Empathy with Robots?
Exploring Emotional Responses to Artificial Entities
by
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a Thesis submitted in partial fulfillment
of the requirements for the degree of

Doctor of Philosophy
in Psychology

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Date of Defense: May 13th, 2016
Statutory Declaration

I, Christina Anne Basedow, hereby declare that I have written this PhD thesis independently, unless where clearly stated otherwise. I have used only the sources, the data and the support that I have clearly mentioned. This PhD thesis has not been submitted for conferral of degree elsewhere.

I confirm that no rights of third parties will be infringed by the publication of this thesis.

Bremen, May 31st, 2016

Signature _______________________________
Dedication

For Mommy-Tulip and Daddio

With love to the moon, to the sun,

and back again.
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Dissertation Summary

The primary purpose of this dissertation is to investigate emotional and empathic responses to humans and to artificial entities. This thesis explores the similarities and differences in how we respond to each other, and to artificial entities. In addition, it uses research on human-artificial entity interaction to better understand what makes a response empathic and differentiates it from emotional responding. Finally, it examines how we emotionally and empathically respond to destruction of certain objects, and how responses differ based on the meaningfulness of the objects being harmed. This dissertation uses experimental results to explain how and why we feel emotions and empathy for things that are only sort of alive and what this means for us as humans in a world where our digital culture is constantly evolving.

Chapter 1 offers a general introduction to research on interaction and communication between humans, as well as between humans and artificial entities. In addition, a brief overview on theory and empirical evidence regarding emotional responses and empathy is provided. Chapter 2, Article 1, is a literature review on empathy. It uses human-artificial entity interaction research to illuminate a new perspective on empathy and emotional responses for things that are perceived as sort of alive and how this challenges previous ideas on empathy and emotional responding. In addition, it discusses what differentiates emotional from empathic responding. Chapter 3, Article 2, presents the results of experiment 1 and 2, drawing conclusions on the affective impact of artificial entities versus humans and various moderating factors. Chapter 4, Article 3, presents the results of experiment 3, which indicate that we do not only emotionally respond to artificial entities, as seen in Article 1, but we also can have empathic responses to objects, things, and entities. Chapter 5, the Discussion, presents a synopsis of the results of experiment 1, 2, and 3, and the literature review. It organizes the research presented into the central themes of this dissertation and discusses these themes based on the experimental results. This section also describes limitations, and
the future implications and research questions that are outcomes of this work. The Appendices offers a summary of all experimental pretests, including the development and creation of experimental stimuli. In addition, it offers background information into how experimental decisions were made, and contains all the experimental forms used.

In sum, this dissertation aims to offer new information on emotional versus empathic responding to artificial entities, and how these responses shed light on our shared humanness. The research presented shows new ways of looking at empathy and emotional responding; it illustrates that by researching how we interact with technology and other entities, we can learn much about being human. Finally it sparks new research ideas and describes future implications that are not only important for academia and further research, but also for how we understand ourselves, our feelings, and our responses in a digital culture that is rapidly advancing.
Chapter 1

General Introduction and Background
Summary

The first chapter describes the theoretical foundation and motivation for all studies within this thesis. The first section presents an overview of the relevant central concepts: human communication and interaction, verbal and non-verbal behavior, the role of emotion in social interaction and its evolutionary significance. The second section addresses mediated communication, how humans interact and communicate with technology (particularly computers), the impact of this type of communication on human relationships, and what humans expect from, and attribute to, technology. The next section focuses on research describing how humans relate to artificial entities and how a variety of factors, such as levels of importance, realism and emotional context impact our evolving relationships with these entities. This also includes a discussion on what is currently known about our emotional responses to artificial entities. Thereafter, I discuss the concept of empathy including its measurement, and its impact on communicative processes, further exploring the impact of empathy on interactions between humans and between humans and machines. In presenting empathy, various other concepts that are often confused with empathy will also be explored. The chapter then outlines the goals of this PhD thesis and subsequent hypotheses, in addition to the motivation behind them. Finally, an overview of the conducted research illustrates how the research questions were specifically focused upon describing, including how it was broken down into one theoretical article, and two research articles and three experiments, is presented.
1.1 Human Communication and Interaction

In The Descent of Man, and Selection in Relation to Sex (1981) originally published in 1871, Charles Darwin expresses that human behavior is likely to have evolved out of naturalistic mechanisms that stem from an increased reasoning ability developing as the human species evolved, and in addition from a natural selection at a group level which increased evolutionary fitness. Darwin (1981) theorizes that the selective advantage of the group and the evolution of individual behaviors, which also increases the group’s selective advantage, are both very beneficial to the individual itself. Therefore, Darwin (1981), and many evolutionary theorists that came after him, understand that group interactive processes are key behavioral components facilitating natural selection. Darwin continued to examine, in The Expression of the Emotions in Man and Animals (1965) originally published in 1872, emotional elements of our interactive behavior, with his basic conclusion that human emotional expressions are evolved, and to a certain extent, adaptive. Darwin (1965) did not believe that the sole purpose of emotions is only to either protect an organism or to prepare it to take action; instead, he believed that they also serve a vital communicative purpose. Being able to signal internal states is important, as it provides the necessary information for social coordination along with the accurate perception of, and proper responses to, a situation (Darwin, 1965). Furthermore, when behaviors serve their adaptive and connective functions, they become learned and ritualized (Eibl-Eibesfeldt, 1985); perception becomes more accurate, leading to greater social affordances between sender and receiver (Gibson, 1966, 1977). Consequently, it becomes apparent that in order to understand human communication and interactive processes, we must be aware of their biological and social origins, their evolutionary development and how communication systems are present across all populations (including animal species) and all cultures (Capella, 1971; Buck & Ginsburg, 1991, 1997; Tamariz, Ellison, Barr, & Fay, 2014; Tomasello, 2008).
A key component of human behavior is communication; unless an individual is living in solitary confinement, communication is a vital interactive component of everyday life. The evolutionary underpinnings of human communication illustrate there are many characteristics of communication that serve a variety of functions (Wilson, 1979). Broadly defined, human communication “…refers to the process of human beings responding to the symbolic behavior[s] of other persons” (Adler & Rodman, 2000, p.2). Behaviors can be understood as communicative if they reduce the ambiguity of another’s behavior in some way (Buck, 1984). Communication also involves a symbolic system (e.g., language, gestures, eye gaze, posture, etc.), that is socially shared and accepted which allows for spontaneous behavior to be interpreted as communicative (Weiner, Devoe, Rubinow, & Geller, 1972). Communication between humans is a continuous process, marked by symbolism, both verbally and non-verbally (Adler & Rodman, 2000). Nonverbal behavior is usually not intentionally sent to the receiver, however, it is often recognized and interpreted the receiver; these nonverbal acts are often used and acknowledged within specific social or cultural groups, and are often a function of both the social context and the emotional content of what is being responded too (Burgoon, Buller & Woodall, 1996; Fridlund, 1991). Furthermore, various types of communication exist, including intrapersonal, interpersonal/dyadic, small group, public and mass communication. All these different types of communication fulfill various functions, which include meeting humans’ physical needs, identity needs, social needs and practical needs (Adler & Rodman, 2000). Humans are highly evolved in their communicative ability, and they typically send and receive multiple messages at the same time; this process is highly relational (Hurford, 2008; Hari & Kujala, 2009). Interactive processes are not solely about generating or receiving social signals, but instead the essence of interaction is the pattern of exchange between individuals (Capella, 1991). Apart from general patterns involved in communication, researchers have continued to explore what
types of universal dimensions exist in human communication. Examining human communication from an emotional viewpoint, Scholl (2013) believes human interaction is focused along three specific dimensions, to meet various needs: affiliation (valence), power (dominance/submissive) and activation (affect intensity), and that “…humans construct their social world along these three dimensions of socio-emotional perception and action” (p.5).

These interactive processes are shaped by various types of verbal and nonverbal communication, and the social regulation of emotion in communication leading to individual and group construction of the social world.

In communicative processes, particularly during human face-to-face interaction (F2F), our verbal and nonverbal behaviors are typically coordinated: the sender and receiver engage most often in turn taking behavior and also hold their bodies/extremities and gaze in specific ways while showing emotional expressions that can be correlated to the types of communication and communicative content that is being shared (Jones & LeBaron, 2002). This sharing is addressed in research on imitation, linked to the facial feedback hypothesis (Laird, 1984; Strack, Martin, & Stepper, 1988) and motor mimicry; in which “…people automatically and non-consciously mimic the behaviors and mannerisms of their interaction partners…” (van Baaren, Decety, Dijksterhuis, van der Leij, & van Leeuwen, 2009, p.32). This connects to the work of Darwin (1965) and Lanzetta and Kleck (1970), discussing facial modulation, in which the face becomes a feedback system that influences the formation of emotion and subsequent levels of communication (Levenson, 1994). Verbal and nonverbal communication has historically been described as two separate processes however criticisms against isolating these from one another are prevalent (Kendon, 1977; Mead, 1975). Progress has been made in studying communication as a process that involves both verbal and nonverbal behaviors, with more researchers understanding the interrelationship of these processes as imperative to human communication and interaction (e.g., Auer & Di Luzio,
Verbal communication is the expression of sounds and/or language to convey a message to another (e.g., Hari & Kujala, 2009). The messages that are often conveyed by vocal signals can indicate much information about the sender such as their affective state, and even various personality traits (Kappas, Hess, & Scherer, 1991). Non-verbal communication includes: facial expressions, paralinguistics (e.g., tone, intonation), gestures, body language/posture, proxemics (e.g., personal space), haptics (e.g., touch), physical appearance, eye gaze and the use of artifacts (e.g., images) (Adler & Rodman, 2000). Social groups, cultural and environmental influences further impact, influence, and shape both forms of communications. For the purpose of this thesis, based on the research presented, communication is described as a process in which the behavior of the sender impacts the behavior of the receiver (and vice versa); these behaviors can be spontaneous or intentional and can include both verbal and nonverbal behavioral acts. Impacting the receiver can be understood as the receiver having any type of response, verbal and/or nonverbal, to the behavior of the sender.

In discussing the complexities of human communication, it would be impossible to ignore the central function of emotions and emotional events within interactive processes; particularly as the experience and perception of emotion is central to this thesis. Emotions are often considered to be intraindividual processes that are highly personal, however further research identifies that emotions are also highly social (e.g., Parkinson, 1996) and that they can also be considered components of interindividual processes (Kappas, 2013). Darwin (1965) also highlighted the social nature of our emotional expressions and regulation. Fridlund (1991, 1994) postulates in accordance with Darwin’s ideas, that our emotional expressions are primarily linked to the achievement of social goals. The view that emotional displays are associated with both emotion goals and social goals has been readily accepted.
(e.g., Hess, Banse, & Kappas, 1995; Parkinson, 2005), and this impacts how we understand human communication and interaction (Kappas et al., 1991). The majority of our affective experiences occur not individually, but rather as a function of our various social interactions whether with family, friends, or at work, in dyads or in larger groups. This is additionally influenced by the shared knowledge present in a culture or social group, and what is accepted or rejected based on various social, feeling and display rules (Ekman & Friesen, 1969; Hochschild, 2003; Matsumoto, 1990; Mesquita & Ellsworth, 2001). Kappas describes “…emotions as social processes” (2013, p. 3), that are a function of our present experiences and are a part of emotion sharing in some form of personal context. When looking at the many facets of human communication, we cannot ignore the social regulation of emotions and how this impacts the interactive process; in addition, how every layer of communication can influence the experience or generation of emotions.

Finally, as a result of the increased influx and acceptance of technology into our daily lives, the discussion of human communication and interaction would not be complete without addressing mediated communication. The study of human communication through various sources of electronic media has evolved dramatically since one of its first empirical reviews by Williams in 1977. At that time, thirty studies were reviewed addressing how human communication was affected by various telecommunication media and how these types of media would either hinder or advance dyadic or small group interaction (Williams, 1977). Since this time, technological advances and a more globally connected population have increased the reliance on, and acceptance of, mediated communication. Many people, laymen and researchers alike, are commenting that nowadays mediated communication has the same impact and can be as intimate as F2F interaction (e.g., Derks, Fischer, & Bos, 2008; Kappas & Krämer, 2011; Walther, Anderson, & Park, 1994). The major difference between these two types of communication is the difference in social preference (Short, Williams, & Christie,
Mediated communication refers to sharing a message (e.g., text, audio, visual) through any type of medium or device (Adler & Rodman, 2000). “Mediated communication includes mass communication, mediated interpersonal communication, and communication through converged media that are both mass and interpersonal in nature” (Adler & Rodman, 2000, p. 21). Mass communication, as in television, or printed press typically lacks interaction and feedback, so this does not resemble typical human interaction. However, mediated interpersonal and converged communication describes everyday tasks such as talking on the phone, writing emails, text messages, communicating via internet chat, and other related forms of interaction. The field of computer mediated communication (CMC) is increasingly interested in the emotionality of interactive exchanges that happen via this medium and how they are similar and different in comparison to F2F interaction. A key criticism of mediated communication is the lack of important nonverbal cues that can be sent and received (e.g., Williams, 1977; Culnan & Markus, 1987), however, as technology develops, many argue that the use of emoticons and other symbols/emblems within mediated communication are equivalent to nonverbal behaviors in F2F interaction (Derks et al., 2008). Further research identifies that CMC has provided people with the opportunity to express themselves without constraints that can be present during F2F communication (Ellison, Steinfeld, & Lampe, 2007; Mazer, Murphy & Simonds, 2007). This helps to explain the success of chat networks, online dating sites, support groups, and computer-mediated therapy (McKenna & Bargh, 1999; Lange, Van de Ven, & Schrieken, 2003; Derks et al., 2008). Some individuals preferring the CMC format to express their most personal and intimate thoughts, feelings and issues (e.g., Postmes, 1997; Miller & Gergen, 1998); the anonymity of this medium is proving to be its strength. These mediated forums, especially now that they are more socially accepted, provide a person with a place to self-disclose emotional experiences that was not
present before. Contrary to prior concerns, this form of communication is in fact reinforcing the communication of emotions, rather than shutting it down (e.g., Derks et al., 2008). A strength of mediated communication in dyadic or group interaction is that emotions are more controlled; individuals appear to have more time to cognitively appraise their responses because of the distance between sender(s) and receiver(s); this is believed to make the communication of emotional experiences in CMC safer than in the F2F context, particularly in relation to negative emotions (McKenna, Green, & Gleason, 2002). The increase in, and support of, mediated communication is likely responsible for the high level of importance placed on various technological devices. Mediated communication allows us to maintain intimate connections with others over specific devices; therefore, we assign these devices more personal meaning than ever before. This concept is important for this thesis as it illustrates our emotional connection to technology and the ever increasing acceptance of it in our everyday lives.

1.2 Human Computer Interaction

Social interaction has been most commonly studied in communication between humans. However, as communication technology progresses, the interest surrounding social interaction involving also technological systems has grown; particularly as it challenges a preexisting concept that complex social interaction requires capabilities which are possessed only by humans (Weber, 1947; Cerulo, 2009). This has been challenged by researchers questioning why human restrictions have been placed on the study of social interaction. Addressing this concern, actor-network theory (ANT) is a theory of social interaction that maps our relationships between each other, objects and even ideas while treating all of these factors as entities within the social network of communication (Callon, 1987; Cerulo, 2009; Law, 1987). ANT identifies that within social interaction there is an actant, and this can be any entity, human or nonhuman, that attains the ability to create change or impact the
interactive process (Callon, 1987; Cerulo, 2009; Law, 1987). This theory changed traditional views on interaction, stating that “…nonhumans are something much more than props…[they] mediate interaction in ways as significant as those of humans” (Cerulo, 2009, p.534). This does not assume humans and nonhumans are treated equally within the study of interaction (Williams-Jones & Graham, 2003); however, it suggests a critical analysis of human interaction with nonhuman entities. Cohen (1989) suggested that humans enter into social exchanges with nonhumans by assuming there is the potential to interact with them and there is mutuality between them and it therefore becomes irrelevant if the nonhumans possess traditional interactive capacities (e.g., Appadurai, 1986; Kiesler & Kiesler, 2004). Interacting with a nonhuman entity as though it possesses human communicative abilities is speculated to occur mindlessly (Langer, 1992) in other words, without the communicator explicitly thinking about this. The automaticity of granting some aspect of sentience to any communication partner, including a machine, could be explained by our evolutionary history of social interaction with others and the environment, along with these responses being necessary for the attainment of goals linked to survival (e.g., Barkow, Cosmides, & Tooby, 1992; Owens, 2007; Jerolmack, 2005, 2009). Even if it appears to be inappropriate to the interactant, we tend to automatically accept things that seem real, even if they are clearly not, and this tendency is based on our past experiences (Bargh, 1988; 1992; Reeves & Nass, 1996).

The study of human interaction and communication is now being greatly impacted by research on how humans interact with nonhumans. In recent years, the subject how humans interact with technology has captivated the interest of researchers. In our advancing society, how humans relate with nonhuman entities such as animals, toys, and other objects, has become more relevant. The focus has been directed with great interest to how humans accept and communicate with different forms of technology, especially computers and other
artificial entities such as robots, virtual characters and avatars. Reeves and Nass (1996) developed the concept of the Media Equation, “…media equals real life” (p.5), to describe how humans interact with and respond to computers, television and new media. Reviewing over thirty-five conducted studies, Reeves and Nass (1996) drew two conclusions: “…individuals’ interactions with computers, television, and new media are fundamentally social and natural just like interactions in real life” (p.5) and “…people respond socially and naturally to media even though they believe it is not reasonable to do so, and even though they don’t think these responses characterize themselves” (p.7). The Media Equation is fundamental to this thesis as it illustrates that people expect media, in various forms, to follow social rules, which are applied from experiences with human to human interaction. In addition, these social responses to various types of media are unconscious and happen among all types of participants (Reeves & Nass, 1996). If human beings perceive non-human entities, or things, as real or as existent interaction partners, these perceptions will greatly impact the communicative process and therefore “…we should not worry as much about whether media are the same as their real-world counterparts, and instead think more about whether media are perceived as identical” (Reeves & Nass, 1996, p.11).

Humans may consciously describe and identify computers as machines, but this does not stop the elicitation of strong social responses to them (Smith et al., 2012). Research continues to accumulate with respect to human interaction with computers and the similarities in communication to human to human interaction (Adler & Rodman, 2000; Thorne, 2008; Thurlow, Lengel, & Tomic, 2004; Walther, 1996). In testing the Media Equation, Reeves and Nass (1996) discovered that people followed the social rule of politeness when interacting with computers. They used both live human-computer interaction and the presentation of images on computer screens to examine the social rules participants follow when interacting with computers (Reeves & Nass, 1996). Examining their choice of stimuli presentation
methods is an important aspect of this thesis as it indicates humans can be as affected by the presentation of still images as they can be by video or real live interaction. Further studies illustrate that the application of social rules and expectations was extended past politeness and reciprocity; humans in various experiments would accept and identify with a computer that was assigned a gender and ethnicity, and thus truly socially categorize the machine (Nass & Moon, 2000). In further studies, computers were assigned “expertise”, which resulted in participants judging the content presented as higher in quality and more accurate in comparison to “generalist” computers (Nass & Moon, 2000). This research further connects the theory of mindlessness to the acceptance of technology. Even personality can be similarly manipulated; when participants are paired based on their personality with either a “dominant” or “submissive” machine, they respond more positively, conform more frequently, and assign higher “intelligence” to machines that match their traits (Nass & Moon, 2000; Nass, Moon, Fogg, Reeves, & Dryer, 1995). Humans also can be complimented and pleased by computers offering flattery, and they will treat them as teammates when told to perform together on a group activity (Fogg & Nass, 1997; Nass, Fogg & Moon; 1996). In examining more complex responses such as betrayal, evidence exists that humans will respond behaviorally with anger and become spiteful (preventing a reward) to a computer that participates in an ultimatum-type game (Ferdig & Mishra, 2004). In addition, a recent study illustrates that appraisal components central to anger development, are predictive of the intensity of anger felt in various provoking human-computer interactions, and that anger-related responses to computers are linked to the concept of Ethopoecia (Charlton, Kappas, & Swiderska, 2015). Since these responses are social and natural, individuals then must simply accept various forms of media as ‘real people and places’ (Reeves & Nass, 1996, Nass & Moon, 2000). It can be concluded that rules of etiquette, politeness, personal space, judgments of praise and criticism, emotional mediation, personality mimicry, in-group versus out-group are all
psychological principles that are not only observed and studied exclusively in human-human interaction but also in human-computer interaction. Nass and Moon (2000) identify that the mindless attribution of traits to computers and other media sources are rooted in the “…overuse of human social categories, over-learned social behaviors, and premature cognitive commitments” (p.82). The research presented in this thesis indicates that humans have both objective and subjective emotional and social responses to artificial entities and other relevant objects that resemble responses seen to human interactants in human to human interaction.

1.3 Human-Artificial Entity Interaction

As technology advances and becomes more present, so does our apparent acceptance of it. How we interact with everyday technology, as previously discussed, is similar to how we would communicate in a F2F interaction with a human. Recently, the types of technology we interact with have evolved. They are no longer confined to one human interacting with a single computer for example in the context of tasks such as word-processing or ‘number-crunching’ (HCI) or a variety of forms of mediated communication (telephone, texting, messaging, Skype, etc.). Instead, we are now finding ourselves in a world that presents an ever-growing offering of artificial entities, such as conversational agents programmed and ready to communicate with us. For the purpose of this thesis, an artificial entity can refer to any type of virtual or embodied avatar, agent, or character, and any virtual or embodied robot (e.g., toy, assistive, educational, and/or humanoid). The level of awareness of technological advances in the general public is mixed. Hence, discussions about robots or autonomous conversational agents are taken by some as elements of science fiction. In reality, the fields of HCI and human-robot interaction (HRI), or artificial intelligence (AI) as an overarching discipline, are already creating artificial entities that can interact autonomously with humans in a social way for minutes or, in some cases, much longer (e.g., Lucas, Gratch, King, &
Morency, 2014). The question of how we perceive, interact with, and accept artificial entities is of great interest to researchers on both sides of the divide; how do we behave when we are exposed to different types of entities is of interest to the engineers who want to build effective artificial social systems and to the behavioral researchers who hope to get a better understanding of human communication by studying these new types of interactions.

The Media Equation was recently revisited in a study examining embodied conversational agents, looking to explore whether the results found in the HCI condition (Reeves & Nass, 1996) could be replicated when humans interacted with an agent (Hoffmann, Krämer, Lam-chi, & Kopp, 2009). Participants interacted with an embodied agent as would be socially expected in human to human interaction; more specifically, results indicated when a robot directly engaged with humans, they responded with higher levels of politeness than with indirect engagement. This was followed by research examining how similar our interaction is with artificial entities and whether this is a result of our social ‘nature’ (Nass & Moon, 2000); whether our interaction routines will continue to dictate how we respond to artificial entities (Krämer, von der Pütten, & Eimler, 2012) and finally what moderates these responses. It was found that humans interacting with artificial entities will attempt to apply habituated forms of communication, which are more typical to social human-human interaction (Krämer et al., 2012). In addition, if human-artificial entity interaction has a high similarity to human-human communication, it is more likely that a meaningful interaction will take place (Krämer et al., 2012).

In fact, the similarities and differences between inter-human and human to artificial entity communication have recently been explored in depth. There is increasingly a belief that in terms of behaviors, humans will interpret any behavior, performed by either a computer or other artificial entity, as a communicative act and humans will establish relationships more quickly if an exchange relationship (balanced cost-benefit) is established (Krämer et al.,
This research further concludes that humans will continue to apply interaction rules and relationship forming concepts that are rooted in interaction between humans towards their interaction with artificial entities. These similarities provide the basis of developing relationships and interactive exchanges with artificial entities (Krämer et al., 2012). While the Media Equation has been evoked to explain interaction between humans and artificial entities, there are also slightly different theoretical frameworks as will be discussed in the next sections.

Despite the results of the research presented in the previous section, it cannot be concluded that humans treat and respond to artificial entities in the exactly same ways they would respond to humans. There are numerous examples that humans interact socially when exposed to different types of artificial entities (e.g., von der Pütten, Krämer, Gratch, & Kang, 2010; Gratch, Wang, Gerten, Fast, & Duffy, 2007; Krämer, Simons, & Kopp, 2007; Nass, Moon, Morkes, Kim, & Fogg, 1997). However, theories of communication and interaction cannot explain why humans respond socially to entities knowing they are machines, and why some entities elicit stronger responses than others. Many different theories attempt to explain why humans interact socially with a variety of entities. Simple explanations such as the innovation hypothesis assume that humans’ social responses to computers are simple novelty effects and they will disappear once the user has familiarized themselves with the entity (e.g., Kiesler & Sproull, 1997). The deficit hypothesis, shares some similarities to the concept of mindlessness (Langer, 1992), in which theorists assume that social interaction with an entity stems from a deficit on the part of the interactant, such as limited knowledge or inexperience (e.g., Turkle, 2011; Jin, & Park, 2013). Some believe social behavior directed towards entities or other non-human objects are actually directed towards the programmer, developer or controller of the entity (e.g., Searle, 1980). For the context of this thesis, I will focus on two specific frameworks – in addition to the more general notion of the Media Equation: namely
the concepts of Ethopoeia and the Threshold Model of Social Influence. The two frameworks will be explored in how they seek to explain human to artificial entity interaction and the emotional responses to artificial entities. The Uncanny Valley and Anthropomorphism will also be discussed in how they differ from Ethopoeia and moderate or influence our interaction with artificial entities.

Ethopoeia has its foundation in humans being unaware of their social responses and being mindless about how and why they attribute meaning. This is of great importance for this thesis as the planned research assumes that individuals’ responses can be termed ethopoeia (Nass, Moon, & Green, 1997; Nass & Moon, 2000). Ethopoeia is defined as:

…a direct response to an entity as human while knowing that the entity does not warrant human treatment or attribution. Models of thoughtful human attribution and behavior or evocation of memories and feelings cannot explain the processes that elicit stereotyping, politeness, reciprocity, and the like toward a computer [or other artificial entity], but an obliviousness to the unique characteristics of a computer [or other artificial entity] as an interactant certainly can (Nass & Moon, 2000, p.94).

As previously addressed, an evolutionary approach is used to explain Ethopoeia; that our brains respond automatically to stimuli that seem real and “…absent a significant warning that we have been fooled, our old brains hold sway and we accept media as real people and places” (Reeves & Nass, 1996, p.12). This links to the previous discussion on mindlessness (Langer, 1992) and also connects to our human tendency to use various shortcuts or scripts in processing information (Sundar & Nass, 2000). These social responses are found in human-computer interaction and human-artificial entity interaction; what impacts the social responsiveness is how real and how often the artificial entity exhibits human-like behavior. Inputting more social cues and social responses into an artificial entity or machine will increase the social responses that are elicited in humans involved in the
interaction (von der Pütten et al., 2010). There is a strong relationship between the Media Equation and Ethopoeia. We treat devices and entities as social actors, as outlined by the Media Equation, because of the process of Ethopoeia, which states that social cues such as normal interaction processes, speech exchange, and the filling of social roles, all trigger our social scripts and then we automatically perform social behaviors without consciously acknowledging who, or what we are interacting with. Ethopoeia, and the Media Equation, assume that as soon as situations or interactions contain social cues, social responses are automatically triggered (e.g., von der Pütten et al., 2010).

The Threshold Model of Social Influence assumes that a threshold of social influence/social verification needs to be crossed between the human and artificial entity in order for social responses and reactions to take place (Blascovich, 2002). Social verification is dimensional and said to be a function of both: types of agency (what sort of artificial entity) and levels of behavioral realism (von der Pütten, 2010). In this model, it is assumed that real people will have the highest level of social influence on one another. When looking at people’s interactions with artificial entities, it is further assumed that if social verification is high, then humans believe they are engaging in meaningful forms of interaction with artificial entities, thereby sharing an experience with them (Blascovich, 2002). This is similar to Ethopoeia as it assumes the power of behavioral realism; in the Threshold model, the higher the realism, the greater the social influence. The Threshold model therefore assumes that realism is of the highest importance in generating responses, therefore an avatar modeled after a real person would automatically have a high social influence; the social influence of an artificial entity would be based on its behavioral realism (e.g., von der Pütten et al., 2010). These findings have been replicated in studies with artificial agents, avatars and computers (Bailenson, Blascovich, Beall, & Loomis, 2001; Guadagno, Blascovich, Gailenson, & McCall, 2007). A recent comparison finds that the Ethopoeia concept is more reliable in
explaining the social responses to artificial entities and their social effects; most importantly how high behavioral realism is a key predictor for how people accept and respond to the artificial entities (von der Pütten et al., 2010).

It is important to not confuse these theories with the notion of the Uncanny Valley (Mori, 1970) or anthropomorphism. Their similarities to previous concepts are only in evoking emotional responses, but they are not used to explain the foundations of why people respond to technology and artificial entities automatically, as if they were human. Anthropomorphism “…describes the tendency to imbue the real or imagined behavior of nonhuman agents with humanlike characteristics, motivations, intentions, or emotions” (Epley, Waytz, & Cacioppo, 2007, p.864). This is different from Ethopoeia, as anthropomorphism assumes that humans are engaging in mindful thought, and thereby hold the sincere belief that the God, deity, object, animal, or entity has human characteristics (Nass & Moon, 2000). This means that when asked about responses to an entity, individuals who anthropomorphize would answer that they believe the entity deserves to be treated as though it was human, whereas Ethopoeia is automatic, and when asked, individuals would believe the opposite about the entity. This is not to be confused with cherished objects (e.g., toys, books) in which the feelings towards the object itself are evoked based on its specific meaning (Nass & Moon, 2000). Anthropomorphism typically varies in intensity based on human likeness and is correlated to the Uncanny Valley (Riek, Rabinowitch, Chakrabarti, & Robinson, 2009). The Uncanny Valley was based on speculations by researcher Mori (1970) on human interaction with robots and artificial entities. Mori (1970) observed that when a robot’s appearance became more human-like it was perceived as more pleasant and likeable, however, only until a certain point of human likeness. When this point is reached, the entity is no longer perceived positively and instead is regarded as being strange (uncanny), evoking a negative emotional response from the human. This is also used to explain why humans
often feel more comfortable interacting with artificial entities that have mechanoid appearances rather than humanoid appearances (Krämer et al., 2012). The Uncanny Valley response has been linked to issues of perceived threat, issues of control and reminders of mortality (Tinwell, Grimshaw, Nabi, & Williams, 2011). Anthropomorphic responses can be moderated and impacted by the Uncanny Valley. The tendency to anthropomorphize is impacted by three factors: “…when anthropocentric knowledge is accessible and applicable, when motivated to be effective social agents, and when lacking a sense of social connection to other humans” (Epley, Waytz, & Cacioppo, 2007, p. 865). Anthropomorphism, when applied to artificial entities, typically involves longer term interaction and is addressed in literature on companion robots or other entities with which people interact for a longer period of time. For the purpose of this thesis and the limited time that participants will be exposed to artificial entities, anthropomorphism is highly unlikely, and any recorded responses can more probably be linked to the Ethopoeia concept.

It can be concluded based on the research presented that humans react socially to artificial entities and treat them as though they were social actors in an interaction. These responses are similar to human to human interaction in a variety of ways: measures of politeness, reciprocity, gender, ethnicity, personality and agency can all be tracked in our interaction with artificial entities and all mimic F2F communication with humans. These relate to the automatic assignment of social rules and the mindlessness of responses that is very common in human to human interaction. What is relatively untouched as a topic of research, is addressing emotional reactions or responses to technology or artificial entities. We know that emotion is prevalent in human to human communication and interaction and greatly impacts behavior. If our social responses to artificial entities are either the same (Ethopoeia, the Media Equation), or graded based on behavioral realism (Threshold Model of Social Influence), as in human to human interaction (e.g., von der Pütten et al., 2010), do
we also emotionally respond to these entities in similar ways? Addressing this type of response transfer is a major part of this thesis.

1.4 Emotional Expressions and Responses to Artificial Entities

The expression of emotion is a fundamental aspect of interaction between humans, and even human to animal interaction; emotional expressions are believed to serve to communicate our inner states and how we feel or are impacted by communicative exchanges (Demoulin, et al., 2004). Emotional responses to others help identify how interactions impact us emotionally and how we view the interactants we are communicating with. The research on and theories of emotion are vast, and summarizing them here would go beyond the objectives of this thesis. It is, however, important to understand what role emotions play in our responses and perception of others by examining some research on human to human interaction and emotional expression. In addition, how humans emotionally respond to artificial entities: what research has already been conducted and thereby identifying what is lacking in the research; thus addressing one motivation for this thesis.

