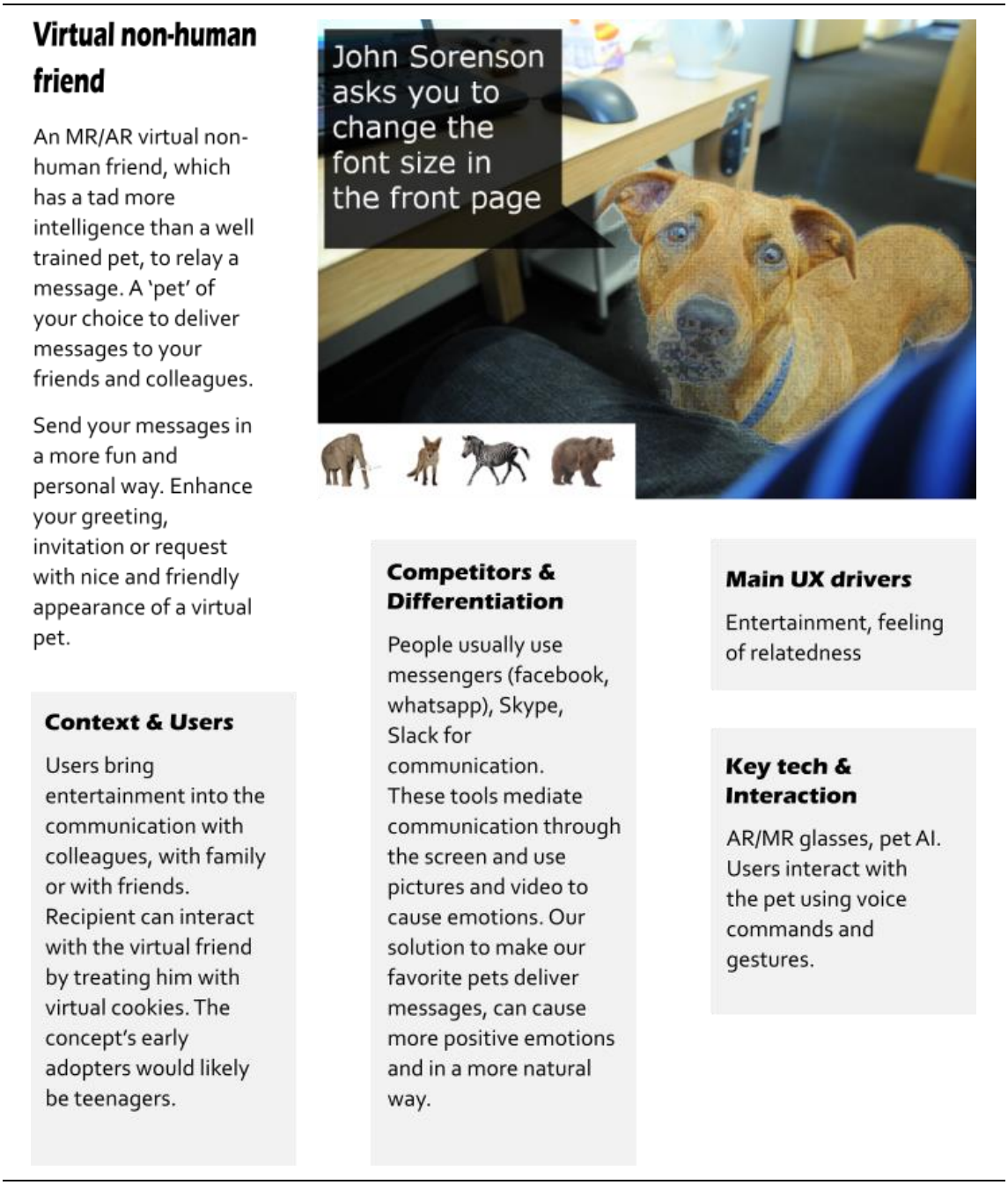

Figure 4: A canvas that describes the ARimal's value (created for the thesis).

One of the design concepts that me and O. Sayenko created in a University of Tampere research project for Nokia Technologies was the augmented reality virtual non-human friend (animal) to deliver messages, which I now call ARimal. ARimal was created in a speculative design process that included a literature review. My role in the creation of ARimal was leading, and the basic structure of the concept was my idea.

We proposed the virtual non-human friend would have a tad more intelligence than a well-trained pet, so that it can deliver a message effectively. We defined that it could

deliver messages to his friends and colleagues, and I made an illustration of this (see the dog in Figure 4).

The canvas shows the ARimal concept in the level of depth that we took the concept in the project. In addition to what I show in the canvas, we briefly ideated two use cases: one, to do a practical joke and two, to show affect (care) with a baby animal. However, we did not go into further details about the use cases in the project.

How the ARimal concept addresses the challenges presented in the introduction

The ARimal concept addresses the problem of lack of richness and limitations of smartphone medium. The ARimal concept allows user to send an animal character that can express complex emotions and that is literally larger than a text message. The ARimal can look the recipient in the eyes and demand them to do something. The ARimal's behavior and qualities such as cuteness can support the emotional content of the message, thus it can seem as if more effort was put into the message.

The ARimal concept addresses the problem of lack of clarity in emoji by enabling more freedom to fine tune the expression than emoji do. The animal character can express complex facial expressions such as "first I smiled, but then I grinned". However, animated stickers are better than emoji at showing expressions and harder to beat in this regard.

The ARimal concept can potentially address the lack of control over the circumstances the messages are received in. The ARimal concept enables more control over the way the message is received, the way the animal appears being one factor. However, we did not go into detail in the project if, how and how much the character would react to circumstances and mood of the recipient.

Some technical premises of the ARimal concept

- Virtual animal character can be selected and sent using a mobile device (not necessarily AR/MR device) and received and previewed with AR/MR devices.
- AR/MR technology can be used to map the room, so that animal characters do not appear inside furniture.
- Daily AR/MR use is fine and receiving messages and animal characters in AR/MR is not too intrusive.
- Familiar animals are easier to receive than unfamiliar and or humanoid characters.
- The user does not receive too many animal characters at once.
- The user can opt to not receive a character.

The thesis and the ARimal concept

I became inspired to conduct a thesis study on the ARimal concept as I felt that further research could answer many questions about it. Moreover, I saw that study of the ARimal could be interesting reading to people from multiple fields, as the concept relates to human behavior, technology, and design.

2.1. Design, critical design and speculative design

This section explains the difference between normative design, critical design and speculative design. The ARimal concept presented in the thesis is a speculative design concept.

Normative/affirmative design (what is usually meant by "design")

Normative design is about solving problems (Dunne and Raby, 2013). If the task is to design a chair, the problem is, why should anyone want it? To answer the problem, the designer increases the value of the chair in some way. Normative design is to make a new or better design that does not disturb people.

Critical design

Designers Fiona Raby and Anthony Dunne developed the term Critical Design in the 90's, when they were in a Computers and Design Research Studio in Royal College of Arts (RCA). According to them, the term originated from worry that developers put critical thinking aside in the rush to develop new technologies, and that new technologies were automatically assumed good and fitting solutions.(Dunne and Raby, 2013)

As is apparent from the term's origin, critical design is a critique of the context and culture in which the designed object exists (Gonsher, 2016). Traditional, affirmative design is about solving problems, while critical design is about finding problems. Critical design is asking questions about the path the world should take, while affirmative design is saying that the world should continue the same old path (Dunne and Raby, 2013). Moreover, traditional design is about reinforcing the status quo, while critical design is design that breaks the status quo. However, while critical design may seem to be a radical practice, critical design is not art or creation of shocking artefacts. Critical design is only successful when the viewer experiences a dilemma of whether the design is serious or not? Is it real or not? Successful critical design is disturbing because it is close to the everyday.

Speculative design

People may think of speculative design as a sub-category of critical design (Gonsher, 2018). However, the speculative design approach takes the critical practice one-step further, towards imagination and visions of possible scenarios. Speculative design differs

from critical design by being explicitly oriented towards future scenarios. It uses fewer physical artefacts and more stories and illustration (fiction). The fiction is used to study the impact of the ARimal concept; and this enables dialogue with the future users (Auger, 2013). Otherwise, speculative design is the same as critical design.

Measuring speculative design's success in the thesis

In the thesis, I use speculative design to let people imagine future communication scenarios. Fictional scenarios are used to study the impact of the proposed new technology on everyday communication, and to enable dialogue with the future users (Auger, 2013). Moreover, I reason based on (Dunne and Raby, 2013), that the speculative design is proven successful if the participants consider the design as something that can be real.

3. Computer-mediated communication

This chapter looks at computer-mediated communication (CMC) theory and concepts that may be associated with the ARimal concept. The chapter discusses the ARimal concept's probable value and gives background for the exploratory study of the concept.

3.1. The concept and challenges in CMC

CMC is generally not as rich in cues as face-to-face communication, which includes far more nonverbal-communication (Bubas, 2001; Kock, 2004). In face-to-face communication, there is instant knowledge of the attention level of the other person, their mood and attitude. It is a challenge to replicate it with CMC.

The limitations of current CMC can become a serious issue when a situation arises that requires a person to show nonverbal communication or care or attentiveness but they cannot meet face-to-face. Nonverbal communication is especially important in relationship development and management, and often more powerful than the verbal communication (Giles and Le Poirre, 2006). Good relationships require good nonverbal communication.

Research by (Watson-Manheim and Bélanger, 2007) suggests humans have five reasons to communicate: coordination, sharing information, information gathering, relationship development, and resolving conflicts. When the aim is to communicate more than information, for any of the reasons, the limitations of CMC can lead to miscommunication. However, CMC is generally better for communicating information that needs to be stored, is very long, or includes graphics.

Moreover, in present CMC it is difficult to send meta-signals to inform the discussion. The meta-signals include at least the location of the discussion, the other actions taken while discussing, incorporated physical objects, and clothes and apparel worn. Pavlov's famous dog experiment may memorably illustrate the difference between direct communication and meta-signals. Pavlov's dogs salivated when he rang a bell (direct communication), but they only salivated while wearing a special harness (meta-signal).(Bateson, 2000)

Emotions in CMC

Which emotions are not directly or indirectly displayed in CMC? According to (Sauter, 2017), researchers specializing in the study of emotions state that there is clear support that some positive emotions relating to knowledge (amusement, awe, interest, relief) and some agency-approach positive emotions (elation and pride) have distinct, recognizable displays via vocal or facial cues. Therefore, the user probably does not directly display positive emotions relating to knowledge and agency-approach positive emotions in the forms of CMC where they cannot see or hear the other user.

Continuing, according to Sauter, some prosocial emotions (admiration, compassion, gratitude, and love) are not reliably communicated in any modality other than touch; and some savoring emotions (contentment, desire, and sensory pleasure) have no distinct recognizable signals. Therefore, as CMC usually does not involve touch, it may not reliably directly communicate prosocial emotions. Words, emoji, and video or audio recordings are probably not reliable signals of prosocial emotions.

The ARimal concept's relation to challenging factors in CMC

Challenges in CMC may also be seen as a combination of individual challenges. The ARimal may help with several individual challenges. Prof. Goran Bubas (Bubas, 2001) mentions the following factors as challenges in computer-mediated communication (CMC). The challenges that the ARimal concept addresses are *italicized*:

Competence: *motivation*, knowledge, skills (attentiveness, interaction management, expressiveness, and composure).

- *Motivation*: the option to send the ARimal could increase the motivation to communicate and receiving it could increase the motivation to respond.
- Knowledge, skills: probably too early to say for the ARimal.

Medium factors: *richness*, *interactivity*, speed, *level of social presence*, and *accessibility*.

- *Richness*: the ARimal could enable more nuance and fine details.
- *Interactivity*: the ARimal could enable more interaction between messaging partners.
- Speed: sending the ARimal would probably take time.
- *Level of social presence*: the ARimal may remind the recipient of the sender far more than emoji.
- *Accessibility*: the use of AR glass/lens technology might improve accessibility.

Message factors: complexity, *equivocality*, quantity, and *emotional content.*

- Complexity: the ARimal probably would not prevent users from making their messages too complex to understand.
- *Equivocality*: the ARimal should enable cutting the number of interpretations for a message.
- Quantity: how many ARimals should be sent or received is unknown.
- *Emotional content*: the ARimal can act happy or sad far more than emoji.

Context factors: culture, relationship level, *status*, time pressure, distance, and task ambiguity.

- Culture: the ARimal may not enable more culturally rich expression.
- Relationship level: users would probably use the ARimal only with familiar people.

- *Status*: the ARimal includes the idea of sending message to a place near the recipient, and them receiving it when they can.
- Time pressure, distance and task ambiguity: the ARimal may not beat the present apps in these.

Outcomes: efficiency, *understanding*, appropriateness, *satisfaction*.

- Efficiency: the ARimal probably is only as efficient as present CMC.
- *Understanding*: the ARimal's acting could make for more understanding.
- Appropriateness: sending the ARimal is likely dependent on knowing the recipient.
- *Satisfaction*: messages with ARimals could be more satisfying.

Positioning the ARimal concept with Media Naturalness Theory

Prof. Ned Kock has developed a theory called Media Naturalness Theory, according to which suppressing key elements found in face-to-face-communication creates cognitive obstacles to communication (Kock, 2004). Based on the theory, there may be a large gap in naturalness between instant messaging and the next best thing (according to the theory): audio conferencing. There are five naturalness criteria used in the theory: (1) colocation; (2) synchronicity; (3) facial expression (conveying and observation); (4) body language (conveying and observation); and (5) speech (conveying and listening to speech). The large gap may form as follows: instant messaging includes low synchronicity (2), but audio conferencing includes high synchronicity (2) and speech (5), and the speech is more significant in terms of naturalness than synchronicity (see also Figure 5).

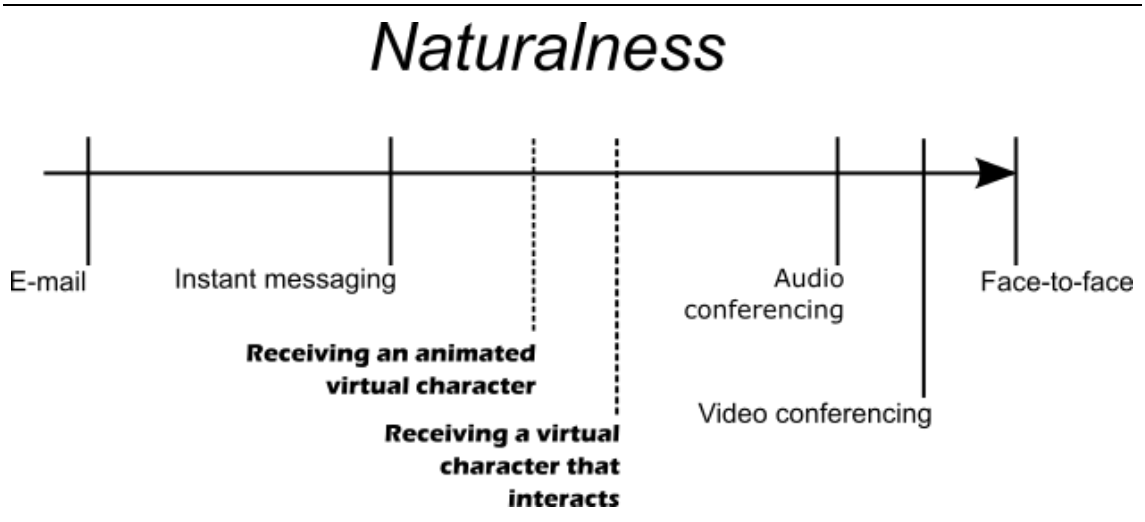

Figure 5: Redrawing of the Media Naturalness Theory line chart (Kock, 2004) and my estimation of the concept's place in it.