Darwin (1965) studied the emotional expressions in both humans and animals, theorizing that these expressions evolved, had adaptive functions, and were typically associated with external expressions of internal mental states. During the time of Darwin, emotional expressions towards objects, or technological developments, were not yet being explored. There are many definitions of emotion. According to one contemporary definition emotions are “…considered to be relatively short-duration intentional states that entrain changes in motor behavior, physiological changes, and cognitions” (Hess & Thibault, 2009, p.120). The expression of emotion is thought to communicate the internal state of the expressor and these expressions can either be automatic and without conscious thought, or deliberate and intentional in nature. Emotional expressions likely not only serve the purpose of communicating feelings, but also influence the behaviors of other people (Levenson,
In other words, emotional expressions have social functions. The expression of emotion, often nonverbally (e.g., facial expressions, bodily posture, hand gestures, etc.), is said to be a function of both the social context and the emotional content, or meaning, of whatever stimulus is being responded to (e.g., Fridlund, 1991; Hess, Banse, & Kappas, 1995; Jakobs, Manstead, & Fischer, 1999, 2001). This is not to say that all emotions are always visible, or that one can always infer the meaning of specific emotional responses based on nonverbal behavior (Kappas, 2003); however, examining emotional expressions, verbally and nonverbally, serves as a means to understanding affective states and how affective states impact human behavior and perception.

We know that these emotional expressions and responses accompany interactions with humans and animals, but what about when we interact with artificial entities? Research illustrates that computers, entities and objects can elicit emotions when we are interacting with them, such as feeling anger at a computer (e.g., Charlton et al., 2015). Research also indicates that we respond socially, and treat these entities as interaction partners based on the behavioral realism they exhibit (e.g., von der Pütten et al., 2010). We know that we respond socially, and have feelings towards entities, but are we feeling with them. Would we see an artificial entity as actually expressing emotion, if presented with visual stimuli depicting this? Or would this not be believable? It is of interest to what extent we emotionally respond to an artificial entity expressing emotion and if we draw the line at specific responses, in this case specific emotions, because we can cognitively determine that it is not possible for an entity to actually feel.

The research that has been conducted so far on emotional expressions, responses and attribution of emotion to artificial entities has either been done with embodied agents or virtual characters, in which a real-time human to entity interaction takes place. Studies on interaction with embodied toy robots such as the iCat (Leite et al., 2013) and the Nabaztag
(Eimler, Krämer, & von der Pütten, 2011) indicate people are able to identify and believe the entity experiences various emotional states based on verbal expressions, posture, and entity movement (e.g., Nabatztag, a robot rabbit, whose different ear positions show specific emotional states). A recent study examining the early brain processing of emotional expressions presented participants with happy versus neutral stimuli of humans, and non-humanoid robots (Dubal, Foucher, Jouvent, & Nadel, 2011). Results of this study indicate that the time courses of automatically processing both human and robot emotional expressions are identical, even when robots do not appear human. These findings are highly relevant, indicating that rapid brain responses (measured via EEG) to emotional stimuli of humans or artificial entities (the expression of happiness) appear to be the same (Dubal et al., 2011). The results are not consistent with the concept of anthropomorphism and instead are more in line with ideas from the Media Equation, and Ethopoeia, which argue any social cues presented will result in social responses. Within the design of virtual characters, research surrounding the expression of basic emotions has been linked to the Uncanny Valley (Mori, 1970). It has been found that fully animated virtual characters with (i.e., the ability to verbally and non-verbally express behaviors and emotions, similar to a human) are typically described as more uncanny than entities that appear less human, however, if the facial expressions of basic emotions are distorted in these characters, the level of uncanniness is intensified and inhibits the perception of the character and effective communication between character and human (Tinwell, Grimshaw, Nabi, & Williams, 2011). This research suggests that distorting emotions or emotional expressions on artificial entities is detrimental to the social interaction process and the perceived believability of the entity, and instead prototypical emotional expressions are easily recognized and contribute to the realism of the entity. In another study, recognition of emotion in human faces expressing the emotions of anger, sadness, happiness and fear were compared with computer avatars and an embodied
mechanical robot face, showing the same prototypical facial expressions (Zhang & Sharkey, 2012). The results indicate that people are able to recognize the entities’ emotional expressions, particularly when these expressions are paired with emotional context. If the context presented is incongruent to the prototypical expression, then recognition of the emotional state is not reliable and the perception of the entity becomes negative (Zhang & Sharkey, 2012). These results are similar to when people view human emotion faces paired with varied contexts, however a key difference in responding is when the perception of the entity changes, participants rate it negatively far more quickly than if it were an incongruent human (Zhang & Sharkey, 2012).

These studies indicate that humans may perceive various emotions in artificial entities; it is likely that these responses are automatic and mindless, as humans interact with these entities and are asked various questions about what emotions are being displayed. It is also apparent that emotional expressions in artificial entities increase the believability and social interaction potential of these entities. Since these studies are predominantly interactive and typically also include questioning the participants about an entities’ emotional state, there is a lack of research on how humans respond spontaneously to emotional stimuli of artificial entities. For example, would emotional still images of artificial entities elicit the same responses as has been demonstrated for human still images (Dimberg & Petterson, 2000; Dimberg, Thunberg, & Elmehed, 2000; Dimberg, Thunberg, & Grunedal, 2002). How would the perception of emotional still images accompanied by a related context of humans and artificial entities be affected? Are artificial entities assigned emotions automatically, or is the presence of interaction and associated questions necessary for entities to be perceived as having human feelings and emotions? This is a relatively basic question that has not been explored. Answering this question is a major goal of this thesis; uncovering the extent to which emotions are spontaneously assigned and perceived in artificial entities will lead to a
better understanding of how we view these entities and how we may form relationships with
them.

1.5 Empathy and Emotion

Empathy\(^1\) is a psychological construct that has an extensive evolutionary history. It is
understood as a key component in the formation and maintenance of human relationships and
the successful development of our social selves. Empathy and its effects on emotional
expressions, interactions and relationship formation with humans and with artificial entities
are key components of this thesis. Specifically, empathy is seen as an intersubjective process
that is strongly linked to emotion, and although no universal definition of empathy exists it is
often described as a process of emotion sharing that occurs while maintaining cognitive
awareness of who the feelings belong to (Decety & Meyer, 2008). Empathy is strongly linked
to emotions and emotional responding, and it is also intuitive. Decety and Meyer (2008)
describe this process as:

\[
\text{Th[e] natural tendency to share and understand the emotions and feelings of others in}
\]
\[
\text{relation to oneself, whether one actually witnesses another person’s expression,}
\]
\[
\text{perceives it from a photograph, reads about it in a fictive novel, or imagines it, refers}
\]
\[
\text{to the phenomenological experience of empathy (p. 1053).}
\]

This definition of empathy as a process is important, as it highlights how empathic
responding can take place in a variety of scenarios; it exists not only in F2F interaction;
instead, it can take place in a variety of situations that do not involve the physical presence of
another person, such as when we view stimuli, imagine a story, or witness an event as an
observer.

\(^1\) Empathy is examined in greater detail in this thesis in Chapter 2, Article 1 to answer and
address research questions posed in this thesis. This section is only an introduction to the
topic.
Historically, empathy was conceived as a translation from the German word “Einfühlung” as coined by Lipps (1903), cited in Baron-Cohen and Wheelwright (2004), then translated by Titchener (1909), cited in Davis (1996); originally from an aesthetics standpoint meaning “...projecting yourself ‘into’ what you observe” (Baron-Cohen & Wheelwright, 2004, p.163). Psychologically, both Lipps and Titchener believed that empathy occurred by witnessing the emotional state of another and then internally, unknowingly, imitating that response; this is now commonly termed motor mimicry (Davis, 1996). An empathic response is often referred to as an emotional response in which the emotion, either positive or negative, of the other is matched and then expressed (Gruen & Mendelsohn, 1986). A sympathetic response is different, as it is an emotional response that is evoked by the experience of the ‘other’, often manifesting in responses of compassion or concern; but is not a reproduction or matching of the perceived emotion of the other (Gruen & Mendelsohn, 1986). The terms empathy and sympathy are often confused in everyday usage, but even in the scientific literature there are inconsistencies in their usage. Gruen and Mendelsohn (1986) further emphasized that sympathy can also be differentiated by the types of emotions expressed, usually negative and in response to the plight of another, whereas empathy can be manifested through any type of emotion state. These ideas are further focused in the passive versus active distinction for each response type; in sympathy the observer ‘comes to feel’, a passive process, and in empathy the observer attempts to ‘get inside’ the other, and thus an active response to their experience (Davis, 1996). A main function of empathy is to connect individuals and thereby promotes social interaction and relationship formation. Empathy, in these frameworks, requires intersubjectivity; some form or sense of a shared experience, thought, or affect that is required to understand the other person’s perspective, emotional response, intention, motivation or thought process (Decety & Meyer, 2008).
Empathy links to evolutionary concepts that have already been discussed in terms of communication and interaction. Humans are seen as social animals in which the responses we have, or actions we take, are linked to the behaviors of another human (Batson, 1990). At a primal level we all rely on one another for survival and therefore we seek and form interpersonal relationships to meet these basic needs of belonging (Baumeister & Leary, 1995; de Waal, 2009). Empathy is evolutionarily advantageous and our ability to cognitively or affectively respond to the emotional experience of someone else strengthens our social ties. Responding from an “other-focused” place of understanding means we can take the perspective of someone else and also have feelings that are more linked to their situation than to our own (Eisenberg, Shea, Carlo & Knight, 1991; Hoffman, 2000). This self-other distinction does not mean that empathic responding cannot be automatic; it does however distinguish empathy from other processes, such as emotional contagion and personal/empathic distress.

Empathy is strongly related to emotion, it can be seen as both a cognitive and affective process involving both a mental state and the expression of emotion (sharing and experiencing affect). As I previously stated, how we express emotion and perceive the emotion of others greatly impacts our social interaction and relationship formation (Schulkin, 2005; Decety & Meyer, 2008). Darwin (1965) described over fifty emotions in humans and argued that the expression and successful interpretation of them increased evolutionary fitness. Emotions can be described as “…short-lived psychological-physiological phenomena that represent efficient modes of adaptation to changing environmental demands” (Decety & Meyer, 2008, p.1056). Our emotions are expressed through our bodies, behaviors, facial expressions and through what we actually say; all of these help to inform others as to our current subjective state (both psychologically and physiologically) and foster social interaction and communication (Decety & Meyer, 2008; Schulkin, 2005). This is not the
same process as emotional contagion in which we automatically mimic the emotional expressions of someone else (no self-other distinction) and then converge with them emotionally (Hatfield, Cacioppo, & Rapson, 1994). In understanding empathy in relation to our social relationships, it is the affective reciprocity and empathic responding that takes place, that are imperative to feeling as though we belong to our social group, and that are understood by our peers in interactive processes (de Waal, 2009). Based on their evolutionary underpinnings, it is argued that emotional and empathic responding are present to a certain degree from birth onwards and linking our affective states is connected to an intrinsic need for secure attachment and relationship safety (Panksepp, 1986). Of course, there are developmental trajectories regarding these phenomena. In infants and children, the expression and interpretation of emotions starts as mimicry between the self and the other, this is an important process as it arguably teaches the child about internal emotion states and interpersonal communication (Gallagher, 2004), assuming the contagion process already proposed by Lipps a century ago. This then leads to the development of a cognitive understanding allowing for the differentiation between emotions felt by the self and experienced by others; a theory of mind that lays the foundation for empathic responding (Decety & Meyer, 2008; Meltzoff & Decety, 2003). The biological underpinnings of empathy help to explain why being empathic likely increases our inclusive fitness and why both humans and animals express empathy in their interactions (Buck & Ginsburg, 1997; Decety & Jackson, 2004; Plutchik, 1987). However, an important difference between humans and animals in their emotional or empathic responding, is very likely the distinction between the self and other, and the awareness of this distinction (present in humans) (Povinelli, Bering, & Giambrone, 2000). Furthermore, our ability to reappraise emotional situations and respond congruently distinguishes us from other species. In addition, Decety and Jackson (2004) highlight that “…one of the most striking aspects of human empathy is that it can be felt for
virtually any target—even targets of a different species” (p. 72). This ability can be explained through social learning that occurs when observing and interacting with others. It is of great importance to this thesis that in human empathy people are able to relate to and help others who are very different from them, even those that are not of the same species, and who experience emotional events that are very different from the personal experiences of the one empathizing (Decety & Jackson, 2004). There are reasons to believe, based on the research presented above, that humans respond with the same social interaction rules and patterns to technology and artificial entities. In addition, they show emotional responses and emotion recognition in their interaction with artificial entities. If we are able to feel empathy for virtually anything (e.g., Decety & Jackson, 2004), does this include empathically responding to an artificial entity, something that is so clearly non-living and non-human? In addition, what would this look like, and with a concept as complex as empathy, how could we determine a response as empathic to an artificial entity? It is clear that emotional responding is a key component of empathy and greatly impacts empathic responding; how we measure empathy and how the concept of empathy has already been explored in the field of HRI will be addressed.

If we are to explore empathy and empathic responses, it is important to examine how these are measured. How to accurately measure empathy is not agreed upon in the literature; the ambiguity amongst researchers of defining what empathy is also contributes to the lack of consensus in how to measure empathy (Wispe, 1986). It is very challenging to establish construct validity within the measurements if no agreed upon definition of the construct exists. Empathy is not only lacking a universal definition, but is conceptualized even within the literature in multiple ways (e.g., Batson, 2009). Empathy also overlaps with other concepts that are similar, (e.g., compassion, sympathy, personal distress) further promoting the lack of clarity, and ability to measure this phenomenon, in this field (Neumann, Chan,
Boyle, Wang, & Westbury, 2015). The different types of measures which have been developed to explore empathy also make it challenging as it is not easy to compare respective results of studies outputs (Gerdes, Segal, & Lietz, 2010). Many measures have a narrow scope and therefore limited validity as referring to the entire construct of empathy (Levenson & Ruef, 1992). From a theoretical standpoint it is possible to see some common ground in defining empathy across various researchers and theories; empathy involves a change in affect (the experience of a feeling) and an evaluation of the situation (cognitive component) (e.g., Hoffman, 2007; Neumann et al., 2015). If empathy is experienced, there is typically some type of physiological response (e.g., Bradley, Codispoti, Cuthbert, & Lang, 2001; Levenson & Ruef, 1992; Neumann & Westbury, 2011), followed by the expression of varied overt behaviors that are directly linked to the intensity of the affective/cognitive experience (Chlopan, McCain, Carbonell, & Hagen, 1985; Ickes, Stinson, Bissonette, & Garcia, 1990; Neumann et al., 2015). Finally, it also believed that the experience of empathy facilitates action, compassion and pro-social behavior (Bernhardt & Singer, 2012; Neumann et al., 2015).

Since there are so many varied components of empathy, various approaches are used in the measurement of it. Within the different measurements there is some agreement on distinguishing between the measurement of situational empathy (responses that occur in a specific situation) and dispositional empathy (levels of empathy are seen as stable personality or character traits) (Zhou, Valiente, & Eisenberg, 2003). Situational empathy is measured either during or directly following a situation or stimuli that are meant to elicit an affective or empathic response; people are either asked about their experience, or physiological measures are analyzed (Zhou et al., 2003). Physiological measures of empathy are founded in research that highlights the experience of empathy as being able to impact both the central and peripheral nervous system and result in various physiological outputs; the intensity
determined by the cognitive or affective impact of the stimulus/situation (Decety & Ickes, 2009). Examining psychophysiology from the perspective of empathy allows for the objective analyses of behaviors that are the result of empathy-inducing scenarios (Neumann & Westbury, 2011). The automatic activation of nervous system responses is typically consistent with how a person interprets the empathy-inducing situation allowing them to be objectively measured (Preston & de Waal, 2002; Neumann & Westbury, 2011). The measures involving the physiological correlates of empathy include: neuroimaging, electroencephalography (EEG), facial electromyography (EMG), eye blinks/startle blinks, electrodermal activity (EDA), heart rate, vocal measures and gestural changes (Neumann & Westbury, 2011; Neumann et al., 2015; Zhou et al., 2003). Using physiological measures to look at empathy is more objective; the response bias or social desirability bias not posing a threat to results. On the other hand, these physiological measures are not associated with any psychological process in a one-to-one fashion, thus, very careful interpretation of physiological measures is required, as there are limits to using physiological activity to diagnose affective states (see Kappas, 2003). These measures have been used in studies that explore how psychophysiology can further expand our understanding of empathy (e.g., Levenson & Ruef, 1992). This research thus connects empathy to other emotion sharing processes that are measured in similar ways, such as emotional contagion, mimicry and activation of mirror neurons (Neumann & Westbury, 2011).

Dispositional empathy, in contrast, refers to empathy as a stable trait. The idea here is that people differ with regard to how empathic they are overall, and that the cognitive and affective components of empathy can be reliably measured and quantified (Zhou et al., 2003). Most often, measuring dispositional empathy is done through the administration of various questionnaires, which have multiple scales specific to different types of empathy; reports made by others is also a way to gather dispositional empathy information, particularly useful
when looking at empathy levels in children. There is an extensive list of self-report measures; as the study of empathy has greatly increased, so has the development of new measures that could be used to understand various conceptualizations of the construct (see Neumann et al., 2015). The most widely known questionnaires include Hogan’s Empathy (EM) Scale (1969), Mehrabian and Epstein’s Questionnaire Measure of Emotional Empathy (QME, 1972) and Davis’s Interpersonal Reactivity Index (IRI, 1980; 1983). These self-report measures also address different aspects of empathy and are typically chosen based on what research question or topic of interest is being addressed. The EM Scale addresses empathy as a cognitive construct, examining role and perspective taking (Hogan, 1969), the QMEE sees empathy as a purely affective process, also looking at how people respond to arousal (Mehrabian & Epstein, 1972) and finally the IRI addresses both the cognitive and affective aspects of empathy with various subscales to address the different components (Davis, 1980; 1983). These self-report measures are looking at how individuals believe they would respond across a range of potential experiences and are very subjective. In other words, these measures might be reliable in that they provide stable results, but they refer to someone’s self-representation how empathic they are. Convergent validity is often not provided. In addition, these measures might be subject to a desirability bias in which responses may not always be accurate of the individuals themselves, but how they would want to be perceived (Losoya & Eisenberg, 2001). In addition, these self-report questionnaires are criticized for not only measuring empathy, but a host of other emotional processes (e.g., arousal, emotional control capacity, attitudes towards others) making the empathy scores resulting from self-reports very difficult to disentangle from other concepts (Zhou et al., 2003). Self-report measures are considered to be very useful, cost, and time effective, but also have their shortcomings when it comes to broad generalizations of data and what the scores truly represent.
Empathy and empathy related responding are very challenging to measure; emotional processes which, to a large extent take place internally, are usually very difficult to assess using only one approach (Neumann et al., 2015; Zhou et al., 2003). This challenge comes on top of the lack of an agreed-upon definition of empathy and thereby the lack of a universal, or at least valid and reliable measure. What is seen as most reliable is the use of a multi-method approach; the use of different measures is more likely to address different aspects of empathy-related responding. The combination of measures creates the greatest potential for a comprehensive account of participant responding (Neumann et al., 2015). For the purpose of this thesis, multiple measures related to empathic responding will be used to gain a broad understanding of emotional responses and how we can classify empathy levels of participants. Facial EMG, heart rate, EDA, and the IRI will be used within the later discussed experiments as measures of situational and trait empathy, and emotional responding.

1.6 Empathy to Artificial Entities

Empathy and empathic responses have been predominantly studied in human to human interaction. However, the increase of interaction with technology has made studying our emotional responses, and also our empathic responses to technology more relevant. Empathy, as outlined, implies responding emotionally in line with the emotional experience of someone else, relevant to their situation (Misselhorn, 2009). It is a topic of scientific debate if we need to cognitively engage with the other person’s situation to be empathic or if empathic responses can also be automatic (as in reacting to a facial expression or vocal tone); it is likely that we can have emotional and/or empathic responses by simply seeing how someone feels, even when we do not know the entire situation. This is important in understanding how we can have empathic responses to technology, artificial entities and even inanimate objects. In terms of responding emotionally to inanimate objects or various entities that we know are incapable of feeling, we have to imagine that they can experience emotion,
or at least mindlessly conclude that it is possible. The phenomenological experience of empathy is not only seen when witnessing real live events; as previously mentioned, these responses can exist to materials that evoke emotions (photograph, novel, film) or in situations where we can imagine emotions being evoked (Decety & Meyer, 2008). In research on pictorial representation (e.g., Walton, 2002) the perceptual experience we have of one thing, for example an image, can be extended to the experience of other things that are not images. From an imaginative perception paradigm, in relation to emotional responses, when we see an artificial entity displaying ‘emotion’ we are imagining perceiving a human displaying the same emotion (Misselhorn, 2009). This would provide a complementary explanation to the Media Equation for our emotional responses to obviously non-emotional objects and things. In addition, when interacting or viewing artificial entities, they are typically more human-like than other forms of technology; the human likeness will increase the salience and believability of the stimuli and will potentially trigger a more human response to the entity (Misselhorn, 2009). Of course this is also moderated by the Uncanny Valley (Mori, 1970), but, Misselhorn (2009) estimates that if the level of human likeness stays below the 80-85% and no strangeness is elicited, it could be concluded that the human-likeness (physical and/or emotional and/or mental likeness) of entities leads to responses typically found in human-human interactions including empathic or emotional responses to them.

Research on empathy and empathic or emotional responses to artificial entities has become highly relevant; in particular for understanding what is needed in the design and implementation process to make an artificial entity believable and useful. Empathy towards artificial entities is mainly researched in embodied human-entity interaction and results are of interest to researchers who want to show how we can program empathy into an artificial entity in order to make it more influential and desirable for interacting with human users. Studies have examined programming an artificial entity or avatar with the ability to recognize
a user’s basic emotional expressions and then respond appropriately to them through feedback and nonverbal behavior and how this subsequently impacts interaction (e.g., Leite et al., 2013; Paiva et al., 2004). Results indicate that humans’ perception of the entities when they were engaging emotionally and/or empathically was more positive, believable, and accepting of the entity as a social interaction partner. Other studies have placed a robot as a film watching partner in a social/psychological paradigm, comparing it to a human film watching partner; although the human companion elicited stronger positive emotions, the presence of the robot discouraged the experience of negative emotions and led to the sharing of amusement or laughter contagion (e.g., Jo, Han, Chung, & Lee, 2013). Other studies have put artificial entities into harm’s way or pleasure conditions to see if humans would feel moral emotions towards artificial entities. In a Milgram-style experiment with computer avatars, Slater and colleagues (2006) found that even though participants knew the shocks given to avatars were not real, they responded subjectively, behaviorally, and physiologically as if they were observing real shocks given to a human subject. In another experiment Rosenthal-von der Pütten and colleagues (2013; 2014) showed participants’ video clips of a toy robot being treated in a friendly way or being tortured; participants showed strong negative affect to watching the toy robot being tortured. This research indicates that humans do respond strongly, with high levels of negative affect when observing artificial entities in emotional conditions. How much of these responses are related to empathy for an artificial entity versus a negative emotion being evoked is a topic of discussion. In reviewing the literature on empathy towards artificial entities, there appears to be a gap in looking at basic emotional and empathic responses to entities. Studies involve either live avatars or real-time artificial entity interaction, without looking at how artificial entities are perceived on their own, in comparison to humans. There seems to be a lack of research on how people respond to artificial entities that portray emotional states in comparison to humans with the same
emotional states, and what similarities and differences emerge. In addition, to what extent are these responses moderated by contextual information? In order to better understand how we emotionally respond to artificial entities and determine if these responses are empathic or are moderated by empathy, this research gap needs to be addressed. For example, the question of the type of purposes such artificial systems might be used for, e.g., tutoring, supporting, supervising, counseling and similar tasks. Also, seeking to understand the concept of empathy from a new angle: how does our interaction with technology and artificial entities, and our subsequent responses change how we look at, and perceive empathy as a construct? Oftentimes we assume empathy to reflect our deep sense of connectedness with others – but what would it mean if we felt similarly connected to a robot puppet? Would that not also challenge some of our assumptions about empathy with humans? Finally exploring the research that exists on harm to objects and artificial entities to uncover whether emotional responses to them are indicative of how much we feel for them or if these responses are more evolutionarily hardwired. All these questions need to still be addressed.

1.7 Goal of the Dissertation

As has been already suggested throughout this introduction, how we interact with and emotionally respond to technology and artificial entities is becoming increasingly relevant in our technology dominated society. It seems as though how we socially respond to these entities is grounded in patterns of human to human interaction and communication. In addition, technology and artificial entities are also capable of evoking emotional responses, similar to those found in human interaction. As we engage more and more with these technologies, it becomes more and more important to understand why we respond to them as if they were human and also what these responses mean. A review of the literature suggests numerous factors that potentially impact and shape our interaction with artificial entities. The research also provides some causes or reasons for why we may emotionally respond to
artificial entities, and attempts to link these emotional responses to the construct of empathy. It is not known, however, to what degree basic stimuli (e.g., still images) of artificial entities may evoke emotional responses and what factors must be present to create a response expected from basic human stimuli. In other words, the minimal conditions for empathy are unclear. Therefore, the aim of this thesis project is to start a systematic investigation of the basic emotional responses to artificial entities and to what extent these responses are similar to human stimuli. In addition, how these emotional responses to artificial entities and humans are either moderated by empathy, or can be identified as empathic responding is of interest to me. To accomplish these goals, this thesis is addressing four issues. Firstly, I examine how the concept of empathy can be better understood by including research on emotional responses to technology and artificial entities; also what this says about empathy and our interaction with entities. Secondly, how do humans respond to basic stimuli of humans and artificial entities expressing similar emotional states, and are these responses impacted by emotion in images, emotion described in text, and/or moderated by interacting with an artificial entity? Thirdly, would these emotional responses to stimuli also qualify as empathic responses? Finally, exploring how humans respond to the destruction or harm of objects with various levels of meaning and whether this research can be linked to empathy for entities. Additional research questions that resulted from the experiments will also be addressed in this thesis.

The purpose of the experiments presented in this dissertation is to demonstrate spontaneous responses to stimuli of artificial entities in comparison to humans and how these responses are a function of emotion or meaning. To extend the assessment of empathy beyond subjective responding, I chose experimental designs that would allow for spontaneous, automatic responses to stimuli (downplaying the role of cognition and perspective taking) to stay congruent with research presented in this introduction on
automatic responding to technology (e.g., the Media Equation and Ethopoeia). To reduce ambiguity or misinterpretation, I only presented stimuli (images, text, film clips) that had already been pretested with respect to emotion and meaning (see Appendix A and B). This allowed for the presentation of stimuli with known properties and for the manipulation of other factors (e.g., artificial entity interaction) to see the resulting effects on emotional responses to artificial entities and what moderates these responses.

The empirical work carried out as part of this dissertation can be summarized as follows:

The literature review on empathy, empathic responses, and similarities and differences to emotional responses are presented in Chapter 2, Article 1, of this dissertation. This literature review article attempts to shed new light on the concept of empathy by analyzing research on human responses to artificial entities.

The first two experiments focused on emotional responses to stimuli of artificial entities and humans displaying various emotions. Experiment 1 showed images depicting emotion paired with emotional text. Experiment 2 showed neutral images paired with emotional text and the effect of toy robot interaction, using artificial entity interaction to manipulate (on a between subject level) the level of emotional responding to presented stimuli. In these two experiments the emotional responses to the images and images with text were relevant, in addition whether these responses could be modulated through artificial entity interaction were explored. Emotional and empathic responses were assessed with several tools (see Method Section of Article 2, Chapter 3).

The results of experiment 1 and 2 inspired a closer look at what empathy and empathic responding means when looking at how we perceive, and accept artificial entities in comparison to humans. Article 2, Chapter 3 is a part of this dissertation that looks at how we can gain a deeper understanding of emotional responses and empathy in humans by
examining responses to artificial entities, as seen in results from experiment 1 and 2 (Chapter 3, Article 2).

Experiment 3 was designed to shift away from only humans and artificial entities and include other inanimate objects to examine emotional responses, and empathy through the lens of destruction and harm (as outlined in section 1.5 of the Introduction). This experiment examined how participants’ objective and subjective emotional responses varied when viewing the destruction of various objects that had different levels of meaning (Chapter 4, Article 3).

The last chapter of this thesis ties together all the experiments, synthesizing the results and presenting the central findings of this thesis. This includes a discussion of the implications this research may have in the field of human – entity interaction and everyday interaction with technology. In addition, a critical look at the limitations of the empirical research carried out and suggestions for areas of future research on human – artificial entity interaction and relationship formation are also presented.

Finally, the stimuli pretest phase involved the development of all stimuli for the three main experiments. The rationale and results behind all five pretests, and one followup experiment, are described in Appendix A and B of this thesis. All forms used with participants in experiments 1, 2, and 3, are found in Appendix C, D, and E, respectively.
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Chapter 2

Article 1: Empathy Re-Explored
Empathy Re-Explored: Using Artificial Entities to Better Understand Ourselves

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Abstract

A review of the literature suggests a consensus that empathy has always played a vital role in the formation and maintenance of human relationships. Empathic understanding and responding being often seen as the social glue that connects humans together and supports social relationships. The ability to feel with/or into another person is a large part of what defines our humanness. A comparison of current research frameworks indicates that although there is no universally agreed upon definition of empathy, central themes are similar for most researchers.

As our digital culture advances, researchers’ interests widen and there is a recent trend to understand how humans emotionally and empathically respond to various technologies, including artificial entities. Empathy has largely been understood as a human, or at least sentient phenomenon, and a process that would only extend to living entities (other humans and animals), given that a necessary component for empathy is the ability to share feelings. However, the field of human-robot interaction (HRI) is rapidly expanding and researchers and industry partners are attempting to build artificial systems that can connect with humans. If these systems are supposed to convey emotion and be empathic to a certain degree, we must be very clear and detailed in what emotional processes and empathy entail to permit effective implementation of artificial systems in that sense. In research with artificial entities, the rules of empathy appear to be violated as there is no shared affect, or shared feeling between a non-living entity and a human, and the question remains: whether emotional processes that occur with artificial entities can be referred to as empathy? In this case a researcher may claim that a simulated feeling is functionally equivalent to a real human emotion and could evoke a similar response. We argue that research with artificial entities offers the opportunity to explore concepts, such as empathy, from a very new perspective.

Keywords: Human-robot interaction, Empathy, Emotional response, Media Equation
2.1 Introduction and Theoretical Background

There is no universally accepted definition of empathy. The construct has been of great interest across a variety of disciplines, yet it remains a great challenge to consensually define and measure. Philosophers, psychologists, sociologists, anthropologists, and many more agree upon the existence and importance of empathy, but what empathy is, how we accurately measure it, and what concepts relate to it are, arguably, confused. The widely differing and often fuzzy definitions of what empathy is, in combination with the seemingly great interest in the topic itself, pose a research challenge. The issue begins the minute we attempt to, or claim to be able to, measure phenomena; definitions should then no longer be so confused.

We argue that by studying empathic processes with technology and artificial systems and how these interactions permeate and affect our modern lives, we have a different perspective that might help the general effort to understand empathic processes. We are at a point in the development of Artificial Intelligence (AI) in which researchers and industry partners are attempting to build artificial systems that can also emotionally connect with humans (Picard, 1997). These systems are supposed to convey emotion, and be empathic. If we are meant to build systems and technology to meet these needs, we must be very clear and detailed in what emotional processes and empathy entail. Now is the time to address and look at this as the field is rapidly expanding, along with our interaction and dependence on technological devices and artificial systems, in the absence of a consensual framework.

The origin of empathy as a term is universally agreed upon. The term itself stems from the concept of Einfühlung (literally translated “to feel into”) introduced in 1903 by the German psychologist Theodor Lipps (as cited in Baron-Cohen and Wheelwright, 2004) and later translated into the term empathy by Edward Titchener (1909, as cited in Davis, 1996).
Before empathy, Adam Smith (1759, as cited in Smith, 1966) had introduced the term sympathy; he described sympathy as a form of imitation in which an observer acts as though they were in the place of the other. Charles Darwin (1965) also described nonverbal expressions of sympathy when observing the matching of facial expressions between individuals. Early theorists already understood these tendencies as elementary motor mimicry, seeing many behaviors between individuals as non-deliberate replications (Baldwin, 1895/1987, as cited in Damon & Learner, 2006; Blanton & Blanton, 1927, as cited in Eisenberg & Strayer, 1987; Hull, 1933, as cited in Eisenberg & Strayer, 1987; McDougall, 1908, as cited in McDougall, 2003; Mead, 1934, as cited in Mead 1967). Empathy eventually became the general term that functionally replaced sympathy (and other similar processes) in the scientific literature during the second half of the twentieth century. Empathy, started to be used as a global term, describing multiple processes (and lacking specific distinctions). Allport (1961) identified this shift as unfortunate, recognizing that the meaning of empathy “…became hopelessly confused and lost to view… [that]…The theoretical coin has depreciated, probably beyond redemption” (Allport, 1961, p.536-537). This theoretical confusion continues to persist in present day research; with no universally accepted definition; empathy effectively means different things to different people (see, e.g., Batson, 2009; Davis, 1996; Decety & Lamm, 2006; Ickes, 2009; Kühnen, 2015). Arguably, this poses enormous theoretical challenges when attempting to label something as empathy or an empathic process, and when wanting to measure empathy and empathic responses. This literature review will synthesize the research on empathy in human interaction and address the most commonly occurring confusions with its definition. It will then evaluate different measurements of empathy, with a strong focus on measurements of situational and dispositional empathy, and how the confusion around empathy persists due to alternative explanations for many empathic processes. Finally, it will conclude with a new perspective
on how research in AI may help create an accepted definition of empathy and will discuss future directions in this dynamic field.

2.2 History of the Empathy Concept

Empathy is vital for successful human interaction and thriving in our social environment. If we are to achieve our daily goals and maintain successful social relationships, it is crucial to understand the intentions, motivations, and emotions of others; particularly as our social relationships vary in intensity and importance, and are often highly complex. Regardless of debate, on a basic level, empathy describes the process in which we are able to recognize and understand the emotions of others and choose an appropriate response to their emotional state (Leiberg & Anders, 2006). Although no agreed upon definition exists, when examining the literature researchers describe empathy as either a cognitive and/or affective response that is based on the perceived or known affective state or experience of another (e.g., Batson, Fultz & Schoenrade, 1987; Eisenberg, 2000; Hoffman, 1984, 2008; Ickes, 1997; Preston & de Waal, 2002; Rogers, 1959; Wispê, 1986). Disagreement still exists surrounding which components are necessary in the definition of empathy, how to measure empathy and how to determine if someone is behaving empathically. Empathy is a multifaceted construct; theorists are debating whether empathy is a result of low and/or high level affective and cognitive responses and whether these are either automatic or intentional (Leiberg & Anders, 2006). Bavelas and her colleagues suggested that “…the terminological problem of empathy arises from [the] failure to distinguish between an overt behavior and a psychological process that is inferred from it” (1987, p. 318).

Defining whether empathy is situational or dispositional is the beginning of many scholarly debates. Numerous sources refer to empathy being a relatively stable trait, an
orientation or a quality of an individual (e.g., Davis, 1980, 1983; Hogan, 1969; Rogers, 1959; Work & Olsen, 1990). This dispositional view of empathy results in some researchers arguing that empathy is a *trait* that exists at varying degrees in different people. Other sources claim empathy is instead situational, and empathic responding is based on the situation, state and emotion of the individual witnesses (e.g., Batson, O’Quin, Fultz, Vanderplas, & Isen, 1983; Eisenberg & Miller, 1987; Toi & Batson, 1982). This conceptual confusion is exacerbated by research that more recently links empathy to the popular notion of emotional intelligence and other research that identifies emotional intelligence as a trait that can be learned similar to social skills (e.g., Burcher, 2011; Ioannidou & Konstantikaki, 2008; Petrides, 2010). Thus, uncertainty continues with research that considers empathy as purely a social skill that can be learned, and strengthened through proper training (e.g., Long, Angera, Carter, Nakamoto, & Kalso, 1999; Şahin, 2012).

The disparity in defining empathy continues, as previously mentioned, with the debate regarding whether empathy is an affective or cognitive process, and the extent to which it is affected by both. The concept of *cognitive empathy* has a long history and arguably its foundation in the works of Heider and Simmel (1944). This theory continued to develop and is now referenced to as *empathic accuracy* or *theory of mind*, inferring that the cognitive ability to view, interpret and make conclusions would be sufficient in understanding how the other viewed and perceived the world (Davis, 1996). Therefore, if learned and properly acquired, it was possible to infer the mental/internal state of the other based on one’s individual perspective and the other person’s perceived experiences (Baron-Cohen & Wheelwright, 2004). Research on theory of mind and empathic accuracy is also linked to how people understand the feeling states of others, and how this motivates helping behavior (Rogers, 1959). The definition of theory of mind that is most agreed upon today is “…a perceiver is able to accurately infer the specific content of another person’s successive
thoughts and feelings” (Ickes, 2009, p.57). The origin of affective empathy is explained as an observer reacting emotionally to the other based on the perception of the emotion being experienced (Stotland, 1969 as cited in Davis, 1996). The work of Batson and colleagues (1991) in the empathy-altruism hypothesis was even more limited to affect alone, concluding that experiencing empathy was rooted only in the experience of concern and compassion while bearing witness to another’s suffering (e.g., Kruger, 2003). Hoffman defined empathy as “…an emotional state triggered by another’s emotional state or situation, in which one feels what the other feels or would normally be expected to feel in his situation” (1984, 1987, as cited in Hoffman, 2008, p. 440). Hoffman however, was more inclusive in his theoretical framework which highlights various empathy constructs such as developmental stages, and the acquisition of skills that would allow for the cognitive conceptualization of empathy responses as well (2008). The affective conception of empathy is still referred to as emotion catching (Hatfield, Cacioppo, & Rapson, 1994). This can include intuiting or projecting of oneself onto the other, such as the imagine other perspective (Batson, 2009), role-taking or the imagine-self perspective and experiencing empathic-distress from situational over-arousal (Hoffman, 2008). The aforementioned affective theories are most interested in the clear concept of emotional contagion and how we experience the emotions of others (empathic concern) or over-experience the emotions of others (empathic distress), including what variables are most important in response conditions.

Although some disagreement still exists in determining the nature of the empathic process (cognitive versus affective) many researchers agree empathy is a comprehensive process that contains both cognitive and affective components, and is not one-dimensional (e.g., Duan & Hill, 1996; Eisenberg, Fabes, Guthrie, & Reiser, 2000; Hoffmann, 2000; Neumann, Chan, Boyle, Wang, & Westbury, 2015; Preston & de Waal, 2002; Zillman, 1991). Broadly defined this implies that empathy “…involves an inductive affective (feeling) and
cognitive evaluative (*knowing*) process that allows the individual to vicariously experience the feelings and understand the given situation of another” (Neumann et al., 2015, p.257).

The acceptance of the multi-dimensionality of empathy allows for its expression cognitively, and affectively and in addition denotes that empathy can be either intrinsically or extrinsically motivated. The presence or absence of empathy is identified in a variety of ways: through overt behaviors (either conscious or automatic) that are moderated by affective and cognitive components, through internal reflection and self report and also through autonomic nervous system activity (e.g., Bradley, Codispoti, Cuthbert, & Lang, 2001; Ickes, Stinson, Bissonette, & Garcia, 1990; Levenson & Ruef, 1992; Neumann et al., 2015; Plutchik, 1990). Depending on the researcher, the focus is either on cognitive or affective components, or a combination of both for a more comprehensive view. In agreeing that empathy contains affective and cognitive components empathy is then viewed as a process that requires not only the recognition of the empathy inducing context (cognitive) but also emotional experience related to the context (affective). Identifying these differing components allows for a more thorough reflection on the measurement of empathy (see *Figure 2.1*).

### 2.3 Clarifying Overlaps and Differences between Empathy and Related Constructs

Confusion surrounding the definition of empathy dates back to its origin (Lipps, 1903 as cited in Baron-Cohen & Wheelwright, 2004; Titchener 1909, as cited in Davis, 1996) and is distinctly linked to *how it is measured*, as previously outlined. The continuing disagreement in the literature surrounds how to describe and measure empathy distinctly and not confuse it with similar affective and cognitive processes. Many researchers measure what they define as empathy using some of the measures conceptually outlined above and then publish their results. However, interpreting these results is often muddled and not all
researchers sort out who uses the term, and in which way; this occasionally leads to the appearance of confusion when there is none, or the appearance of agreement, where in fact there is none. Typical confusions arise when the following processes are referred to as empathy: sympathy (pity), personal distress, compassion, emotional contagion, projection, and motor mimicry (e.g., Batson, 2009; Bavelas et al., 1987; Decety & Lamm, 2009; Eisenberg, Shea, Carlo, & Knight, 1991; Hoffman, 2008; Leiberg & Anders, 2006; Neumann et al., 2015; Preston & de Waal, 2002; Zhou, Valiente, & Eisenberg, 2003). Sometimes, even a supportive statement, which might arise out of norms of politeness or etiquette are labelled as being empathic. Researchers have recently pointed out that these different processes strongly relate to each other and might in certain circumstances even take place concurrently: “…mimicry or emotional contagion precedes empathy, which precedes sympathy and compassion, which in turn may precede prosocial behavior” (Singer & Lamm, 2009, p.82). Of course, this creates a challenge for researchers in attempting to define an emotional response or process as empathy, and subsequently link it to past and ongoing research.

Of the emotional processes that contribute to definitional issues, empathy is arguably most confused with the term sympathy. Empathy is often seen as an extension of sympathy, a more intensive and personal emotional process; empathy involving feeling into, experiencing similar feelings to the other and showing emotional solidarity; whereas sympathy is more of an externalized process in which the person sees the struggle of another and provides comfort or reassurance (Gerdes, 2011). Again, these processes may occur concurrently or exclusively. Compassion is commonly defined as an awareness of the suffering of others with a desire to alleviate said suffering (Goetz, Keltner, & Simon-Thomas, 2010; Jazaieri et al., 2013), seen as both an affective and motivational state (Bernhardt & Singer, 2012). The process of compassion for some researchers is seen as a vital part of both empathy and sympathy, in which empathy remains a more emotionally intense personal experience, whereas sympathy
is more detached from the self; some researchers also believe compassion moderates responses in both states. Others define compassion as being different from sympathy and empathy, characterizing compassion distinctly by the presence of feelings of loving-kindness we have for other people and wishes for their well being (Bernhardt & Singer, 2012). In this case, empathy is seen as a shared cognitive/affective state and sympathy as feelings for someone else (Bernhardt & Singer, 2012). These subtle differences seem very challenging to distinguish in physiological measures or subjective questionnaires. For the purpose of this article, we chose to see compassion as an emotional state, linked to both empathy and sympathy, which drives pro-social behavior.

Personal distress is a process that can, among other causes, be linked to empathic over-arousal, an overextension of empathic concern (Eisenberg et al., 1994). Empathic concern is seen as an other oriented response motivated by witnessing the emotional responses of the other; this then leads to affect sharing and empathy (Batson, Fultz, & Schoenrade, 1987; Cheetham, Pedroni, Antley, Slater, & Jäncke, 2009; Eisenberg, 2000; Eisenberg & Strayer, 1987). Personal distress however is a self-oriented response, typically as a result of observing a distressing event of another without detachment of self, which can result in empathic over-arousal, feelings of fear, uncertainty and vulnerability and the desire to quickly alleviate the personal distress through a self-regulatory mechanism (Batson et al., 1987; Batson, 1997; Cheetham et al., 2009; Davis, 1980, 1996; Eisenberg et al., 1994). The self-oriented aspect of personal distress separates it from empathy, but can be a distinct consequence of witnessing individuals in distress.

The process of mimicry has been said to contribute significantly to empathic responding. Hatfield, Cacioppo, and Rapson (1994) identify mimicry as the automatic synchronization of observed emotional expressions, including vocalizations, mannerisms and
various postures with those of another individual. The difference here is that mimicry, due to its automaticity, does not require the self-other distinction. The process of mimicry has been shown to influence social judgment and individual behaviors towards the mimicker, including a tendency for compliance (Chartrand & Bargh, 1999). Mimicry, measured through physiological responding, such as facial EMG, illustrates consistently that human observers when seeing the affective expression of another, (e.g., smile or frown) will respond with the same facial expression; mimicking, unconsciously, what is simply observed (Dimberg & Öhman, 1996). This effect is also observed when we are exposed to stimuli with positive and negative valence (Cacioppo et al., 2000). Other research proposes that facial mimicry is not simply matching expressive muscle movements; instead mimicry may require contextual information, and the process of mimicry is dependent on the relationship existing between sender and receiver (Hess & Fischer, 2013). Some researchers view mimicry as an automatic process that connects individuals through shared affective expressions, whereas others believe mimicry fulfills a social function and may have evolved as a skill that links the self to the other and increases communication. Arguably, these two views are not fully mutually exclusive. Evidence that mimicry may not be a solely automatic process (Hess & Fischer, 2013) could mean that building technological systems requires even more elements (above and beyond facial recognition and emotional expression) in order to be defined as structurally similar to a human. Emotional contagion, often seen as a consequence of mimicry (Hatfield, Cacioppo, & Rapson, 1993), has also been identified as a distinct process linked to, but not identical with empathy. Emotional contagion is seen as a primitive occurrence in which two individuals converge emotionally as a consequence of one individual automatically mimicking and synchronizing a variety of expressions of the other (Hatfield et al., 1993). It is popularly referred to as catching the emotions of others (Hatfield et al., 1993; Hatfield, Rapson, & Le, 2009). Just as with mimicry, emotional contagion is an automatic processes
and does not require the ability to distinguish whether affective processes and responses are caused by the self or the other (Decety & Jackson, 2004; Decety & Lamm, 2006), and this distinction is a vital component of the process of empathy.

Distinguishing empathy, from other plausible alternatives listed above is a challenging task. Empathy, based on sorting through terms that are similar to empathy in the literature has left researchers with little agreed upon criteria. Empathy is an “other-oriented” response that requires the ability to form a self-other distinction and is not solely an automatic process. Empathy requires the ability to reflect on one’s own emotional experiences and compassionately respond from a place of shared affect. Empathy involves “feeling-into” or “feeling with” the other and the ability to share some elements of an affective experience; this is distinctly different from the other processes that involve “feeling for” (Singer & Lamm, 2009).
Figure 2.1 Relationship of different concepts of empathy discussed in the paper with the dimensions of state versus trait, and cognitive versus affective empathy.

2.4 Measuring Empathy

Due to empathy’s complexity, researchers use a variety of approaches, methods and tools to measure it. Measuring empathy differs depending on how empathy is categorized, as either a trait or a state, or both. As outlined above, regarding trait empathy, researchers believe empathy is a stable trait an individual possesses; a component of personality that can be measured and is often referred to as dispositional empathy (Zhou, Valiente, & Eisenberg, 2003). State empathy researchers believe empathic responses happen in response to various contexts/events and that empathy is more of an active process that can change based on life experiences; this is often referred to as situational empathy (Zhou et al., 2003). Many
researchers agree the best measure of empathy or empathic responses is through the measurement of both trait and state empathy, providing the most comprehensive understanding of individuals’ perception and behavior (Neumann, Chan, Boyle, Wang, & Westbury, 2015). Trait empathy measurement originated using self-report questionnaires and subjective scales already in the 1940’s (e.g., Dymond, 1949, as cited in Neumann et al., 2015). Trait empathy measurements continued to develop, capturing affective and/or cognitive aspects of empathy. Many of these scales are still predominantly used in research today including Hogan’s Empathy Scale (1969), the Questionnaire Measure of Emotional Empathy (QMEE, Mehrabian & Epstein, 1972), and the Interpersonal Reactivity Index (IRI, Davis, 1980; 1983). As the interest in the topic of empathy grew, further conceptualizations and complexity in its definition added measures of bodily responses linked to affective states, self-awareness of the experienced affect (Batson et al., 1987; Neumann et al., 2015) and how these affective states may be linked to emotion regulation (e.g., Eisenberg et al., 1994; Gross, 1998). Interest in bodily responses led to the use of peripheral physiological measures of activation of the autonomic nervous system (ANS), such as electrodermal activity (EDA) and heart rate (e.g., Levenson & Ruef, 1992) and the use of central nervous activation measures, such as magnetic resonance imaging (MRI), as well as measures of the activation of the somatic nervous system (SNS), such as facial electromyography (EMG) in an attempt to measure state empathy and empathic responses objectively. In a recent review of empathy measures, Neumann and colleagues (2015) identify that today the measures of empathy include: self-report questionnaires, behavioral methods (evaluative and performance based), measures of central and autonomic nervous system activity and facial EMG. It is very common to use both a subjective measure (e.g., self-report questionnaire) for trait empathy in combination with an objective measure (e.g., facial EMG) for state empathy to better understand human behavior in an experimental paradigm. Studies using multiple measures
“…generally show that different measurement approaches correlate well with each other” (Neumann et al., 2015, p.259).

2.5 Developing Artificial Empathic Systems

A review of the literature has illustrated there are some criteria that allow empathy to be distinguished from other similar processes in human-human interaction; although these are not consistent, they serve as a foundation when it comes to defining what it means to be empathic. We see empathic responses and the sharing of affective experiences within all forms of human relationships. Humans are often viewed as social animals, in which our thoughts and our behaviors are typically directed towards another individual, or are in response to them (Batson, 1990). The development of “…a capacity to understand others and experience their feelings in relation to oneself illustrates the social nature of the self, inherently intersubjective” (Decety & Jackson, 2004, p.71). We are constantly in interactive processes with others and are relating to them using our subjective experiences as a baseline. This is an essential element in the definition of empathy; the very foundation stemming from the shared similarity of feelings and experiences between the self and other(s) (Decety & Jackson, 2004). Our shared and perceived similarity with others is a key component in our need to belong, identified as an essential human motivation. Baumeister and Leary (1995) argue that it is within our evolutionary drive to develop and maintain satisfying interpersonal relationships (Baumeister & Leary, 1995). Empathy, in various intensities and forms is a prerequisite for the formation and maintenance of these social relationships (Nickerson, 1999). Due to these factors, empathy has been predominantly researched as a phenomenon that was present in human-human interaction (Cacioppo & Patrick, 2008; Davis, 1996).

It is clear that we also interact with things that are not human. Typically in childhood we develop closeness with puppets, stuffed animals, dolls, other toys and even cartoon
characters. We know our toy is not feeling anything, nor can it communicate with us but we utilize imagination and various cues to relate our interaction with these characters to typical human social interaction. This is not magic; we simply project feelings and intimacy onto our toys and interact with them as though they were alive. In addition, the field of human-animal interaction (HAI) has rapidly grown over the last decades as research has indicated the countless mental, emotional and physical health benefits exist as a result of interacting and bonding with an animal or personal pet (e.g., Beetz, Uvnäs-Moberg, Julius, & Kotrschal, 2012). In addition, some research shows animals have emotion-like states, feelings, and some type of consciousness that allow and encourage us to connect with them affectively (e.g., Dawkins, 2000; Mellor, 2012). This led to curiosity surrounding how and whether empathy is present in our interaction with animals. Taylor and Signal (2005) were interested in how levels of human empathy (trait empathy) correlate to the perception and treatment of animals. The link of human-human empathy towards attitudes about animals was explicitly studied by examining individual scores on the Interpersonal Reactivity Index (IRI) (Davis, 1980), trait empathy, in contrast to individual scores on the Animal Attitude Scale (AAS) (Taylor & Signal, 2005). Results of this study indicated that higher scores on the IRI (human-human empathy), indicating higher levels of trait empathy were positively correlated to higher scores on the AAS (human-animal empathy), concluding there is a definite link between trait empathy for humans and positive attitudes towards animals (Taylor & Signal, 2005). This research demonstrated empathy was not only a human phenomenon and researchers have become more interested in examining where else we may respond empathically.

Empathy is most often outlined as including an affective process that involves feeling with [or] into the other and responding compassionately from a place of shared affect. We observe this process in human-human interaction and also in human-animal interaction, in which it is clear the human and/or animal is experiencing some type of emotional response
and is being met by the other empathically. Research indicates that dogs and horses are capable of distinguishing between positive and negative human states, and will alter their approach behavior based on emotion recognition (Racca, Guo, Meints, & Mills, 2012; Smith, Proops, Grounds, Wathan, & McComb, 2016). In both human-human and human-animal interaction, all interactants are alive and are capable of feeling a range of emotions, and having an array of actual experiences. What happens when these rules of empathic interaction are broken, when a human responds with, what appears to be empathy, to an object, to something that is not alive? Is it still empathy? Or in other words, is it useful to refer to it as empathy?

Over the past decades our interaction with technology has increased dramatically. We rely on technology in many areas such as communication and interaction, entertainment, work, education, advancement, health and medicine, transportation, and countless others. The Media Equation, or notion that media equals real life, put forward by Reeves and Nass (1996) described that “…individuals’ interactions with computers, television, pictures, and new media are fundamentally social and natural, just like interactions in real life” (p.5); and this research was conducted two decades ago. This, in combination with knowing that we respond to puppets, dolls, stuffed animals and other toys emotionally, has increased interest in how we would respond to evolved technologies or technology that would be programmed to act as though it were alive. Technological advancement in all areas has only intensified the natural and seamless interaction we have with it today. Further research supports the ease in which we communicate with technology is rooted in humans being unaware of their social behaviors and responses towards technologies (Nass & Moon, 2000). Ethopoeia, a concept coined by Nass and Moon (2000), is seen as responding directly to an entity as though it were human, while cognitively knowing that the entity does not merit human treatment. Recently research has expanded to study how humans respond to artificial entities (e.g., robots and
virtual characters) and whether they are accepted as seamlessly into interactive processes as other technology sources. It has been established that humans interacting with artificial entities will attempt to apply habituated forms of communication that are more typical to social human-human interaction (e.g., Hoffmann, Krämer, Lam-chi, & Kopp, 2009; Krämer, Rosenthal-von der Pütten, & Eimler, 2012). Krämer and colleagues have also concluded that the greater the similarity of interaction applied from human to human, to artificial entity interaction, the greater likelihood meaningful social interactions will take place (2012).

Researchers studying human interaction with technology and artificial entities are also looking at the role that empathy may play in this type of interaction. When a human responds to an artificial entity as though it was human, is this empathy, or is this a similar affective process that is assumed to be empathy? Researchers are attempting to develop technology that would allow empathy and empathic responding to be programmed into artificial entities to increase affective interaction, and successful communication and connection (e.g., Krämer, 2009, Krämer, Eimler, & von der Pütten, 2011; Krämer, von der Pütten, & Eimler, 2012; Leite, Martinho, Pereira, & Paiva, 2008, 2009; Leite et al., 2013; Paiva et al., 2004; Rosenthal-von der Pütten, Krämer, Hoffman, Sobierag, & Eimler, 2013; Rosenthal-von der Pütten et al., 2014). Because we are now at a point in the development of artificial systems where researchers are attempting to create devices that operate emotionally or can convey an empathic response; now is the time to look at how and if this can be done with what we know about empathy and empathic responding. This creates a distinct twist in the literature surrounding empathy and empathy research. If empathy is a process that requires ‘feeling with’ another person and sharing affect or an affective experience, then it is not possible to claim that humans can share empathic experiences with entities that have no real emotion, that are not actual beings, instead things that cannot actually feel – and in turn the machines cannot be truly empathic if one uses empathy as a “feeling with” concept – given the machine
does not feel. In this case can a researcher claim that a simulated feeling is equivalent to a real human emotion? This becomes more complex as research exists illustrating humans are responding emotionally to images and videos of artificial entities who appear emotional or are described in emotional situations (Basedow & Kappas, 2014, 2015; Rosenthal-von der Pütten et al., 2013, 2014). We know, cognitively an artificial entity feels nothing; so how do we begin to explain these processes, and how do we prevent misinterpretation?

Examining how humans respond emotionally to artificial entities may help us gain more insight and knowledge about empathy and related affective processes. We are cognitively aware an artificial entity feels nothing. As researchers we are able to control the perception of these entities by inputting affective components that change how they are appraised and perceived by naïve subjects. This creates opportunities to explore concepts, such as empathy, in a controlled setting and to truly determine which affective processes are present in human-human interaction and human-artificial entity interaction. It is clear that humans respond emotionally to technology, machines, toys, and various artificial beings and that affectively programming or developing these, lead to stronger emotional responses (Krämer, 2009; Krämer et al., 2011; 2012; Leite, Martinho, Pereira, & Paiva, 2008, 2009; Leite et al., 2013; Paiva et al., 2004; Rosenthal-von der Pütten et al., 2013; 2014). As we have seen in the review of measures, correlating subjective empathy questionnaire data, skin conductance, facial EMG data, heart rate, MRI and others, does not automatically make the responses to these artificial beings empathic. These responses could relate to a myriad of other processes that we have also mentioned that are similar to empathy. It may be that researchers claiming these results to be empathy, are missing a large opportunity to discuss what types of affective processes take place in our interaction with ‘things’, and to better explore if we can claim that a human truly feels with technology.
<table>
<thead>
<tr>
<th>Empathy Component</th>
<th>Implementation with Human Subjects</th>
<th>Implementation with Artificial Entities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognizing emotional</td>
<td>Detection of facial movements, expressions, body posture, voice</td>
<td>- Use of facial recognition software to identify human emotional expression and allow entity to respond contingently</td>
</tr>
<tr>
<td>expressions</td>
<td></td>
<td>- Human recognizing facial expressions of an entity</td>
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<td></td>
<td></td>
<td>- Impact of body posture, affective movements, and the voice on human–entity interaction</td>
</tr>
<tr>
<td>Recognizing emotional</td>
<td>Physiological measures (e.g., skin conductance, heart rate)</td>
<td>- Sensor information for empathic or emotional processes</td>
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<tr>
<td>states</td>
<td></td>
<td>- Used for entities to respond contingently</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sensor information to better understand how humans respond empathically to entities and what situations/entities evoke strongest responses.</td>
</tr>
<tr>
<td>Situational empathy</td>
<td>Context knowledge + Emotional expressions</td>
<td>- Pairing an entity with affective contextual knowledge and exploring emotional responses to the entity, and situation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Programming an entity to notice cues of an emotional state/situation and provide empathetic responses to a human subject</td>
</tr>
<tr>
<td>Responding empathically</td>
<td>Motor mimicry</td>
<td>- Machine mimicking human behaviors (e.g., verbal: communicative sounds, speech acts, and nonverbal: posture, head hand movement, gaze direction, facial expression)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Human mimicking machine behaviors (verbal/nonverbal)</td>
</tr>
<tr>
<td>Empathic accuracy</td>
<td></td>
<td>- Accurate recognition of what a human subject is feeling by the entity using the measures described above</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Accurate recognition by human subject of what an entity “is supposed to be feeling”. Is this enough to meet criteria for empathic accuracy?</td>
</tr>
<tr>
<td>Emotional contagion</td>
<td></td>
<td>- Through the process of mimicry, the entity could <em>catch</em> the emotion of the human subject and express the emotion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Possible for the entity to strongly embody a specific emotion so that the human subject would <em>feel</em> the same as the emotion portrayed by the entity</td>
</tr>
<tr>
<td>Trait empathy</td>
<td>Questionnaire measurement</td>
<td>- Memory of previous interaction with the entity in comparison to other human users. How this is impacted by trait empathy levels.</td>
</tr>
<tr>
<td>Feeling the emotion</td>
<td>Internal emotional state, consciously intuiting affective state</td>
<td>- Two levels: Internal representation of agent’s emotion state, and subjective experience of an agent’s state. Is Consciousness necessary??</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Emotional model built inside the entity</td>
</tr>
</tbody>
</table>

*Figure 2.2* Overview of empathy concepts discussed in the paper. This links empathy research on human subjects to options for creating empathic human-artificial entity interaction.

### 2.6 Reflections: Is it Really Empathy? It Might Just Be

There is good reason to believe that it might be useful to use the term empathy to describe a process that is occurring in our interaction with not only humans, and animals, but
also with artificial entities. Although responding empathically has numerous benefits for communication, social connection and forming attachment, empathy, and empathic responding can also be reduced to a biological trait necessary for increased survival. Our need to rely on others and have them respond to our needs, both physically and emotionally is seen throughout the life cycle; in varied stages we are completely dependent on others to survive (de Waal, 2009). Our automaticity in responding emotionally or empathically to beings that are non-human could be supported by this notion. Further research illustrates that humans are very unique in resonating empathically with others in need, even those who are unrelated to us, or are a member of a different species (Lamm, Meltzoff, & Decety, 2010).

What distinguishes us from these other species and allows us to respond empathically to them is the human capacity for self-reflection and emotional reappraisal (Povinelli, Bering, & Giambrone, 2000). In terms of understanding the affective components of empathy from the context of social communication, Kappas (2013) argues that “…emotional displays serve communicative purposes and social contexts have a modulatory function, but the emphasis is still on emotion as an intrapersonal process” (p. 3). He believes expressions are better understood in terms of what they do then as what they express. Empathy, also then having a strong intrapersonal and evolutionary component for individual responses, may explain why we respond to artificial entities automatically, simply assigning emotion or other affective components to them and responding, ‘as if’ they were human. So expressions trigger empathy-like responses regardless of who the other is because of what these expressions do.

The interesting question is why we would think of responses to machines or dolls as empathy-like, but to humans or animals as empathy? What if the link between what is going on in the other is just as much a belief as in the machine? We tend to think of empathy as a way of knowing the other, as we discussed above. But often we do not actually have a ground truth to the success of these empathic processes. I might feel sadness for the widow, who
might not actually be sad, but we believe that this is an empathic process. I might feel anger with the individual who has been slighted, but in fact, the display of anger is not actually genuine. This leads to a reflection on the term empathic accuracy, understood as the ability to correctly identify the emotional state of another, and respond appropriately (Baron-Cohen & Wheelwright, 2004; Ickes, 2009). We know the robot does not feel, so every emotion empathically felt or transmitted is by definition not accurate – but we tend to ignore that empathic responses to photos of humans who pose expressions, such as the classical sets used in emotion research (e.g., Ekman & Friesen, 1976) are in fact not empathically correct if the smile conveys happiness, because it is not really there in the actor. So empathy to a robot might not be so different from empathy to an actor after all. Here we need to reconsider how we conceive of empathic accuracy.

Utilizing research on artificial entities as a new way to understand human behavior and affective responding, by reframing human empathy research in the way we just outlined, may continue to provide rich opportunities for understanding how we appraise, perceive, and feel, not only about each other, but the rapidly evolving technological world around us.

2.7 Conclusion

The purpose of this literature review was to explore the concept of empathy, and differentiate empathy and empathic responses from other similar processes. Empathy does not have a universal definition, which makes the understanding and measurement of empathy difficult and the discourse regarding research in this area very complex. This literature review pulls together research on empathy and related processes. It attempts to delineate some of the research on what it means to be empathic. Empathic responses are distinguished from emotional responses. What makes this literature review unique are the connections made between empathy, empathic processes, and artificial entities. The major claim of this review
is that research on human-artificial entity interaction can further expand the understanding and definition of what empathy is. By exploring how humans respond to agents that are only sort of alive, this literature review indicates it may be possible to feel deeply for objects that have no actual feelings or emotions. Research on empathy using artificial entities offers insight into which parts of emotional and empathic responding are distinctly human, or reserved for humans only, and what responses are found towards the non-living. It sheds new light on our own humanness and how we are likely to emotionally and empathically adapt when responding to our ever expanding digital culture.
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Chapter 3

Article 2: Emotions for Entities?
Emotions for Entities: An Exploration of Affective Responses to Humans and Robots

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**Abstract**

We interact increasingly mediated via information and communication technology (ICT). Occasionally, the ‘other’ might not even be human, but increasingly an autonomous agent in virtual or physical form. Research suggests that we treat such technology as though it were an ‘equal’ in common interaction. In line with the Media Equation, based on the concept of Ethopoeia, we apply social rules and expectations to our communication with artificial entities and we unconsciously assign agency to them. Socially we respond as though such non-human entities were humans, but do we respond emotionally to them as if they were? In other words, do they matter affectively to us? Experiment 1 focused on physiological responses (facial muscular activity, electrodermal activity) to the presentation of human and artificial entity stimuli (emotional images and text) and examined whether these responses were related to empathy (IRI scores). The results of experiment 1 suggested that individuals show surprisingly similar emotional responses to both human and artificial entity stimuli; however, this is not related to trait empathy. The results indicated we respond to entities emotionally, assigning humanness, if they visually contain affective information; however, it is not clear to what degree complex states of mind would be attributed to robots without visual cues. Experiment 2 looked at physiological affective responses to neutral human and artificial entity images, paired with emotional text and examined if trait empathy (IRI scores) impacted responses. In addition, what if people are confronted with neutral still images of artificial entities, only paired with emotional text, such as in a Goodenough-Tinker paradigm. Would the context suffice to transform the perception of the entities’ affective state? In a between-subjects condition participants were either interacting with toy robots for ten minutes or not, prior to the experiment to see if this impacted responses in the sense that imagining robots’ emotions could be influenced by explicitly practicing emotional interactions with them. The results indicated engaging in active play with robot figures did
not increase the response to artificial entity or human stimuli. The results were also characterized by complex interactions between target (human-robot), emotion and epoch (the stimuli presentation stages: image, and then image and vignette) and suggest emotional context was not sufficient to clearly elicit expressive and physiological responses when paired with neutral stimuli. The results suggest that visuals are very important for eliciting emotional responses to robots, as neutral images of robots paired with emotional context were not sufficient to elicit systematically empathic responses; we argue that this has design implications for human-robot interaction.