The main reason I believe the concept of using a virtual character to enhance a text message is more natural than instant messaging, is that the character exists - in a truer meaning of the word "exists". The ARimal character seemingly comes in four dimensions (space and time) and may be received like a messenger. Whereas a text message seems to exist in a 'very thin slice of time and space' and comes wrapped in a simple container.

3.2. Emoji, GIF and sticker use and challenges

Understanding the use frequencies of emoji helps to avoid inventing exceedingly rare and improbable communication scenarios for the ARimal concept. According to researchers, people use emoji to convey their general feeling in messaging; they rarely use emoji to convey their actual facial expression, reaction, or thought (Bubas, 2001; Glikson, Cheshin, and van, 2017). For example, normally people understand the face with the tears of joy emoji does not mean the person is laughing aloud.

Glikson et al. write that people should know that one can interpret emoji in different ways and that their use may lead to misunderstandings. The problem with the emoji is their lack of expressiveness; they lack nuance, fine detail and interactivity. Our facial expressions are highly detailed and alive, the emoji are not.(Glikson et al., 2017)

As for the usage of emoji, all the emoji use charts, from Apple (Leswing, 2017), Emojipedia (Emojipedia, 2016) and Facebook (Huma, 2017) tell the same basic story: only a few emoji are used often, and the ones that are used often, are rather general and lack ability to express nuance (see Figure 6).

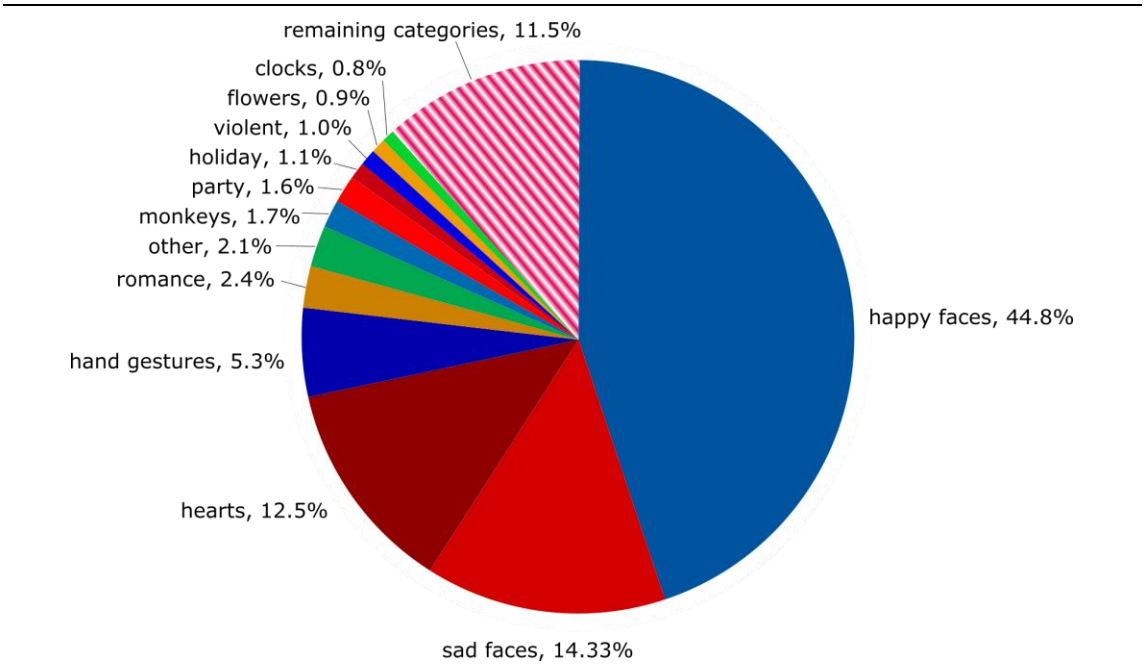

Figure 6: Pie-chart of emoji categories as a percent of all emoji usage, adapted from (SwiftKey, 2015)

SwiftKey's recording

Over 250M smartphone devices (both iOS and Android) had SwiftKey as their keyboard. In April 2015, SwiftKey published a report on worldwide emoji usage. SwiftKey analyzed over one billion pieces of emoji data, from 16 different languages and regions between October 2014 and January 2015. They found that as there are over 800 emoji, the frequency of most emoji is often small (see Figure 6). The happy faces (includes heart eyes, winks, kisses, smiles, and grins) are the most popular emoji by far at 44.8% of all usage. The second place is shared between sad faces (includes sad and angry emoji) (14.33%) and hearts (includes all colors of heart and broken heart emoji) (12.5%). The third place goes to hand gestures at 5.3%. Most of the rest of the emoji are used equally rarely.(SwiftKey, 2015)

The other companies' recorded data look very similar to SwiftKey's. Facebook recorded the Emoji used in Facebook walls worldwide, Apple from iPhones in the United States, and Emojipedia recorded the most viewed emoji on its site worldwide (Emojipedia, 2016; Huma, 2017; Leswing, 2017). I have not reported their data to save space.

Use of GIFs in messenger apps and social media

Use of GIFs is a relatively new phenomenon compared to emoji, Facebook started to support GIFs in 2015 (Warren, 2015), while emoji started to become popular already in 2010 (Blagdon, 2013).

GIPHY, the largest GIF search engine in the world, seen in Facebook messenger and elsewhere, reported the 25 most viewed GIFs of 2017 in December 2017 (GIPHY, 2017). Based on their list of most viewed GIFs, it seems that GIFs are best suited for communicating love, caring, great happiness, surprise, and dismay. I assume people use GIFs mostly to communicate affect and to react to events. Moreover, GIFs are probably preferred over emoji when more nuance than what emoji provide is required.

To illustrate GIF usage, the following is a description of the four most viewed GIFs in GIPHY:

1. Love Gnome by Anna Hrachovec, 340MM views. A stop-motion animation of a knitted gnome knitting a heart. People used the gnome commonly for everyday affection.
2. White Guy Blinking, 226MM views. A close-shot of blinking face. People used the GIF commonly as a reaction to unexpected insultation.
3. DNCE's Waving Pug, 215MM views. A dog waving its paw. People used the GIF commonly to say 'hello'.
4. The Fall Out Boy Llama, 197MM views. 3-d 'disco' llama. People used the GIF commonly to express celebration and dancing.

Problems and challenges of current GIF use

The world's largest non-emotion-annotated GIF database GIPHY contains around 150M GIFs, but the world's largest emotion-annotated GIF database GIFGIF (made in MIT's media lab) contains only around 6119 GIFs. Therefore, nobody knows with any certainty what emotions over 99.99% of the GIFs represent the best; and there is currently not a good way to search for GIF that would match an emotion.(Chen, Rudovic, and Picard, 2017)

The GIFs in the GIFGIF database are emotion-labeled by humans. There are 17 universal emotion categories used, and each GIF can belong to several emotion categories (example: amusement, happiness, excitement, relief). However, the votes vary across different cultures (Rich, Hu, and Tome, 2017). There is no country or culture specific set of GIFs, which would limit the time needed to select a good GIF.

Most GIFs in GIPHY selection and probably elsewhere too, are "naturally grown, free-range GIFs" (Rich et al., 2017). This means that you may get GIFs made from Batman animations and videos of the 2016 U.S. presidential election when you only want to convey a simple emotion. The GIFs ability to "convey emotion, empathy, and context in a subtle way that text or emoticons simply can't", is also their weakness when they are grown "free-range".

The previously mentioned problems and challenges of GIFs are supported by a recent qualitative study by Jiang et al. 2018. They found that miscommunication of GIFs often resulted from misinterpretation of the messaging context and lack of common ground (e.g. one sends a GIF that comes from a movie and the other has not watched the movie and misses the joke). Moreover, they noted that it is hard to tie a GIF into an emotion, and suggested that users should be enabled to sort GIFs by emotion.(Jiang, Fiesler, and Brubaker, 2018)

Use of stickers

Stickers are images or animations that can be sent the same way as GIFs (see Figure 7). Stickers are a new feature in WhatsApp instant messaging app (since October 2018 according to Google Play), which is popular in U.S. and Europe. However, stickers have been a popular feature of the apps that are popular in Korea, China and Japan, namely KakaoTalk, WeChat and Line for a long time (Cha et al., 2018; Colin, 2018; Korea Foundation, 2016). This probably means that there has not been as much interest towards stickers in the U.S. and Europe as in East and Southeast Asia.

Figure 7: KakaoTalk chat with animated stickers (Korea Foundation, 2016).

According to a recent study of KakaoTalk stickers (see Figure 7), there can be misinterpretation of emotion when stickers' have multiple facial or bodily expressions (Cha et al., 2018). Moreover, the researchers found that in real chat settings, people can get confused of what message the sticker is referring to (e.g. in Figure 7 one could mistakenly think that the duck sticker is referring to the message above it). As a solution to the second problem, the researchers proposed letting users annotate the stickers with text.

The concept tries to address the gaps of emoji, GIFs and stickers

People can use GIFs in a great variety of situations. People seem to need GIFs that are not tied to specific things and contexts, and that are more positive than negative in feeling. However, there is no easy way to find a GIF that matches an emotion, and when the user finds one, it will likely seem tied it to some cultural event, which is not proper. The present GIF user will likely end up using a GIF that is 'good enough', as they get frustrated searching for a good one. Even the best GIFs people have found (the 10 most viewed GIFs according to GIPHY) show quite specific things or action, which the recipients need to ignore or re-interpret. However, in the ARimal concept the user is in full control of what that they send and the way the characters act. Moreover, in the concept, the available animations/acts are purposefully designed for communication purposes.

From the most viewed GIFs it seems that GIFs are best suited for communicating love, caring, great happiness, surprise, and dismay. Moreover, it is notable that people

viewed a GIF related to love over 1.5 times more often than any other GIF. However, the concept can enable communicating these emotions with more ‘weight’. Receiving a 3-d character is clearly receiving more than a GIF, a 2d animation.

On emoji usage it was noted people use emoji to convey their general feeling in messaging; they rarely use emoji to convey their actual facial expression, reaction, or thought. However, in the concept people could make the animal character do complex facial expressions, such as a smile and then grin; and they could make the animal act out what happened to them or how they reacted to something.

The stickers (see Figure 7) are in some ways like the ARimal concept, they are both mostly about animal characters that move/act and they can both be used to enhance messages. Moreover, they can both be used to display complex emotions, such as “first I grinned but then I smiled”. However, the stickers cannot be modified or annotated, and they are usually rather stylistic, meaning that their user must either like the designer’s style and the exact expression of the sticker or do compromises.

Moreover, the emoji, GIFs and stickers are not capable of acting towards the recipient, but the animal characters in the ARimal concept are. If the user wishes to send an anthropomorphic cat to do a hugging-pose towards the recipient, to enhance text “I love you”, they can. Or, if they want to enhance the message “You idiot!”, for a good friend, they could send them a monkey that throws bananas at them. There are many possibilities for making the message come across more clearly using the concept.

Emoji and GIFs are used most often (by a large margin) to communicate feelings of love and joy. The visual communication of love and joy may always be the most important visual communication, no matter the technology. Based on the GIF and emoji use frequencies, the following emotional elements are the most important in present instant messaging: joy, love, humor, sadness, and thinking.

3.3. Effects of animal presence on communication

This section focuses on probable psychobiological effects of animal presence on communication. Moreover, this section includes pictures of products and projects obviously related to the ARimal concept.

Psychobiological effects

Several studies mentioned by (Beetz, Uvnäs-Moberg, Julius, and Kotrschal, 2012) suggest interacting with live animals can have positive effects on humans such as reduction of stress; increased trust towards other persons and enhanced empathy. The following are some of the results from the studies.

5 to 24 minutes of stroking a dog can change hormone balances in a positive way in humans. The effect is greater if the dog is one’s own.(Odendaal and Meintjes, 2003)

Presence of a dog can lower blood pressure in children, whether the dog is familiar or unfamiliar, when compared to reading condition. Blood pressure was found to be lower when the animal was present during the entire time and not only on second half of the study.(Friedmann, Katcher, Thomas, Lynch, and Messent, 1983)

Presence of a dog may make any person seem more trustworthy - a short summary of the results from (Eddy, Hart, and Boltz, 1988; Hart, Hart, and Bergin, 1987; Wells, 2004).

Petting a live animal, but not a toy, can reduce self-reported anxiety. The researchers produced anxiety in participants by indicating to them that they might ask them to hold a live tarantula spider later on. Then the researchers divided them in groups, and instructed them to pet either a live rabbit, a live turtle, a toy rabbit, a toy turtle, or to just rest. The result was that only the petting of live animals reduced their self-reported anxiety. The physical activity of petting alone did not cause the effect.(Shiloh, Sorek, and Terkel, 2003)

(Beetz et al., 2012) think these positive effects of human animal interaction are dependent on the quality of the human-animal relationship. The unconditional love people commonly think animals provide may help to explain the effect. They also go into more detail, and estimate, the positive effects of human animal interaction come mainly from oxytocin release. Oxytocin is a hormone that increases eye contact, empathy, face memory, trust, pair bonding, social skills, positive self-perception, learning ability and generosity among other things. Therefore, human animal interaction may be broadly beneficial to humans and to human interaction, and to communication as well. However, (Beetz et al., 2012) appear cautious; research on direct oxytocin effects in human animal interaction is still rare. There may not be enough studies on how great or significant the oxytocin effect is.

Presence of virtual animals is also probably positive

Figure 8: Kids interacting with Cinder, an augmented-reality cat (of the AR 'mirror type') in school spaces (Umbrellium, 2016). Screenshot from video.

I found a project that suggests an AR virtual animal's presence may have some of the same positive effects as presence of a real animal. City of Cambridge Education Foundation commissioned digital creation studio Umbrellium in London to create a system to make students more aware of their environment (Ferreira, 2016; Umbrellium, 2016). Umbrellium created a virtual cat called Cinder that appears on a large 'augmented-reality' mirror that 'reveals' the cat in the physical space of the school's atrium (see Figure 8). People affect the cat's behavior and appearance by how they interact with it. Environmental sensory data (solar power measurements) also affects it. The cat can make friendly gestures and play with people, to teach them about the measurements.

Umbrellium does not explain in detail why they chose a cat, and to my knowledge, there are no scientific results on its effects. However, I assume that they chose a cat, because they were sure it would have a positive effect comparable to an office-cat, and that it would make people more interested in the solar sensory data and their environment (the message the school wanted to convey).

Figure 9: Illustration of the ZOOO Microsoft HoloLens app. The app lets you view animals in mixed reality and the animals will look you into your eyes (ViRD, 2018).

I also found an app called ZOOO that has some clear similarity to the ARimal. Quote from the app creator/s: "ZOOO is an entertainment application for HoloLens, with which you can summon life size animals wherever you are" (ViRD, 2018). In the ZOOO app, the animals will look at the user and tilt their bodies to the direction of the user (see Figure 9). It seems apparent from ZOOO presentation, the gaze and direction of the virtual animal add to the feeling of its presence.

Theoretically, ZOOO could be turned into a messaging application by simply having someone else activate the animal display from a distance. Then the app's animal would come closer to the ARimal concept.

What the effects of animal presence on communication mean for this study

The studies and concepts discussed in the section show that animals could have a positive effect on human interaction and communication whether they are real or 'convincingly realistic'. It seems reasonable to expect lively and intelligent virtual animals to have some of the same positive effects on humans as real animals. Imaginary creatures may not have those effects.

Considerations based on the studies and concepts presented in the section:

- It is probably better to present virtual animals as animals and not as toys
- It would be a good idea to ask about pet ownership and familiarity, as pet owners may see the concept differently
- It may be good to ask about the receiver interacting directly with the virtual animal
- It may be good to ask about the virtual animal looking at and being aware of the receiver

3.4. Communication in augmented-reality

Researchers have long been expecting augmented-reality glass technologies to enable communication where the user can attach the message to the physical environment, in order that another AR glass user can view it. As is apparent from papers published over 20 years ago, such as one by (Rekimoto, Ayatsuka, and Hayashi, 1998). However, unfortunately I cannot seem to find but little research and apps that enable this.

Figure 10: Screenshot of HoloMessages video app (Tzabar, 2018).

HoloMessages. There is apparently only one simple HoloLens app that seems to let the user place messages in the 'real world', called HoloMessages (Tzabar, 2018). HoloMessages works by scanning QR-code, loading user information, and then leaving a message (see Figure 10). The creator of HoloMessages has intended it for office use.

Figure 11: Screenshot of video from Microsoft Research Holoportation project. The man standing on the left side is virtual. (Cutler, Fowers, and Chang, 2016)

Holoportation. Microsoft Research has a project where they develop a telepresence application for HoloLens mixed reality glasses (see Figure 11) (Cutler et al., 2016). The project is best explained with a quote:

> "Holoportation is a new type of 3-d capture technology that allows high-quality 3-d models of people to be reconstructed, compressed and transmitted anywhere in the world in real time. When combined with mixed reality displays such as HoloLens, this technology allows users to see, hear, and interact with remote participants in 3-d as if they are actually present in the same physical space."

Holoportation is different from the ARimal in that the ARimal is mostly about asynchronous communication whereas Holoportation is wholly about synchronous communication. Moreover, Holoportation is about human representations whereas the ARimal is about non-human characters. In the ARimal, the user is not present and the ARimal is not a 3-d-suit/model played by the user. The common thing between the concepts is that they are both situated communication.

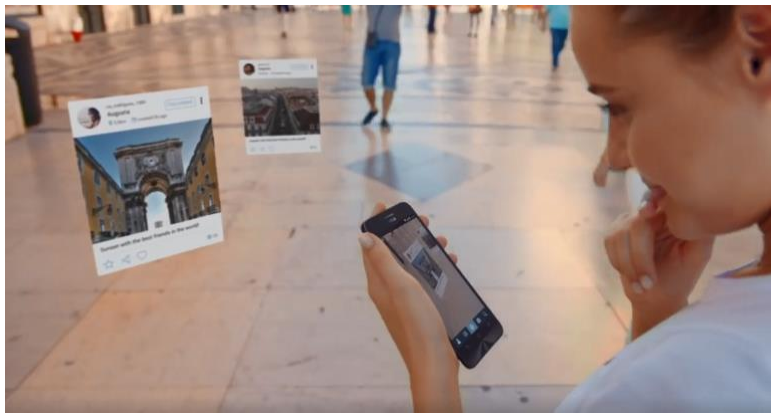

Figure 12: Woman using their smartphone to view social AR content. Screenshot from Catxy app promotion video (Catxy, 2018).

A mobile AR example. Catxy is a mobile AR social network smartphone application, that lets people leave messages to physical locations for others or friends to see (see Figure 12)(Catxy, 2018). The app comes closest to the ARimal when the message that is left is an animal GIF or a video.

The meaning of the applications to this study

The Umbrellium and ZOOO applications help to show the potential of virtual message-enhancing animals, while the other applications help to show the promise of AR interaction. Moreover, the ARimal can exist in the same ecosystem with them: the user may alternatively view the virtual animal with a smartphone; the user may leave a message without the virtual animal; and developers may say that the virtual animal can act as an icebreaker or initiator or a gateway or portal for telepresence when needed.

It could be interesting to hear if people imagine sending virtual animals to specific places. Alternatively, if they tie the virtual animals to specific events.

4. Agency and perception

To continue the literature review from another disciplinary perspective, this chapter is about design-work theory, how humans perceive objects, and about phenomena related to human perception. The chapter helps understand my design choices and study methodology.

4.1. Types and reasons for visual perception and imagination

This section presents an understanding of visual perception and imagination, and its relation to design theory. Understanding visual perception helped the researcher to decipher the interviewees' comments.

First and second stages of visual perception

Studies support that the first stage of all visual perception may be the perception of visual features, the color and form of an object, and the second stage may be the perception of their patterns as edges (Humphreys, Price, and Riddoch, 1999). An adult can quickly see if something is dangerously sharp or if something looks heavy or expensive, etc. This visual reading ability is the foundation of a concept called visual language (Cherry, 1968). Visual language is a system of communication using visual elements.

When I use this visual language in a systematic way in design work, to keep the visual communication across objects consistent, or within desired limits, I call it design language. Designers control how people will perceive something by using a design language in an appropriate way. Designers choose the appropriate patterns of shape and color to achieve the desired degree of similarity to existing objects. Doctor of Arts Vuokko Takala-Schreib describes it this way: "design language is visual symbolic communication in a community"; "it is self-evident within a culture, because it is a part of the community discourse".(Takala-Schreib, 2000)

The third stage of visual perception

Studies support the third stage of visual perception may be visual recognition, where visual representation is matched with structural descriptions in memory (Humphreys et al., 1999). Familiar objects are easier to recognize, especially when seen from a familiar viewpoint. Deviations from typical viewpoints and contexts make it harder to recognize a familiar object (Bulthoff and Newell, 2006). Bulthoff and Newell found that this principle also applies to novel objects. Therefore, it can be wise to present novel objects from familiar viewpoints.

The viewpoint and context are also in the designer's control, and therefore part of visual language and design language. When people cannot freely walk around an object, then the designer is in control of the viewpoints. However, even when people can change

their viewpoint freely, the designer can use visual balance to control which viewpoints they will most likely use.

The meaning of the visual perception issues for this study

To study a design concept like the one in the thesis, many visual elements need to be used. Moreover, everything should come from a common angle, having similarity to present technology, and in natural order, or participants can misunderstand the concept. Considering the presentation of characters, 'one should not bring a lion to the house before explaining that it is tamed. It is too late to explain it afterwards'. The characters should not be visually misleading.

Stylistic influence on perception. I argue based on my experience, that if the style of the object of the visual question is thematic or stylistic, it will be more tasteful to some participants than for others, which can skew the results (unless the question is explicitly about styling). Non-visually oriented people may not be able to cut out the style from the question, even if they are told to do so. It is best to avoid stylizing characters altogether.

Perception and character choice. Following the review of visual perception, I reason that a person may like one virtual creature over the others that are nearly as good, because:

- **There is visual language that causes stronger emotions**. They might say, "It is the sweetest looking thing" or "It looks friendly"
- **Recognizability**. They might say, "It looks more like a dog than the other dogs"
- **Concrete details about it**. They might say, "This dog fetches a ball, let it fetch a stick for her"
- **Abstract thoughts**. They might say, "It looks friendly to me, it should look friendly to him"

A person's comments can reveal (in theory) what they saw that made them pick a character.

4.2. Common household pets' emotions

The thesis is about asking questions about virtual creatures that resemble pets, therefore it is important to know what basic knowledge there is on common household pets' expressive and emotion reading capabilities. The knowledge is necessary for me to understand and discuss pet owners' expectations and opinions on the virtual creatures. More so, as I do not own a pet and I am familiar with only cats and dogs.

The following list of pets is based on a mix of U.S. statistics concerning pet ownership and European statistics concerning number of pet animals.

The most common household pets in the U.S. in 2015 were dog (71%), cat (49%), fish (11%), bird (8%), and other (9%) (Harris Interactive, 2015). The number of pet

animals in Europe in 2016, by animal type, in descending order: cat, dog, ornamental bird, small mammal, aquaria, and reptiles (FEDIAF, 2016).

Fish are removed out of consideration, because sending them to deliver a message in air would likely be a significantly more bizarre idea than sending a land animal. Moreover, snakes and spiders are removed out of consideration, because many people fear them and even looking at pictures of them could be very unpleasant for some. Next, the pets, and how people commonly perceive them:

Dogs

Dogs are very expressive animals. They mainly communicate non-verbally and secondarily through vocalizations. They can communicate the following groupings of emotions: feeling fearful, aroused, anxious, aggressive, and relaxed. They use their faces and bodies to convey most of this information. To understand what a dog communicates, it is crucial to observe the entire dog, as well as the context. This takes practice, as a dog can communicate more than one of the mentioned groupings at once.(Tufts University, 2018)

A study by (Albuquerque et al., 2016) on dogs' ability to recognize emotions, found that dogs look significantly longer at a face whose expression of emotion matches the attached vocalization. The researchers state that researchers previously thought only humans have this ability. Their results suggest domestic dogs have a perception of emotion, rather than simple discriminative processes. Common belief that dogs understand human emotions is therefore at least partly true and not a mere dream. Dogs are very intelligent animals.

Cats

Cat owners perceive cats as less emotional than dogs a survey finds (Coren, 2017). Cat owners perceived cats to show basic emotions of happiness, anger, fear, surprise, and disgust. However, cat owners perceived cats to show less sadness than dogs and be less capable of complex social emotions (sympathy, compassion, and pity). According to Coren, other data shows cat owners also perceive cats as less friendly than dogs.

The ways cats communicate seem to be harder for humans to understand, than the ways dogs communicate (The Humane Society, 2018). Cats are easier to overstimulate than dogs and like to be alone more. Humans may practice self-control around cats more than dogs due to these differences.

Ornamental birds

Ornamental birds are remarkably intelligent; they have primate-like numbers of neurons in their brains, their small brains are very neuron dense (Olkowicz et al., 2016). They can be more intelligent than dogs and cats. This may mean they can have the capacity for

complex emotions (Cat, 2018). Moreover, it may mean that their brains and behavior is like that of a 3-year old child. Their emotions may range from happiness to sadness in a surprisingly short period. They may not seem as stable-minded as dogs and cats, though they can be more intelligent.

Parrots can be especially intelligent. One African Grey parrot named Alex developed a vocabulary of 100 words and could identify 50 different objects, and for example, express his opinion about cleanliness of his cage without anyone asking. Moreover, most birds may have exceptionally good memory, as they may need to locate thousands of seeds they have collected and buried across hundreds of square miles.(Foster and Smith, 2018)

Some ornamental bird owners believe their birds can express the following groupings of emotions: feeling fearful, aroused, anxious, aggressive, and relaxed. Some parrot owners, especially of African Greys, also report, they are very empathic, i.e. capable of understanding others state of mind.(White, 2016)

Small mammals

A pet rabbit owner thinks rabbits are more social than cats, that they do not give unconditional love like dogs, and that they are less intelligent than both are (rabbitspeak.com, 2016). Another pet rabbit owner, H. Davis thinks rabbits can display the following emotions: love, contentment, joie de vivre (racing), anger, fear, irritability, bossiness, jealousy, insecurity, grief, and loneliness (Davis, 2011). However, I had difficulty finding scientific studies that spoke about rabbit emotions, so perhaps rabbit "emotions" are more about reactions to environment than actual emotion display.

Hamsters, writes (Watson, 2015), display basic moods of happiness, unhappiness, fear, anger, and boredom. I was unable to find scientific studies that would suggest hamsters have emotions.

Relevance for this study

Pet ownership statistics and common sense suggest that in case of virtual creatures being like animals, people will most likely expect them to be virtual dogs, cats, ornamental birds, and small mammals. These animal types and breeds were included in the study.

It seems pet owner's opinions about their pets' emotions and science do not match. A person may anthropomorphize pets and think they display emotions when they are not actually displaying emotions. I have considered in the study that peoples' perceptions on animals' capabilities vary.

4.3. Non-human actors and agency

This section discusses theory on agency, description of how the amount of agency may be related to learning capability, and description of how learning capability may be related to artificial intelligence. Theory of agency is important to the thesis, because the ARimal concept is an intelligent virtual animal messenger and not a mere 3-d-animation included in the message.

Agency denotes the exercise or manifestation of capacity to act, especially with intention (Schlosser, 2015). According to Prof. of Philosophy Helen Steward, many philosophers might say animals do not have agency, though Steward herself argues that they do, because they have the power to act or not act (Steward, 2015).

I reason that many more philosophers might say the concept studied in this thesis does not have any agency, as it is not real. However, when people perceive virtual characters as having agency, one may take the view that perceiving it means that it exists for them. The agency is then in this view all inside people's imagination. Whether or not all agency is like this, is not a relevant question to the thesis.

Things that people do not perceive reliably as acting, such as plants, do not have agency in this view. Moreover, only the amount of capacity to act that is proven to be expected should be said to exist in this view. For example, when shown a video of a sitting dog, probably all people will be sure in their mind that the dog can decide to stand up, but probably only some of them will be sure that it can decide to fetch, and probably none of them will think the dog can decide to order a pizza. In this view, no one can claim that the participants perceive "the dog as capable of deciding to fetch", without them clearly saying, they do. Therefore, one must give participants a chance to tell if they perceive "the sitting dog" as capable of more than sitting.

Why people perceive agency?

Humans are programmed to attribute mental states to animals (Urquiza-Haas and Kotrschal, 2015). Human brain uses many different processes to attribute mental states to animals, and animals that are perceived to be closer to humans as species are processed by the brain in different way than other animals. According to researchers Urquiza-Haas and Kotrschal, there are many things which can cause humans to attribute mental states to animals. Among the causes are different kinds of motions, facial expressions, personal experiences of the observer, and the observer switching between inductive and causal reasoning.

Measuring agency

Agency has been measured on robots. For instance, researchers Zlotowski et al. have measured perceived intentionality of a robot with three questions and a 7-point scale

(Złotowski, Sumioka, Bartneck, Nishio, and Ishiguro, 2017). Moreover, the amount of intentionality perceived for a robot is affected by how much like human it looks and acts. According to Urquiza-Haas and Kotrschal, people are capable of perceiving different amounts of intentionality, and there are many ways to perceive action. Based on the previously mentioned literature, I reason that it may be possible to measure agency by dividing agency by criteria of action and presenting it in multiple levels. The minimum level of agency would mean no capacity to act of any kind, and the maximum level the superhuman capacity to act, only attributed to supreme deities of religions. For example, level one could be a video of a dog sitting still and doing nothing more, level two could be a video of a dog sitting still and barking, level three could be a video of a dog sitting still, barking, and looking into the camera, and so on. Each new level should mean more perceived capacity to act than the last.

After the levels are defined, it may be possible to determine which agency levels the character animations or videos will fall into. Then, the desired agency level may theoretically be seen from which animations or videos the participants choose and how they wish to modify them. However, there are two important facts to remember when making conclusions:

1. The levels are approximate, they are not equally large, and they cannot be converted to percentages.

2. A creature can display different levels of agency at different times, developing creatures requires knowing what are the required maximum and minimum level of agency required.

Low level of agency		**Middle level of agency**	**High level of agency**
“Predictable”		**“Wild”**	**“Trained”**
Viewed as a software agent, bot	**Viewed as a robot**	**Viewed as a creature**	**Viewed as a pet / working animal**
Not conditioned and has no irritants / stimuli.		Not conditioned but has irritants / stimuli.	Conditioned and has irritants / stimuli.