*Keywords:* Human-robot interaction, Emotional response, Empathy, Theory of Mind, EMG, Electrodermal Activity
3.1 Introduction and Theoretical Background

Human interaction via and with technology has increased significantly over the last decades. In fact, our reliance, dependence, and acceptance of information and communication technology (ICT) have continued to grow at an astonishing pace. Interestingly, it appears that as people engage with smart media/technologies more and more in everyday life, they tend to treat these artifacts as an ‘equal’ in communicative and interactive processes, at least sometimes (e.g., Krämer, von der Pütten, & Eimler, 2012). In fact, different theoretical constructs such as the Media Equation Theory (Reeves & Nass, 1996), founded upon the Ethopoeia concept (e.g., Nass & Moon, 2000) address the postulate that humans might tend to treat certain machines, systems or objects as social actors. While these concepts become increasingly popular (e.g., Krämer et al., 2012; Rosenthal-von der Pütten, Krämer, Hoffmann, Sobieraj, & Eimler, 2013; von der Pütten, Krämer, Gratch, & Kang, 2010), we know little regarding the prevalence of this type of subjective transformation. Does it always happen? Is it true for all people? Are there cultural differences, or is there an impact due to age or context? Clearly, there are many empirical questions open that are relevant for different reasons, from being able to design interfaces that are more adapted to their users, or to understanding strong reactions to machine malfunctions (Charlton, Kappas, & Swiderska, 2015). However, as psychologists, we are initially particularly interested in a fairly basic question – how do people emotionally react to and engage with artificial entities? This curiosity is more than just extending one’s horizon in the face of technological advances. Understanding how and why we might feel pity for a machine that gets maltreated, might help us understand how we relate to humans as well.

While there has been interest in the phenomenon of the Uncanny Valley, (Mori, 1970) where an artificial entity elicits negative emotions when it is not yet fully human (e.g., Rosenthal-von der Pütten & Krämer, 2014), there is little known on emotions that are social
or relational in nature. So while the Uncanny Valley relates to an emotion about something, when we interact with humans we often have emotions with them – we share emotions, we feel empathy, we sense emotions in the other. Some initial research already exists on empathic or affective responses to artificial agents in extreme conditions, such as being hurt or even destroyed (e.g., Rosenthal-von der Pütten et al., 2013; 2014); however, very few studies investigate people’s responses in less intense cases to artificial entities, whether these are images, virtual representations on a screen, or embodied devices.

In communicative and interactive processes, humans express and display various behaviors, experience automatic physiological arousal, and maintain self awareness of how they are responding to stimulus or to a specific situation. In research on human-artificial entity interaction, it is of interest which components of human-human interaction remain when humans engage with an artificial entity. Explaining the interactive social process between humans and embodied virtual agents is a key focus of many researchers (e.g., Krämer et al., 2012; Nass & Moon, 2000; Reeves & Nass, 1996) as is identifying challenges of this type of research such as the acquisition and programming of artificial entities, or creating believable behaviors in virtual avatars/characters. This research typically explores real time interaction between the human and the artificial entity. We, however, are interested in minimal conditions that lead to social and emotional processes with artificial entities. Given there is a lot of research with sophisticated avatars, agents, or robots, (e.g., Breazeal, 2003; Breazeal, Gray & Berlin, 2009; Lee, Stiehl, Toscano, & Breazeal, 2009) demonstrating that adults and children react strongly to such systems, this is not an interesting question compared to how sophisticated they would need to be. Is a photo of a toy or robot sufficient to evoke a response? Or perhaps a short textual description of a scenario? Would these affective responses be dependent on the specific emotion being displayed? In the same way that even still images of humans not known to the observer and presented without context,
can elicit expressive responses (e.g., Dimberg & Öhman, 1996); artificial entities may evoke these responses as well.

Numerous publications have examined human interaction and involvement with technological devices such as computers, smart-phones, tablets, animated toys, CGI characters, virtual agents, and, more recently, with embodied robots (Aylett et al., 2015; Breazeal, 2003; Jones et al., 2015; Rosenthal-von der Pütten & Krämer, 2014). Reeves and Nass (1996) first proposed the Media Equation Theory after various studies illustrating that social behavior present in our interpersonal relationships was also present in human-computer interaction. This research showed that individuals automatically apply gender, ethnicity, group membership, status, politeness, reciprocity, reciprocal self-disclosure, and personality traits to computers (Nass & Moon, 2000; Nass, Moon, & Carney, 1999; Reeves & Nass, 1996). Further research indicated that humans’ social responses and reactions to virtual agents and embodied entities were comparable to responses towards humans (Kopp, Gesellensetter, Krämer, & Wachsmuth, 2003; Krämer, 2008; Krämer, Bente, & Piesk, 2003; Rickenberg & Reeves, 2000).

To explain the similarities in social responses to a variety of artificial entities, various concepts emerged such as anthropomorphism, which refers to the tendency to impart humanlike characteristics, including emotion, motives and intentions onto the behavior of an artificial entity (Epley, Waytz, & Cacioppo, 2007; Nass & Moon, 2000). Those who anthropomorphize their responses have the genuine, conscious belief that the artificial entity deserves human treatment (Nass & Moon, 2000; Waytz, Gray, Epley, & Wegner, 2010). This is opposed to the simple automaticity of doing something because you always do it when you interact with someone – because interaction implies perhaps that the something must be a someone. Waytz and colleagues (2010) suggested that this attribution of mind to an artificial entity, that it has the capacity to feel and/or to think, is caused by the need for social
connection and perceiving a similarity to the self. In contrast, the Media Equation Theory posits that humans will treat computers and artificial entities as if they were real interaction partners, and will attribute agency, emotion and meaning to these interactions based on the feedback and cues they receive from the computer or entity (Reeves & Nass, 1996).

Furthermore, the Ethopoeia concept, on which the Media Equation is based, explains social responses to entities as automatic and without conscious processing, as mindless (Nass, Steuer, Tauber, & Reeder, 1993; Nass & Moon, 2000). In this sense, research on Ethopoeia indicates humans will automatically make social attributions to entities, even those with minimal social cues mindlessly; this even when being aware that these attributions are inappropriate to the computer or entity (Nass & Moon, 2000) Mindlessness is often interchanged with the terms habit or automaticity in which individuals’ responses are context-dependent (Langer, 1992). Both the Media Equation and the Ethopoeia concept propose that the application of social rules to interactions with computers and other agents is an unconscious and automatic process that occurs, even while aware that the agent does not merit human treatment (Nass & Moon, 2000). We treat agents or devices as social actors, as the Media Equation states, because of the process of Ethopoeia which argues that the exchange of any social cues, such as interaction, speech, social roles, is enough to trigger our social scripts of communication and we automatically will perform social behaviors fitting to the situation. Humans are inherently social beings requiring social connection and interaction for survival, which may explain these automatic responses (Nass, Moon, Morkes, Kim, & Fogg, 1997; Nass & Sundar, 1994). Human behavior is often linked to specific contexts and categories, so responses to entities can become functionally fixed, without conscious awareness (Langer, 1992) and this provides a framework for differentiating responses to entities. Current research on contemporary automaticity theory finds that unconscious processes dictate how we interact with others and make a majority of our decisions. Our
embedded attitudes, below the conscious level of awareness, will shape our attitudes and behaviors towards others, whether they are human, or not (Bargh & Chartrand, 1999; Bargh, Schwader, Hailey, Dyer, & Boothby, 2012; Morsella & Bargh, 2011). Research conducted in the theoretical context of the Media Equation Theory, which supports this non-conscious responding is linked to participants’ self report during debriefing: subjects insisted, when consciously reflecting, they would not respond to an artificial entity as though it were human (Nass & Moon, 2000; Reeves & Nass, 1996). The Media Equation Theory was recently tested in a study by Hoffmann, Krämer, Lam-chi, and Kopp (2009) demonstrating that social interaction rules, such as reciprocal conversation, active listening, introducing self, asking questions and engaging in eye contact and prompting conversation, as also described in the original Media Equation Theory, were reproduced in interactive sessions between participants and an embodied conversational agent (ECA).

Emotions are social and often develop in human interaction (Kappas, 2013). As was just outlined, recent research suggests similarities exist in human-human and human-entity interaction and both types of communication are social in nature. Thus, it is plausible that affective responses to artificial systems are pervasive and understanding them would have a beneficial impact on designing systems that work well together with humans. We encounter these entities in the real world, outside research settings, so how we perceive them and interact with them is of greater relevance. Research not only suggests that individuals respond to artificial entities as though they were human (greeting behaviors, non-verbal behavior, greeting the entity, politeness and reciprocity in exchange) but it also suggests people can form strong emotional attachments to various technologies (Leite, Martinho, Pereira, & Paiva, 2008; Sung, Guo, Grinter, & Christensen, 2007; Wada & Shibata, 2006, 2007). Some of these emotional responses can be consciously understood, such as when a toy or therapeutic robot can take on similar meaning to that of a cherished object (Nass & Moon,
2000; Wada & Shibata, 2006, 2007). Other studies examine entity embodiment and the Ethopoeia concept, suggesting that interacting with an avatar and physically embodied artificial entity are functionally equivalent as long as there is high behavioral realism (Leite et al., 2008; von der Pütten et al., 2010). Much of the current research involves humans physically interacting with, or being exposed to various forms of artificial entities (robot toys, androids, CGI characters, avatars, virtual agents, and embodied agents). Further developments in the field have led to programming readable emotional expressions into interactive agents, now receiving much attention due to the impact on interaction and relationship formation with agents (Breazeal, 2002; Saldien et al., 2006).

We know that humans react with unconscious emotional responses to still photographs of humans displaying different emotions (e.g., Dimberg, Thunberg, & Elmehed, 2000). Studies have shown that humans automatically mimic the emotional responses of happiness and sadness, measured through facial muscle movements, when shown still photographs of humans displaying happy and angry facial expressions (Chartrand & Dalton, 2009; Dimberg et al., 2000). Would this also be the case if humans were shown images of artificial entities with emotional expressions? Would a response also be elicited to an affective context, presented as a text description only, without any visual representation? How little is required to prompt an emotional response to artificial entities? Researchers may not need to obsess about the naturalness of a human-entity interactive process if a still image would already elicit an emotional response. If this were the case, it may be simpler to construct an emotionally evocative device or system than predicted. In turn, for the researcher whose goal it is to understand basic affective processes it would be very valuable to understand the boundary conditions that trigger emotions and empathy. In fact, there is a positive correlation between high electrodermal responses, mimicked facial expressions, and high scores on self-report empathy measures in response to human affective stimuli (Hess &
This indicates that self-reported empathy may be of interest to include in experimental measurements. If observing still images of artificial entities also results in mimicked human facial expressions, it will be of interest to see if self-reported empathy is a moderating factor, as seen in research on responses to human stimuli.

Researchers have started to explore behavioral and emotional responses to artificial entity stimuli. Current research has been interpreted as indicating that the human brain tends to respond analogously to human and robot movement stimuli (Dubal, Foucher, Jouvent, & Nadel, 2010) in some situations, thereby increasing interest as to which responses would derive from displayed emotional images. Specifically, Dubal and colleagues examined event related potentials (ERPs) in response to the presentation of happy versus neutral images of humanoid and non-humanoid robots (2010). Results at the behavioral level indicate that occipital P1 amplitude was higher for happiness than neutral images, and the occipital P1 emotion effect and response times were similar for both human and robot stimuli, suggesting that early brain processing of emotional expressions is not limited to a human embodiment (Dubal et al., 2010). Further research indicates participants are able to recognize the emotions (happiness and anger) in robot facial expressions to an extent, when specifically directed to examine various artificial entities with manipulated emotional expressions (Zhang & Sharkey, 2012). In addition, the emotional context embedded in an expression also impacts individual interpretation of said emotion, even in a situation involving computer avatars (Creed & Beale, 2007). Zhang and Sharkey found that people better recognized emotions in robot faces (simulated facial expressions of joy, surprise, fear, sadness, anger, and disgust) when they were presented with audio recordings (positive, negative or neutral) that were congruent to the presented emotions’ valence (2012). Furthermore, research on mimicry indicates that in a face-to-face condition with an android, human participants spontaneously match the emotional expressions (happy/angry) of the android (Zhang & Sharkey, 2012). It is
clear human subjects are able to identify clear emotional expressions in human images
presented to them (e.g., Ekman et al., 1987; Izard, 1971). In addition, recent research
indicates humans can also identify basic facial expressions when presented with images or
video clips of artificial entities (e.g., Breazeal, 2002; Zhang & Sharkey, 2011). In research
with human subjects it is known that emotional context also plays a role in how emotional
expressions are interpreted (Niedenthal, Krauth-Gruber, & Ric, 2006) and that the emotional
context surrounding the basic emotion images being shown can override the emotion
judgment with subjects responding to context before basic expression (Carroll & Russell,
1996). The research above also indicates that even with artificial entities emotional audio
recordings impact how accurately subjects identify basic emotional expressions in artificial
entities (Zhang & Sharkey, 2012). Although we can say that subjects affectively respond to
images with emotional expressions of humans and artificial entities, there are no comparative
studies as to how these responses may differ (i.e., strength of the responses, differences
between human and entity stimuli). Research also indicates that context, both visual and
auditory impacts emotional responses to human stimuli, and, in addition, auditory context
(positive and negative) also impacts judgment of artificial entity stimuli. However, there are
no comparative studies that examine how humans respond to visual context (affective text)
when presented with both human and artificial entity stimuli. With the research presented it
could be assumed that humans will respond automatically to the emotional facial expressions
presented in human and robot stimuli, but intensity in responses may differ. Human
behavioral responses could be interpreted as mindless, regardless of the target displaying the
emotion. Adding the contextual information to the images, in the form of a short vignette,
may result in a difference in responding. Automaticity in responding may be reduced. In
addition this provides us with an opportunity to comparatively look at similarities and
differences when subjects are presented with affective stimuli of humans and entities, side by side.

To measure emotional responses to the presented images and text we will not simply ask participants for their subjective opinions. Instead we will use objective psychophysiological measures. Research illustrates that facial expressions were seen to bring an automatic and similar facial response in observers (Dimberg et al., 2000; Ekman et al., 1987; Izard, 1971), so we will use facial electromyography (EMG) to measure specific facial muscle movements linked to emotional expressions. Since we are using images that show less obvious facial expressions than typical Facial Action Coding System (FACS) images (Ekman & Friesen, 1978) or International Affective Picture System (IAPS) images (Lang, Bradley, & Cuthbert, 2008) facial EMG has advantages over the use of visual or subjective questionnaire methods, as it measures subtle facial responses to stimuli. \textit{Corrugator supercilli} activity (knitting of the brow) has been reliably associated with a valence dimension; negative states have been found to have high activity, and positive states very low activity (Cacioppo, Petty, Losch, & Kim, 1986; Lang, Greenwald, Bradley, & Hamm, 1993; Norris & Cacioppo, 2007). Likewise, \textit{Zygomaticus major} activity (lip corners pulled up and back) is associated with high activity for positive states and lower activity in negative states (e.g., Cacioppo et al., 1986; Lang et al., 1993). However, the work of these researchers indicates that very negative states can also be associated with some \textit{Zygomaticus major} activation. In addition, particularly the smile is associated with various social phenomena and thus is more difficult to interpret (Kappas, Krumhuber, & Küster, 2013). Facial EMG activity is often used in measuring facial muscle activation during the presentation of affective stimuli and can help to examine dynamic responses to stimuli, objectively and in real time (van Boxtel, 2010). We will measure electrodermal activity (EDA), analyzed as skin conductance level (SCL) to examine arousal levels in participants. Measuring psychophysiological responses allows us to side-
step issues of social pressures (response biases), or accessibility on self-report regarding participants’ responses to human and artificial entity stimuli. In addition, measures of trait empathy were included to assess whether it also affects emotional and/or empathic responses towards machines.

3.2 Research Question and Hypotheses

To investigate the question whether still photographs of artificial entities, such as robots, would elicit emotional expressions and responses, images of both humans and artificial entities were selected from open-internet sources such as “pinterest” or using google image search via appropriate key words. The selection included artificial entity images (N=105) and human images (N=85) displaying the emotions of anger, sadness, happiness, fear, shame, guilt and pride as expressions. The display of emotion was depicted through recognizable facial expression (e.g., smile, frown), postural stance (e.g., head hanging down), and/or symbolically/contextually (e.g., broken heart held by robot). These images were pre-tested for perceived emotion (see Appendix A1). The results of the pretest indicated that images depicting the emotions of anger, sadness, happiness, and pride were well identified for both targets (to view the full set of images selected, see Appendix A1). It was important that the images did not depict more than one emotion strongly - in other words the displays were clear and unambiguous. The emotions of anger, sadness and happiness have been clearly identified in facial expressions research in studies (e.g., Ekman, 1999; Ekman & Cordaro, 2011; Ekman et al., 1987; Lazarus, 1991). Pride although not identified as a basic emotion also has identifiable criteria; research by Tracy and Robins (2007; 2008) illustrates that the prototypical pride expression involves a small smile on the face (Zygomaticus major activation), opened up posture and a tilted head up and back. Further research suggests humans respond by mimicking what they observe in others faces, postures and vocal expressions (Blairy, Herrera, & Hess, 1999). Although mimicry might not be required for
emotion recognition, there is evidence that it does help in the recognition of subtle emotions and in identifying quick changes in facial expressions of emotion (Hess & Fischer, 2013). In addition to the selection of images, we developed vignettes (to view all vignettes selected, see Appendix A3), also pre-tested, portraying the same emotions of anger, sadness, happiness and pride to assess the interaction of visual cues and context information. Vignettes with the highest scores per emotion were selected and paired with the images (of the same emotion) during the second phase of stimuli presentation. Facial EMG and EDA were chosen as measurements for inferring the level of sympathetic arousal and selected components of facial activity of the participant respectively during the presentation of each stimulus. We are testing whether people respond emotionally to photos of artificial entities, to texts, and to combinations thereof. If we can demonstrate that such responses occur, we would have established minimal conditions for emotional responses to artificial systems as previous studies in this context used ‘richer’ information, such as dynamic stimuli (e.g., Rosenthal-von der Pütten, 2013; 2014). We expect subjects to respond even to minimal cues in static photos, because of empirical evidence, that people tend to treat artificial entities as if they were human and responses to human still photos, vignettes and combinations thereof have been empirically demonstrated. Similarly, as empathic responses in humans are moderated by trait empathy – different degrees to which people feel with other people – we expect the same phenomena to affect the responses to the artificial characters.
3.3 Experiment 1 - Method

3.3.1 Participants

Thirty-four participants (25 female), age range 18-25 years ($M = 20.12$, $SD = 1.72$) from an International European University were recruited using an online undergraduate mailing system. Participants were given €5 or course credit for their participation. The experiment’s duration was approximately one hour. All participants had normal or corrected to normal vision and provided informed consent prior to taking part in the experiment.

3.3.2 Stimuli

The image stimuli pretested included 190 heterogeneous images (87 human, 103 artificial entities), author-selected, depicting various primary and secondary emotions, and were selected from open-internet sources such as “pinterest” or using Google image search via appropriate key words. Images (divided between two groups due to amount of stimuli) were presented to pretest participants in an online survey format using SurveyMonkey and participants, recruited from Amazon Mechanical Turk, were asked to rate perceived presence of various emotion(s) anger, sadness, fear, happiness, shame, guilt, and pride, on a Likert-scale of 1 = not at all to 7 = very strongly. The images selected were chosen to depict one of the emotions selected, not multiple emotions. Because the images were not always consistently identified as having one emotion, images and thereby complete emotion categories (shame, guilt, and fear) had to be eliminated due to ambiguity (see Appendix A1.4). In addition, images with unclear ratings (such as multiple perceived emotions in one image) were removed (see Appendix A1.4); this resulted in 24 final images (six images per emotion split between human and artificial entity). All details of this pretest are described in Appendix A1.
The text vignettes were pretested in a separate experiment. Fifty-two vignettes (homogenous in gender/length) describing situations of anger, sadness, happiness, or pride written by the author, similar to vignettes presented in Krumhuber, Tsankova and Kappas (2016); for more information see Appendix A2. Vignettes were three sentences long, describing an emotional situation. An example of a vignette presented:

*Anger: I was told that I was useless, worthless, and no good. I was just trying to do my job and one little mistake led to my ‘boss’ firing me. I have been let go from my job with no cause, no explanation, nothing! I will find a way to show my boss how this feels! I cannot believe how angry this has made me.*

There was no reference to humans or artificial entities in the vignettes. Vignettes were randomized for presentation in an online survey using SurveyMonkey, where participants recruited from AmazonMechanicalTurk were asked to rate: to what extent does this vignette depict the following emotion(s) anger, sadness, fear, happiness, shame, guilt, and pride, on a Likert-scale of 1 = not at all to 7 = very strongly. From the analysis the six vignettes with the highest intensity rating for each of the emotions anger, sadness, happiness, and pride were selected, leaving 24 vignettes. The complete process is described in Appendix A2.

Given that some vignettes might be perceived unfitting to photos of robots, a final pretest paired the vignettes with the images (see Appendix A3). Vignettes and images were paired together (each image received two vignettes in the pretest), based on emotion categories (matching image to vignette) and participants were asked to: *please choose the short story that you believe is ‘most plausible and believable’ to fit the presented image.* Based on percentage certainty ratings for the pairing of vignette to associated image, vignettes with the highest ratings per pairing for each of the emotions anger, sadness, happiness, and pride were selected. Full details of this pretest are described in Appendix A3.
The results of the pretests generated a set of twenty-four paired stimuli to be used in experiment 1. Participants in this experiment viewed a series of 24 images, 12 human and 12 artificial entity with three images depicting each of the following emotions: anger, sadness, happiness, and pride, paired with vignettes of the same emotion (to view images and vignettes selected, see Appendix A3). The design and final selection of stimuli is described in Appendix A3.

3.3.3 Design and Measures

Experiment 1 was a within-subjects experimental design. Stimuli were presented to participants while recording facial EMG and skin conductance (SCL). Stimuli were randomized and presented all in the same format of different epochs (following instructions). Stimuli were presented to participants on a computer via MediaLab 2008.1.33 software (Empirisoft Corporation). Following the stimulus presentation, participants were asked to complete a questionnaire reporting their perception of the study and to complete Davis’s (1983) Interpersonal Reactivity Index (IRI) to measure individual trait empathy levels. Within the analysis, stimuli presentation was broken down into three epochs (baseline, image, and image/vignette). There were two other within factors: emotion (anger, sadness, happiness, pride), and target (human or artificial entity) to address the research questions.

For the acquisition of facial responses, bipolar sensors were placed over the left Corrugator supercilli (knitting of the brow) and the Zygomaticus major (pulls lip corners up and back) regions according to the guidelines in Fridlund and Cacioppo (1986). A third electrode was placed on the upper center of the forehead, as the ground electrode. Facial EMG site preparation and electrode placement procedures were followed also according to Fridlund and Cacioppo (1986). Prior to placing electrodes, the skin above the muscle area was cleaned with electrode prep pads (containing rubbing alcohol and pumice). Electrodes were surface Ag/AgCl electrodes (10 mm diameter with 15 mm distance between centers of
electrodes). An adhesive ring was applied to the electrodes and then attached to the skin. The center of all electrodes were filled with a saline gel to maximize skin connectivity. Activity over each muscle group was recorded using two electrodes placed approximately 1 cm apart (center to center) parallel to the muscle. Muscle group activity was continuously recorded using a BIOPAC MP 150 system (Biopac Systems Inc., USA). The EMG was sampled at 2000 Hz with a 50-Hz to 500-Hz bandpass filter and a 50-Hz notch filter with the Biopac Acqknowledge 4.0 software (Biopac Systems Inc., USA), according to manufacturer guidelines. To analyze facial EMG, every file was first visually inspected offline to exclude artifacts and noise. Following visual inspection, data was analyzed with the Biopac Acqknowledge software (Biopac Systems Inc., USA), programmed to cut data files to specific time windows and extract data values. The script cut the data according to stimuli markers, programmed into the stimuli presentation software MediaLab, for the onset of each epoch (baseline, image, image/vignette). After extraction, the facial EMG data was used to calculate facial responses to the stimuli. Skin conductance levels were measured following standard procedures according to Boucsein (1992). Skin conductance sensors, filled with an electrodermal cream were applied to participants’ left hand at the index and ring finger distal phalanges and activity was recorded also using the BIOPAC MP 150 system (Biopac Systems Inc., USA). The recorded skin conductance data was processed in a similar manner as the facial EMG data described above.

To explore to what degree trait empathy impacted emotional responses to the stimuli, participants completed the IRI (Davis, 1983) following the end of stimuli presentation. The IRI measures individual levels of trait empathy, defined by Davis as the emotional response to the observed experiences of the other (1983). The IRI contains 28 items and uses four questions subscales: perspective taking, fantasy, empathic concern, and personal distress to address the cognitive and affective components of empathy. The IRI produces four subscales
scores and one total score. The total score and subscales scores were analyzed with the facial EMG and skin conductance data. (For a detailed Experimenter Script describing what was said to participants, see Appendix C.)

3.3.4 Procedure

Upon arrival in the laboratory, participants were greeted and led to the experimental room. Here they were instructed about the general purpose of the study: to observe images of humans and robots and read paired text. Subjects were informed about the face cleaning protocol and sensor attachment related to the facial EMG measures and skin conductance sensors. Participants then signed informed consent and answered questions related to age and gender. EMG sensors were attached at three sites. Participants were then seated in the stimuli-presentation booth and skin conductance sensors were attached to the left hand. All sensors and electrodes were then connected to the respective BioPac modules. Participants were then left alone as the experimenter started the programmed script on a computer. They were aware they could ask for help/or stop the experiment at any time, having contact with the experimenter through an in-booth microphone. Participants were presented with 24 randomized stimulus trials (see Figure 3.1).
Figure 3.1. Illustrates one stimulus trial. Epoch 1 = blank screen (3 seconds), Epoch 2 = image presentation (3 seconds), Epoch 3 = image and vignette presentation (20 seconds).

One trial consisted of the following sequence: 3 seconds blank screen, 1 second fixation cross, 3 seconds image only, 20 seconds image paired with vignette. Participants were instructed to simply observe the stimuli and would then click to continue after the paired presentation of image and vignette. When stimulus presentation was complete participants were asked to smile and then frown following the experiment to ensure proper facial EMG recording activity and electrode attachment. Participants were then asked to complete a questionnaire asking about their perceptions of the study and then to complete the IRI (Davis, 1983). Finally, participants were debriefed regarding the purpose of the experiment to examine similarities and differences in responses to robot and human stimuli. Participants were informed they could receive further information once the experiment was completed. Participants were then thanked for their participation, received compensation, and left the laboratory.
3.4 Results

Statistical analyses were performed using IBM SPSS for Windows (Release 21.0; August 14th, 2012; SPSS Inc. IBM, Chicago). We calculated multivariate analyses of variance (MANOVAs) with the three independent variables epoch (baseline, image-only, image with-vignette), emotion (anger, sadness, happiness, pride), and target (human, artificial entity) and the dependent variables of facial EMG for the Corrugator supercilli and Zygomaticus major muscles, and skin conductance levels (SCL). When Mauchly’s test indicated that the assumption of sphericity had been violated, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity.

We identified a main effect for epoch. Participants showed increasing Zygomaticus major muscle activity change from baseline, to image, to image and vignette, $F(1.55, 51.24) = 5.86; p = .009$.

We identified a main effect for emotion, two significant results emerged. Participants showed Corrugator supercilli activity in response to the presented stimuli, $F(2.72, 89.69) = 4.17; p = .010$. Participants displayed Zygomaticus major activity in response to the presentation of the stimuli, $F(2.54, 83.67) = 3.95; p = .015$.

There were no significant effects for target. This could suggest there were no differences in acceptance of human or artificial entity stimuli, regardless of epoch and emotion. We also found no interaction effects for target.

An analysis of variance (ANOVA) shows there were no significant effects for empathy scores, $\geq .1$. The results of the IRI, both the total score and subscales of scores, were not related to any responses to the stimuli.
Further analysis of the interaction between epoch and emotion revealed significant results for both Corrugator supercilli, $F(3.43, 113.02) = 4.38; p = .004$ and Zygomaticus major, $F(3.70, 122.06) = 4.09; p = .005$ activity. Pairwise comparisons of Corrugator supercilli activity indicated significant changes in muscle activity for happiness indicating the highest muscle activity at baseline and a continuing decrease of muscle activity during the presentation of happiness stimuli over the epochs of image $F(3.43, 113.02) = 4.38; p = .027$ and image/vignette $F(3.43, 113.02) = 4.38, p = .040$. Significant changes in Corrugator supercilli activity also occurred for sadness showing a continuous increase in muscle activity during sadness stimuli presentation between baseline and image/vignette $F(3.43, 113.02) = 4.38, p = .005$ and image to image/vignette $F(3.43, 113.02) = 4.38, p = .006$.

![Figure 3.2](image.png)

Figure 3.2. Corrugator supercilli activity, during all epochs, for human and artificial entity stimuli. Error bars indicate $+1SE$ of the mean.

For Zygomaticus major activity pairwise comparisons indicated significant changes in muscle activity across all four emotions. For anger, muscle activity increased during the presentation of the image $F(3.70, 122.10) = 4.09, p = .039$ and the image/vignette $F(3.70, 122.10) = 4.09, p = .030$. The stimuli for the emotion sadness resulted in some muscle
activity during image presentation $F(3.70, 122.10) = 4.09, p = .029$. Stimuli depicting happiness showed increased muscle activity increased during the presentation of the image $F(3.70, 122.10) = 4.09, p = .009$ and image/vignette $F(3.70, 122.10) = 4.09, p = .008$. For the emotion pride a continuous increase in muscle activity for image $F(3.70, 122.10) = 4.09, p = .025$ and image/vignette $F(3.70, 122.10) = 4.09, p = .032$ was observed.

![Graph showing Zygomaticus major activity for human and artificial entity stimuli.](image)

**Figure 3.3.** Zygomaticus major activity, during all epochs, for human and artificial entity stimuli. Error bars indicate $+1SE$ of the mean.

### 3.5 Discussion – Experiment 1

Emotional responses were found towards the presentation of still images of humans and robots; however there was no difference in the intensity of these responses. This is consistent with the theory of the Media Equation (Reeves & Nass, 1996) and the Ethopoeia concept (Nass & Moon, 2000; Nass & Sundar, 1994). The same is true for when participants read a text vignette providing context for the facial expression.

According to the Media Equation Theory, rooted in the Ethopoeia concept, participants would show no differences in responses to human or artificial entity stimuli, if the stimuli presented met minimal social cues. This research indicates that both: socially
treating an entity as if it were human in an interaction (Media Equation) and mindlessly applying social rules to the entity (Ethopoeia) happens automatically when stimuli either appear to have some human-like quality or when presented in an interactive scenario (e.g., Reeves & Nass, 1996; Nass & Moon, 2000). We hypothesized that participants would, in the case of still image and text presentation, respond more strongly to human stimuli in comparison to artificial entity stimuli, based on the believability of emotional experience and interaction norms with humans. In addition, because the stimuli were still images and not interactive, it was believed that the social cues evoked by the entities would be less stimulating than those evoked by the human images. The Media Equation and Ethopoeia concept had not previously been applied to a still image comparison between humans and artificial entities with emotional expressions and context. The dependent variables related to target (facial EMG and SCL) showed no significant differences in responses to human versus artificial entity stimuli. This may suggest that the Ethopoeia concept and the theory of Media Equation are more broadly applicable than hypothesized. This study indicates participants make no significant distinction in believability or acceptance of human stimuli versus artificial entity stimuli. Furthermore, participants show expected behavioral results to presented stimuli, to both image and image paired with vignette. These expected results include increases in Corrugator supercilli muscle activity for stimuli showing the emotions anger and sadness. Also as expected, increases in Zygomaticus major muscle activity for stimuli depicting the emotions happiness and pride occurred. There were some differences between image presentation and combined image/vignette presentation. This may highlight that emotional context, in the form of text elicits a behavioral response, and that the image is not the only important response elicitor. The assumption of the Ethopoeia concept is that the more artificial entities present characteristics that are related to human features (in this experiment: emotional expressions and affective text), the higher the assumption that they
elicit social responses automatically. The results may allow us to make certain assumptions that the Media Equation Theory and the Ethopoeia concept may no longer apply solely to embodied entities, but also to still images of artificial entities and text depicting human emotions.

We further assumed that participants with higher levels of trait empathy would have stronger responses to the emotional stimuli than those with lower levels of trait empathy, based on the research by Hess and Blairy (2001). Research related to affective and cognitive empathy (Davis, 1983) explains that individuals with high levels of empathy typically perceive and experience the emotions of others more strongly. There were no significant effects for empathy scores, which may indicate that although participants showed behavioral responses that mimicked the displayed emotions in the images and text, regardless of target, trait empathy was unrelated to these responses. This could be explained by mimicry research showing subjects mimic emotional expressions without a tie to empathy levels (Chartrand & Dalton, 2009). Since the results of this experiment indicate that affective still images evoke mimicry, and this is not linked to empathy levels, it would be interesting to examine if trait empathy impacts responses to embodied artificial entities. The research of Zhang and Sharkey (2011; 2012) indicates that subjects identify and mimic basic emotional expressions when shown videos of live artificial entities, but they do not examine any link empathy. If entities were alive in the presence of subjects, would empathy levels impact emotional responses or mimicry as inspired by Hess and Blairy (2001)?

Results of the first experiment indicated that responses to artificial entity and human stimuli had similar results in Corrugator supercilli and Zygomaticus major activity. There was no effect based on trait empathy and no effect based on target. We expected behavioral differences; assuming that since human subjects have more exposure to human emotional expressions and in addition, the affective vignettes would make more sense when paired with
human stimuli, that their responses to human stimuli would be stronger than to artificial
text stimuli. The results suggest that the emotions of anger, sadness, happiness, and pride
are assigned with surprising believability to artificial entities. The results of the interaction
between epoch and emotion indicated that when participants viewed the combined image and
vignette their responses were sometimes more significant than when viewing just the image.
The differences that emerged between image presentation and vignette presentation sparked
an interest as to whether these effects could be replicated if emotional images were removed
and replaced with neutral images. If there was no emotional picture, would vignettes still
power an emotional response to the neutral image stimuli? This provided the foundation for
the development of a second study, experiment 2. We showed, in experiment 1 that humans,
in some senses, mimic the emotional expressions of the humans and the artificial entities in
response to the still image, and then also to the emotional text; however, it is also possible
that we observed a ceiling effect. We looked for clearly emotional robot images and we took
clearly emotional human images and within this specific paradigm we saw physiological
responses to the stimuli. If we removed the emotional image, and only had neutral images,
paired with emotional text, what differences would emerge? We assume that by removing
emotional cues in the image, including emotional expressions, postures and/or symbolic and
contextual meaning, we remove the automatic, spontaneous emotional response to the image
(Dimberg et al., 2000). If there were no emotional cues in the image, would participants only
be able to assign the contextual situation to human stimuli, pairing human emotion with
human image?

In addition to understanding whether affective context, as communicated via a brief
text vignette is enough to evoke emotional responses towards robots, this experiment also
aims to uncover how previous interaction shapes an emotional response to an artificial entity.
Studies on social interaction with artificial entities illustrate that the social effects elicited by
virtual agents or robots are higher when they are socially or physically present (Jung & Lee, 2004; Kidd, 2003). Similar to hypotheses presented by Rosenthal-von der Pütten and colleagues (2013) we were interested if the physical presence of and interaction with a toy robot, prior to stimuli presentation will evoke more emotional responses from the subject. We believed that having to simulate affective behavior or feelings in toy robots would facilitate imagining affective responses in the second part of the experiment where only a neutral image was paired with an emotional context. To this end we intended to manipulate participants’ imagination using a priming condition, in which participants would play with a toy robot (Danbo robot) prior to stimuli presentation.

Figure 3.4 . Danbo, 13”. The Japanese toy maker Kaiyodo began making plastic toy action figures of the Danbo following the popularity of a television show, Yotsuba&!, featuring the character. This experiment used two Danbos measuring 13” and one Danbo measuring 9” for participants to interact with.

Our main hypothesis for experiment 2 was that participants who played with the Danbo robot (Figure 3.4) would have stronger subjective and behavioral responses to
artificial entity stimuli in comparison to the participants in the other condition. For participants in the control condition, we assumed that behavioral responses to neutral human stimuli and neutral artificial entity stimuli, paired with emotional context, would be similar, as seen in the results from experiment 1. Finally, we were interested whether these responses would be moderated by trait empathy scores.

### 3.6 Experiment 2 – Method

#### 3.6.1 Participants

Sixty-four participants (40 female), age range 18-27 years ($M = 20.34, SD = 1.85$) from an International European University were recruited through online undergraduate mailing system. Participants were given €6 or course credit for their participation. The experiment’s duration was approximately 75 minutes. All participants had normal or corrected to normal vision and provided informed consent prior to taking part in the experiment.

#### 3.6.2 Stimuli

The human emotion images from experiment 1 were replaced with neutral human images from the Radbound Faces Database (Langner et al., 2010), two female and one male. The artificial entity emotion images were replaced with neutral robot face images of the NAO robot (Aldebaran Robotics), with three different angle (two front angles, one slight side angle) and color combinations (two grey, one orange). These three different robot images were used in order to make the robots appear as different entities, through color and posture changes. The three human and three robot images were used to replace all 24 images from experiment 1. Therefore, each neutral image regardless of target was shown four times, once per emotion. The same vignettes (24) from experiment 1 (depicting anger, sadness, happiness, and pride) were randomly paired with the neutral images of humans and robots.
This created 24 paired stimuli that were presented in experiment 2 (to view the neutral images and vignettes used in this experiment, see Appendix B1). The complete design and stimuli selection process is described in Appendix B1.

3.6.3 Design and Measures

Experiment 2 was a between-subjects experimental design. Participants were randomly assigned to either the experimental condition ($N = 32$) or control condition ($N = 32$). To address our hypotheses, a pre-experimental condition was developed to engage participants in ten minutes of active play with a small robot toy figure, the Danbo robot. The design of the pre-experimental condition, including the pretesting is described in Appendix A4. Participants in the experimental condition were given an assortment of task-neutral items (e.g., soap-dish, wooden blocks, metal springs, clay-pots, twine, etc.), and three Danbo figures (two 13”, one 9”) (Figure 3.5).
Participants were also given a digital camera (Samsung ES65). Subjects were asked to interact with the Danbo figures by creating a collection of photos. They were able to take photos of just Danbo figures, or create scenes with the random items and the Danbo figures; there was no limit on the number of photos created. The control group participants received the same task-neutral items and the camera and were instructed to interact and play with the items and take pictures of what they had created. After ten minutes, both groups were brought into the experimental room for stimuli presentation (For a detailed Experimenter Script describing what was said to participants, see Appendix D.)

The same stimuli presentation methods, physiological measures (facial EMG and skin conductance) and analysis methodology as used in experiment 1 were used in experiment 2.
All participants completed the Positive Affect Negative Affect Schedule (PANAS) to measure changes in mood (Watson, Clark, & Tellegen, 1988) at three experimental intervals to assess if mood shifts affected responses to stimuli. Pre-PANAS was administered prior to sensor application and play condition, mid-PANAS was administered directly after play condition, and post-PANAS after stimulus presentation. The post-experiment questionnaire and the IRI (Davis, 1983) were administered exactly as in experiment 1.

3.6.4 Procedure

Participants were randomly assigned to the experimental condition or control condition. Upon arrival at the laboratory, participants were greeted and led to the experimental room. Here they were instructed about the general purpose of the study: first to be creative and engage in play and photo making, and then to observe images of humans and robots and read paired text (full instructions, see Appendix D). Then, the facial EMG cleaning and sensor application protocol was explained. Participants then signed the informed consent, filled out a demographics sheet, and a pre-PANAS mood scale (Watson et al., 1988). EMG sensors were attached at three sites: one pair of electrodes at Corrugator supercilli (knitting of the brow), a second pair at Zygomaticus major (pulls lip corners up and back) and a third electrode was placed on the upper center of the forehead, as the ground electrode, according to guidelines in Fridlund and Cacioppo (1986)). The sensors were clipped onto the shirts of the participants so the cables would not interfere with the activity. Participants were then led to a small room, directly next to the prep room. Here they were given a small digital camera and were asked to take a seat at a table where all task-neutral items were laid out, and depending on the condition, the Danbo figures. The priming activity was pretested with \( N = 10 \) participants to control for boredom, enjoyment, and participant’s interpretation about the meaning of the activity (see Appendix A4). Participants were instructed to create images (scenes that could be taken with a camera) through playing, and interacting with the items at
their disposal. The participants in the experimental condition were instructed to use the Danbo figures in their images. Participants were told to engage for ten minutes and then the experimenter would return. After ten minutes the participants filled out a mid-PANAS (Watson et al., 1988). They were then led back to the experiment room and were seated in the stimuli-presentation booth where skin conductance sensors were attached to the left hand. All sensors and electrodes were attached to the BIOPAC MP 150 system (Biopac Systems Inc., USA). Participants were then left alone as the experimenter started the script. Participants were aware they could ask for help and stop the experiment at any time through an in-booth microphone. Participants completed one experimental run. When the stimuli presentation was complete, participants were asked to smile (pulling their lips back) and frown (creasing their eyebrows). Participants were asked to complete a questionnaire asking about their perceptions of the study, a post-PANAS (Watson et al., 1988), and then they completed the IRI (Davis, 1983). Participants were debriefed regarding the purpose of the experiment: to examine similarities and differences in responses to robot and human stimuli. Participants were informed they could receive more detailed information once the experiment was completed. Participants were then thanked for their participations, received compensation, and left the laboratory.

3.7 Results – Experiment 2

We calculated multivariate analyses of variance (MANOVAs) with the four independent variables in the experiment, condition (Danbo play or general play), epoch (baseline, image, image/vignette), emotion (anger, sadness, happiness, pride), and target (human, artificial entity) and the dependent variables of facial EMG for the Corrugator supercilli and Zygomaticus major muscles, skin conductance levels, the IRI empathy scores, specifically the empathic concern (EC) scale, and the three PANAS scores from pre, mid, and
post experiment. All data were then transferred and restructured in R to perform the statistical analyses and create the figures below.

We identified no significant differences between epochs, $F(6, 90.64) = 0.439; p = 0.853$ for the covariate in a simple MANOVA; participants did not show significant differences in responding between baseline, image and image/vignette.

![Overall Reactions](image)

**Figure 3.6.** The overall responses (*Corrugator supercilli, Zygomaticus major* activation), and EDA, to the stimuli presented to participants in both experimental conditions.

A MANOVA for all three measurements and all four emotions shows no significant effects for experimental condition (playing with Danbo toy robots, versus general play control condition), $F(12, 47) = 1.29, p=.256$. The facial EMG and EDA responses to presented stimuli (image, and image/vignette) were unchanged regardless of whether participants were part of the control group (general play) or the experimental group (Danbo play) (see Figure 3.7 and 3.8).
Figure 3.7. Facial EMG (Corrugator supercilli and Zygomaticus major) and EDA responses to neutral images presented. Depicts both the experimental and the control condition. No significant effects.
Likewise, there was no significant influence of trait empathy, including subscale data, of the IRI on psychophysiological responses to the stimuli. For the IRI total score: $F(12, 47) = 0.377, p=.966$. For the Empathic Concern subscale: $F(12, 47) = .902, p=.552$.

There were significant results for the PANAS mood-scales. A Wilcoxon signed-rank test indicated that participants in all conditions showed significant increases in positive mood scores ($Z= 7.130, p<.001$) and decreases in negative mood scores between pre-PANAS and mid-PANAS after the play activity, ($Z= 1.437, p<.001$). See Figure 3.9, and 3.10.
Figure 3.9. Total PANAS scores for positive attitude across all participants, three intervals.

Figure 3.10. Total PANAS scores for negative attitude across all participants, three intervals.

3.8 Discussion – Experiment 2

The main goal of this experiment was to empirically examine if there is a difference in how people relate to humans and artificial entities if the information presented was reduced
In addition, how little interaction with a toy robot is required to shape an emotional response to an artificial entity? After the first experiment, it was clear that primary and secondary emotions were assigned to human and artificial entity stimuli, with no significant differences. These results can be explained with the Media Equation Theory and the Ethopoeia concept, suggesting that the research on these two concepts can be applied to more than just embodied, interactive stimuli. The similarities in responding to both artificial entity and human stimuli created a further research question; to understand if the responses were based on the emotional images, the text, or both. In this sense, experiment 2 explored if it may even be more likely that people could imagine emotional responses even if they were presented with only neutral images, when these images were paired with affective vignettes. This experiment presented an opportunity to explore physiological response similarity through emotional context alone, and whether response differences would exist. Using images with no emotional cues, or programmed humanness would let us explore if participants would assign the contextual emotional situation to human stimuli only, since this is realistic and believable? Or if neutral artificial entities, paired with emotional context, would also prompt responses; would the Media Equation theory and Ethopoeia concept extend even further than affective images? In addition, to what extent would emotional responses to artificial entities be moderated by interacting with toy-like robots? Would this interaction preempt affective responding?

According to the research of Krämer and colleagues (2012) rules of social behavior and interaction are surprisingly similar in human to human, and human to embodied or virtual artificial entity interaction. Giving individuals time to play and interact with an artificial entity (Danbo), based on human norms of interaction, would start to increase the comfort with the entity (Danbo) and develop a personal relation to it. Our primary hypothesis was
based on this assumption, although results indicate that interaction with a toy entity had no impact on response to the stimuli, similar to results seen in research by Rosenthal-von der Pütten and colleagues (2013). Although the two play conditions were pretested, it is of potential interest, and an idea for future research, whether the increase in positive mood, for both groups, overshadowed specific effects of Danbo interaction versus general play.

As previously mentioned research on the Media Equation Theory and the Ethopoeia concept highlight that social responses to artificial entity stimuli is dependent on the level of humanness displayed, and the triggering of social cues. In this experiment the humanness was presented in the affective vignette. Thereby it can be assumed that simply the photos of a neutral robot face (NAO Robot) would not elicit an emotional response since they do not have any human characteristics or likeness, however the neutrality could make it more likely that people could imagine emotional responses, when the vignette pairings occur, even if they are only presented with neutral robots. It appears however, this neutrality did not make it more likely for subjects to imagine and have emotional responses. It is likely that the lack of realism between neutral image and affective vignette may explain the lack of results for our hypothesis between human and artificial entity stimuli. It was hypothesized, based on the results of experiment 1, that although a neutral human and artificial entity face would also likely elicit a neutral response, the pairing of emotional context would result in a response since it is a believable scenario that a human being, or even maybe an artificial entity could experience situations of anger, sadness, happiness, and pride. This was not found in the results to either image or image/vignette stimuli for humans or artificial entities. Based on the results presented, we may be observing a ceiling effect in the second experiment. In the first experiment we looked for clearly emotional robots and emotional humans and we observed physiological responses.
3.9 General Discussion and Conclusion

The main goal of this research was to explore the extent to which humans respond emotionally to affective stimuli of humans and artificial entities and whether these responses are moderated by empathy. In addition to explore if affective responses to artificial entities can be influenced by prior interaction with a toy robot. This research was inspired by the notion that people sometimes tend to treat artificial entities like humans, as postulated by the Media Equation (Nass & Moon, 2000; Nass et al., 1999; Reeves & Nass, 1996), and the Ethopoeia concept (Nass et al., 1997; Nass & Moon, 2000; Nass & Sundar, 1994; Reeves & Nass, 1996). Previous work has shown this is the case with interactive artificial entities (e.g., Kopp et al., 2003; Krämer, 2008; Krämer et al., 2003; Rickenberg & Reeves, 2000). To empirically test affective responses, we used a pretested collection of affective and neutral images (human and artificial entity), and vignettes depicting anger, sadness, happiness and pride. In addition, we created an interaction paradigm to explore the effects of interacting with artificial entities in the form of a robot-toy. We used a wide range of dependent variables; these included quantitative behavioral data, various scales and standardized psychological measures.

According to the Media Equation theory and the Ethopoeia concept, it can be assumed that humans will respond to affective artificial entity stimuli. Because the stimuli used in experiment 1 were affective images, instead of actual human-entity interaction, we assumed that subjects would respond to a lesser extent than to affective human stimuli, based on the believability of assigned emotional stories, the strength of stimuli, and the social responses elicited. Instead, results indicated humans responded behaviorally with equal intensity to both human and artificial entity affective stimuli. This lack of significant differences indicated it does not make a difference for either affective evaluations or reactions when people are observing human or artificial entity stimuli, and that images evoke similar affective responses
to embodied stimuli (e.g., human-robot or human-computer interaction). This may suggest that humans unconsciously assign emotional meaning to artificial entities, despite conscious awareness that these entities are not alive (in this case only images were presented). This could further advance research on the Ethopoeia concept.

According to the Media Equation theory (Reeves & Nass, 1996) increased interaction with technology increases comfort with that specific technology and the likelihood of continued interaction. We acknowledged increased interaction leads to greater attribution of social behaviors to entities or virtual characters as well (von der Pütten et al., 2010). We believed that participants who play with the Danbo robot would have stronger behavioral responses to artificial entity stimuli in comparison to the participants in the general play condition. We identified no significant differences in behavioral responses to the affective stimuli regardless of Danbo interaction. Interacting with a toy entity did not intensify behavioral responses to artificial entity stimuli. We assume that this play condition was not strong or intense enough to elicit behavioral differences.

We anticipated that pairing neutral images of humans, and artificial entities with affective vignettes would elicit some behavioral responses. We assumed that subjects may imagine the emotional scenario more intensely if it was paired with a neutral face. Since the vignettes describe affective scenarios that happen in everyday life, it may have been easier to project affect from the vignette onto a neutral human face versus a neutral robot face; this was not the case. This hypothesis was related to research that shows humans responding physiologically and subjectively to being presented with affective vignettes (Krumhuber et al., 2016). Similar to experiment 1, we found that there were no behavioral differences between responses to neutral human or artificial entity stimuli.
This overall lack of significant results to neutral images paired with affective vignettes could potentially be explained by the significant results of the pre-PANAS and mid-PANAS measures in experiment 2. Participants in all conditions showed significant increases in positive mood scores, and decreases in negative mood scores following the play activity, prior to the presentation of stimuli. These significant changes in mood, regardless of experimental condition, could explain why there were no subtle behavioral differences in responses to the stimuli, regardless of the emotion being depicted. Mood research identifies that changes in mood can influence perception, social interactions and interpretation of information (Forgas, Bower, & Krantz, 1984; Forgas, Chan, & Laham, 2001). An area of future research interest is to explore whether changes in mood can impact affective behavioral responses to various stimuli and how mood may impact our perception of artificial entities.

Emotional responses can be influenced by levels of trait empathy as indicated in the research on emotional empathy and increases in facial feedback and mimicry (Andréasson & Dimberg, 2008; Dimberg, Andréasson, & Thunberg, 2011). We assumed that those individuals with higher trait empathy scores measured using the IRI, would be expected to have greater behavioral responses to affective stimuli. We found no significant effects or relationship between high levels of overall empathy or subscales scores (e.g., Empathic Concern subscale) and increases in behavioral responses in either of the experiments. In summary, this research question was not supported. We infer that these automatic affective responses to stimuli are not linked to the process of empathy.

The results of these two experiments can help to shed new light onto how easily we tend to assign affect to artificial entities. In addition, the results highlight the automaticity of responding to affective still images of humans and artificial entities, and associated context. It appears that these responses are unconscious, and there is an ease in which we assign
humanness, and human emotion, even if the context is illogical. In addition, the impact of mood and how this may shape or change our responses to humans and artificial entities provides an opportunity for future research on this topic. Additional studies should concentrate on these aspects and systematically vary the type and intensity of emotions across human and artificial entity stimuli. These studies would also have to target if, and how, these responses can be manipulated through changes in mood, or stronger interactive conditions. In this way, future data targeting these unanswered questions can also be gathered to have a fundamental influence on the emotional perception and behavioral responses to artificial entities.
3.10 References


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Footnotes

¹The Danbo robot is a Japanese ‘cardboard’ robot that appears in comics and TV shows in Japan (Yotsuba & !). The toy maker Kaiyodo began making plastic toy action figures of the Danbo to interact with following the show’s success.
Chapter 4

Article 3: Emotional Responses as Mediated by Empathy?
Not Every Emotional Response is Mediated by Empathy: How Do We Respond to Destroyed Objects of Various Meaning?

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Abstract

People sometimes respond to acts of wanton destruction with moral disgust towards the act, and empathy for the victim – yet this is not always the case. The present study demonstrates systematic differences in empathy and moral disgust towards a range of targets of destruction. Participants viewed video recordings of standardized staged attacks on humans, meaningful attachment objects (doll, teddy bear), robots, generally meaningful objects, and meaningless objects. The patterns of facial electromyography (Corrugator supercilii, Zygomaticus major, Levator labii activity) and physiological responses (EDA, HR) as well as subjective report data support the notion that wanton destruction of particularly meaningful or cherished objects can elicit responses of similar intensity as those elicited by human-to-human harm. However, surprisingly, this does not appear to be a simple function of similarity of an object to being human. Rather, the results suggest that early or otherwise intense emotional experiences with certain objects may lead these objects to become more meaningful and thus more likely to be included in our moral and empathic “circles”.

Keywords: Emotional response, Empathy, Psychophysiology, Facial EMG, Human-robot interaction, Cherished objects, Violence
4.1 Introduction and Theoretical Background

At a very basic level, humans have often been described as social animals (Batson, 1990). Individuals rely on one another for survival and the formation of interpersonal connections is a vital component to meeting their basic needs (Baumeister & Leary, 1995; de Waal, 2009). The process of interaction and communication is not simply the exchange of factual information about the state of the world. Instead, much of interaction is about the exchange of emotional states and the management of relationships. Specifically, considering the intra- and inter-individual functions of emotions, including emotion regulation, emotions serve important social functions (Kappas, 2011). People matter to us! Charles Darwin believed that emotions not only are a function of environmental demands, but also would serve important functions in communication (Darwin, 1965). Successful signaling of our internal states or social motivations and the perception of others are vital components for adaptation and connection as they foster social cohesion and appropriate responses to our environments (Darwin, 1965). In fact, many emotions are elicited in the context of interactions with others, and these emotional experiences meaningfully connect us in our social environment. Furthermore, emotions are highly social; most of our emotions are felt and shared with others (e.g., Rimé, Mesquita, Boca, & Philippot, 1991; Parkinson 1996), and thus are vital components of inter-individual processes (Kappas, 2013). Emotions are believed to be in some senses universal across human and animal populations and amongst various cultural groups (Buck & Ginsburg, 1991, 1997; Capella, 1991).

One of the most radical changes regarding how we interact with each other has been triggered very recently via technological advances, such as the Internet. Even more different, today, we don’t only interact with humans and other animal species; we also interact with technological devices and embodied agents. Based on what we know regarding social interaction, it may be anticipated that our emotions will also shape the way we interact with
actors in digital culture, such as various types of technology, and even artificial entities and robots. This opens on one hand new fields of study to understand this rapidly expanding field, but also offers new insights into basic human affective processes. The present study will compare emotional and empathic responses to human and non-human actors.

The process of emotion sharing, vital to human interaction and feeling the emotions of others, is considered a form of empathy (Decety & Meyer, 2008). Researchers exploring empathy highlight that the experience of affect sharing, and the matching of emotional expressions with others, while maintaining the distinct self, is part of our everyday social interactions and is key to forming successful relationships (e.g., Davis, 1996; Decety & Meyer, 2008; Gruen & Mendelsohn, 1986; Schulkin, 2005). Empathy connects us; it is an affective and cognitive process that provides a shared experience through feeling or thinking about the feelings of others and being impacted by them.

What is interesting about the process of empathy, in relation to us as social animals, is that we do not only feel empathy for humans, but we also feel empathy for animals. Darwin (1965) emphasized the similarities between the emotional expressions in humans and in animals, because he wanted to emphasize the phylogenetic origins of human emotional expressions. Thus, we assume we have emotions and empathy for humans and animals because of the similarity that exists between species. Since the publication of Darwin’s book in 1872, numerous studies have demonstrated that humans are able to extend empathic responses to non-human animals and empathic responding to different species is positively correlated with phylogenetic similarity (Prguda & Neumann, 2014; Westbury & Neumann, 2008). Empathy for humans, animals, and even other entities is impacted by the Kindchenschema (Lorenz, 1943); infants of mammals are even more similar to each other when they are young, thus this is a powerful schema across species. The Kindchenschema suggests that infant and childlike features such as large eyes, a round face, plump cheeks and
a large forehead, are perceived as cute and evolutionarily non-threatening; and these features motivate caretaking behavior and inhibit aggression (Glocker et al., 2009; Lehmann, Veld, & Vingerhoets, 2013). The Kindchenschema has also been extended to baby animals when humans show similarly increased sensitivity in responding to baby animal stimuli, as they would to human-infant stimuli. The link is not surprising that in empathy research higher levels of empathy shown towards animals are indicative of higher trait empathy levels, and are also linked to pro-social behavior (Westbury & Neumann, 2008). These empathic responses are proposed to be automatic (Preston & de Waal, 2002) in which a monotonic linear trend occurs: the strongest emotional responses are to humans, then primates (non-human bipeds), then quadruped mammals and finally birds (Prguda & Neumann, 2014; Westbury & Neumann, 2008). The similarity in emotional and empathic responding between humans and animals also connects the similarity in emotional needs between species (Zahn-Waxler, Hollenbeck, & Radke-Yarrow, 1984).

A fairly recent line of research focuses on how humans respond to artificial and autonomous entities. This is linked to our rapidly growing interaction with this type of technology, and recent research is claiming that we are also feeling empathy with these non-living things, (i.e., various robots and other artificial entities); (e.g., Leite et al., 2013; Rosenthal-von der Pütten et al., 2014). In line with the Media Equation theory (Reeves & Nass, 1996) and the Ethopoeia concept (Nass & Moon, 2000), researchers are showing that humans socially treat robots as they would other humans (e.g., Hoffmann, Krämer, Lam-Chi, & Kopp, 2009; Krämer, von der Pütten, & Eimler, 2012). Related to empathic responses in the context of specific events, there is a second line of interest, namely the more long-term process of developing emotional attachment to companion entities, particularly in research with older adults and therapeutic robotic companions (e.g., Krämer, Eimler, von der Pütten, & Payr, 2011; von der Pütten, Eimler, & Krämer, 2011). Lastly, a third line of research is
associated with the attempt to program empathic responses into social robots (Aylett et al., 2015; Jones et al., 2015; Leite et al., 2013). The present study will focus on the first issue – emotional and empathic responses to humans and non-human artefacts.

Research by Rosenthal-von der Pütten and colleagues (2013; 2014) demonstrated that participants in their research responded emotionally (physiologically and subjectively) to the torture of a toy robot, indicating they were empathizing with a robot being harmed. The toy robot used by Rosenthal-von der Pütten and colleagues (2013; 2014) is Ugobe’s Pleo robot, a small autonomous dinosaur robot (see, http://www.pleoworld.com/). The studies by Rosenthal-von der Pütten and colleagues (2013; 2014) showed participants video clips of harming/violent behavior, and video clips of positive touch, towards a human (female), the Pleo, and a cardboard box. The violent acts included hitting, choking, suffocating, punching and the positive touch included massaging, caressing, and hugging. Rosenthal-von der Pütten and colleagues measured physiological and subjective responses of participants, in two different studies, to these video stimuli (2013; 2014). The results indicated that participants responded strongly to the negative stimuli for the human and the Pleo, in addition to showing some responses to the cardboard box; indicating affective responses may have been to the acts of torture, not only the stimuli it was performed on. Participants also responded to the positive videos of the female and the Pleo being treated kindly. This research elicited great interest in the community of Human-Robot-Interaction (HRI) researchers (e.g., Hoenen, Lübke, & Pause, 2016; Suzuki, Galli, Ikeda, Itakura, & Kitazaki, 2015; Tsuji et al., 2014), as well as those who are interested in empathy in humans. This seemed the first solid evidence of empathy towards robots being just like empathy towards humans.

But why did this happen? The artificial entities in question are not alive, they are not even biologically similar to us, or to other mammals; what is sparking these emotional and maybe even empathic responses? One argument could be that in these studies, particularly the
studies using the Pleo, the artificial entity is very baby-animal like, even cartoonish, representative of a known toy or cartoon character; something familiar. The perception of the Pleo is likely impacted by the Kindchenschema (Lorenz, 1943) and our experience with cherished objects. The Pleo has many characteristics of an animal baby: large round eyes, small nose and mouth, thick and plump body shape, and is perceived as cute. The Pleo, based on these infant-like characteristics is likely to evoke caretaking behavior and positive affective responses in human subjects (Glocker et al., 2009; Lehmann, Veld, & Vingerhoets, 2013).

Figure 4.1. The Ugobe Pleo is an autonomous toy robot, slightly larger than a shoe-box, and is modeled after a Camarasaurus dinosaur. Image retrieved from: http://www.pleoworld.com/pleo_rb/eng/pleovspleorb.php

Consequently, some emotional responses in the Rosenthal-von der Pütten’s experiments (2013; 2014) are probably already elicited by simply watching the violent acts and torture taking place (hitting, beating, strangling, etc.), but the responses are likely even stronger when watching a Pleo, a cute baby dinosaur robot with large eyes and baby animal sounds (purring, whimpering, crying, etc.), being tortured. The present study was designed to
shed light on the type of responses observed in various studies on emotional and empathic responses to robot harm (e.g., Bartneck, Rosalia, Menges, & Deckers, 2005; Bartneck & Hu, 2008; Hoenen et al., 2016; Rosenthal-von der Pütten et al., 2013; 2014; Suzuki et al., 2015; Tsuji et al., 2014).

In the present context, we will constrain empathy to emotional responses to violence afflicted to someone or something. This is not only relevant in many applied contexts, such as trauma, witnessing violence to others (Brockhouse, Mstefi, Cohen, & Joseph, 2011; MacRitchie & Leibowitz, 2010; Wilson & Thomas, 2004) or factors affecting prosocial behavior, such as helping others who are being abused (Foubert & Perry, 2007; McMahon & Banyard, 2011). Given that we know quite a bit about responses to humans being hurt, the question is what types of emotional responses are elicited if violent acts are done to robots that do not look like animals, or known ‘cute’ characters? Or, whether it is possible to also have emotional responses to other non-sentient objects, i.e., those that do not resemble robots? Can we extend the hypotheses that both emotional and empathic responses extend to all objects, or only to objects that have specific meaning, or both? In addition, what determines which objects or elements of destruction elicit the highest responses? By exploring our emotional responses to violence and the destruction of various ‘things’, we are able to obtain a greater understanding of human emotion, empathy and emotional/empathic responding.

4.2 Theoretical Background

4.2.1 Measurement of Emotion and Empathy

Measuring human emotion, emotional states or empathic responses accurately is a large problem in the field of affective science (e.g., Hollenstein & Lanteigne, 2014; Mauss & Robinson, 2009). As affective responses to an event, such as watching someone or something
being harmed, are central to inferring that empathy was involved, a few comments shall be made as to how such affective responses are thought to be indicative of emotions. It is a myth that the measurement of emotion is simple and we should all automatically be able to know when someone is experiencing an emotion, what the emotion is, and what its causes are (Kappas, 2011; 2013). A consensual component model of emotional responding, suggested by Mauss and Robinson (2009) holds that a situation (in which emotion is evoked) is typically followed by an appraisal process and then the emotional responses in different domains, namely “…subjective experience, peripheral/autonomic nervous system, central nervous system [ANS] [and/or] behavior” (p.22) follow. Responses in these different domains have been shown to be only moderately correlated. In fact, there is arguably no gold standard in measuring emotional responses, as the responses are comprised of different facets: the appraisal and personal significance at the beginning of the response (Lazarus, 1991; Scherer, 1984), and then the subjective experience of the emotion as well as changes in peripheral or central physiological activity or in behaviors or behavioral tendencies, thereafter (Frijda, 1988; Gross, 2007). Reviews of emotion measures agree that all measures of emotion can be relevant, are not interchangeable, and should be used in combination to gain a deeper understanding of human emotion and emotional responses (Ekman, 2016; Mauss & Robinson, 2009). Thus, multiple response domains were used in the present context, namely self-report of subjective experiences, autonomic responding as indicators of arousal (e.g., Bradley & Lang, 2000; Cacioppo, Berntson, Larsen, Poehlmann, & Ito, 2000) and facial behavior as indicated via electromyographic recordings of muscle activation as indicators of valence (e.g., Dimberg, Thunberg, & Elmehed, 2000; Fridlund & Cacioppo, 1986; Philipp, Storrs, & Vanman, 2012).