Table 1: My estimation on Classical conditioning and non-human actors, and how conditioning could relate to the view of agency

My estimation of the three agency-levels in relation to actors and conditioning (as shown in Table 1) may help to understand how much effort must be put into the development of the virtual creatures. The table presents a general view that allows for exceptions. The

logic of the table is this: if a robot is viewed as conditioned and having irritants/stimuli, it is likely also viewed as a kind of a pet or working animal. The theory behind Table 1, from bottom up, is explained next:

Bottom row, classical conditioning

Psychologist Ivan Pavlov did original classical conditioning experiments back in the 1890's to his dogs, but some developers now use the theory as an inspiration for building artificial intelligence (James, 2018). Developers call one type of artificial intelligence algorithm reminiscent of classical conditioning Reinforcement Learning (RL). Companies such as Google's Deep Mind pair the algorithm with Neural Networks, to estimate the value of stimulus given to an RL agent. Developers used this approach in building the artificial intelligence that was famously able to beat the World Champion of the board game 'Go' in the game. The game of 'Go' is believed to be so complex that it requires estimation of the value of a move, and not only calculation of the outcome.

According to the theory of classical conditioning (Vilkko-Riihela and Laine, 2015), there are four types of stimuli:

- Unconditioned stimulus: Stimulus that the actor is born to react. Unconditioned stimulus causes an unconditioned response.
- Neutral stimulus: Stimulus that the actor is not interested in, or which does not cause significant emotional expression or reaction.
- Conditioned stimulus: Stimulus that the actor is not born to react to, but which after conditioning, causes conditioned response.

Furthermore, there are two types of responses to stimuli:

- Unconditioned response: Actor's natural born response to unconditioned stimulus.
- Conditioned response: Actor has learned response to conditioned stimulus.

Some examples of conditioning in the ARimal concept are listed below. Knowing these helped me to understand whether participants were talking about sending a message enhancing virtual animal that was animal-like:

- If the people do not expect unconditioned stimulus, they will probably not expect the virtual creature to react instinctively like an animal.
- If the people do not expect neutral stimulus, they will probably not expect the virtual creature to sometimes care and sometimes not.
- If the people do not expect conditioned stimulus, they will probably not expect the virtual creature to learn anything.

Moreover, the question of learning is important, for if the participants do not expect virtual creatures to learn anything, then it may be possible that it is enough to make a virtual creature that is not capable of learning. Such a virtual creature would appear as

stupid only if a person tries to train it (they might also feel like an idiot after trying to train it).

The middle row, bots to working animals

There may be four key notions that distinguish agents (such as some types of bots) from arbitrary programs: reaction to the environment, autonomy, goal-orientation and persistence (Franklin and Graesser, 1996). The reason I placed bots into low-level of agency in Table 1 is that even though a bot may be able to react to environment it does not technically justify calling it "irritated" or "stimulated". Experts in the field of psychology apply the concept of stimuli only to living beings (Vilkko-Riihela and Laine, 2015).

4.4. Positive appearance effects of creatures and robots

Next, I present some major positive appearance effects of creatures and robots that are important to consider for the concept.

Anthropomorphism

To anthropomorphize is to attribute human traits, emotions, or intentions to non-human entities (Nauert, 2015). Its likelihood of occurring in the concept may be increased by including humanlike physical features, movements, sounds, and actions. If anthropomorphism is important to the concept, the study participants may want the creatures to do humanlike actions. I have included such creatures in the study.

Baby schema

Baby schema means finding babies cute due to their infantile facial configuration (high forehead and big eyes, small nose and mouth, round face) and body features (Borgi, Cogliati-Dezza, Brelsford, Meints, and Cirulli, 2014). Researchers Borgi et al. have proven baby schema to work also for animals, and that humans have the schema since being small children. If baby schema is important to the concept, the study participants may prefer baby animals to full grown animals. I have included both baby and full-grown animals in the study.

Nostalgia

Nostalgia is a yearning for the return of past circumstances, events, and other things (Burton, 2014). People may yearn to see animals they have seen before and liked. People may also yearn for those moments when they have physically received gifts and/or letters. Nostalgia may one day be a major reason people adopt the concept of sending virtual creatures with messages. I have helped nostalgia to rise in the study by letting participants see many different creatures, in many different contexts.

4.5. Avoiding the uncanny valley effect for virtual animal characters

In 1970, Masahiro Mori, a robotics professor at the Tokyo Institute of Technology observed negative emotional reactions of human observers towards very life-like robots and prostheses (Mori, MacDorman, and Kageki, 2012). Mori observed that when robots began having a considerable amount of human likeness, but something was still missing, it suddenly evoked uncomfortable feelings in human observers. Mori called the sudden dip in perception the uncanny valley. Mori also noted that the dip became deeper if there was motion or physical contact.

The effect seems easy to understand at first glance, but there appears to be no agreement among researchers on what causes the effect, or if the effect even exists (Wang, Lilienfeld, and Rochat, 2015). However, the hypotheses and findings do not necessarily cancel each other out. The effect may be due to both perceptual processing (pathogen avoidance hypothesis, mortality salience hypothesis, evolutionary aesthetics hypothesis), and cognitive processing (violation of expectation hypothesis, categorical uncertainty hypothesis, mind perception hypothesis). Alternatively, any single one of them may cause the effect singularly, in which case the effect may not be as strong.

Appearance of 3-d creatures and the uncanny valley effect

There are few research papers on non-human artificial characters. This lack of empirical research was pointed out by Schwind et al. (2018). Their study investigated the effects of realism, stylization, and facial expressions of virtual cats on human perception. The researchers conducted two studies using cat renderings as stimuli: In the first study, they collected quantitative measurements of how eerie people see virtual cats presented from high to low levels of realism (sketch to photo). Supplementary, the researchers asked participants of their attitudes towards virtual cats in current video games. Then they conducted a second study on cat perception with three factors on cat faces realism, atypical features (enlarged eyes, facial expressions etc.), and emotion. The researchers based their second study on related work that shows atypical human faces cause very negative reactions. The researchers conducted both studies as online surveys to collect reliable data from a large sample.

In short, Schwind et al.'s results indicate that current video game animal-like characters look uncanny for similar reasons as humanlike characters. The researchers conclude that to avoid the uncanny valley effect, the virtual animals should, quote "either be given a completely natural or a stylized appearance". Virtual animals rendered at a high level of realism should have the same appearance as real animals. To avoid the effect, people should perceive the virtual animals as representing animals. The researchers' results show that people dislike a realistic animal that represents something other than itself.

The researchers note that one way to avoid the effect is to use highly realistic computer graphics, or to abstract or stylize an animal character. The graphics should show realistic fur geometry, shading, correct face and body proportions, and consonance of environment and animal. They suggest, if designers do stylization, it should be done as animators do it in animated films. They base their suggestions on earlier research on human- and animal-like 3-d characters.

Behavior of 3-d creatures and the uncanny valley effect

Researchers (Tinwell, Nabi, and Charlton, 2013) studied whether realistic virtual characters that show incorrect facial expression when startled by alarming sound are more uncanny. Their results show that they are. Moreover, they suggest psychopathy ratings are a strong predictor of perceived uncanniness. People who perceive psychopathic personality features in virtual characters will likely also perceive the characters as uncanny.

Discussion by (Wang et al., 2015) seem to support the idea that virtual characters can feel uncanny when they do not behave in an expected manner; and that this is regardless of the realism. People probably unconsciously connect the degree of uncanniness to the uncommonness of the behavior.

The meaning of uncanny valley design challenges for this study

I estimate, based on the discussion in the section and on summary and discussion by (Wang et al., 2015), that designers can control the uncanny valley effect by not creating ugly characters (appearance-based perception) and by not making them violate all the rules/norms of a person with their behavior. As a designer, I consider that something is ugly when it deviates from the visual language in a way that seems too chaotic, and that something violates the rules/norms by its behavior when it deviates from expected behavior in a way that cannot be easily justified. For instance, I believe that getting mauled by a bear would feel uncanny, because it would break the rules of a person's narrative, 'how can this happen to me?', and that it would be even more uncanny, if the bear's fur would also be neon-green.

5. Exploratory study of the concept

The ARimal concept was rated as promising in the project it was created in, and I saw that it would be useful to study the concept further. I wanted to provide details where a small amount of information existed and to lay groundwork for further studies. I saw a study could potentially save time by determining at an early stage if more advanced research on the concept is worth pursuing. Moreover, I had interest in studying the concept of agency. The research questions were formulated against this background:

- **Is the design concept acceptable?**
- **What is the desired level of agency for different scenarios?** One: what kind of independent action the character should display, and two: whether perception of agency can be divided into levels by using action criteria or not?
- **What presented animal characters participants would prefer in different scenarios?** What characters are selected out of a selection of characters in messaging scenarios the participants make up and in scenarios that I have designed?
- **How participants describe potentially uncanny looking characters?** Do participants comment that there is something wrong with a character or with the most anthropomorphic characters?

5.1. Methods and research process

To answer the research questions, I conducted 12 focused interviews. According to (Lazar, Feng, and Hochheiser, 2010), focused interviews are a good way to answer questions about design concepts. The interviews I conducted followed within-subjects design.

Control variables

To ensure the interviews were focused, I used a Web-app as a low fidelity prototype to demonstrate the concept and present virtual character choices. The Web-app brought the interviewees one-step closer to the reality of messaging and closer to the futuristic scenario of using an augmented-reality messaging application. The interviewees used the Web-app to see and guess which characters they would use in the future.

Independent and dependent variables

The independent variable in the study was the messaging scenario that was changed within the Web-app (see Figure 13). The Web-app, the selection of characters and questions about selected characters stayed the same (they were control variables). The dependent variables were the effects caused by change of the scenario: the selected character, the reasons given for the selection, and answers to the other questions.

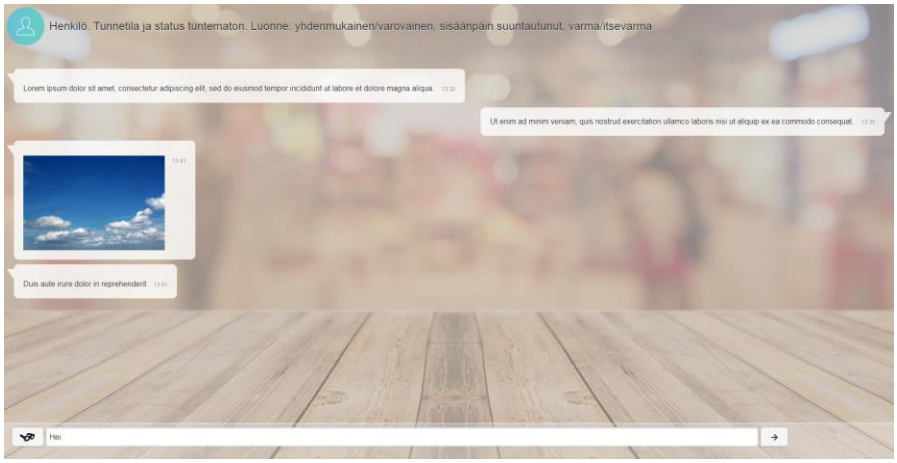

Figure 13: The low-fidelity prototype resembled WhatsApp a little. It was supposed to illustrate using an AR messaging app in front of a table with AR glasses.

Data gathering

All the interviews were voice recorded. However, I did not ask the interviewees to think-aloud. In addition, I wrote down interviewees' choices; I made the Web-app/low-fidelity prototype record the character choices in the scenarios into a log; and I took screenshots of the interviewees' choices, for backup.

5.1.1. Messaging scenarios

To answer the question, "What presented animal characters participants would prefer in different scenarios?", I asked the interviewees to first invent five scenarios (recipient, message, character) (dependent variables) on their own, and then select characters in six messaging scenarios I had designed (control variables). In the predefined scenarios, I asked them questions about their selection after each choice.

I created the six scenarios mostly based on the GIF and emoji use statistics presented in the section 3.2 Emoji, GIF and sticker use and challenges. Where I did not create the scenario based on the use statistics, I created it because the ARimal concept made novel messaging possible. It took approximately 45 minutes for the interviewees to go through the predefined scenarios.

I designed the scenarios to cover dimensions of "**showing you care**", "**showing how you feel,**", and "**persuasion**". I chose these dimensions, because I thought they could benefit the most from the 'weight' the concept brought (as discussed in the sections 3.1 and 3.2). However, the dimensions did not exist in a vacuum; they overlapped depending on interviewee's thought process.

Next, the scenarios in order, and justification for each:

Scenario 0. Showing you care, showing love.

This scenario was used only if the interviewee had experience using text messages (not only SMS) in romantic communication. "Your intention is to show love to your partner with the character and the character will deliver the message "I love you"".

Justification: **emoji use statistics**. Emoji and GIFs are second most often used to communicate love. Therefore, it is likely that this concept, which essentially consists of graphics and a message, would be used in similar manner. For instance, I can easily imagine sending cute animals to my wife, to say, "I love you".

Scenario 1. Showing how you feel, having a thinking mindset.

"Your intention is to tell your friend that you are pondering a question and the character will deliver the message "Would it be better to live 1000 years or 10 times 100 years?"".

Justification: **emoji use statistics**. Apple's and Emojipedia's emoji usage statistics suggest that thinking face emoji is in the top 10 most used emoji. While it may be used mostly as a quick response to a question, it shows that people are used to visually communicating that they are pondering a question. In the concept, the user could send an owl, cat or some other 'wise-looking animal' to show that they are pondering a question.

Scenario 2. Showing you care about the other person.

"Your intention is to send birthday greetings to your friend and the character will deliver the message "Happy birthday"".

Justification: **emoji use statistics, novel possibility**. Emoji and GIFs are most commonly used for communicating joy, including in birthday greetings, and birthday is a special occasion, which already includes the concept of sending gifts and cards. Therefore, this scenario should work well for the concept of sending a virtual character, even for the more skeptically minded interviewees.

Scenario 3. Showing you care, with sarcasm directed at the other.

"Your intention is to show your friend that you are jokingly-mad at them and the character will deliver the message "For yesterday"".

Justification: novel possibility. While GIFs and emoji are not used commonly as a practical joke, the concept of sending a virtual animal in augmented reality should work well as a practical joke. I can imagine sending some scary animal for this purpose, for a powerful effect, or a normal animal to surprise the other person. I included this scenario because of its novelty.

Scenario 4. Showing how you feel, with sarcasm directed at oneself.

"Your intention is to tell your friend, you have slept past the train station and the character will deliver the message "Guess who slept past the station?"".

Justification: emoji use statistics. Face with the tears of joy emoji and other laughing emoji are one of the most commonly used emoji, and they may be used for laughing at oneself; sad face emoji are also common for expressing that one has made a mistake. I believed these half-serious emotions could be communicated with virtual characters that do something that looks stupid or which look angry.

Scenario 5. Trying to persuade a friend to help.
"Your intention is to ask your friend for help moving a sofa and the character will deliver the message "Could you help me move one sofa"".

Justification: novel possibility. Asking for help by sending a dog that looks the other person in the eyes is a novel idea. This scenario was included because the concept can enable weightier, yet more lighthearted requests.

The scenarios did not include time and location; it was up to the interviewee to imagine when and where the character would appear. Moreover, I did not say the shown emotions are the only emotions that can be displayed; or that the character's appearance must be what is shown (i.e. "this one always wears a funny hat"); or that the character's behavior must be what is shown (i.e. "it can't smile or jump of joy"). Instead, I emphasized the interviewees could have wished for action and objects they did not see.

5.1.2. Agency and animal characters

The agency research question had two parts (in practice), one: what kind of agency the character should display, and two: whether perception of agency can be divided into levels by using action criteria or not. In other words, there were two constructs, first the action criteria, and second, the arrangement of the action criteria (levels), and the first one was not dependent on the second. I could use the action criteria to describe the interviewees' wishes for character action, whether putting actions into levels of agency was proven feasible idea or not.

In the early phase of the thesis work, I determined 11 agency levels, which I later understood to be too detailed. I based the agency levels on what I discussed in the section 4.3 Non-human actors and agency. The 11 levels were: (1) the character does not move. (2) the character moves. (3) the character plays, eats or makes noises. (4) the character looks at the camera. (5) the character reacts, and/or it can be made to do something by pressing a button. (6) the character can be interacted with without using buttons. (7) the character displays free, uncontrolled will. (8) the character displays abilities rarely seen in animals. (9) the character displays abilities never seen in animals. (10) the character shows it has more emotions than animals. (11) the character shows that it has humanlike intelligence (compare to movie Planet of the Apes).

After thinking about the 11 levels and looking at examples of animal behavior, I determined I should compress the 11 levels to four agency levels. The four final levels were as follows (see Table 2):

	Description, action criteria	**Abbreviation**
Agency 4 ***(above the high-level)***	The character displays abilities never seen in animals; it displays more emotions than animals; it displays human-like intelligence.	The character is more than an animal.
Agency 3 ***(corresponding to high-level)***	The character is interacted with; it shows free uncontrolled will; it displays abilities rarely seen in animals.	The character is interacted with.
Agency 2 ***(corresponding to mid-level)***	The character looks at the camera; it reacts to a person; its mood changes; it begs for something.	The character looks like it needs attention
Agency 1 ***(corresponding to low-level)***	The character is still, moves, eats, or plays by itself.	The character is in the room.

Table 2: Description of the agency levels. The agency levels 1-3 corresponded to low, mid and high agency levels that I described in section 4.3.

I determined the agency level for each animated character GIF/clip I made, based on which one of the descriptions it fitted the best (shown in Table 2). However, I did not make equal number of GIFs for each agency level for each animal type, and did not see that as necessary.

Getting to know the agency desired for a scenario. If a person chose a GIF of a dog that sat still (Agency 1) and did not describe it as doing something more, I wrote only that they wanted the virtual dog to appear in the receiver's vicinity and sit still. However, if they said that the character should try to get the receiver to interact with it, after I asked them about interaction, I wrote that they assumed it is capable of interaction. Moreover, when their description did not match what was in the GIF, I discussed why it did not.

*Getting to know if the agency levels make sense***.** I invented a sorting task where the interviewees sorted two sets of four GIFs by agency (low to high). If their order matched mine, then the agency levels were a plausible idea. If their order did not match mine, then my understanding of what agency is, was either wrong or agency was too difficult concept to understand in a couple of minutes.

5.1.3. Animal character GIFs and potential uncanniness

Figure 14: Still image of one of the animal character GIFs, a kitten sitting in a basket and looking at the camera for attention.

The animal categories I chose for the study were dogs, cats, birds, small mammals, and other. I chose these because they were the most common pet categories, as discussed in the section 4.2 Common household pets' emotions. I presented the collection of these animals as animated GIFs (see Figure 14), where each GIF acted as a representation of a 3-d-character that would go with the message in augmented reality.

I made the GIFs by first cutting 5-second video clips out of animal videos I found from YouTube with video editing software. Then I converted them to GIFs with converter software. My use of the video clips should have fallen under the U.S. copyright legal doctrine of fair-use, which allows use for nonprofit educational purposes without asking permission. I made 147 GIFs at first but then I cut the number down to 47.

In choosing the 47, I paid attention that I left out all the animal GIFs that included objects that were directly related to the scenarios, such as birthday hats. I also left out the less visually clear (low brightness and contrast) GIFs; GIFs with human faces; GIFs with clear ties to pop-culture, and GIFs that were too much like the other GIFs. In Appendix 3 is a preview of all the GIFs I used and a link to cloud archive containing them.

However, even after the careful selection process, each individual GIF/clip still had multiple possible hidden variables that may have affected the interviewees' selection. Some of the possible hidden variables were:

- Breed
- Age
- Color/s
- Brightness and contrast
- Camera angle and movement
- Animal movement speed
- Human hand included or not
- The surroundings and furniture
- Recognition of the animal as a movie character
- The type of action

It might have been possible to control the hidden variables, if I had made the animal clips all in 3-d or using only one kind of high-quality stock footage. However, I determined them to be both too expensive and too time consuming for the purposes of the thesis.

Potential uncanniness. I cut some of the GIFs from animal movie trailers and scenes (talking animals), to answer how participants describe potentially uncanny looking characters. In interview analysis, I noted if/when participants commented that there was something wrong with a character or with the 'Hollywood' characters.

5.2. Procedure

First, I brought the interviewees to a screen that showed the structure of the interview and that had links to the next phases of the interview (see the screen 1 in Figure 15). Then I gave them to read an introduction to the study on paper (see Appendix 2) and gave them a recording permission form. After they signed the form, I started the sound recording.

Figure 15: Screenshots of the first two screens of the interview.

In the screen 1 (see Figure 15), I asked the interviewees some questions about their CMC practices, mainly to orient the interviewees to think deeper about their communication needs and practices. The questions were:

- Could you tell about your experiences about communicating your feelings, using WhatsApp or messenger or the like?
- What about request / wishes / congratulations / showing that you care?
- How well the present applications and technologies suit your communication needs?
- *If I did not know the answer already*. Have you used text messages or instant messaging to support a romantic relationship?

If the interviewees knew what it is like to send messages to a romantic interest, I included the designed romantic communication scenario in the interview.

The screen 2. Next, I opened the concept introduction screen from the low-fidelity prototype (see Figure 15). In the screen, the interviewees saw the concept image, the dog, and all the character GIFs. I asked the interviewees the following open questions:

- Which characters you would use, for whom and with what kind of messages? Please state the number of each character (the GIFs were numbered). Please invent five scenarios.
- Do you have pets or are you familiar with pets?
- Do some of the characters remind you of some familiar animal? Please state the number of each character.

When the interviewee selected characters, I tried not to lead the interviewee in their choices in any way. Moreover, I asked the interviewees about familiarity, because earlier experience with pets might have affected the character choices.

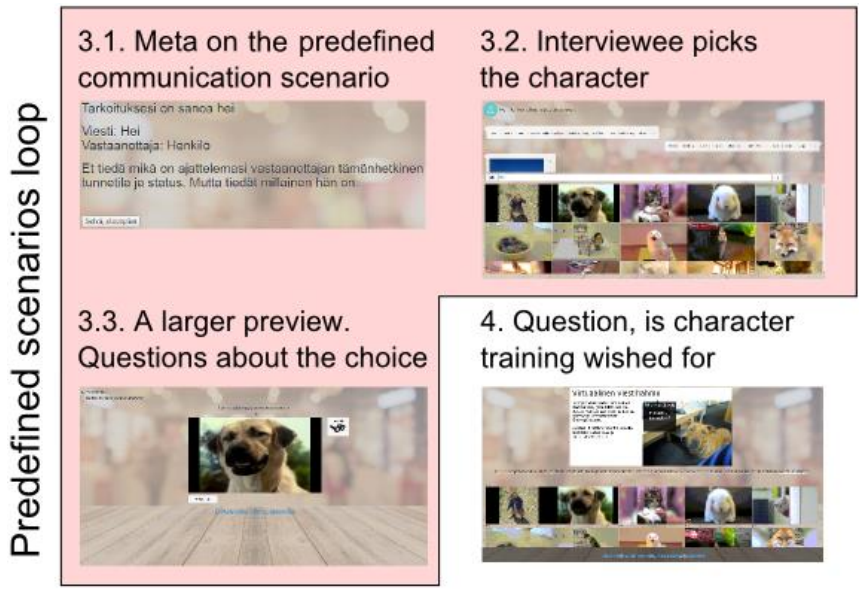

Figure 16: Screenshots of the predefined scenario screens and of the training question screen.

The predefined scenario screen 3.1. Before the predefined scenarios, I walked the interviewees through a basic 'hello, person' messaging scenario, to show them how everything worked. I explained that each messaging scenario would start with a screen that stated the message, message's intent, receiver, and that the receiver's status and emotional state are unknown (see Figure 16).

The predefined scenario screen 3.2. I explained that with the low-fidelity prototype I tried to show a situation where a transparent augmented-reality messaging app was being used with augmented-reality glasses while sitting in front of a table. Then, I had the interviewee pick the character in the predefined scenario (see Figure 16). The animal characters were shown as 48 animated GIFs. They were the same GIFs that the interviewee saw before.

The predefined scenario screen 3.3. When the interviewee clicked one of the virtual creature GIFs, the screen changed to a preview screen (see Figure 16). If the interviewee did not go back to select some other character, I asked them questions about their choice:

- Why did you choose this character?
- Would you change the appearance of this character, add some apparel, clothes, or decorations?
- Interaction is a kind of action that occurs as two or more objects influence one another. Can the character be interacted with? How? What is included in it?

I clarified the questions, and asked more questions, until the interviewee answered the following sub-questions as well:

- Does the character move in relation to the receiver or is it in the space as if the receiver did not exist?
- Does the character make some sound, or does it talk?

I had aimed the questions at understanding what character the interviewee chose in a scenario and why they chose it and how the agency level I had previously determined for it relates to their description. In cases where the interviewee chose e.g. a talking dog but did not say it should talk, I did not assume it should talk.

The screen 4. After the scenarios, I brought the interviewees to a page that did not have a graphical user interface (see Figure 16), and I asked them the following questions:

- How do you imagine setting up your character/s?
- Would you train them by hand or do you adjust them setting by setting, or do you select a ready-made character?

I aimed these questions at finding out if they would be prepared to spend time training a character. If they did, it would support they need characters with high agency.

Figure 17: Screenshots of the two last screens of the interview.

The screen 5. I brought the interviewees to a page that listed only the anthropomorphic characters I thought belonged to agency level four (see Figure 17). These characters might be uncanny to some. I asked the interviewees about the characters:

- Is there are a character in here that you would rather not use, for any reason?
- (If they did not see any of the characters as uncanny). What kind of character and its behavior would feel uncanny?

I aimed these questions at finding out if the characters that display humanlike behavior are described as uncanny. However, I did not seek to understand why the characters were or were not uncanny to the interviewees, as I wanted to focus more on the other questions. Moreover, at this point, the interviews had already lasted around 40 minutes.

The screen 6. In the end, there was a sorting task, where I asked the interviewee to pick the animal type that is most familiar to them, and then sort two sets of four animal GIFs by the agency shown in them (see Figure 17). I set the initial positions of the four GIFs in the same true random order for each interviewee.

	Task A	**Task B**
Agency 4	big-white-dog-talking	big-white-dog-talking
Agency 3	dancing-small-dog	young-dog-told-to-sit
Agency 2	begging-small-dog	small-dog-moving-ear
Agency 1	corgi-sitting	dog-chasing-tail

Table 3: Example of the sorting task division.

Further explanation of the task. I had divided the GIFs into two smaller sets of dogs, cats, birds, and small mammals (see Table 3 for dog example). In the sets of dogs, cats and small mammals there was one GIF in each that appeared twice, because I did not have equal number of GIFs for each agency level. The purpose of the task was to find if the interviewees agreed with my agency order. The positive result meant I had a good concept of agency, and negative that either I did not, or they did not understand the concept of agency.

5.3. Participants and recruitment

Twelve Finnish speakers were interviewed, most of them students of the University of Tampere. They were from the fields of human technology interaction (HTI), computer science and other fields. I recruited people from other fields on the presumption that people from other fields have different styles of communication and different kind of friends. In total, I managed to recruit:

- 5 participants I knew to be familiar with HTI
- 7 participants from around the university campus

I recruited most of the participants in person. I talked to them in the campus hallways, showed them the concept, study introduction paper, and asked them if they could participate. After having difficult time to recruit people who had never met me before, I began to promise movie tickets for participation.

I did not specify the number of genders, as I did not consider gender a meaningful factor for the study with 12 participants, and all the participants preferred all kinds of characters and invented relatively similar scenarios regardless of their names.

Pilot. Before the 11 other interviews, I did a pilot interview with a senior member of the university's Computer-human interaction department staff. The pilot interview went well and did not reveal any major issues; there were also no technological failures. The expert commented that my interviewing style was on the point and good.

The pilot interview revealed only a couple of small issues. The two most significant of them were: I did not ask the question about human-character interaction clear enough. *(2)* My original sorting task had too high visual-cognitive load. I had asked the pilot to sort 9 GIFs by agency at once, and it seemed too difficult. I changed the task, so the other participants sorted only 4 GIFs at once (2 sets of 4 GIFs).

5.4. Analysis

I transcribed the interview recordings, and then I analyzed them with Grounded Theory (GT) method (Glaser and Leonard Strauss, 1967). The basic idea of the GT method is to read (and re-read) the transcripts and label variables (categories and concepts) and their interrelationships (i.e. do coding). The GT method is used to, quote: "discover the major themes that emerge from the interviews, and then develop a sense of conceptual categories among those themes, perhaps with high confidence about how several subthemes contribute to the same category" (Muller and Kogan, 2012). The GT method is commonly used this way in Human-Computer Interaction.

After transcribing the interview recordings, I coded the data based on what details the answers revealed. For instance, I coded the answers to the question on character-recipient interaction as the character being there, being aware of the recipient, wanting something, and so on.

Second, I did so-called pattern coding, where I used patterns I found in the data as the basis of new coding. For example, only after I had analyzed multiple interviews, I saw that the interviewees seemed to share final reasons for selecting a character (reasons as in the saying 'the last straw that broke the horse's back'). However, I did not only do coding as in a typical GT study; I also tested the agency level hypothesis with the sorting task.

5.4.1. The types of data I analyzed

Data on interviewees messaging practices. I looked for basic shared variables, such as satisfaction with technologies. I intended the questions primarily to prepare the interviewees to the scenarios.

Data on interviewee's and my messaging scenarios. The scenarios produced the most data. In the scenario data, I looked for shared variables and interrelationships. I looked for the effect of the scenario (receiver, intent and message). Moreover, I looked for the effect of agency, animal type, appearance, and familiarity on choice. For details, see Appendix 4.

Data on preparing and using characters. I looked for shared variables relating to preparing and using a character, and interrelationships. Moreover, I analyzed whether the described method of preparing a character matched with what was required of the characters in the scenarios.

Data on uncanniness. I looked for shared variables and interrelationships in described uncanniness. Were any of the 'Hollywood' characters uncanny (on a surface level)?

Data from the sorting task. I looked for my agency level pattern to find whether people can order characters by agency as I had proposed. Moreover, I looked for whether the participants' orders agreed with each other.

The analysis of the data as whole. I looked for whether the participants associated the Arimal concept with the same existing concepts/products, for example did many think of Tamagotchi at some point of the interview. Moreover, I analyzed agency, whether what could be described as intelligent interaction was commonly hoped-for across scenarios (including the scenario of preparing the character for use) and participants.

6. Results

None of the participants expressed the concept could not work or that it was ridiculous. Moreover, out of the 12 participants, I thought that only two expressed the kind of skepticism that could mean that they thought the concept was more likely to fail than succeed. However, when I asked the participants about their messaging practices, all expect one participant said they were satisfied with current technologies and did not feel they needed anything more. I discuss the meaning of these observations in the next chapter, as well as the meaning of the results given below.

6.1. The sorting task results

I present the sorting task results first, as the results inform the interpretation of other agency related results.