The general logic of using emotional responses to some event as an indicator of empathy is as follows. According to appraisal theory, a general appraisal of relevance is
necessary for emotional changes in the named components to occur. Someone reacts emotionally because the stimulus mattered. So someone watches someone being hit, then the idea is that an emotional response is the consequence of an evaluation that the act of violence mattered to the observer. This would be necessary for empathy (assuming one conceives of empathy as a process that also involves emotional responses in the empathizer). However, perhaps there are other reasons why one would respond emotionally. Watching a tree fall and having facial and autonomic responses might not be due to empathy with the tree, but other processes that relate to, for example, the dynamics of the event. Thus, affective response and empathic response cannot and should not be equated. The following section will discuss in more detail the issue of emotional responses to things.

4.2.2 Emotions towards Things

Emotions are not only tied to situations and events, or to interactive processes; they are also present in how we connect with and feel about our possessions, cherished objects and other meaningful items that belong to us, and to the people we care about. Contact with a special object is enough to elicit an emotional response. “Material possessions are often much more than their functional properties; for example, possessions may be used to construct one’s self and thus become a symbolic manifestation of who one is” (Ferraro, Escalas, & Bettman, 2011, p.169). Special objects may become extensions of who we are and the value of cherished objects is not derived from their monetary value or specific functionality (Belk, 1988). Cherished possessions, regardless of the owner’s age, gender, or culture, derive their value “…from the histories of the people – oneself or others – to which they have been attached” (Diesendruck & Perez, 2015, p.11). Loss or damage to a cherished object, whether a coffee mug, t-shirt, or teddy bear, result in very strong emotional responses such as extreme loss, grief and sadness (Belk, 1988; Gjersoe, Hall, & Hood, 2015; Hill, 1991; Keefer, Landau, Rothschild, & Sullivan, 2012). These losses can injure an individual’s sense of self.
(Diesendruck & Perez, 2015) as the cherished possession is a marker of their identity and “...the loss of an identity marker is a symbolic form of death of self” (Ferraro et al., 2011, p.169). It is clear that possessions hold special meaning that vary individually, and emotional responses to them are very strong. Possessions take on these intense meanings as a function of various factors: personal security/attachment, basic human needs of closeness, and cultural values of individualism versus collectivism, consumerism and materialism (Diesendruck & Perez, 2015). Children typically have cherished items, such as soft blankets or a special stuffed animal, doll, or toy. These objects are meant to provide security, comfort and safety for the child and are often present to help regulate emotional responses at sleep-time, during trips, and when caregivers are away (e.g., Diesendruck & Perez, 2015). By studying how small children (ages 3-4) perceive their cherished objects, a recent research has shown differences between animism, attributing life to a lifeless object, and anthropomorphism, attributing human-like qualities, including emotional states to non-human entities or beings. This breaking research shows that children do not simply anthropomorphize everything as was previously believed, but they distinguish their responses, assigning mental states only to their valued objects (Gjersoe et al., 2015). These results are dependent on the object having strong emotional worth, and personified features like a face, expression or body (Gjersoe et al., 2015). Furthermore, Gjersoe and colleagues hypothesized that how adults responded to their special possessions: the strength of their anthropomorphic tendencies in general and to cherished items in present day may be linked to early development and levels of social connectedness (2015).

4.2.3 Emotional Responses to Harm

It is clear that cherished objects have the capacity to elicit strong emotions; positive feelings when the object is present, looked at and described, and very negative emotions when the object is broken, destroyed or disappears (Belk, 1988; Gjersoe et al., 2015; Hill,
Among these very negative emotions the emergence of sadness, loss, and sorrow is expected, however, it is also very likely that people feel anger and disgust when something bad happens to a special possession. Since cherished objects are described as extensions of the self, it makes sense that the loss or harm to such an object is felt as a personal loss and even as a threat to the self (Ferraro et al., 2011).

This sets the groundwork for emotional responses of disgust, moral disgust, and anger, if a cherished object were to be harmed. Darwin (1965) conceptualized disgust as an adaptive emotion, an emotion that aims to protect the individual feeling it. Disgust’s primary adaptive function is to keep an individual from harm; be it physical, emotional, perceived or even imagined (Rozin, Haidt, & McCauley, 2000). Theoretically, disgust is often studied in association with themes of contamination and in response to repugnant social behaviors and strong violations of social norms (Gutierrez & Giner-Sorolla, 2011; Ottaviani, Mancini, Petrocchi, Medea, & Couyoumdjian, 2013; Simpson, Carter, Anthony, & Overton, 2006). However, disgust is also often associated with morality and moral judgments; the experience of disgust being positively correlated and having a bi-directional relationship with moral judgments (Haidt, 2001; Russell & Giner-Sorolla, 2013; Yang, Li, Xiao, Zhang, & Tian, 2014). Moral disgust is elicited from immoral acts and from violations of social norms like fairness and human rights. Behavioral measures (facial expression), and subjective (self report) cross-cultural data illustrate that moral disgust stimuli depicting unfairness and harm, elicit strong disgust responses, initially thought to only be strongly elicited with physical disgust stimuli (Chapman, Kim, Susskind, & Anderson, 2009). In addition, this type of disgust typically intensifies over time and often co-occurs with anger (David & Olatunji, 2011; Ottaviani et al., 2013; Russell & Giner-Sorolla, 2013; Yang et al., 2012). Within the study of moral emotions, anger has been seen as a common response to both actual and symbolic forms of harm (Rozin, Lowery, Imada & Haidt, 1999). Disgust and anger may
overlap as emotional responses to moral situations, but there are distinct differences that allow researchers to distinguish one emotion from the other. This is important when wanting to study both anger and disgust responses in the same experimental paradigm. First of all, they are defined as two different basic emotions since they are believed to have different facial expressions that can be objectively measured (Ekman, 1999; Vrana, 1993; Whitton, Henry, Rendell, & Grisham, 2014). Secondly, physiological responses may also differ for anger and disgust, even if there are divergences in studies attempting such a differentiation (Ekman, Levenson, & Friesen, 1983; Levenson & Ekman, 2002; Russell & Giner-Sorolla, 2013). A physiological measure such as heart rate (HR) often shows acceleration for an anger response, after a brief deceleration associated with orientation, and more long-lasting deceleration for a disgust response to various provoking stimuli (Stark, Walter, Schienle, & Vaitl, 2005). Being distinct basic emotions may also explain why each has a different action tendency: disgust is typically communicated through a withdrawal response (protective) whereas anger is typically expressed as a hostile response (aggressive) (Gutierrez & Giner-Sorolla, 2007; Lazarus, 1999). So although they may co-occur, we assume to be able to distinguish anger and disgust responses to a variety of stimuli.

A significant component of humanness is our ability to feel and express emotions. We experience many feelings as a result of a variety of situations and experiences. It is clear cherished objects can evoke even stronger feelings, as they are an extension of who we are; the loss or harm to these objects often leads to sadness, anger, and even disgust. We know from research just mentioned that we can feel for our cherished objects, particularly if they are damaged or lost; however, are these responses also present for other people’s cherished objects and various objects of meaning? In addition, are there differences in responses towards objects we have never or only briefly interacted with, such as artificial entities and various robots? While artificial entities are becoming commonplace in society, not everyone
has had personal experience with them and they still have no defined social role as such, so what kind of emotions, when damaged will they evoke? Research linked to cherished possessions, emotional responses and human-robot interaction (HRI) examines the topic of robot abuse to gain a better understanding of human responses to these objects, these machines. Since artificial entities, particularly robots, are beginning to be a part of everyday society (household robots like vacuums and lawnmowers, robot pets), it is of interest how much humanness is assigned to these machines. The field of HRI is advancing and robots are increasingly capable of interacting socially, supporting their users, and cooperating with humans in various activities (Bartneck & Hu, 2008; Goetz, Kiesler, & Powers, 2003). As previously mentioned, the Media Equation Theory (Reeves & Nass, 1996) or Ethopoeia concept (Nass & Moon, 2000) and HRI related research (e.g., Hoffmann et al., 2009; Krämer et al., 2012) suggest humans treat technology sources, computers and artificial entities with the same social interaction rules as they would a real person. Research on robot abuse (e.g., Bartneck et al., 2005; Bartneck & Hu, 2008; Rosenthal-von der Pütten et al., 2013, 2014; Suzuki et al., 2015; Tsuji et al., 2014) offers insight into emotional responses of humans towards artificial entities and if concepts such as the Media Equation and Ethopoeia still hold true in more extreme conditions.

4.2.4 Robot Abuse?

The most popular studies on robot abuse involve the reproduction of the Stanley Milgram obedience experiment with shocks administered to virtual human characters (Slater et al., 2006) and to an embodied mechanical robot (Bartneck et al., 2005; Bartneck & Hu, 2008). For the embodied mechanical robot, all participants carried out the experiment to completion by administering the final shock; they did initially show compassion by not wanting to inflict the final shocks, but following social pressure from the researcher, they ultimately carried them out (Bartneck & Hu, 2008). The robot used in the study was very toy-
like in appearance, so these results need to be interpreted carefully, but it appears the Media Equation may have its limitations. In the case of the virtual human, which was more life-like, not all participants gave the complete set of shocks, and many showed compassion by wanting to stop prior to the end of the experiment. Although participants were cognitively aware that the virtual entity was not real, and the shocks were not real, their physiological, behavioral and subjective responses to the experiment were as strong as if it was a real person (Slater et al., 2006). As previously mentioned, research with the Pleo robot toy (Rosenthal-von der Pütten et al., 2013; 2014) shows participants responding positively to acts of care and negatively to acts of torture towards the robot. This research elicits questions regarding other factors that may impact emotional responding. Especially, as these emotional responses are found to be similar in intensity as to when humans respond to human stimuli. This is interesting and opens up the door for research on the destruction or harm of entities in less extreme paradigms. Other studies that involve ‘killing’ a mechanical mini-robot show that participants’ destruction and the intensity of hitting the robot was dependent on the perceived intelligence of the machine (Bartneck & Hu, 2008). It appears concepts such as the Media Equation, Ethopoeia, and anthropomorphism, despite their limitations, are very relevant when trying to understand why humans respond to robot abuse emotionally. It may be because we see robots as sort of alive (Turkle, 1998), partially human, or possessing human-like qualities and therefore we are greatly impacted. Or perhaps these responses are simply basic human reactions to acts of destruction, torture, and harm as seen in research on moral emotions, in particular the responses of disgust and anger.

4.3 Research Objectives

The results of the studies by Rosenthal-von der Pütten and colleagues (2013; 2014) demonstrate that participants show emotional responses (significant increases in skin conductance levels (SCL)) to the torture videos of the toy robot (Pleo) and the human. These
results have been interpreted as indicating empathic responding to the treatment of the toy robot. To counter one alternative explanation, in the second study (Rosenthal-von der Pütten et al., 2014), a neutral object, a box, was used as a control item and it was treated either affectionately or destructively. The results of the second study, which instead of skin conductance used functional magnetic resonance imaging (fMRI) data, indicated that participants also reacted emotionally to the videos of the box with no significant differences found in the physiological activation patterns between the three items. Objectively, the fMRI results indicated emotional responding to the acts of torture/abuse regardless of whether a cardboard box, toy robot, or human were being hurt. Subjectively, questionnaire data indicated participants felt the most distress and had the strongest responses to the human in distress, followed by the robot in distress, and reported no significant feelings about the box (Rosenthal-von der Pütten et al., 2014). These results, in particular the physiological results, are very interesting for the design of the proposed experiment.

Both studies use objective measures (electrodermal activity or fMRI) and subjective measures to gauge emotional responses of participants to the stimuli. Importantly, Rosenthal-von der Pütten and colleagues (2013; 2014) used a combination of objective and subjective measures; physiological measures are finer grained and sensitive to participant responses, and are also not subject to response bias. The measures in Rosenthal-von der Pütten and colleagues’ research are very interesting; however, they missed the ability to examine specific emotional responses. Electrodermal activity gives information about levels of arousal and general activation levels and it also provides information about the meaningfulness of the stimuli, but it does not tell the researcher whether the subject thinks something is wrong, or morally questionable. Brain activation is a great method for looking at activation patterns but is also difficult to process because no 1-1 mapping of specific emotions or dimensions are possible. This is why using facial EMG is interesting; it allows the researcher to draw
inferences about emotional processes. We must be careful to not over-interpret these inferences (Kappas, 2013), but we can look at specific emotions such as disgust, as seen in the research on moral disgust (Haidt, 2001; Russell & Giner-Sorolla, 2013; Yan et al., 2014). For the proposed study we will combine facial EMG (related to moral disgust), EDA for arousal and meaningfulness, and augment these measures with heart rate (HR) and self report data; this creates a combination of objective and subjective data to systematically investigate the emotional responses of participants.

The motivation for this current study is to explore how humans emotionally respond to the simple destruction of a selection of items. The purpose is to determine which factors contribute to emotional responses; is the act of destruction/violence enough, or are these mediated by the type of object and meaning of the object. In the work of Rosenthal-von der Pütten and colleagues, the human, Pleo and box were treated affectionately (e.g., stroked, cuddled, hugged) and were tortured (e.g., strangled, hit on a table, hit on the side) (2014). The results indicated fMRI activation for violence towards all three objects; however, fMRI data, although indicative of an emotional response, is a sensitive measure. From this study it cannot be determined through the objective data, if the meaning of the different objects impacted the physiological results at all, or if it was simply a strong response to violence. The subjective data indicate that participants were most distressed by the human being hurt, followed by the toy robot, with no conscious awareness of their responses to the box. The study proposed will look at the controlled destruction of each object with a baseball bat. The use of a cardboard box was great as a control object (Rosenthal-von der Pütten et al., 2014), but it also yielded results that were unclear and could not be completely explained. For the purpose of the proposed experiment we used hitting the ground, no object, as our control stimulus. In addition, the responses to the Pleo can be due to a variety of reasons, as previously discussed. We explored existing research on cherished possessions and selected a
variety of items (see Appendix A5) that had different levels of meaning, to explore if meaning moderates emotional responses. We included standard toy-like robots to look at emotional responses to robots. In accordance to the background of empirical research, we hypothesized that participants will have and will display affective responses (measured through psychophysiology) to videos showing the destruction of objects (H1). In addition, we hypothesized that the intensity of the physiological responses will be influenced by the meaningfulness of the object being destroyed (H2). Moreover, we assumed that participant’s empathy scores (H3a) and subjective questionnaire data (H3b) will be positively correlated to physiological measures. The results of the proposed experiment expand on the research presented so far. By choosing specific psychophysiological and subjective measures, we hopefully will be able to draw more specific conclusions about what impact the meaning of stimuli has on affective responses. In addition, whether acts of violence or destruction are so powerful that they automatically trigger a biological response which outweighs the meaning of the items (explaining the fMRI results from Rosenthal-von der Pütten and colleagues, 2014), or if humans inherently distinguish based on the importance of various objects and this impacts physiological responding.

4.4 Method

4.4.1 Participants

Forty-two participants (21 female), age range 18-27 years ($M = 20.79, SD = 1.88$) from an International European University were recruited using an online undergraduate mailing system. Participants received €10 or course credit for their participation. The experiment’s duration was approximately one hour. All participants had normal or corrected to normal vision and provided informed consent prior to taking part in the experiment.
4.4.2 Stimuli

The stimulus material used was a selection of pretested video clips showing the destruction of a variety of objects with a baseball bat (see Appendix A5). The videos were filmed in a small white room, which allowed the researcher to control for light, sound, and object placement.

*Figure 4.2.* Example of floor, and white background for videos. Objects that were destroyed were placed in the center, on the floor shown.

The videos were filmed using a Canon PowerShot SX510 HS. The videos were controlled for length (8-12 seconds) and contained three phases (Phase 1: zoom in ≈ two to three seconds, Phase 2: hitting object ≈ four to seven seconds, and Phase 3: zoom out ≈ two to three seconds). In addition, they were controlled for intensity of swinging of the bat towards the object, and number of hits on the object (five swings). The person hitting the objects wore all black and could not be identified as male or female. For the videos of the humans being hit by a bat, both the male and female victim wore the same clothing. The pretest included videos of thirty-one objects selected by the researcher and believed to have varying levels of meaning, based on cherished possessions research. These included: human stimuli, emotionally meaningful objects stimuli, robot stimuli, generally meaningful objects,
and non-meaningful objects. The pretest analysis was based on Likert scale responses (1-7) for pleasantness, realism, shock, and discomfort per video. From the analysis, ten videos that elicited the greatest responses fitting into the perceived meaning categories were selected. A test video, with a very low rating was also selected to be shown to participants as an example stimulus prior to the start the experiment.

The final video stimuli were categorized into five types: Type 1: two human victims (male, female, both with back towards camera), Type 2: two emotionally meaningful objects (teddy bear, baby doll), Type 3: two toy robots, Type 4: two meaningful objects (guitar, Nintendo console) and Type 5: two non-meaningful objects (cardboard box, fan), one control video (floor), and one example object (old telephone). The videos contained sound: for the hitting of the humans the sounds were painful, yet acted, groans, and for all other objects the sound was the organic result of hitting the object with a bat. The video clips were controlled for height and width and were presented to participants in the middle of a large projection screen. Video clips were played to participants using Windows Media Player (version 11.0 for XP). Volume was controlled for participant presentation at a level of 80-85dB using a Dell computer stereo speaker system (AX210 USB).
Figure 4.3. Overview of the objects in the experiment; shown by Type and Meaning classification.

4.4.3 Design and Measures

The experiment was a within-subjects experimental design. Stimuli were randomized and presented to participants on a computer via MediaLab 2008.1.33 software (Empirisoft Corporation). Participants’ physiological responses were taken with facial EMG, skin conductance responses, and heart rate (HR) using photoplethysmography (PPG). Participants were asked three questions after each video using a Likert scale from 1-7: How negative/positive do you feel, How meaningful is the target/object for you, and How activated do you feel? All participants completed the Positive Affect Negative Affect Scale (PANAS) to measure changes in mood (Watson, Clark, & Tellegen, 1988) at two experimental intervals to assess if mood shifts affected responses to stimuli. Pre-PANAS was administered prior to sensor application and post-PANAS after stimulus presentation. Following the stimulus
presentation, participants were also asked to complete a questionnaire reporting their perception of the study and then to complete Davis’s (1983) Interpersonal Reactivity Index (IRI) to measure individual trait empathy levels. For the analysis, stimuli presentation was broken down into 500ms blocks to accurately analyze the phases of destruction in the video (focus in, then zoom out on the object, destruction of the object, and zoom in on destroyed object) to address the research questions.

For the acquisition of facial responses, bipolar sensors were placed over the left Corrugator supercilli (pulls the brow together and down), the Zygomaticus major (pulls lip corners up and back) and the Levator labii (raises the upper lip in combination with widening of the nostrils) regions according to guidelines set out by Fridlund and Cacioppo (1986). A fourth electrode was placed on the upper center of the forehead as the ground electrode, also according to guidelines in Fridlund and Cacioppo (1986). Facial EMG site preparation and electrode placement procedures were likewise in accordance to Fridlund and Cacioppo (1986). Prior to placing the electrodes, the skin above the muscle area was cleaned with electrode prep pads (containing rubbing alcohol and pumice). Electrodes were surface Ag/AgCl electrodes (10 mm diameter with 15 mm distance between centers of electrodes). Electrodes had an adhesive ring to apply to the skin and the center of the electrode was filled with a saline gel to maximize skin connectivity. Activity over each muscle group was recorded using two electrodes placed approximately 1 cm apart (center to center) parallel to the muscle. Muscle group activity was continuously recorded using a BIOPAC MP 150 system (Biopac Systems Inc., USA). The EMG was sampled at 2000 Hz with a 50-Hz to 500-Hz bandpass filter and a 50-Hz notch filter with the Biopac Acqknowledge 4.0 software (Biopac Systems Inc., USA), according to manufacturer guidelines. To analyze facial EMG data, every file was first visually inspected offline to exclude artifacts and noise; three participants were excluded due to recording drop-outs. Therefore, the data from 39
participants were included in the analyses. Following visual inspection, data was analyzed with the Biopac Acqnowledge software (Biopac Systems Inc., USA), programmed to cut data files to specific time windows and extract data values. The script cut the data according to stimuli markers, programmed into the stimuli presentation software MediaLab, and at 500ms intervals to allow for better analysis with video phases. After extraction, the facial EMG data was used to calculate facial responses to the stimuli. Participants were asked to smile, frown and pull their nose upwards, following the experiment to ensure proper facial EMG recording activity and electrode attachment. Skin conductance levels were also measured following standard procedures according to Boucsein (1992). Sensors, filled with an electrodermal cream were applied to participants’ left hand at the index and ring finger distal phalanges and activity was recorded also using the BIOPAC MP 150 system (Biopac Systems Inc., USA). The recorded skin conductance data was processed in the same manner as the facial EMG data described above. Heart rate levels, taken through PPG were also measured following standard procedures described by Allen (2007). The PPG finger sensor was attached to the participants’ left hand at the middle finger distal phalanx and activity was recorded using the BIOPAC MP 150 system (Biopac Systems Inc., USA). The data was processed in the same manner as the facial EMG and skin conductance data.

Self-report measures were used to assess a variety of factors. After each video, Likert scale questions addressed how the feelings of participants were impacted by the destruction of various objects. In addition, the perceived meaning of the object and level of activation from the destruction was of interest. Participants also completed the IRI (Davis, 1980; 1983) following the end of stimuli presentation. The IRI measures individual levels of trait empathy, defined by Davis as the emotional response to the observed experiences of the other (1980; 1983). The IRI contains 28 items and divides questions into four subscales: perspective taking, fantasy, empathic concern, and personal distress to address the cognitive
and affective components of empathy. The IRI produces four subscales scores and one total score. The PANAS mood scale (Watson et al., 1988) addressed how mood and emotional states shift and change after the presentation of the videos. The results of the post-video questions, the IRI total score and subscales scores, and the pre/post PANAS were analyzed on their own and also together with the facial EMG, skin conductance and HR data.

4.4.4 Procedure

Upon arrival at the laboratory, participants were greeted and led to the experimental room. Here they were instructed about the general purpose of the study: to watch activating videos and respond to a set of questions after each video. Subjects were informed about the face cleaning protocol and sensor attachment related to the facial EMG measures, skin conductance and heart rate sensors. Participants then signed informed consent and answered questions related to age and gender; they also completed the pre-PANAS. Participants were told they could leave the experiment at any time without consequence. EMG sensors were attached at four sites. After facial EMG sensor application, participants were seated in the stimuli-presentation booth and skin conductance sensors and a PPG sensor were attached to the left hand. All sensors and electrodes were then connected to the BioPac module. Participants were then left alone as the experimenter started the programmed script on a computer. They were aware they could ask for help and/or stop the experiment at any time, having contact with the experimenter through an in-booth microphone. The experiment started with a two-minute long baseline, then the practice trial, and another one-minute baseline period. The experiment consisted of 11 stimulus trials; 1 practice trial and 10 randomized trials. One trial consisted of the following sequence: 2 seconds blank screen and 8-12 seconds video with three phases (Phase 1: zoom in ≈ two to three seconds, Phase 2: hitting object ≈ four to seven seconds, and Phase 3: zoom out ≈ two to three seconds), followed by three questions. Participants were instructed to watch the video; when the video
was over participants would click an arrow and answer three Likert-scale questions. When stimulus presentation was complete, participants were asked by the researcher to smile (pulling their lips back), frown (creasing their eyebrows) and pull their nose up (widening nostrils raising upper lip) to ensure electrode contact remained intact. Participants were then asked to complete a questionnaire asking about their perceptions of the study, then the post-PANAS and finally the IRI (Davis, 1983). When subjects had finished the questionnaires, they were shown a YouTube video of a cute puppy compilation (≈3min) to counteract the negative videos of destruction that participants just watched. Finally, subjects were debriefed regarding the purpose of the experiment to examine similarities and differences in responses to various stimuli being damaged. During the debriefing it was clarified that the human victims were not harmed because they wore extensive padding. Participants were informed they could receive further information once the experiment was completed. Participants were then thanked for their participation, received compensation and left the laboratory.

4.5 Results

4.5.1 Self Reported Data

Statistical analyses were performed using IBM SPSS for Windows (V 22.). In cases where the assumption of sphericity was violated, $p$-values for Greenhouse-Geisser adjusted degrees of freedom are reported.

*Post Video Likert-Scale Questions.* Subjective responses to the individual videos were grouped by video type and submitted to a multivariate analysis of variance (MANOVA) on the questions for valence, arousal, and meaningfulness. Perceived valence, $F(4, 152) = 26.14$, $p < .001$, $\eta^2 = .41$, arousal, $(3.23, 122.58) = 36.83$, $p < .001$, $\eta^2 = .49$, and meaningfulness, $F(4, 152) = 24.33$, $p < .001$, $\eta^2 = .39$, all revealed significant differences between the five types of videos that were furthermore generally consistent with the linear contrast pattern
predicted in H3 (all p-values < .001). Thus, participants reported being the most strongly
affected (negative valence, high arousal) by the types of videos hypothesized to be most
meaningful, and this pattern generally coincided with the meaningfulness perceived by
participants. However, contrary to our expectations, pairwise comparisons between the
individual types of videos showed significant deviations from this pattern for meaningful
objects (type 4, Nintendo and guitar). Across all 3 questions, this type of stimuli elicited
unexpectedly intense responses that were not significantly different from emotionally
meaningful objects (type 2, teddy bear and baby doll), valence $F (12, 27) = 0.74, p = .46$;
arousal $F (12, 27) = 1.97, p = .06$; meaningfulness $F (12, 27) = 0, p = 1.0$ and that were, in
part, significantly more intense than subjective responses towards the robots (type 3), valence
$F (12, 27) = 1.64, p = .11$; arousal $F (12, 27) = 2.98, p < .01$; meaningfulness $F (12, 27) =
2.46, p = .02)$. All three questions had a significant effect that generally fits the linear model
of meaning predicted in our hypothesis (H3), in which we predicted that participant’s
empathy scores (H3a) and subjective questionnaire data (H3b) would be positively correlated
to physiological measures.

**Empathy.** Trait empathy, as measured through the total IRI score, significantly
correlated with the intensity of responses to all three questions if the target was either a
human (type 1, male and female) ($p$-valence: .02, $r = -.38$; $p$-arousal: .01, $r = .40$; $p$-
meaningfulness: <.01, $r = .43$), or an emotionally meaningful object (type 2, teddy bear and
baby doll) ($p$-valence: .04, $r = -.32$; $p$-arousal: .02, $r = .39$; $p$-meaningfulness: <.01, $r = .44$).
However, none of the other correlations with empathy for any of the other target types,
including the robots, reached statistical significance (largest $r$-other = .23, $p = .16$). Due to the
fact that this analysis used the same data (IRI score) to predict responses to 5 different types
of videos, it could be argued that the significance level for the above correlational findings
should be Bonferroni adjusted, and this adjustment would render the above correlations non-
significant. However, the above tests are highly interdependent instances of the same conceptual hypothesis, namely that empathic responses might not be elicited equally for human-like vs. non-humanlike entities, and the purpose of this exploratory analysis was to evaluate where this boundary might be found. Our hypothesis would thus be best reflected by a pattern of significant and non-significant findings, for which family-wise adjustments of error rates are not a suitable tool. In consequence, the observed \( p \)-values are only of limited informative value in comparison to the effect sizes reflected by the pattern of correlations.

On the basis of the initial results for the empathy score, we conducted additional explorative correlational analyses on the individual subscales of the IRI. Again, this represents an investigation onto the heterogeneity of the effect – for which the collection of new data would be the best means of correcting for biases introduced by partially overlapping tests on correlated data. However, on the basis of the results for the total empathy score, we expected to find a replication of the general pattern when comparing the outcomes for valence, arousal, and meaningfulness. These were three different types of subjective responses obtained from participants that might show the same or a different pattern in such a more fine-grained analysis. First table 4.1 shows the correlations between the empathy (sub) scales and valence.

Table 4.1.

Pearson correlations between the IRI total empathy score and its subscales (EC: Empathic Concern; PD: Personal Distress; FS: Fantasy; PT: Perspective Taking) with subjective report of valence by type of video. To avoid redundancy, only the upper half of the table is shown. Significant correlations with valence are highlighted in the shaded cells. Intercorrelations between the IRI subscales are reported for completeness only.

<table>
<thead>
<tr>
<th>Scale</th>
<th>IRI total</th>
<th>EC</th>
<th>PD</th>
<th>FS</th>
<th>PT</th>
<th>T1 Val</th>
<th>T2 Val</th>
<th>T3 Val</th>
<th>T4 Val</th>
<th>T5 Val</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRI total</td>
<td>1</td>
<td>.731**</td>
<td>.676**</td>
<td>.678**</td>
<td>.314</td>
<td>- .379*</td>
<td>- .324*</td>
<td>- .167</td>
<td>- .094</td>
<td>- .110</td>
</tr>
<tr>
<td>EC</td>
<td>.731**</td>
<td>1</td>
<td>.564**</td>
<td>.223</td>
<td>.054</td>
<td>- .384*</td>
<td>- .352*</td>
<td>- .228</td>
<td>- .189</td>
<td>- .186</td>
</tr>
<tr>
<td>PD</td>
<td>.676**</td>
<td>.564**</td>
<td>1</td>
<td>.246</td>
<td>- .223</td>
<td>- .415**</td>
<td>- .202</td>
<td>- .253</td>
<td>- .245</td>
<td>- .031</td>
</tr>
<tr>
<td>FS</td>
<td>.678**</td>
<td>.223</td>
<td>.246</td>
<td>1</td>
<td>.036</td>
<td>- .115</td>
<td>- .164</td>
<td>- .020</td>
<td>0.059</td>
<td>- .044</td>
</tr>
<tr>
<td>PT</td>
<td>.314</td>
<td>.054</td>
<td>- .223</td>
<td>.036</td>
<td>1</td>
<td>- .009</td>
<td>- .083</td>
<td>0.094</td>
<td>0.141</td>
<td>- .027</td>
</tr>
</tbody>
</table>
As table 4.1 suggests, EC and PD appeared to have played a greater role for this measure. We therefore followed this up with the same correlational description of the data for arousal, as represented in table 4.2.

Table 4.2.

*Pearson correlations between the IRI total empathy score and its subscales (EC: Empathic Concern; PD: Personal Distress; FS: Fantasy; PT: Perspective Taking) with subjective report of arousal by type of video. To avoid redundancy, only the upper half of the table is shown. Significant correlations with arousal are highlighted in the shaded cells. Intercorrelations between the IRI subscales are reported for completeness only.*

<table>
<thead>
<tr>
<th>Scale</th>
<th>IRI total</th>
<th>EC</th>
<th>PD</th>
<th>FS</th>
<th>PT</th>
<th>T1 Aro</th>
<th>T2 Aro</th>
<th>T3 Aro</th>
<th>T4 Aro</th>
<th>T5 Aro</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRI total</td>
<td>1</td>
<td>.731**</td>
<td>.676**</td>
<td>.678**</td>
<td>0.314</td>
<td>.396*</td>
<td>.385*</td>
<td>-0.115</td>
<td>-0.073</td>
<td>0.030</td>
</tr>
<tr>
<td>EC</td>
<td>.731**</td>
<td>1</td>
<td>.564**</td>
<td>0.223</td>
<td>0.054</td>
<td>0.309</td>
<td>.417**</td>
<td>-0.072</td>
<td>-0.199</td>
<td>-0.118</td>
</tr>
<tr>
<td>PD</td>
<td>.676**</td>
<td>.564**</td>
<td>1</td>
<td>0.246</td>
<td>-0.223</td>
<td>.374*</td>
<td>.446**</td>
<td>0.091</td>
<td>0.103</td>
<td>-0.052</td>
</tr>
<tr>
<td>FS</td>
<td>.678**</td>
<td>0.223</td>
<td>0.246</td>
<td>1</td>
<td>0.036</td>
<td>0.148</td>
<td>0.269</td>
<td>-0.047</td>
<td>-0.027</td>
<td>0.029</td>
</tr>
<tr>
<td>PT</td>
<td>0.314</td>
<td>0.054</td>
<td>-0.223</td>
<td>0.036</td>
<td>1</td>
<td>0.134</td>
<td>-0.234</td>
<td>-0.287</td>
<td>-0.094</td>
<td>0.217</td>
</tr>
</tbody>
</table>

As for valence, table 4.2 shows a very similar pattern of correlations for self-reported arousal of participants in response to the different types of videos. Finally we analyzed the correlations with self-reported meaningfulness, as reported in table 4.3.

Table 4.3.