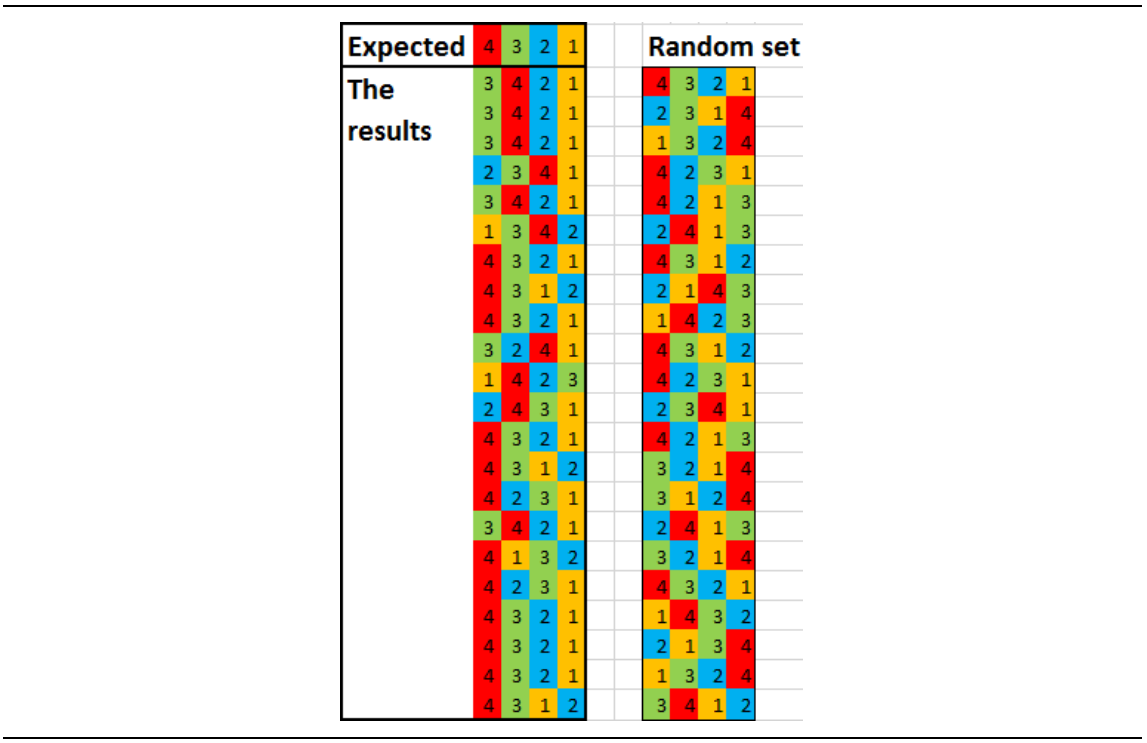

Figure 18: The sorting task results, not including the pilot. Two rows for each participant, animal species mixed together. Compare the results to what the random set looks like.

The sorting task results (see Figure 18) show some clear patterns and the patterns show that the participants did not have random understanding about the concept of agency I explained to them (compare to the random data). The random data consolidates that there are at least some trends in the results. The participants placed agency level 4 the way I had placed 12/22 times, level 3 11/22 times, level 2 12/22 times and level 1 16/22 times. The sorting task results do not include the pilot, because their task was to sort nine animal GIFs at once, and I understood it was too demanding.

6.2. Scenarios that participants suggested

The scenario character pick results answer to the research question: what presented animal characters participants would prefer in different scenarios? In the section I detail the imagined messages and illustrate the selected characters.

Out of the 47 representations of AR messenger characters available, the 12 participants imagined 54 use scenarios, and picked 34 different GIFs in scenarios they suggested. Most times a single GIF was picked was five, maximum times a single GIF could have realistically been picked would have been 12 times (assuming all would have picked it once).

The message types they imagined were likewise varied. The most common message type was what I call "asking for something", with 15 instances out of the 54 scenarios the participants created. The second most common message type was "any message with this character", with 10 instances out of the 54. The third most common message type was "telling one's status", with nine instances out of the 54. Of the remaining 20 scenarios not included in these three types, three were about informing about action to be taken by the sender (with or without the recipient), three were about showing surprise, and the rest (14 scenarios) were not shared.

The recipients the participants imagined were not as varied as the messages. The imagined recipients were anyone 21/54 instances, friend 16/54, spouse or partner 5/54, workmate 3/54, parent 3/54, romantic interest 2/54, girl or boyfriend 2/54, one's child 1/54, and expert of a field 1/54. However, one should not interpret "anyone" as literally anyone, but as any of the other recipients mentioned.

Asking for something

15/54 of the scenarios that participants suggested. These scenarios can be compared to my scenario of asking a friend for help for moving a sofa. They are about getting the other person to respond or answer in some way. However, in some cases I had to rely on the tone of their voice and my memory of the interview to define whether they were imagining about expecting a response or not.

I counted the following imagined messages and comments as asking for something. GIF 1 (top left, see Figure 19): "for asking for something", "if I need some help". GIF 2: "come eat pizza!", "let's go for lunch!", GIF 3: "come to party!". GIF 4: "come take pictures", "come dance with me". GIF 5: "I need some affection". GIF 6: "yes, yes, wait a while!". GIF 7: "how are you doing?", "hey, what's up?". GIF 8: "bring something from the store", "bring something from the store", "bring something from the store", "bring something from the store" (four identical scenarios from four separate participants).

Figure 19: Stills of the characters the participants picked for asking for something.

The parrot GIF proved to be not like the other 46 GIFs. The parrot GIF seemed to fit only to a shopping message, while the other GIFs could fit many scenarios. Four participants imagined the same scenario of "bring something from the store", when they saw the parrot GIF. However, even if the four are discarded as questionable, the message type of "asking for something", where some type of response is expected, would still share the top spot with the next message type, "showing one's status" with 11/54 instances.

The selected GIFs illustrate two ways of asking for something with the ARimal, direct and indirect. E.g. the small dog that begs signals a direct question to the recipient and the dog that chases its tail makes the recipient wonder why it was sent. Both ways seem to be equally good and needed.

Showing their status

11/54 of the scenarios that participants suggested were about showing their status. These scenarios were about showing what one is experiencing or doing. The scenarios matched with predefined scenarios of telling about missing the train station and telling that one is pondering a question.

I counted the following imagined messages and comments as showing their status. GIF 1 (top left, see Figure 20): "Oh no, unreal!", "Reaction to a new situation", and "I am surprised about something I heard". GIF 2: "I have done something stupid". GIF 3: "I am in trouble". GIF 4: "I am a little busy right now". GIF 5: "Waiting for you". GIF 6: "Did the exam, didn't know a thing". GIF 7: "Ranting about something". GIF 8: "I am really busy right now". GIF 9: "I am grumpy!"

Figure 20: Stills of the characters they picked for showing their status.

The selected GIFs illustrate at least four ways of showing one's status with the ARimal: exaggerated acting (e.g. the dog chasing its tail, being in trouble), exaggerated facial expression (e.g. the cat showing shocked expression), exaggerating both facial expression and acting (e.g. Peter rabbit doing a scare expression), and neutral (e.g. the puppy sitting happy, "Waiting for you"). People probably need all the methods.

Any message

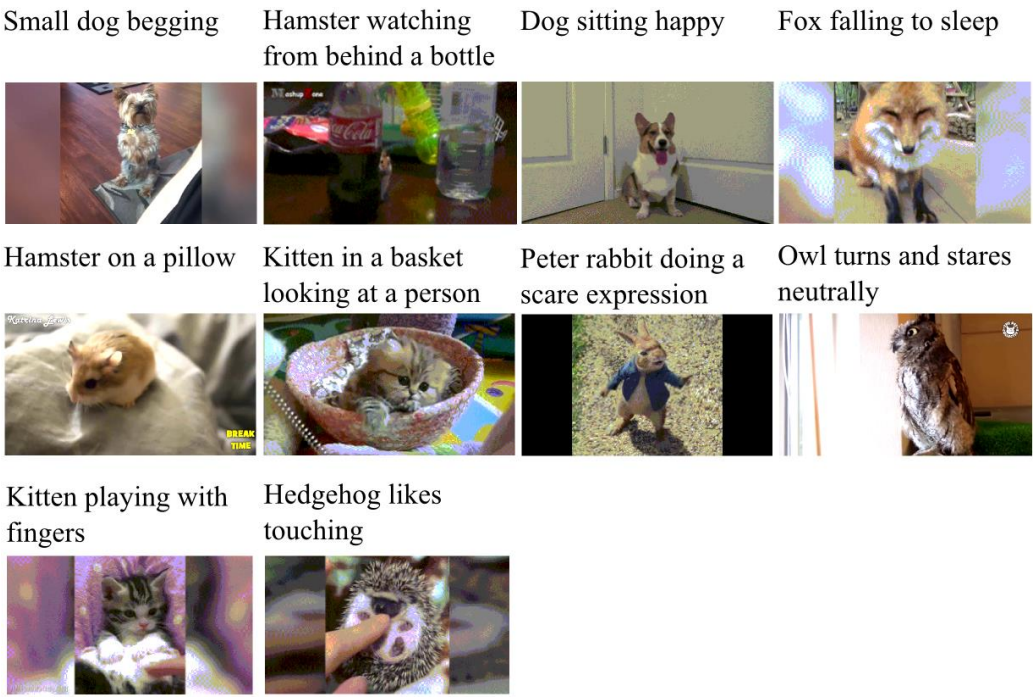

Figure 21: Stills of the characters the participants picked for sending with any message.

In 10/54 of the scenarios that participants suggested the participants said they could send the character with any message. On the surface, the characters they picked for sending with any message look like the other characters they picked (see Figure 21). However, the characters might match a combination of cuteness, happiness, generalness and non-ridiculousness, better than the other characters they picked for the other shared scenarios.

Other scenarios

20/54 of the scenarios that participants suggested were far more unique. The other scenarios were about saying something specific to the recipient, and in most cases, the recipient was a specific person. The scenarios did not have shared themes.

General details about the participants' own scenarios

The GIF selections did not seem to show character-specific patterns (other than the parrot pushing a mini shopping cart GIF). In only 2/54 cases the selected animal was a baby animal. Designed anthropomorphism (i.e. the animal was one of those Hollywood creations) were 11/54 cases. The selected animals were 13 dogs, 12 cats, 11 birds, 10 small mammals, eight other animals. One may see the effect of nostalgia from the familiarity count and from recognizability counts in next section's predefined scenarios.

Familiarity and selection reasons in the participants' own scenarios

The participants chose an animal belonging to a category of animals they said was familiar to them 22/54 times. In 8/54 of the instances, the participants selected a familiar looking animal. The questions on familiar animal categories and on familiar looking animals were asked after they had created scenarios.

6.3. Predefined scenarios

Out of the 47 GIF representations of AR messenger characters available, the 12 participants picked 35 different GIFs in predefined scenarios. Most times a single GIF was picked was 6. Here I have not illustrated the selected characters, as there is not visual knowledge that did not already appear in the participant's scenarios.

0, "I love you". The scenario was done by ten participants. Most participants seemingly picked the character based on its emotional effect on them.

1, "Would it be better to live 1000 years or 10 times 100 years?" The scenario was done by 12 participants. Most participants seemingly picked the character based on concrete details about it or its action. Only four participants said their choice was affected by knowledge of culture (e.g. knowledge that owls are thought to be wise).

2, "Happy birthday". Twelve participants did the scenario. Most participants seemingly picked the character based on concrete details about it or its action. They connected the action to the message. Moreover, only two participants wished to add decorations or special effects.

3, "For yesterday!" Twelve participants did the scenario. Most participants seemingly picked the character based on concrete details about it or its action; they did not focus on strong emotions, such as being scared. Most did not want to shock the recipient.

4, "Guess who slept past the station?" Twelve participants did the scenario. Most participants seemingly picked the character based on concrete details about it or its action, focusing on its dramatic impact. One participant wished to pick a dog that was not in the selection.

5, "Could you help me move one sofa?" Twelve participants did the scenario. Most participants seemingly picked the character based on concrete details about it or its action. They wanted the character to look and act as if it needs something.

General observation about the seriousness of imagined use

The ways it seemed the participants were imagining sending the messages in predefined scenarios were mostly somewhat playfully (36/70), followed by playfully (32/70) and neutrally (12/70). They probably saw the use of the characters as being comparable to use of emoji, stickers and GIFs in seriousness.

The GIFs the participants did not pick. There were 8/47 GIFs that were never picked, not in the scenarios that participants suggested or in predefined scenarios. However, I find them just as acceptable as the rest; they were probably just slightly worse in comparison or left out by chance.

6.4. Details behind character preference in all 124 scenarios

The seeming primary factors for character selection. The participants seemed to have three final reasons for ending up on one GIF (see Figure 22). This is my interpretation of their answers.

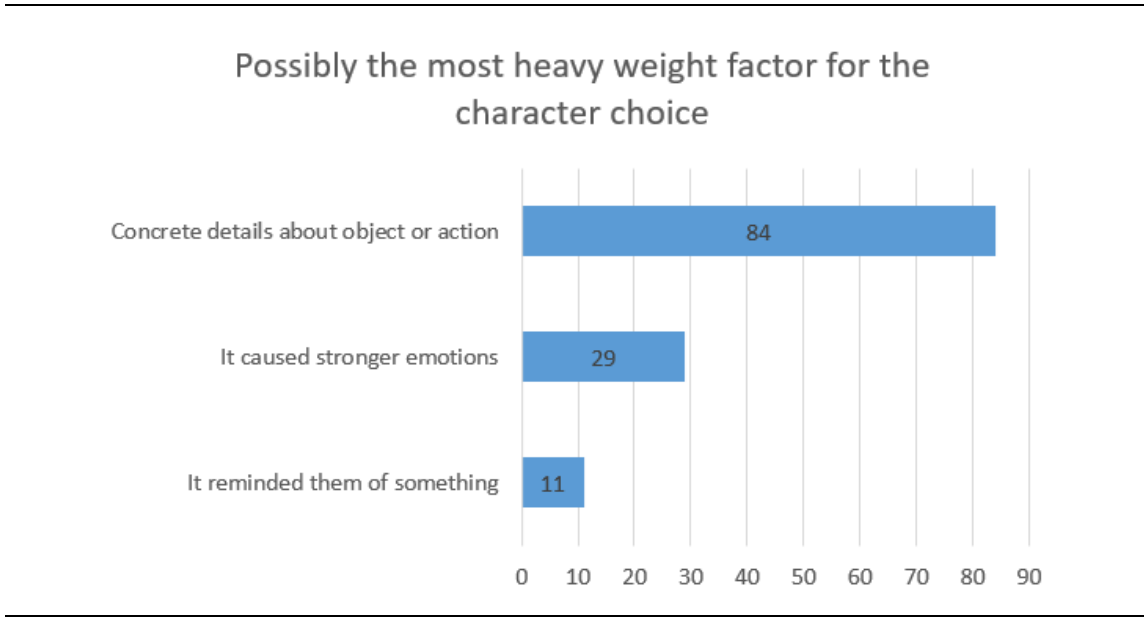

Figure 22: The seeming primary or most heavy weight factors for the character selection (my interpretation of their answers).

I counted concrete details of object or action when participant did not seem emotionally moved and talked about details; I counted "it reminded them of something" when the character reminded them of some character or animal they knew; and I counted "it caused stronger emotions" when they seemed emotionally moved.

Baby-schema and anthropomorphism in selected characters. Out of the characters' concrete qualities, I believe baby-schema clearly affected the selection in 8/124 of the cases (where the selected animal is in my estimation a baby animal) and designed anthropomorphism (i.e. at least the animal's facial expressions were computer generated) in 22/124 of the cases. 4/47 animals were baby animals, and 4/47 were anthropomorphic.

Nostalgia. The participants selected an animal that they had said reminded them of some other animal 16/124 of the cases.

Training. In the latter part of the interviews, I asked overly broadly about character preparation. Ten participants estimated they would modify a template, one estimated they

would build it from ground up, and one estimated they would train it ‘physically’ using AR.

Uncanniness. Most participants, 8/12, had no problem with the ‘Hollywood’ characters, while four considered them uncanny looking. Note, I focused more on the other research questions.

6.5. Recipient-character interaction

I asked questions about recipient-character interaction after each character selection in predefined scenarios, these are the results.

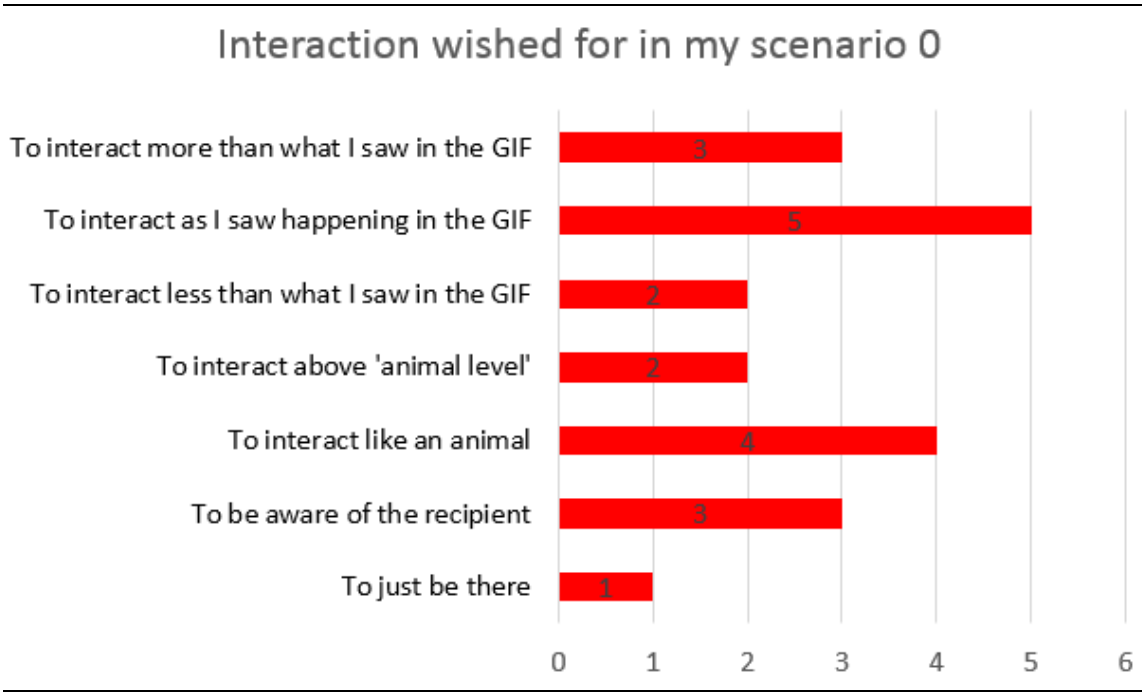

Figure 23: What the character-recipient interaction the participants wished for in my scenario 0 (“I love you”, friend) would look like

I present the “I love you” scenario results separate from other scenarios as I had left this scenario out for the participants who did not have experience in romantic text messaging (see Figure 23). The participants who did the “I love you” scenario preferred the character to interact as an animal would, for a while, whereas in other scenarios this was the least preferred type of interaction (see Figure 24). Perhaps animals are lovelier as normal animals. However, a very important detail is no participant spoke of the character as truly independent or as having a soul, as real animals have. The “to interact like an animal” and the other descriptions should be understood to mean only a short and limited appearance of independence. This applies to the next figure as well.

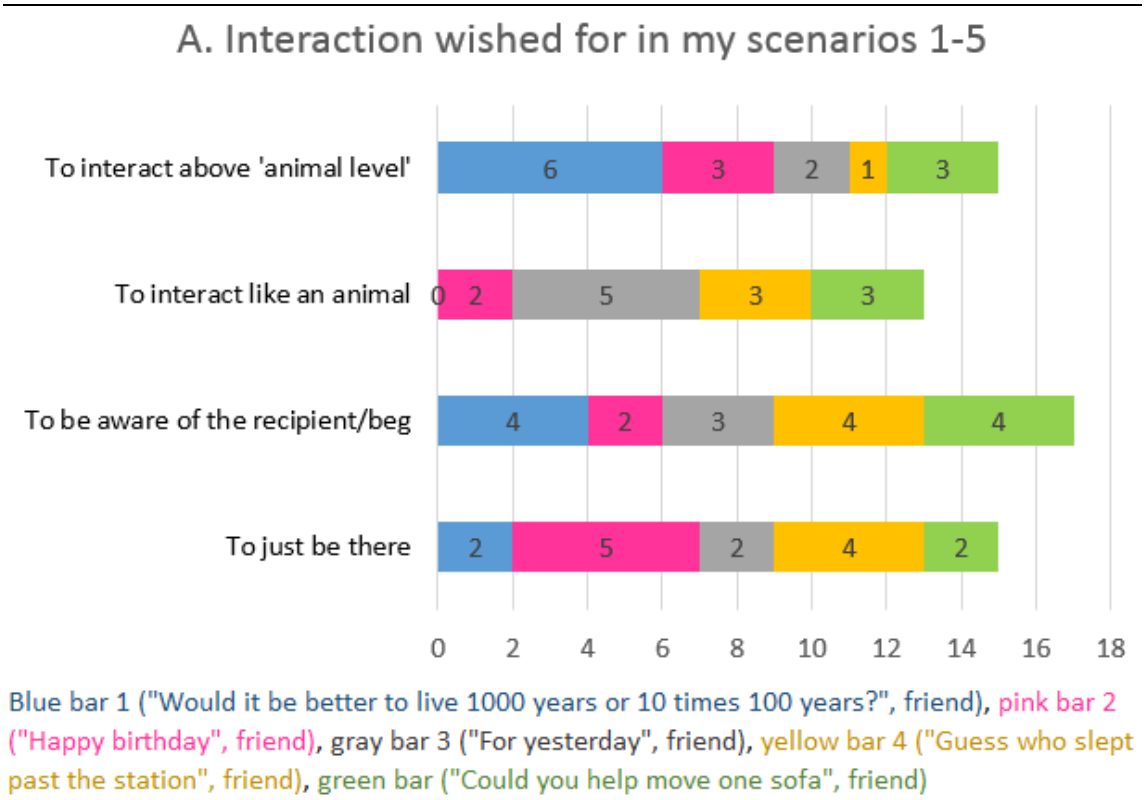

Figure 24: What the character-recipient interaction the participants wished for in predefined scenarios would look like

All the participants completed all the predefined scenarios, 60 scenarios are directly comparable to each other (see Figure 24). Seven participants needed all types of interaction, while five stayed away from ‘above animal’ interaction. However, as stated before, the interaction descriptions here are not literal, the participants did not wish for the character to have true independence. Moreover, I have counted speaking animal wishes into above ‘animal level’ interaction, but the wishes do not include recipient-character discussion.

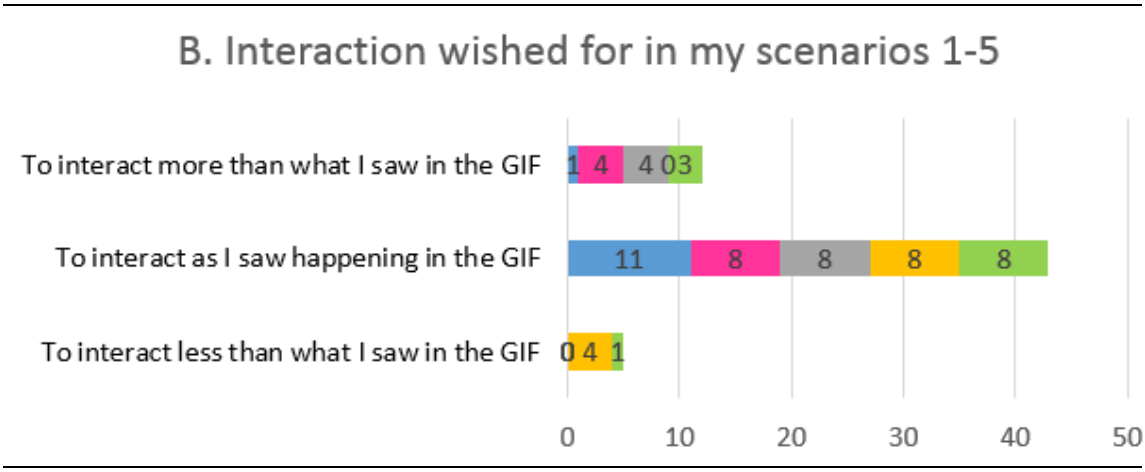

Figure 25: I interpreted how many times the participants wished for more, less, or the same interaction, as I thought was shown in the GIF.

The second figure (see Figure 25) shows that in most scenarios most participants said the character should interact as it did in the GIF, and that more participants wished for more interaction than wished for less. For example, if a GIF showed a human petting a cat, and they wished for the cat to appear with the message, but not interact, I counted that as “to interact less than what I saw in the GIF”.

6.5.1. Interaction in the participants' own scenarios

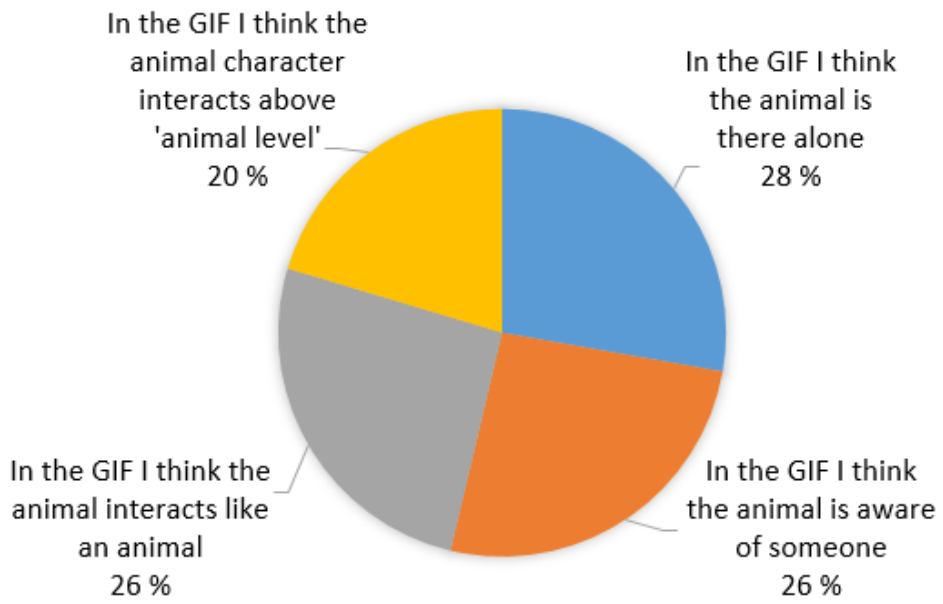

Figure 26: The interaction I saw in the GIFs that participants selected in their own scenarios.

In the participants' 54 own scenarios, where I did not ask them about the character-recipient interaction, the results look relatively like the interaction results from predefined scenarios (compare Figure 26 section sizes to Figure 24 total bar sizes). This suggests the amount of interaction they intuitively preferred was about the same as what they preferred after having to think deeper about it.

7. Discussion

In the discussion I primarily focus on knowledge that should help develop and study the ARimal concept further. My second focus is on how people would use the concept and what that may tell about present CMC.

Based on how researchers (Oulasvirta and Hornbaek, 2016) defined research problems, the study involved constructive research problems, as the main aim was to produce understanding for constructing the ARimal characters, and to lesser extent the user interface for using them. Second, the study involved empirical research problems, as it observed how participants sorted animals by their display of agency, to gain understanding about the phenomena of agency. Third, the study involved conceptual research problems, as it sought to explain the participants' character preferences and how they relate to present CMC.

However, the study was limited to general level research into the problems. The study was limited to using GIFs and video clips, as developing good looking animated 3-d animal characters would have taken too much time and effort. Moreover, the Web-app used to illustrate the concept was a low-fidelity interactive prototype, which only allowed studying the participants' first impressions and their speculation of how the concept might be used if it was fully functional. Next, I will discuss and interpret how the results answered the research questions.

7.1. The ARimal concept seems acceptable to people

The first research question was, in practice, whether the ARimal concept is acceptable. The answer to the question is that it appears acceptable.

The study participants were open minded towards the concept, though almost all of them said that they were satisfied with the current technologies. Moreover, when asked to invent scenarios, the participants said most often that anyone could be their recipient, and when they did imagine recipients, they imagined friends, family, etc. and not "only my father on a cloudy Sunday at six o'clock". This suggests the participant imagined the concept could be used quite often in the future.

Concerning the low-fidelity prototype that I made to study the ARimal concept, the study's use of it was successful; I believe it helped the participants to imagine using an AR messaging application.

7.2. Agency and interaction

The second research question was what is the desired level of character's agency for different scenarios? This research question meant: what kind of independent action the character should display, and: whether perception of agency can be divided into levels by using action criteria or not? Next, I interpret how the results answer the questions:

Determining an accurate enough framework for the level of agency for different kinds of interacting characters is difficult or outright impossible

The results from the sorting task suggest that it is reasonable to divide a set of animal characters into interacting and non-interacting, and say the non-interacting display less ability to act independently. They also suggest that it is reasonable to expect anthropomorphic characters to signal more ability. In other words, the results suggest that some of the paths taken by the mind to attribute mental states to animals, as discussed by (Urquiza-Haas and Kotrschal, 2015), are shared by many people. However, the results do not suggest that dividing a set of interacting animal character clips into less able and more able to act independently is reasonable, as the participants counted different things as signals of higher ability.

However, it is possible that the sorting task results would have been different if I had asked the participants to sort the least familiar category of animals instead of the most familiar, because memories might have biased what they saw as display of agency. Moreover, the results could have been different if I had used a set of GIFs of a single animal. I had used a variety of GIFs, the same GIFs as in the scenarios for the task; because I did not realize how differently people could view the same animal characters. People might agree more about the levels of agency displayed by just one animal.

If the study is repeated in the future, four agency level GIFs of one animal character should be cut of one shown in the scenarios (i.e. in the scenario there would be a barking dog, and in the sorting task the same dog, but sitting still, and so on).

Most participants invented use for all types of interaction, including 'above animal' type

The interaction preference results show that no participant wanted the same amount of interaction for every scenario, that above 'animal level' interaction was acceptable, and that the participants did not get stuck with the interaction shown in the GIFs but were able to ask for more. Five out of the twelve participants did not want 'above animal' interaction. However, there was not a clear yes-no divide between the two groups: Most of the five appeared merely to decide to play it safe after considering it.