*Pearson correlations between the IRI total empathy score and its subscales (EC: Empathic Concern; PD: Personal Distress; FS: Fantasy; PT: Perspective Taking) with subjective report of meaningfulness (MF) by type of video. To avoid redundancy, only the upper half of the table is shown. Significant correlations with meaningfulness are highlighted in the shaded cells. Intercorrelations between the IRI subscales are reported for completeness only.*

<table>
<thead>
<tr>
<th>Scale</th>
<th>IRI total</th>
<th>EC</th>
<th>PD</th>
<th>FS</th>
<th>PT</th>
<th>T1 MF</th>
<th>T2 MF</th>
<th>T3 MF</th>
<th>T4 MF</th>
<th>T5 MF</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRI total</td>
<td>1</td>
<td>.731**</td>
<td>.676**</td>
<td>.678**</td>
<td>0.314</td>
<td>.434**</td>
<td>.438**</td>
<td>0.229</td>
<td>0.211</td>
<td>0.176</td>
</tr>
<tr>
<td>EC</td>
<td>.731**</td>
<td>1</td>
<td>.564**</td>
<td>0.223</td>
<td>0.054</td>
<td>.402*</td>
<td>.470**</td>
<td>0.187</td>
<td>0.136</td>
<td>0.182</td>
</tr>
<tr>
<td>PD</td>
<td>.676**</td>
<td>.564**</td>
<td>1</td>
<td>0.246</td>
<td>-0.223</td>
<td>.474**</td>
<td>.354*</td>
<td>0.310</td>
<td>0.278</td>
<td>0.149</td>
</tr>
<tr>
<td>FS</td>
<td>.678**</td>
<td>0.223</td>
<td>0.246</td>
<td>1</td>
<td>0.036</td>
<td>0.216</td>
<td>0.273</td>
<td>0.152</td>
<td>0.172</td>
<td>0.067</td>
</tr>
<tr>
<td>PT</td>
<td>0.314</td>
<td>0.054</td>
<td>-0.223</td>
<td>0.036</td>
<td>1</td>
<td>-0.058</td>
<td>-0.040</td>
<td>-0.126</td>
<td>-0.112</td>
<td>0.037</td>
</tr>
</tbody>
</table>

Again, the pattern of responses for perceived meaningfulness appeared to largely mirror the data found for valence and arousal judgments. In this analysis, no significant
correlations were observed for the fantasy subscale (largest $r = .27, p = .09$), or for perspective taking (largest $r = -.29, p = .08$). However, out of the 12 possible pairwise correlations between the subjective responses to human (type 1) and emotionally meaningful objects (type 2) videos with these subscales, 10 reached statistical significance (largest $r = .47, p < .01$), with one more narrowly failing to reach significance ($r = .31, p = .06$). Again, out of the 18 remaining pairwise correlations with the other 3 types of videos, none reached statistical significance.

4.5.2 Facial EMG

Separate repeated measures ANOVAs of facial EMG activity were conducted for Corrugator supercilii (corr), Zygomaticus major (zyg), and Levator labii (lev) sites. For these analyses (of facial EMG data), we collapsed phase 2 and phase 3 into a new main phase as the EMG effects of the destruction did not appear to dissipate immediately, as well as to simplify the statistical design. Therefore we analysed phase A (close-up of object prior to destruction) and phase B (destruction and zoom out from destroyed object). For all other analysis we mainained the three phases, 1, 2, 3 as previously described.

For corr, results concerning the interaction between type and phase failed to remain significant after Greenhouse-Geisser corrections, $F(2.48, 94.29) = 2.51, p = .074, \eta^2_p = .06$, although the analysis of the predicted pattern of per-type responses suggested a linear relationship ($p = .039, \eta^2_p = .11$) in line with the predicted direction of stronger responses toward the destruction of increasingly humanlike and more meaningful entities. For zyg, a significant effect of phase was observed, $F(1, 38) = 9.77, p < .01, \eta^2_p = .21$, while there was no significant interaction between type and phase at this site, $F(2.07, 78.71) = 1.81, p = .17, \eta^2_p = .05$. The direction of the significant phase effect revealed more activation at zyg in response to the destruction segment, a finding that is be consistent with the well known curvi-
linear relationship between zyg-smiling and stimulus valence (Lang, Greenwald, Bradley, & Hamm, 1993).

While we had expected corr and zyg responses to be generally related to the relative valence of the destruction scenes, our hypotheses concerning facial EMG were most specifically targeted at lev activity which can be expected to involve a dimension of moral appraisal such as those associated with disgust and empathy rather than the overall valence of the stimulus as such. We observed a significant type x phase interaction for lev, $F(2.87, 108.99) = 3.67, p = .016, \eta^2_p = .09$, that was in line with H1, and H2. More specifically, results again suggested a significant linear effect of stimulus type ($p = .019, \eta^2_p = .14$) consistent with increasingly more intense responses towards the destruction of increasingly humanlike/meaningful entities. Additionally, a substantial effect size was found for a significant phase effect at lev, $F(1, 38) = 19.33, p < .001, \eta^2_p = .34$. Post hoc comparisons revealed this main effect to be significant for all types of videos (type 1: $p < .001$; type 2: $p = .001$, type 3: $p = 0.14$; type 4: $p = .009$), except for the meaningless objects that failed to elicit a significant response (type 5: $p = .225$) despite showing the same kind of physical damage. The overall main effect of type was not significant, $F(3.02, 114.85) = 2.09, p = .105, \eta^2_p = .05$. Figure 4.4 summarizes the results of this analysis.
Figure 4.4. Levator Labii response by type of film clip in comparison between zoom-in phase and main phase including zoom-out. Error bars represent SEM.

4.5.3 Autonomic activation: Electrodermal activity and heart rate

Using the same statistical design as for the analysis of facial EMG, but including all three phases, a repeated measures ANOVA of electrodermal activity revealed a highly significant type x phase interaction, $F(1.84, 69.98) = 6.22, p = .004, \eta^2 = .14$, in-line with H1, where we predicted participants will have and display affective responses (measured through psychophysiology) to videos showing the destruction of objects and H2, where we hypothesized that the intensity of the physiological responses will be influenced by the meaningfulness of the object being destroyed. As for the results observed for lev and cor EMG, these results were again consistent with a linear contrast pattern ($p = .005, \eta^2 = .19$). Furthermore, follow-up pairwise comparisons showed significantly stronger responses for human stimuli (type 1) in comparison to all other types of targets (human stimuli (type 1) vs. emotionally meaningful objects (type 2): $p = .006$; human stimuli (type 1) vs. toy-robot
stimuli (type 3): $p = .044$; human stimuli (type 1) vs. meaningful objects (type 4): $p = .024$; human stimuli (type 1) vs. non-meaningful objects (type 5): $p = .019$). Interestingly, none of the other pairwise comparisons between the different types of videos showed any significant differences in the intensity of the EDA response (lowest $p = .56$). Thus, while all video types elicited significant (toy-robots (type 3), non-meaningful objects, (type 5): $p < .05$) or at least marginally significant (emotionally meaningful objects (type 2), meaningful objects (type 4): $p < .10$) responses, the phase x interaction appeared to be driven by the responses elicited by human targets (type 1) who elicited disproportionately intense EDA responses to the attack and to the destruction ($p = .001$, $\eta^2_p = .25$). This suggests that, in comparison to the hypothesis-conforming but more subtle findings in respect to the elicited facial EMG activity, changes in electrodermal activity may have been a particularly sensitive measure in this study, suggesting a particularly intense autonomic response to seeing harm being done to another human being.

*Figure 4.5.* Skin conductance response by type of film clip in comparison between zoom-in phase and main phase including zoom-out. Error bars represent *SEM.*
Analyses of baseline-adjusted changes in HR showed a significant main effect for phase, $F(1, 50.04) = 14.18, p < .001, \eta^2_p = .27$, indicating a heart rate deceleration effect in response to the destruction phase ($M = 75.08, SD = 13.72$) in comparison to pre-harm stimulus presentation ($M = 77.54, SD = 16.17$). No main effect of video type, $F(2.13, 80.91) = 0.89, p = .42, \eta^2_p = .02$, nor interaction was found, $F(1.48, 56.04) = 1.65, p = .21, \eta^2_p = .04$.

To further investigate the time-course of the phase effect, we conducted another repeated measures ANOVA to separate the main destruction phase from the eventual zooming-out of the scene by the camera, yielding a type (5 levels) x phase (3 levels) within-subjects analysis. As before, this analysis showed a significant effect of phase, $F(1.80, 68.48) = 7.60, p = .002, \eta^2_p = .17$. Post hoc comparisons for phase further showed a significant deceleration ($p = .003$) from zooming-in ($M = 77.54, SD = 4.44$) to the destruction ($M = 75.33, SD = 4.25$), as well as between zooming-in, and zooming-out phases ($p = .002; M = 74.51, SD = 4.44$). Thus, the deceleration was still present at the time of zoom-out, with no significant differences compared to the average of the destruction phase ($p = .26$).

**Figure 4.6.** Heart Rate (BPM) in response to the videos throughout the 3 phases (zoom-in, destruction, zoom-out). Error bars represent SEM.
4.6 Discussion

We conducted an experiment designed to examine how participants respond emotionally to the destruction of a variety of objects that differed in meaning and significance and that included humans and non-human objects with arguable differing degrees of humanness. We wanted to understand what similarities and differences in emotional responding occur when participants view human harm versus object destruction and how these responses may be linked to empathy. Using psychophysiological measures of facial EMG, skin conductance, heart rate and subjective questionnaires, we compared how participants responded not only to human and robot-like stimuli being harmed, but also to a selection of cherished objects, personally relevant items and irrelevant items being destroyed. We used the act of hitting the empty floor as our control condition to look at activation to a neutral stimulus, no object while maintaining the act of hitting with its dynamics and implications. We stratified the objects, and stimulus videos into five different categories based on object similarity and pretest data. Type 1, containing stimuli of harm towards one male and one female (back towards camera), were separated from the other types as we hypothesized that responses to human stimuli would be stronger than all other objects. Type 2, the teddy bear and baby doll, seen as emotionally meaningful objects, were placed in one category as they are also similar in attachment levels based on the cherished objects research presented. Type 3, the two toy robots placed together, the categorization of these objects as meaningful were based on the research by Rosenthal-von der Pütten and colleagues (2013; 2014), and we expected emotional responses based on their findings. Type 4, the acoustic guitar and Nintendo were classified as meaningful objects for our subject pool of young adults. Finally type 5, the fan and the box were hypothesized as irrelevant stimuli and thereby as not meaningful to participants.
We found facial EMG activation patterns that suggest that the destruction of meaningful objects and violent behavior might have elicited moral disgust. Importantly, the facial EMG activation was only significant for *Levator labii*; with significant responses to humans and all objects that were hypothesized to be meaningful (Types 1-4). The results are consistent with the notion that the act of destruction or violence towards someone or something that is personally significant will elicit a disgust response. In addition, these responses are significantly different from other facial responses that may have been predicted such as an anger response, described in moral emotion research, or happiness, by conveying a sense of Schadenfreude. Significant responses to cherished object destruction also indicate the importance and long lasting impact of attachment objects. Even when participants are adults, these objects which were once a source of joy, comfort, and peace are still highly relevant, and harm to these objects elicits strong emotions (Diesendruck & Perez, 2015; Ferraro et al., 2011). It is important to note that harm towards robot-like toys elicited disgust responses but these responses were the least significant in comparison to other types of stimuli (types 1, 2, and 4). It is likely that the toy-like, mecanoid appearance is not as emotion-inducing as the cute animal-like dinosaur robot (Pleo) used by Rosenthal-von der Pütten and colleagues (2013; 2014), and instead the responses found in her research are more likely linked to their chosen robot appearing more like a cherished object or pet. Follow-up research here could explore responses to harm of a variety of entities that systematically differ from animal like to mechanical (e.g., see Rosenthal-von der Pütten & Krämer, 2014, for a classification and evaluation study of robots according to the uncanny valley).

Electrodermal activity (EDA), as measured through skin conductance responses (SCRs), indicated arousal for violence towards human stimuli, but not for any other type of stimuli. As Darwin (1872, as cited in Darwin, 1965) acknowledged, emotional responses can have communicative purposes; SCRs are an ANS response that are automatic and, in this
case, are likely specific to the stimuli shown. Here the responses may illustrate a primal, physiological arousal response that is likely indicative of a specific emotional state only present for human stimuli (Ellsworth, 1994); linking responses to a fight or flight feeling that takes place when watching humans being violently hit. This supports the hypothesis that responses for humans differ from responses to other objects. This is an important finding; our responses to humans being harmed shows reactions that are not present with any other item, indicating how human stimuli evokes clearer and stronger responses. Although we are capable of connecting to objects and various items, objective responses are impacted by the meaning and personal relevance of the objects being harmed (see Figure 4.3). In addition, the deceleration of heart rate (HR) during stimuli destruction is relevant. Levenson (1992) demonstrated HR decreases associated with disgust. Despite the somewhat unclear state of research in physiologically distinguishing discrete emotions, the present findings are worthy of following up. It is clear that participants felt strong emotions towards the destruction of objects with relevant meaning; this can be interpreted in the sense that these responses may not only be emotional but also empathic.

The subjective responses to stimuli indicate that humans elicit the strongest responses than all other objects, as was to be expected. From a purely bio-psychological perspective, violence towards humans and hence our own ‘kin’ is the most threatening and elicits strong protective instincts. Cherished objects are also highly important and evoke strong feelings as they are high in meaningfulness and are being valued. An attachment theory perspective can explain these results as it links childhood attachment, to objects that offered comfort and that we nurtured; watching them be destroyed, even if not belonging to us, ties into a complex emotional web linked to our experiences as children. Other meaningful items also elicit strong responses; our experience with these objects, their perceived value, and meaning attributed to what they represent and can be used for are likely factors that impact responding.
Responses to robot-like toy stimuli were much less intense than expected; these results are likely based on robots not yet being meaningful enough in our digital culture to elicit responses or the toys having been perceived not as real robots – their monetary value also not being very high in comparison with ‘real’ robots. In addition, these mechanoid robots do not elicit strong emotions, as would be expected from a cute or animal shaped robot, as in the case of the research of Rosenthal-von der Pütten (2013; 2014). They are stereotypical robots that appear mechanical and toy-like.

In addition, trait empathy measured subjectively through self-report was correlated to feelings of negativity, perceived meaningfulness, and arousal. Participants who scored themselves as more empathic (total score, and subscales of empathic concern and personal distress) showed stronger subjective responses to human stimuli (Type 1) and cherished object stimuli (Type 2). These participants felt significantly more negative and aroused, and attributed more meaning to the humans and cherished objects being harmed. This indicates that self-reported trait empathy is correlated to stronger subjective responses to harm and destruction. Although there were no correlations between trait empathy and physiological responses as expected, the pattern of results found in the subjective data still indicates levels of empathy impact how we respond: how we respond physiologically and how we cognitively appraise our situation. Further research on empathy, and empathic responding to harm and destruction to humans and objects will help to disentangle the components of empathy – this is also relevant to studies on dehumanization and conflict between groups (Halevy, Bornstein, & Sagiv, 2008; Haslam, 2006) an issue we did not touch upon in the present research.

The results indicate that emotional responses to general destruction and violence exist, when any object of meaning is involved – simply observing violent movement without anything being harmed does not elicit a similar response. In addition, as to be expected our
results demonstrate that harm to human stimuli elicits stronger responses than harm or destruction to all other stimuli. Cherished objects research may be able to help explain some of our emotional responses to robots that are designed as toys, teddy bears or dolls. These embodiments may result in stronger emotional responding and may also better explain the results in Rosenthal-von der Pütten and colleagues experimental work (2013; 2014). This also has great implications for robot design and the use of varied embodiments in different experimental paradigms. As we are continually exposed to a rapidly expanding digital culture, our responses to mechanical robots may become more intense; in addition, these responses are likely impacted by previous interaction with this technology. It would be interesting to look longitudinally at children today, who are exposed to more technology during development, if their responses would be different to watching various robots being harmed – however, this should include ‘real’ robots. For researchers who require humans to have emotional responses or attachments to robots during their studies, taking into account cherished object research may be more important than was originally identified. It is clear that adult participants respond to these emotionally meaningful objects with great intensity, and it is reasonable to assume that humans are more likely to accept social robots who meet some of these criteria, at least visually.

This study does have limitations. The choice of toy-robot is debatable. Just as Rosenthal-von der Pütten and colleagues (2013; 2014) used a robotic toy animal, we used a toy robot, made of plastic. Selecting this stimulus was intended to represent a stereotypical robot that someone who is not involved in robotics research would identify with, and would objectively identify as a robot. However, these robots are likely still perceived by participants as toys. There are pragmatic reasons to not smash real, humanoid, or other embodied robots, particularly financial, but this would be an obvious next step for this line of research. It would also be of interest if prior robot interaction had an impact on emotional responding, and here
we are referring to robots in general, and to the specific robot to be harmed or destroyed as a second variable.

4.7 Conclusion

Humans respond emotionally and empathically to harm to humans, as well as to harm and destruction of cherished emotionally meaningful objects, meaningful items, and even toy robots. The research presented indicates that emotionally, humans show bodily responses, such as the expression of disgust and heart rate deceleration to objects being destroyed. The strongest responses are towards human stimuli, which are also the only stimuli evoking strong electrodermal responses. It is clear the human connection to conspecifics is, at least in part, automatic and stronger than our connection to cherished objects, other relevant items and artificial entities. Strong responses to cherished, emotionally meaningful objects, and limited responding to robots indicates that these fields of research may need to function together to improve emotional responding to artificial entities. The strength of such stimuli also provides a context to differentiate between emotional and empathic responding. Participants who were subjectively most affected by the stimuli were also the most empathic, according to self-reports. Further research offers opportunities to explore emotional versus empathic responding, and in addition, how and why we respond to artificial entities and what else may moderate these responses. The use of harm and destruction offers a creative approach for examining human responses to a wide variety of stimuli. Replications of this study using other items will give further insight into what items mean the most to us, and what is distinctly human. This type of research allows us to better understand emotional and empathic responses, and how they are moderated by meaningfulness. This research illustrates how our connection to each other is more powerful than our connection to things, including our connection to cherished objects. This research also shows the importance of examining emotional responses and distinguishing what makes a response object or entity specific,
versus specific to what is being done to the object or entity. This is an innovative study, systematically examining behavioral and subjective responses to the destruction of various entities and objects of meaning. The results shed light on our human connection to each other and how these responses may differ from our connection to things. It opens up a discussion on meaningfulness as a moderator of emotional and empathic responses. It also allows us to further investigate what is meaningful to us, the impact on our emotional responses, and how this knowledge can be used to advance our connection to various things, even to artificial entities.
4.8 References


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Chapter 5

General Discussion
5. General Discussion

The developments and advances in digital culture have changed our society dramatically in the last decades; human acceptance of, dependence on, and interaction with technology has affected practically every sphere of life, including the landscape of social interaction and communication. Initially, through the development of advanced computers (smart machines), people started to talk about technology as if it had a mind of its own; as if the machine was truly thinking (Koch, 2016; Reeves & Nass, 1996; Turkle, 1984, as cited in Turkle, 2005; Turkle, 2011). This started a societal shift about how technology is perceived and illuminated the question: what is so special about being a human, if technology starts to be capable of so much (Turkle, 1984, as cited in Turkle, 2005)? Digital culture continued to advance as human-computer interaction changed; from one-to-one interactions eventually morphing into humans interacting in multiple networks with various machines (Turkle, 2011). The emotional importance and social relevance of computers also evolved; it became an intermediary between people, in various networks, all over the world, and provided connection, reliability and the opportunity for exchange (Tidwell & Walther, 2002; Walther, 1996). Computer mediated communication (CMC) became common place in our interactions and social connection with others, both liberating and limiting our interpersonal connections (Tidwell & Walther, 2002; Walther, 1996). Computers were being treated with the same social interaction rules as humans, and the field of affective computing expanded, indicative of advances in digital culture (Nass & Moon, 2000; Nass, Moon, Morkes, Kim, & Fogg, 1997; Picard, 2003; Reeves & Nass, 1996). As time progressed, this acceptance and influence of digital culture only continued and intensified; many people now live fully networked lives and interact daily with an array of technological devices. Our computers and cell phones have become personal portable devices and mediated communication has taken over (Picard, 2003; Tao & Tan, 2005; Turkle, 2011). Our strong emotional responses to these technologies
illustrate our attachment to them, along with a willingness to welcome new technology into our lives if we believe it serves a purpose.

Technologically, the development of toys and games also advanced rapidly; these domains which originally would not have been identified with computers, increasingly involved digital technologies. Games were being played online, with group and individual interaction being mediated by the computer. Playing against the computer, and seeing the computer as a game player, or competitor also became common place. Toys started to become active interaction partners; from dolls that could cry and need to be fed like actual infants, to the animatronic talking bear, Teddy Ruxpin. Thereafter the Tamagotchi, a digital pet, the size of a keychain, dominated the toy market, affording children, youth and adults the opportunity to take care of a virtual pet, in a small, personal, virtual reality. The development of the Furby, following the Tamagotchi, was an example of an electronic, instead of virtual, robotic toy; the company Tiger Electronics being the first to successfully launch so many affordable domestically-aimed robots into the market. Even now, the Furby’s popularity continues, and its digitization has increased, allowing users to connect multiple Furbys over wireless networks, while feeding and caring for their Furbys through a smart phone App. These toys, in effect are simple robots, and their popularity and development indicated that the field of robotics was also rapidly advancing.

The field of robotics changed dramatically, and advanced quickly, as we became networked in the mid-1990s, and for the first time we were connected to infinite information and each other (Turkle, 2011). Although this was the time in which the field was advancing and becoming more popular, the concept of robots, including the term, go back to the 1920’s. Issac Asimov wrote nine science fiction short stories which he compiled into the book *I Robot* (1950, as cited in Asimov, 1977). Although these stories were fictionial, they opened up discussion and interest regarding human interaction with robots, and also how this relates
to morality. The notion of robots started to become a topic of public discourse. Robots, in the public eye, were often viewed, under the notion of everyday helpers (e.g., Rosie in the Jetsons) and this familiarity was much greater, than people’s experience with industrial robots. Due to people’s familiarity with the helping, or toy-like robots that are seen in the media, many would not even recognize various robots or virtual characters that have become part of everyday interaction (Kakoudaki, 2015). Consequently, public discussions now include the applicability of robotics in various facets of human life; as they were no longer only useful for assembly lines and dangerous tasks (Rosenthal von der Pütten, 2014). Robots were being developed as support systems in our daily lives (e.g., Matarić, 2006) and were designed to help solve various problems by taking over low priority tasks in a variety of settings, such as in health care environments (e.g., Onishi et al., 2007). In addition, as previously mentioned, virtual characters and robotic toys were becoming commonplace for children, demanding attention and receiving it in return; all in all, robots were starting to be seen as friends and companions (Turkle, 2011). It has become clear that interaction with a variety of technologies, whether computers, phones or robots have become, in some ways, part of a popular digital culture. We treat these technologies as interactive partners, as though they were people, and we have emotional responses to them. Times have truly changed. As reflected upon by Sherry Turkle:

I feel witness for a third time to a turning point in our expectations of technology and ourselves. We bend to the inanimate with new solicitude. We fear the risks and disappointments of relationships with our fellow humans. We expect more from technology and less from each other (2011, p. xii).

It appears that people are interested in how we respond to and connect with technology, in particular robotics. A Google search for example delivers 5,020 hits for the keywords “empathy for robots” (as of 25.03.2016). Although closely interlinked, the aspect
of emotion is much less explored; on the other hand Google delivers only 361 hits for the keywords “emotions towards robots” (as of 25.03.2016). With increasing interaction and emotional responses to technology and robotics, this dissertation explores how we emotionally accept and apply socio-emotional interaction rules to robots. Furthermore this thesis addresses empathy and the role it plays in how we view and emotionally respond to artificial entities. Based on how our interaction with technology and robotics are advancing, this research becomes more and more relevant, and is also a topic that needs further attention and development. This thesis therefore attempts to answer what similarities and differences exist in emotional and empathic responses to both humans and robots, and what mediates these responses. This dissertation is also of interest for those who want to better understand empathy in human relationships, and what makes this a unique process. It is also relevant for people who are interested in how humans interact with and relate to machines and non-living entities. Those who seek to understand why we are so impacted by our interactions with these smart technologies will also find this dissertation a compelling read.

The first goal of this thesis was to provide an overview of human-human interaction and the similarities and differences when compared to mediated and artificial entity communication and interaction. The next objective was to review existing research on how we emotionally respond to artificial entities. Finally, it endeavored to differentiate between emotional responses and empathy, not only in their written definition but in levels and types of responding. This dissertation includes a comprehensive overview of how to measure emotional and empathic responses. A major contribution of this review is a theoretical overview of the similarities between how we interact with humans and entities, including commonalities in emotional responding. In addition the differences that have been found in human-artificial entity interaction and responding are presented. This provides a theoretical synopsis which allows for the identification of research gaps and the selection of various
research questions to address what is missing from the literature on human-artificial entity interaction.

The second goal was to systematically examine our emotional responses to artificial entities such as robots and how these are similar and/or different from our emotional responses to humans. This dissertation has explored how well the collected data fit into some of the existing literature surrounding our social behaviors with artificial entities. It also has compared whether these behaviors are similar to those in human-human interactions. Furthermore, are emotional responses to artificial entities moderated by empathy and/or moderated by previous artificial entity interaction? By answering these questions, conclusions can be drawn as to the impact artificial entities may have on us, and implications regarding the design of emotional entities.

Thirdly, this dissertation has explored the type of emotional and/or empathic responses that would be elicited by the destruction of a variety of objects, and whether these responses are moderated by the meaningfulness of the object to the individual. The purpose of this particular objective was to examine how the personal meaning of various objects moderate emotional and empathic responses. In addition, this objective is also concerned with investigating how important robots are in comparison to other objects. Finally, this dissertation has investigated whether empathic responses are more present in response to video stimuli depicting destruction, versus simple image and vignette stimuli depicting emotional states.

5.1 Empathy: Literature Review Summary

The first article (Chapter 2, Article 1) reviewed literature dealing with the construct of empathy, and additionally provided a new perspective by discussing how humans’ interactions with technology and artificial intelligence (AI) might relate to empathy. In fact,
the interest in HRI is rapidly expanding; researchers and industry partners are competing to build artificial systems that can successfully connect socio-emotionally with humans. A major obstacle however is to implement believable behaviors in the technology and, possibly, getting humans to accept them as actual social interaction partners. If these systems are supposed to convey emotion and be empathic, we must first be very clear and detailed in what exactly emotional processes and empathy entails, and how to avoid false reporting and/or improper programming.

Many of the concepts put forward in this thesis suggest that empathy requires the ability to reflect on one’s own emotional experiences to compassionately respond from a place of shared affect. Empathy involves “feeling-into” or “feeling with” another (Singer & Lamm, 2009). It is important to note empathy is not the same as a simple emotional response, or a mimicked facial expression; it is much more complex and is therefore also very challenging to measure. Depending on the definition, empathy involves cognitions about the emotional state of the other, or subjective experience/feeling of the state of the other, or both. Assessing empathic responses to a human, an animal, or a device should then involve these different components. Also, there are aspects that relate to the general capacity or skill of an individual to be empathic – trait empathy – in addition to the empathic response in a concrete situation. Thus, it is best to try to measure both – the trait and the state aspects of empathic responding (see also, Neumann, Chan, Boyle, Wang, & Westbury, 2015). The literature review brings forward innovative ideas of how to input empathy into artificial systems and measure levels of empathic responding for both humans and artificial entities.

As already described, a fundamental component of empathic interaction is that empathy requires feeling. Empathy is the sharing of affect and being able to respond to the feelings of another as observed in human-human interaction and also in human-animal interaction. However, in research involving artificial entities, these rules are broken. There
cannot be literally shared affect, or shared feeling between a non-living entity and a human, unless machines are developed that will possess feelings. Thus, the question of whether emotional processes occurring with artificial entities can or should be referred to as empathy, still remains. In this case, a researcher may claim that a simulated feeling is equivalent to a real human emotion and therefore will evoke a similar response to organic empathy. Research with artificial entities offers a unique opportunity to explore concepts such as empathy, in a controlled setting and to determine which affective processes are present in human-human interaction and human-artificial entity interaction. The experiments in this dissertation attempt to find answers to some basic questions about emotional versus empathic responding to artificial entities and what this means in relation to our humanness.

5.2 Emotions for Entities: Experiment 1 - Summary

The first experiment used psychophysiological measures and self-report questionnaires to explore emotional responses to artificial entities and humans, their similarities and differences and if the responses were moderated or impacted by empathy. In communicative or interactive processes humans express and display an array of behaviors, experience automatic physiological arousal and maintain self awareness of how they are responding to a specific stimulus or situation. The aim of this first experiment was to explore minimal conditions that would lead to social and emotional processes with artificial entities. This research area is still relatively untouched, as many studies have focussed on more sophisticated artificial entities and exposure to stronger or more complex stimuli, or “live” human-robot interaction (e.g., Breazeal, 2003; Breazeal, Gray, & Berlin, 2009; Lee, Stiehl, Toscano, & Breazeal, 2009; Rosenthal-von der Pütten et al., 2013; Rosenthal-von der Pütten, Schulte, Eimler, Sobieraj, … & Krämer, 2014). Inspired by the assumptions of the Media Equation (Reeves & Nass, 1996) and the Ethopoeia concept (Nass & Moon, 2000; Nass & Sundar, 1994), I hypothesized that simple emotional stimuli (e.g., still images and text) may
be enough to elicit expressive responses to artificial entities as well as humans (human stimuli example: e.g., Dimberg & Öhman, 1996). Through the use of these simple stimulus materials, I was able to examine what prompts emotional responses to artificial entities and compare the responses to those elicited by human stimuli. In addition, I investigated whether these responses to artificial entities correspond to what we already know about humans reacting with unconscious emotional responses to still photographs of humans displaying different emotions (e.g., Dimberg, Thunberg, & Elmehed, 2000), and if this is indeed the case, what were the mechanisms underlying them.

Thirty-four participants, wearing facial EMG sensors (at Corrugator supercilli for brow movement, and Zygomaticus major for cheek movement, sites), and skin conductance sensors were shown twenty-four randomized stimulus trials, images and text of twelve humans and twelve artificial entities depicting the emotions of anger, sadness, happiness and pride. Thereafter participants completed a self-report empathy questionnaire, the IRI (Davis, 1983), and were asked to fill out a few brief questions on their perception of the experiment.

The results obtained from experiment 1 illustrated a higher degree of similarity in responding to both artificial entities and humans, indicating that the Media Equation even holds for simple pictures of machines/entities. Emotional responses were found to the presentation of still images of both humans and robots and there was no difference in the intensity of these responses. The Media Equation (Reeves & Nass, 1996) posits that we treat entities as social actors because of the process of Ethopoeia (Nass & Sundar, 1994), which argues that various social cues (e.g., interaction behaviors, speech, social role filling, etc.), delivered by an entity, for example, will trigger our social scripts and therefore we automatically perform social behaviors. Therefore, according to the theory of the Media Equation (Reeves & Nass, 1996) and Ethopoeia concept (Nass & Moon, 2000; Nass & Sundar, 1994), participants would not show different responses to human or artificial entity
stimuli, if the stimuli were interactive or embodied. Therefore, based simply on the believability of emotional experience and interaction norms with humans, and a lack of social cues by using still image and text presentation (in comparison to embodied interaction), I hypothesized that participants would respond more strongly to human stimuli compared to artificial entity stimuli.

The behavioral responses elicited from the stimuli were as expected (e.g., increased *Corrugator supercilli* activity for anger and sadness). Participants showed responses to stimuli of images and images combined with text. The responses to the image paired with affective text were occasionally stronger than responses to the image only which implies that the context of a specific image may be as important as the image itself. The results were in line with the assumption of the Ethopoeia concept that the greater the presence of human characteristics in artificial entities (in this experiment: images and text depicting emotion), the more likely they will elicit social responses. The results from experiment 1 may allow for certain assumptions: that the Media Equation Theory and the Ethopoeia concept no longer apply solely to embodied entities, but also can be used to explain responses to still images of artificial entities and text depicting human emotions; thus are more broadly applicable than previous research indicates.

The similarity of responses to both the human and artificial entity stimuli may also be indicative of a ceiling effect. Images and images paired with vignettes were pretested to depict specific emotions or emotional expressions. The stimuli were strong for both humans and artificial entities. A lack of differences in responding could be indicative of the strength of stimuli and/or the similarity in intensity of stimuli. This also provides the rationale for experiment 2. By removing the emotional cues from the images and replacing them with neutral images we halt spontaneous emotional responses to the image specifically and we can explore the impact of affective context, in the form of vignettes.
Based on research conducted by Hess and Blairy (2001), I hypothesized that participants with higher levels of trait empathy would have stronger responses to the emotional stimuli than those with lower levels of trait empathy. The results from the empathy self-report however indicated there were actually no significant effects in scores. Research related to affective and cognitive empathy (Davis, 1983) suggests that individuals with high levels of empathy typically perceive and experience the emotions of ‘others’ more strongly, which may indicate that although participants showed behavioral responses which mimicked the displayed emotions in the images and text, regardless of human or artificial entity, trait empathy was unrelated to these responses. Another explanation could also be that there were not enough high or low-empathic participants to distinguish differences in responding.