However, the participants did not seem to mean there should be a 'futuristic artificial intelligence' interacting with the recipient

All the people I interviewed seemed to imagine sending the character to accomplish a set mission only, without having interaction involving a believable display of social intelligence. While the missions they imagined could be complicated and require the animal character to interact with the recipient, they did not seem to talk about believable human-animal like interaction. They did not say the animal should act realistic, or that it would have stimuli, learn, misbehave, change behavior, or anything else that I would

have interpreted to mean the character should be more believable than non-player characters in current video-games. Moreover, in the cases where the character was anthropomorphic, they did not seem to wish for the level of character-human interaction such characters are seen having with humans in movies (e.g. Marvel Studio's Guardians of the Galaxy movies include a raccoon character that is practically a human in a raccoon suit). They seemed naturally to think the recipient would be aware that they are not dealing with a 'futuristic artificial intelligence'.

However, the use of looping GIF animations to show the characters, the difficulty of putting such a wish about intelligence into words, and the society's unfamiliarity with artificial intelligence in general, could be plausible explanations why they did not seem to wish for believable socially intelligent interaction.

7.3. Character preference and use cases

The third research question was what presented animal characters participants preferred in different scenarios? This research question could also be expressed as: What characters were selected out of the selection of characters in messaging scenarios the participants created and in scenarios that I had designed?

The participants preferred animal characters that were active, and used them as actors to illustrate messages, which is difficult to do with GIFs, emoji and stickers

It seemed that the most common and most clear reason why participants picked one character representing GIF over the others was concrete details about object or action in the GIF. The participants tended to connect the objects and actions in the GIFs to the messages. As an example, one of the GIFs depicted a slow loris (i.e. 'a monkey with huge eyes') hanging from a vertical pole in a living room, and one participant chose it for my "help me move one sofa" scenario and wished the loris would hang from some furniture in the recipient's room.

The prevalence of the wishes for concrete illustration suggests people have a need for visualizing their messages with actors and props, which is something one cannot do in a normal face-to-face meeting, and that is difficult to do using emoji, GIFs or stickers. However, one must consider that these were choices made in interviews, not in real world scenarios, and the concrete stories could have been simply easier to imagine in the interviews.

The participants thought the animal characters could be used for any purpose, but they were most interested in using them to show one's own status and for asking for something

I had designed my messaging scenarios to cover dimensions of "showing you care", "showing how you feel,", and "persuasion". I had chosen these dimensions, because I thought they could benefit the most from the 'weight' the concept of AR character brought. The results seem to support the dimensions could benefit from the 'weight'.

However, the result came from the set of animal character GIFs that I provided, and the use scenarios were shown to be wished for only with these characters. To repeat the result, similar characters should be used. I believe the dimension of persuasion would be affected the most if the test were repeated with an entirely different set of characters, as there are probably more ways to show status than to show need.

Participants' familiarity with a species of animal and with an animal, did not usually appear to drive their choice

Future AR messaging character developers could benefit from the knowledge that participants' familiarity with a species of animal and with an animal, did not usually appear to drive their choice. The participants chose an animal belonging to a category of animals they said was familiar to them less than half the time. It was not important for the participants to use species of pets they personally knew.

I was surprised by how many times the participants chose unfamiliar animals and how many times a pig, fox, two monkeys and two lizards were picked. It seems that animal character unfamiliarity could be as important as familiarity. Moreover, the surprising result leads to a question: are people more interested in using even more unfamiliar characters than the presented? This study included only three animal characters that made the participants ask, "What is that?" Maybe the study did not include enough unfamiliar animal characters.

It is good to include some baby animals in the selection of animals

As shown in the results, of the animal characters I provided, 4/47 (8 %) were in my estimation baby animals. The participants selected them in 8/124 of the cases (6 %). In comparison, there were 4/47 (8 %) anthropomorphic characters and they were selected in 22/124 (18 %) of the cases, nearly three times as often. The result suggests that a few baby animals should be in the selection of animals.

However, it is possible that I had unintentionally included poor baby animal characters; that the participants were not able to imagine emotional messaging. Further study with different characters, and done by a different interviewer, could produce a different result.

7.3.1. Uncanny valley

The last research question was how participants described potentially uncanny looking characters? This research question could also be expressed as: Do participants comment that there is something wrong with a character or with the most anthropomorphic characters? I did not put as much effort into this question as into the other questions, as I wanted to focus on the others more, so the interpretation of the result is also not as long.

Most of the participants did not have any issues with the anthropomorphic characters

I asked whether the participants could use all the 'made in Hollywood' animal characters. Eight of the twelve had no problem with them, while four considered them uncanny looking. The acceptability by most was expected, as the characters' faces were of relatively high-quality and quality was known to be an important factor from Schwind et al. (2018). Moreover, this result was in line with what characters the participants picked in the scenarios. However, the humanlike interaction and humanlike appearance did not appear as equally uncanny, as some of the weirded-out participants considered humanlike interaction in the scenarios as an option.

When I discussed the uncanny valley with one of the participants, they wondered, "I cannot understand how some people could see these as uncanny, given the movies and all". It was a revealing comment. The study did not try to reveal why to some participants the 'Hollywood' characters are completely acceptable, while to some they are completely unacceptable.

7.4. Future work idea

I have an idea or wish that further study could be done in virtual reality (VR). I believe 'physically located' communication in AR may be developed inside VR, at least in early stages. Researchers could have a person and their good friend be inside VR environment, in separate rooms (separate both physically and virtually) and send messages to each other. The conditions could be: getting a message while sitting, getting a message while doing a task, getting a message with a virtual animal, and getting a message with a virtual animal while doing a task. In addition, in VR it could be studied whether a virtual character's virtual touch could communicate admiration, compassion, gratitude, and love, like a real touch.

8. Conclusion

The thesis contributed the speculative design concept, which I called the ARimal, and design related knowledge about animal characters, use scenarios, and character-recipient interaction, for further study and development.

The ARimal concept appears acceptable, and the participants imagined the virtual animal characters could be used to enhance common messaging in the future. The results of the study suggest the ARimal concept could improve on emoji, GIFs and stickers in all the ways mentioned in the introduction. Moreover, the results suggest the ARimal would not be used rarely like monkey and flower emoji.

Sending messages with emoji, GIFs and stickers is unnatural way of communication compared to face-to-face communication. The results suggest ARimal enhanced messaging may be a more natural form of communication, because the ARimal can look the recipient in the eyes and interact with them.

Moreover, it is hard or impossible to send emoji, GIFs and stickers to show complex expressions, such as "first I smiled, but then I grinned", because the emoji are not animated, the GIFs are hard to find, and the stickers are stylized and often too ambiguous. The results of the study support that ARimal could solve the issues, except the issue of ambiguity, as the ARimal would be animated, intended for enhancing messages from the start, and the characters would not be stylized but rather realistic looking and customizable. The ARimal might not solve the issues of ambiguity as it does not prevent the sender from falsely assuming the recipient will understand the character's expression.

Moreover, the results suggest the ARimal's 'physical' presence could affect the interpretation of the message. With the ARimal, the sender could, to a degree, control the recipient's circumstances of receiving a message. However, the study did not investigate questions such as where the ARimal should be received and when.

The study also involved a theory on agency. The study attempted to find whether it would make sense to claim an animal character displays more agency than another animal character. The results suggest it may not make sense to divide interacting characters into agency levels, but anthropomorphic characters may be placed above non-anthropomorphic and non-interacting under interacting in their amount of display of agency.

Overall, the thesis study shows the communication using AR technology should be studied further and that more thought could be put into reality-perception continuum of agency and intelligence. I propose studying the type of communication, where animal characters are sent with text, in a live setting in virtual reality, between two people.

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Appendix 1

Introduction to the interview in Finnish

Tervetulotoivotus ja tarkoitus

Kiitos että osallistuit tähän haastattelututkimukseen ja autat minua graduni kanssa. Aluksi annan sinulle hieman tietoa siitä, mitä tulet näkemään, ja aikaa kysyä kysymyksiä ennen kuin aloitamme.

Tänään pyydän sinua arvaamaan, miten käyttäisit tulevaisuuden viestintäteknologia konseptia. Päämäärä on nähdä mitä arvaat ja miksi.

Haastattelijan rooli

Minun roolini on ohjata sinut konseptin läpi, kysyä sinulta kysymyksiä, ja kuunnella vastauksiasi ja kommenttejasi tarkasti.

Haastateltavan rooli

- Pyydän sinua varmistamaan, että ymmärrät pian esitettävän konseptin.
- Voit kysyä niin monta kysymystä konseptista ja tutkimuksesta kuin haluat.
- Sen jälkeen pyydän sinua arvailemaan mitä vaihtoehtoja käyttäisit konseptin sisältä ja miten.
- Vääriä vastauksia ei ole.
- Jos sinusta tuntuu milloin tahansa, että olet hukassa tai et pysty etenemään saamiesi tietojen varassa, niin kerro minulle. Tämä ei ole suoriutumiskoe.
- Ääni-nauhoitan tämän haastattelun myöhempää tarkastelua varten. Sinun nimeäsi ei liitetä eikä mainita tämän haastattelun löydösten yhteydessä. Tästä on vielä erillinen lupapaperi.
- Lopussa kysyn muutaman kysymyksen haastattelun sujumisesta.

Onko sinulla kysyttävää ennen kuin aloitamme?

Appendix 2

Prototype walkthrough script in Finnish.

Olen tehnyt tätä tutkimusta varten prototyypin, joka esittää lasit päässä tosimaailmaan sijoittuvaa viestintäsovellusta. Tämä esittää tilannetta, jossa henkilö istuu pöydän ääressä lasit päässä ja käyttää läpinäkyvää sovellusta.

Kuplat esittävät kuvitteellista keskustelua ja ovat olemassa ainoastaan mielikuvittelun tukemiseksi.

Ylävasemmalla näkyy aina vastaanottajan nimi ja alhaalla olevassa viestikentässä näkyy se viesti mikä hänelle on tarkoitus lähettää.

Viestikentän vieressä on painike jossa on lasit, sillä avataan valikoima virtuaalihahmoja jotka voi lähettää viestinä tai viestin lisänä.

Hahmoesityksen painaminen avaa esikatselutilan.

Esikatselutilassa ei nyt ole ääntä, mutta hahmo voisi ehkä pitää ääntä.

Jos meillä olisi oikeasti toimivat lasit päässä, videon oikealla puolella oleva painike "Laseihin" avaisi hahmon ruudun ulkopuolelle.

Esikatselusta pääsee tarvittaessa takaisin hahmovalintaan painamalla nappia "Takaisin".

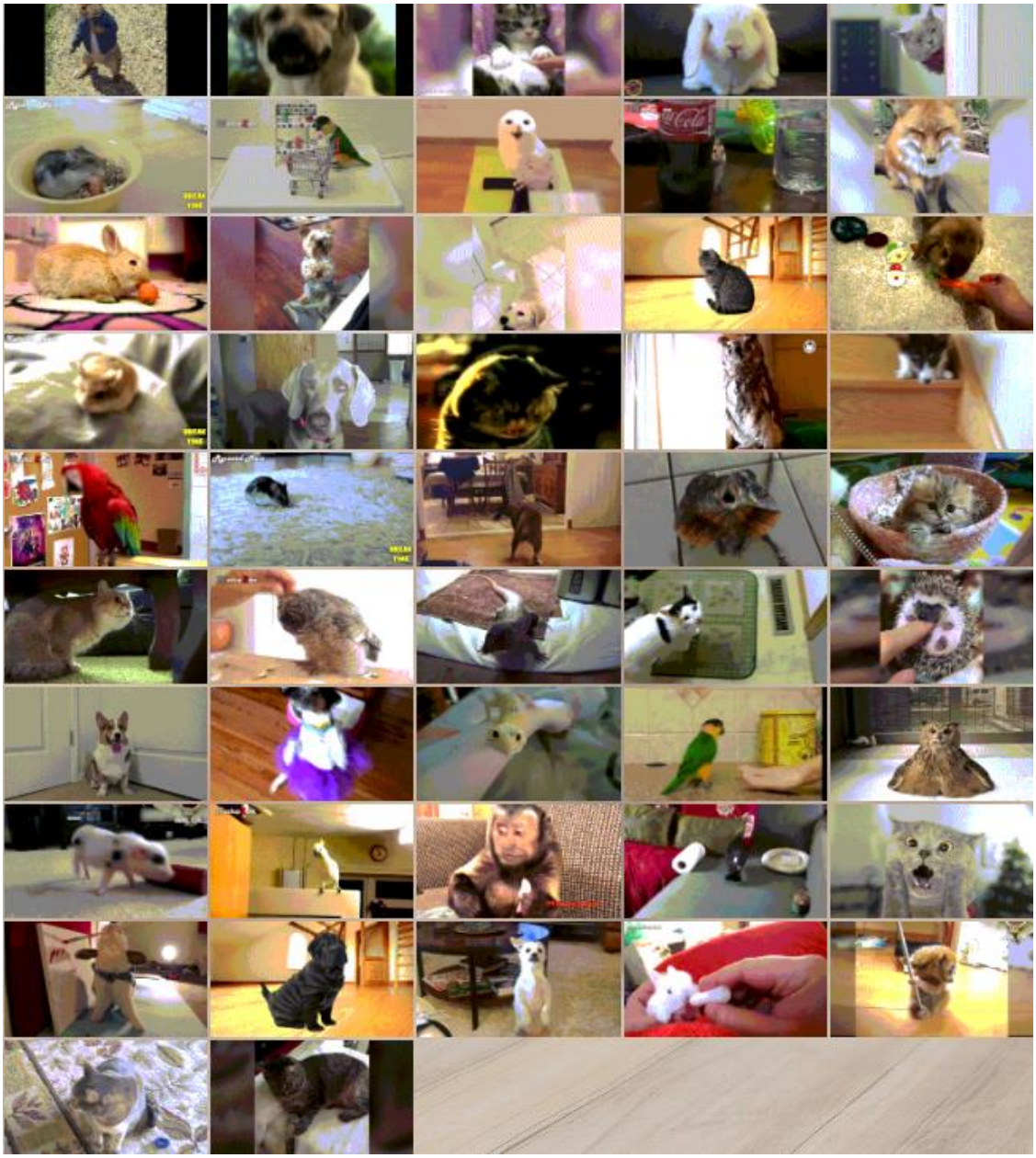
Painamalla "Valitse", avautuu kysymyskenttä, jota käytetään haastattelussa.

Appendix 3

GIFs that represented augmented-reality animal characters.

Link to Microsoft Onedrive archive:
https://1drv.ms/f/s!AipX7oEND6CehOkZ8jGkACIrNbrNlg
Password to the archive:
I_will_not_use_these_without_permission

Screenshot of the GIFs:



Appendix 4

This is a description of the data/details I looked for in the interviews. The details I looked at in interviewees' own scenarios as whole:

- Their imagined recipients?
- Their messages / message types?
- How many of scenarios participants suggested were the same as mine?
- How many times each GIF was picked?
- Did mentioned familiarity with the type of animal (e.g. cats) matter?
- Did mentioned familiarity of the animal matter?
- Did animal's age matter (baby-schema)?
- What were the 'final selection reasons' (seemingly) for a GIF?
- What manner the message was seemingly sent (e.g. playfully)?

By predefined scenarios and as a whole:

- How many times each GIF was picked?
- Did mentioned familiarity with the type of animal (i.e. cats) matter?
- Did mentioned familiarity of the animal matter?
- Did animal's age matter (baby-schema)?
- What were the 'final selection reasons' (seemingly) for a GIF?
- How often was the character wished/described as not being (e.g. a video), being, being aware, wanting something, interacting like an animal, interacting in a way an animal could not? How many times this matched with my perception of the GIF? How many times the wish was for more or for less than what I saw in the GIF?
    - Last in the scenarios data, I compared the interviewees' scenarios to mine (were their imagined recipients, intents and messages similar).