In conclusion, the results of experiment 1 indicate that participants respond to both human and artificial entity stimuli with remarkable similarity and consistency. Behavioral differences towards the stimuli were hypothesized. It is suggested through this research that humans are able to assign primary and secondary emotions with surprising believability to artificial entities. It also became apparent that participants not only responded strongly to the images on their own, but also often responses were stronger when viewing the image and vignette in combination.

5.3 Emotions for Entities: Experiment 2 - Summary

It was illustrated in experiment 1 that humans perceive and mimic emotional expressions of humans and artificial entities with a great degree of similarity and that emotional cues seem to initiate responses to both types of stimuli. The second experiment in this dissertation therefore addressed the importance of emotional cues in responding to artificial entities and humans. I assumed by removing emotional cues from the image such as emotional expressions, postures and/or symbolic and contextual meaning, I removed the automatic, spontaneous emotional response to the image (Dimberg, Thunberg, & Elmehed,
As I noticed distinct evidence of responses toward stimuli composed of emotional images and text, it would be of interest how participants will respond when the stimulus presented is a pairing of a neutral image and emotional text instead. Experiment 2 offered a chance to explore whether the responses from experiment 1 would be replicated if emotional images were removed and replaced with neutral images. If humans no longer saw the emotion clearly, and had to assign text to both an artificial entity and a human, would the responses still be of the same intensity as was previously seen? Similarly, this study explores at how trait empathy is linked to responses to neutral images of artificial entities and humans, and whether responses to affective vignettes, either paired with human or artificial entity stimuli, are impacted by empathy levels.

The neutrality in the stimulus set (i.e., neutral images, then paired with affective vignettes) allowed for the exploration of how easily emotions, through context alone, are assigned to artificial entities and the level of affective information that is needed to elicit an emotional response to neutral stimuli. Other researchers have also explored how previous artificial entity interaction impacted responses towards and acceptance of artificial entities. Furthermore, studies on social interaction with artificial entities illustrate that the social effects elicited by virtual agents or robots are higher when they are socially or physically present (Jung & Lee, 2004; Kidd, 2003). Therefore, the current study presented an opportunity for a between-subject design that additionally explored whether the physical presence of, and interaction with a toy robot, prior to stimuli presentation will evoke more emotional responses from the subject. In experiment 1 the expressions in images were very strong, therefore for experiment 2 the emotional cues were made weaker, i.e., the visual is neutral and only the situational context provides the information and a label. For participants, it may be difficult to imagine how a robot or toy could be emotional (as described only by the presented context) so playing with such a toy robot, thereby staging socio-emotional
scenarios, was believed to counteract such difficulties. Other studies have used similar interaction paradigms in an attempt to foster closeness between humans and artificial entities (see Rosenthal-von der Pütten and colleagues, 2013).

The sample in experiment 2 consisted of sixty-four participants randomly divided into two experimental groups. Participants completed the Positive Affect Negative Affect Scale (PANAS) at three intervals to assess how mood was impacted by the experiment and play condition (Watson, Clark, & Tellegen, 1988). Half of the subjects played and created pictures with Danbo robots and the other half played with random objects and created pictures. The reason for this between subjects condition was based on the research by Krämer and colleagues (2012) who conclude the rules of social behavior and interaction are surprisingly similar in human to human and human to embodied or virtual artificial entities interaction. It was assumed that giving individuals time to play and interact with an artificial entity (Danbo), based on human norms of interaction, participants would start to increase their comfort level with the entity (Danbo) and develop a personal relation to it; this then would result in higher emotional salience and responding for artificial entity stimuli. After the play condition, participants wearing facial EMG sensors (at Corrugator supercilli for brow movement, and Zygomaticus major for cheek movement, sites) and skin conductance sensors were shown twenty-four randomized stimulus trials: images of twelve neutral humans and twelve neutral artificial entities paired with text describing situations that elicit the emotions of anger, sadness, happiness and pride. Thereafter, participants completed a self-report empathy questionnaire, the IRI (Davis, 1983), and were asked to fill out a few brief questions on their perception of the experiment.

The results of experiment 2 indicated that previous interaction and play with a toy robot did not increase emotional responses to artificial entity stimuli as hypothesized; these results are similar to those presented in Rosenthal-von der Pütten and colleagues (2013).
While there was a significant increase in the positive mood of the participants from the interactive play with the Danbo and other items, emotional responses in the actual experiment were not impacted. It is proposed that the elevation in positive mood may very well have impacted the results.

In addition emotional responses in response to neutral human or artificial entity images paired with emotional texts were not found to be significant. Research on the Media Equation (Reeves & Nass, 1996) and the Ethopoeia concept (Nass & Moon, 2000) suggests that treating entities as if they were human, and associated social responses to artificial entities are dependent on the level of social cues and humanness displayed by the entity. The results of this study indicate that the neutral face on the NAO robot likely did not have enough human characteristics or likeness to elicit measurable emotional responses from subjects. It can also be assumed based on interactive experience that for the human and artificial entity stimuli, a neutral face is not realistically feeling any of the emotions described in the text. The lack of realism, and the subsequent confusion elicited by these stimuli, may explain the lack of significant results. Like in experiment 1, there were also no significant results for trait empathy, indicating stimuli were not strong enough to evoke empathic responding related to trait empathy levels. Subjective questions related to state empathy levels were not asked.

In conclusion, the psychophysiological and self-report data from experiment 2 showed that neutral human faces and neutral artificial entity faces do not evoke emotional responses, even when paired with emotional text. Participants seemed confused and uncertain regarding the pairing of the image to the text. It became obvious that the short interaction with a toy robot was not sufficient to create a connection to robots that would impact results in the perception of artificial entities. Differences may have been evoked if interacting with an active and more engaging robot. Moreover, it is likely that a ceiling effect was observed
for these stimuli and that potentially the pairing of a neutral face to affective context was not clear or intense enough to elicit emotional responses (opposite as to what was seen with prototypical emotional stimuli). In addition trait empathy also did not moderate participant responses.

5.4 Experiment 3: Summary

The literature review and results from experiments 1 and 2 explored more in depth the concept of empathy, along with the similarities and differences between empathy and emotional responses. In addition, they offered new perspectives that could be applied to research with artificial entities to better understand what empathy is and what the mechanisms of empathy between humans are. In experiment 1, it became evident that emotional responses to artificial entity stimuli were not only present, as measured through physiological responses (facial EMG), but they were equal in intensity as for the human stimuli. Empathic responses, as measured through trait empathy scores correlated to physiological responses, however were not found and this was also the case for experiment 2. Experiments 1 and 2 were therefore indicative that empathic responses to static stimuli seem to require clear visual representations of emotional states, and situational context does not suffice to elicit responses. This notion laid the foundation for experiment 3, which was based on research showing emotional and potentially empathic responses to stronger stimuli derived from abuse or harm towards robot. Past research has not presented a comprehensive overview of humans’ emotional responses to violence and the destruction of various ‘things’, artificial entities included, to obtain a greater understanding of human emotion, empathy and emotional/empathic responding, and how we relate to these various objects. Experiment 3 sought to bridge this research gap.

The sample consisted of thirty-nine participants, wearing facial EMG sensors (at *Corrugator supercilli, Zygomaticus major*, and *Levator labii* sites), skin conductance sensors
and a photoplethysmogram (PPG) finger sensor to measure heart rate. Participants completed the PANAS (Watson et al., 1988) before and after stimuli presentation. They were shown one practice video followed by 11 randomized video trials; each video showed the destruction or harm befalling one of the following: human stimuli, emotionally meaningful objects stimuli, robot stimuli, meaningful objects, and/or non-meaningful objects stimuli. Thereafter participants completed a self-report empathy questionnaire, the IRI (Davis, 1983), and were asked to fill out a few brief questions on their perception of the experiment.

The results of experiment 3 indicate that participants responded both emotionally and empathically to the destruction of stimuli. The facial EMG activation patterns were consistent with the notion that the destruction of meaningful objects and violent behavior elicited moral disgust. Skin conductance responses (SCRs) however indicated highly significant levels of arousal only for harm towards human stimuli. This is an interesting finding as it points to a difference in the meaning of responses between facial activation and skin conductance. It is likely that the skin conductance response elicited by watching violence towards humans, a direct threat to our kin, specifically in terms of robots versus humans, and that these responses were a primal reaction. Heart rate deceleration at the onset of destruction also illustrated how the act of violence or viewing harm, regardless of the stimulus, impacts physiological responding. Subjective self report data continued to show that human stimuli were perceived to be most meaningful, followed by all other meaningful or relevant objects, including the robots. Total empathy scores were correlated to participants’ feeling more negative and attributing more meaning to human stimuli and emotionally meaningful cherished object stimuli. In addition, subscales of empathic concern and personal distress in the IRI showed significant correlations to feelings of negativity, describing the objects as meaningful, and feeling activated across all relevant items; highest rankings for humans, then cherished objects, then meaningful items, and finally robots.
This is the first study, known to us, to illustrate empathic responding and how levels of empathy are related to the meaning of various objects, including artificial entities, and their harm and/or destruction. This study included physiological measures, looked at trait empathy scores, and in addition asked subjective questions of participants related to their feeling states, after participants watched the items being destroyed. Although the trait scores are not significantly correlated to the physiological data, we did obtain strong evidence for empathic responding from the subjective scores of trait empathy and from how participants ranked the objects. It is fair to assume strong stimuli which are threatening, or showing harm and violence in real time, elicit much stronger and rather primal responses compared to still images. The similarities between measures: physiological, behavioral and both subjective questions and questionnaire data indicate it is likely that the physiological responses were not only emotional, but empathic. Participants not only responded physiologically, but also subjectively, identifying feeling negative emotions when meaningful items were harmed; this can be seen as both the affective and cognitive components of empathy. In addition the strong correlation between trait empathy scores and subjective questionnaire data showed that participants were feeling with the meaningful objects that were hurt or destroyed. The results from experiment 3 shed a new light on emotional and empathic responding. The research on cherished objects may be able to help explain some of our emotional responses to robots that are designed to look like toys or animals. These embodiments may result in stronger emotional responding and may also better explain the results in Rosenthal-von der Pütten and colleagues experimental work (2013; 2014). The robots used in this experiment were toy robots, mechanical in appearance, typical to what is identified as a stereotypical robot, so that participants could identify the object as a robot. This study has great implications for robot design and the use of varied embodiments in different experimental paradigms.
5.5 Conclusions

5.5.1 What Makes a Response Empathic: Empathy towards Things?

A primary research objective of this dissertation was to examine what makes a response empathic and by focusing on human-artificial entity interaction, a more specific objective was devised: to investigate whether people can have empathy for things that are ‘sort of alive’. The literature review on empathy, followed by all three experiments in this thesis aimed to address what characteristics are parts of empathic responses that differentiate them from purely emotional responses. In addition, it was also explored whether it is possible to feel empathy for inanimate objects, such as an artificial entity, and if these experiences were comparable to empathy towards humans and animals. Chapter 2, Article 1, the literature review on empathy, illustrated that empathy is not simply an emotional or affective response to presented stimuli, although this may be part of an empathic response. Instead, empathy involves feeling with another person: sharing affect or an affective experience (Decety & Jackson, 2004; Singer & Lamm, 2009) and is commonly seen in human-human and human-animal interaction (Dawkins, 2000; Mellor, 2012; Taylor & Signal, 2005). Chapter 2, Article 1 aims to show that empathy, as we currently know and define it, may be better understood if we also study human responses to artificial entities. Empathy is so biologically engrained in our evolutionary needs and goals (de Waal, 2009; Lamm, Meltzoff, & Decety, 2010) that a simulated feeling may even be enough to evoke an empathic response. These strong intrapersonal and evolutionary components may explain why we respond to artificial entities automatically, by simply assigning emotion or other affective components to them and responding ‘as if’ they were human. Based on this prior knowledge and experimental results presented in this dissertation, I can conclude that it is indeed possible for people [to] have empathy for not only for living things (i.e., humans, pets) but also for things that can be
perceived to be alive. This finding is important for future research and the design of human-artificial entity interaction.

The results of experiment 1 and 2 illustrate that empathy is not always present in emotional responses and caution is required for interpreting responses to a variety of stimuli. Although subjects responded with the same emotional intensity to human stimuli as they did to artificial entity stimuli, the emotional responses were not linked to trait empathy levels. Experiment 1 indicated there was likely automatic mimicry, of both human and artificial entity emotional responses, with participants simulating the expression of the target in the affective image. Although automatic mimicry, and in this experiment specifically the assumed simulation of an emotional facial expressions, has been said to contribute significantly to empathic responding (Hatfield, Cacioppo, & Rapson, 1994), it does not require a self/other distinction and is often an unconscious process (Dimberg & Öhman, 1996). In terms of empathy, this illustrates that if artificial entities are able to display human emotions (via facial expression and posture): mimicry and other forms of emotional responding may take place; however, it is also clear that more is likely needed to evoke empathy. A limitation of experiment 1 and 2 was the use of stimuli such as still images, which may lack the affective intensity required to provoke stronger emotional responses. This may also explain why I saw no correlations between trait-empathy and emotional responses to stimuli. I used the measurement of both trait and state empathy in all experiments to provide the most comprehensive understanding of individuals’ perception and behavior (Neumann et al., 2015).

The stimuli used in experiment 3 were much stronger than in the previous two experiments and as intuitively expected, evoked much stronger emotional responses. Distinctive from the first two experiments, here empathic responses took place. The criterion for determining that these responses were empathic was the presence of significant
physiological/behavioral responses in combination with significant trait empathy scores correlated to subjective feeling state questions answered by the participants. The study was inspired by Rosenthal-von der Pütten and colleagues’ work (2013; 2014) on emotional and empathic responses towards humans and robots. Specifically, how people respond emotionally to harm and destruction and to what extent the meaning, and/or emotional attachment to objects, impacts this responding. The results of experiment 3 are contributing greatly to the literature by showing that destruction, to any relevant or meaningful object, triggered a physiological and subjective response, in comparison to non-meaningful objects. In addition, harm towards humans and cherished objects evoke even stronger emotional responses, objectively and subjectively. The hierarchical intensity in emotional responding towards items of different meaning also indicated that currently toys resembling stereotypes of robots are already viewed as meaningful as other personally relevant items. Laymen viewing robots as personally relevant objects could have an important impact for future research design. Especially, as the meaning attributed to these entities is likely continuing to increase as our digital culture progresses.

Experiment 3 showed how empathic responses could be evaluated through objective measures of facial EMG and skin conductance and subjective measures, using the IRI and Likert scale subjective questions on feelings of negativitiy, meaningfulness of stimuli and activation/discomfort. A significant finding is that participants responded most empathically to harm towards humans, as shown by strongest objective and subjective responses. Although this was hypothesized, human stimuli were also the only among all other meaningful stimuli to evoke automatic skin conductance responses. This shows a strong autonomic nervous system response to harm of our conspecifics and also gives more evidence to evolutionary explanations of empathy (de Waal, 2009). It is however important to note cherished objects, such as teddy bears and baby dolls, also elicit strong emotional and empathic responses.
Results obtained from these objects of attachment may offer interesting research opportunities for the future design of artificial entities. In addition, as our culture and technology advances, it will be of interest to investigate whether there will be a change in types of attachment objects and whether future generations will respond more strongly to artificial entities.

In conclusion, it becomes evident, that empathic responses are linked to strong, meaningful stimuli, not only to humans. Evoking empathy, in an experimental setting is a large research challenge and will require stimuli of higher emotional intensity than in real-world environments. By looking at the results of all three experiments, and in line with the literature review presented in this thesis, it can be concluded that empathy is a much more multifaceted response than the simple display of emotion. In addition, it is also clear that people respond empathically to things that are perceived to be sort of alive (Turkle, 2011), or have strong emotional and/or personal meaning and significance. Therefore, empathic responding to artificial entities, as discussed in Chapter 2, Article 1, is indeed possible; if one defines empathy accordingly as not necessarily involving a matching of emotional states – if objects are harmed that do not have emotional states. For many researchers in the field of robotics or artificial intelligence the process of having empathy for artificial entities is similar to simulation theory, as it is discussed often within the context of theory of mind research. Simulation theory proposes we assess how someone else feels by placing ourselves into their shoes, using our own motivational and emotional resources in combination with practical reasoning (Michlmayr, 2002). For the purpose of this thesis, in terms of experiencing empathy for artificial entities: some consider the cognitive component of empathy as necessary, therefore believing that an artificial entity is worthy of empathic concern would result in empathic responding. For others, the notion of affective empathy posits that we sometimes don’t need to think, or intuit, but we simply just feel something; and this may
explain why we feel for artificial entities, similar to how we feel for emotionally meaningful objects. However, both, the cognitive and affective components are relevant and essential.

5.5.2 Emotional Responses to Humans versus Artificial Entities

The second main objective of this thesis was to systematically examine our emotional responses to artificial entities such as robots and how these are similar and/or different from our emotional responses to humans. It has been proposed that humans respond to artificial entities using the same social interaction rules that they apply to other humans (e.g., Hoffmann, Krämer, Lam-Chi, & Kopp, 2009; Krämer, von der Pütten, & Eimler, 2012). In addition, research indicates humans do respond emotionally to technology; and that programming entities with simulated emotion increases these responses (Krämer et al., 2008, 2011, 2012; Leite et al., 2008, 2009, 2013; Paiva et al., 2004; Rosenthal-von der Pütten et al., 2013, 2014). Moreover, most research that explores emotional responses to artificial entities focuses on how to program these technologies so they can show emotion, or better yet empathy (Krämer et al., 2008, 2011, 2012; Leite et al., 2008, 2009, 2013; Paiva et al., 2004; Rosenthal-von der Pütten et al., 2013, 2014). Robots and other artificial entities that closely resemble humans, or display obviously human traits (e.g., emotionality), are likely to be judged according to human “rules” of interaction. However, I hypothesized that emotional responses toward artificial entities may not require great programming, or expensive stimuli; rather it may be a much simpler process. Based on this, a clear gap in the literature was identified: exploring emotional responses towards artificial entities by using simple emotional stimuli (i.e., easily identifiable emotional expressions and/or postures in images) and thereby understanding the similarities and differences in emotional responses. The lack of theoretical research on emotional responses to basic human and artificial entity emotional stimuli was addressed in experiment 1 and 2.
When selecting the stimuli for experiment 1, particularly the emotional images of artificial entities, a large sample of different robots was purposefully used. A study by Bartneck and colleagues (2007) which explored responses of likeability to pictures of humans, robots and faces, revealed humans were rated as less likeable than toy robots and human robots; so a diverse sample of stimuli was chosen to prevent this. Other studies also explored the perception and emotional responses to various robots based on the Uncanny Valley hypothesis by Mori (1970), which posits that as a robot’s design becomes more human, subjects respond with greater empathy and positivity to it, until a certain point is reached when the resemblance is uncanny, and subjects then respond with revulsion, (e.g., Rosenthal-von der Pütten, 2014) although they did not look at responses towards human stimuli. This research indicated that participants rated different levels of personal comfort, depending on the robotic embodiment: either zoomorphic, mechanic, or humanoid. It is clear that subjects respond emotionally to artificial entities in different judgment studies. It is also indicated that artificial entities are considered to be human-like if they have human-like physical features: e.g., head, torso, arms, legs and facial features: e.g., eyes, brows, nose, mouth (DiSalvo, Gemperle, Forlizzi, & Kiesler, 2002; Rosenthal-von der Pütten, 2014); these features were therefore seen as vital components for the basic stimuli selected for experiment 1. Many issues are said to influence the perception of artificial entities, such as gender and personality traits (Syrdal, Koay, Walters, & Dautenhahn, 2007) and attitudes towards robots (Nomura, Shintani, Fujii, & Hokabe, 2007); however, none of these prove to be consistent indicators for influencing perception (Rosenthal-von der Pütten, 2014). Finally, it is evident a comparison of emotional responses to affective stimuli of artificial entities and humans was missing from the literature, regardless of the many studies investigating robot appearance (Rosenthal-von der Pütten & Krämer, 2014).
The results of experiment 1 were meant to give insight into the affective perception of artificial entities in comparison to humans. The results indicated that humans responded emotionally, with the same intensity, to images of artificial entities and humans displaying recognizable emotions (anger, sadness, happiness, and pride). This is a significant theoretical contribution to the research field. It demonstrates that humans respond emotionally to artificial entities in the same manner as they do towards humans when exposed to clearly identifiable stimuli. This research connects very nicely to previous work surrounding the similarities in social interaction rules between humans and artificial entities (Hoffman et al., 2009; Krämer et al., 2012). This finding has strong design implications for human-robot interaction, as they indicate that inducing emotional responses from humans towards artificial entities may be less complicated and require less investment (e.g., time, money, technology) than previously assumed. That being said, all of the stimuli used did have specific design characteristics: none of the artificial entities were overly human-like (as to not trigger Uncanny Valley responses) and all were non-threatening. All had human-like shapes and design characteristics, as described above, and many also had child-like characteristics that would induce pleasantness or likeability (as seen in artificial entity clusters from research by Rosenthal-von der Pütten & Krämer, 2012). All of these specifications may indicate that in order to easily induce similar emotional responses between humans and artificial entities, the design characteristics must follow certain protocol. In addition, replications of this research may offer opportunities to extend a classification system for emotional artificial entities and offer different entity categorization for use in both academic and social settings.

The results from experiment 1 offer a theoretical contribution and extension to the work of many researchers studying the Media Equation, Ethopoeia concept and automaticity/mindlessness (Hoffmann et al., 2009; Langer, 1989; 1992; Langer & Moldoveanu, 2000; Nass & Moon, 2000; Reeves & Nass, 1996; Tversky & Kahnemann,
The automatic and unconscious assignment of social rules and responses to computers and other technologies as though they were human is described at length in this thesis and the aforementioned literature. From an evolutionary standpoint, it is thought that humans successfully cope and carry out life tasks by developing automatic responses, particularly to social experiences or interactions. Reeves and Nass (1996) described, that by programming media, technology, and presently smart machines with enough characteristics that remind us of social interaction, our brains are being tricked into responding socially and accepting these technologies as though they were people. These, often referred to as mindless or automatic responses, imply we are not actively or consciously viewing the situation and making conclusions (Langer, 1989, 1992; Langer & Moldoveanu, 2000). Instead, we use mental shortcuts, and based on the functional similarity of the smart technology with which we are interacting, we apply human interaction rules to them. The results of experiment 1 indicate these are not simply rules of interaction or communicative similarity. Instead, the automaticity of responding seems to also be linked to emotional responses; the entity is no longer perceived as only being similar socially, but also similar emotionally. To mindlessly apply emotionality to a non-living being, to something that is truly just sort of alive, implies that making an inanimate entity come ‘alive’ may simply require making it appear emotional, rather than actually programming emotion into it.

The results of experiment 2 provided even more support of the importance of emotional expressions for the perception of, and responses to affective stimuli. The neutral faces of humans and robots, paired with emotional text were not sufficient to elicit emotional responses towards both artificial entity and human stimuli. These results indicate how important emotional facial and postural expressions are for humans to feel connected to their viewed target, as seen in responses during experiment 1. Neutral expressions apparently leave participants confused, which results in no expressive responses to presented stimuli. These
results also relate to research presented by Rosenthal-von der Pütten (2014) on robot appearances: participants did not express agreement for wanting a specific appearance of a robot, but did note that it was important to have all aspects of the appearance connected to a specific, identifiable function. The neutral facial expressions of both robots and humans in experiment 2 failed these criteria as they did not serve any function; particularly when paired to the emotional vignettes. This may also provide another explanation as to why there were no emotional responses to the presented stimuli in experiment 2.

In both experiment 1 and 2, I only presented participants with the emotional images and text and assessed their objective responses to stimuli; we did not include any subjective questions. It would be interesting to re-run the studies and additionally use subjective rating scales to not only rate the entity, but to also look more in-depth into human-robot interaction and what other responses may be taking place. This may enable researchers to further explore how humans perceive emotional robots on the concepts of anthropomorphism, animacy, likeability, perceived intelligence and perceived safety (Bartneck, Kulić, Croft, & Zoghbi, 2009). In addition, it would be relevant to discover if any of the spontaneous emotional responses humans displayed towards the artificial entity stimuli would change, if participants were asked to reflect on them through subjective questions; thus changing the automaticity of responding.

Other objectives that were explored in experiment 1 and 2 examined whether emotional responses to artificial entities are moderated by trait-empathy and/or moderated by previous artificial entity interaction. The results of both experiments indicated that any responses towards presented stimuli were emotional responses and were not moderated by trait-empathy. I also included objective measures of facial EMG and skin conductance which are sometimes used as indicators of state empathy. In both experiments there were no differences in intensity of responses between human and artificial entity stimuli and these
measures were also not correlated to trait empathy scores obtained through the IRI (Davis, 1983). As previously mentioned, the stimuli used in experiments 1 and 2 were not very intense and may not have been emotionally relevant enough to trigger an empathic response. In addition, still images and text may not be the best paradigm to test empathic responses as the process of feeling with or into another is hindered by stimuli that lack interaction and engagement. Also, there were no subjective questions regarding the emotional impact of the stimuli in experiment 1 and 2; it would be of interest to insert stimuli questions from experiment 3 and re-run the study to see if this would alter the outcome. In experiment 3, we did see empathy impact responses to stimuli; this will be discussed in further detail during the discussion of the last core research theme.

It appears that responses to stimuli in experiment 2 were not moderated by previous interaction with an artificial entity. Previous research on both human (Meyer et al., 2013) and human-artificial entity interaction (Bartneck & Hu, 2008; Groom, Takayama, Ochi, & Nass, 2009) indicate that previous interaction can increase comfort levels and also change the evaluation of a situation, or an entity. In contrast, the results of experiment 2 indicate that the previous interaction with a toy robot (Danbo) did not have any effect on the results and was not linked to perceiving the robotic stimuli as more meaningful. Similar results have also been described in research by Rosenthal-von der Pütten and colleagues (2013), in which participants interacted with a Pleo robot prior to being shown robotic stimuli, and this had no impact on responses to video stimuli. Based on the outcomes of experiment 2, it is of interest to see if a longer period of interaction with, or exposure to, an artificial entity would impact emotional responding to artificial entity stimuli. This offers an exciting avenue for future research.

In conclusion, the present research emphasizes that emotional responses to artificial entities can be surprisingly similar to emotional responses to humans. When artificial entities
are presented with stereotypical human affective expressions, humans will automatically respond emotionally to presented stimuli. This provides many challenging opportunities for future research about what is needed for a robot to evoke emotion and to be considered emotional. The results also indicate that even when emotional responses are present; this does not automatically mean that the response is empathic. Furthermore, I have shown that having an array of different measures of emotional responding is important to decipher emotional from empathic responses. Finally, previous interaction with robots, occurring for short periods directly before the experiment (Chapter 3, experiment 2; Rosenthal von der Pütten et al., 2013), does not impact emotional responses to artificial entity stimuli; although this does not exclude the possibility that a longer period of interaction may. It is clear from the literature and results presented, that the perception of artificial entities as emotional is a largely automatic process. This too offers great opportunities for improving the future of human-robot interaction design.

5.5.3 Emotional and Empathic Responses to Harm and Destruction

The third main objective of this thesis was to explore what emotional and/or empathic responses would be elicited by the harm and destruction of a variety of objects, and whether these responses are moderated by the meaningfulness of the object. As previously described, emotional and empathic responses are not only tied to situations and events, to specific people or to interactive processes; they are also present in how we connect and feel about our possessions and meaningful items (Belk, 1988; Diesendruck & Perez, 2015; Ferraro, Escalas, & Bettman, 2011). Emotional responses to encouraging situations, affirmative interactions and even to cherished objects usually include a range of strong positive emotions (Diesendruck & Perez, 2015). Strong violations of social norms, such as causing harm or damage to people, animals or even cherished objects can result in the expression of very negative emotions such as anger and moral disgust (Ferraro et al., 2011; Gutierrez & Giner-
Sorolla, 2011; Ottaviani, Mancini, Petrocchi, Medea, & Couyoumdjian, 2013; Simpson, Carter, Anthony, & Overton, 2006). This core theme was based on research by Rosenthal-von der Pütten and colleagues (2013; 2014) which showed that participants responded emotionally, physiologically and subjectively to the torture of a human and a toy robot (Ugobe’s Pleo – resembling a baby dinosaur). While this research illustrated that harm towards a robot causes emotional and even empathic responding, the conclusions of these studies cannot be interpreted as applying to all robots or artificial entities, or interpreted as definite empathy towards an entity; many other factors impacted these findings. Therefore, the third main objective of this dissertation aimed to address which factors contribute to emotional responses. Is the act of destruction enough, or is this mediated by the type of object and how meaningful the object is.

The results of experiment 1 and 2 laid the foundation for the development of experiment 3. Results indicated that basic, still image stimuli could evoke emotional responses for artificial entities; however, these stimuli did not evoke empathic responses (i.e., no correlation to trait empathy levels, no subjective questions asked related to feeling states). Changing the stimuli and creating more intense and emotionally engaging stimuli could potentially result in stronger emotional responses and evoke feelings of empathy. The work of Rosenthal-von der Pütten and colleagues (2013; 2014) concluded that people respond emotionally to torture, harm and destruction of humans and robots, and that these responses are also empathic. These results were interpreted as very strongly supporting our acceptance and emotionality towards artificial entities without exploring other factors that may have impacted responding. The results from experiment 3 and those of Rosenthal-von der Pütten and colleagues (2013; 2014) do show that humans respond emotionally (physiologically and subjectively) to harm, destruction and torture. This however has a simple explanation: Darwin (1965) identified that emotional responses, in particular disgust served an adaptive
and protective function. Viewing this type of stimuli likely elicits a primal response with any emotional reaction serving an adaptive function: to keep an individual from harm; whether be it physical, emotional, perceived or even imagined (Rozin, Haidt, & McCauley, 2000). In addition, some of the results in experiment 3 can also be interpreted from an empathic pain framework. Research indicates that there is a cerebral commonality between experiencing pain ourselves and the perception of pain in others (Jackson, Meltzoff, & Decety, 2005; Jackson, Rainville, & Decety, 2006). Watching harm done to someone or something else, and the resulting physiological and subjective responses may be indicative of a similar process to what has been described in research on empathic pain. Since automatic responses to destruction can be anticipated, experiment 3 answered questions surrounding what else can impact these responses.

The results of experiment 3 show more than a simple adaptive or evolutionary response. By breaking down the stimuli that were destroyed into sub-groups with different levels of meaning, it is possible to observe how these expected responses are moderated and differ from one another. The harm and destruction of all stimuli that had personal relevance elicited disgust, as measured through facial EMG. The results show that the destruction and harm towards humans, emotionally meaningful cherished objects, robots and meaningful objects resulted in expressive responses consistent with socio-moral disgust. Destructive behaviors violate social norms and thus elicit strong disgust responses; responses that initially were thought to only be strongly elicited with physical disgust stimuli (Chapman, Kin, Susskind, & Anderson, 2009). Interestingly, skin conductance responses were only significant toward human stimuli, indicating a primal, physiological arousal response which is possibly indicative of a specific emotional state (Ellsworth, 1994) only present for human stimuli. Spontaneous skin conductance activity has been linked to levels of task engagement and meaningfulness of the content of the task (Pecchinenda & Smith, 1996). The spontaneous
skin conductance responses to human stimuli only, may indicate participants were highly engaged and impacted by the human stimuli, due to its meaningfulness, in comparison to other stimuli. This finding thereby also indicates that human stimuli (the most meaningful stimuli), elicited the strongest emotional responses. This has an important implication for future studies involving humans and artificial entities. Although the use of skin conductance measures are less invasive and more portable compared to other physical measures, interaction with robots may not be enough to evoke significant skin conductance responses in comparison to interaction with or involving other humans.

Subjectively, we found that responses are strongly moderated by the perceived meaning or importance of the stimuli. The various sub-types of items showed a distinct hierarchy when participants were asked about their feelings of negativity, how meaningful they found the items, and their arousal levels. The hierarchy indicates subjective emotional responses to items had different levels of meaning: humans bring forth the strongest responses, followed by emotionally meaningful cherished objects (teddy bear/doll), then meaningful objects (guitar/Nintendo) and finally robots (stereotypical small robot, toy design). Non-relevant objects (box, fan, and floor) did not evoke any significant subjective responses. These subjective responses also correlate to the physiological reactions to stimuli destruction. Likely, since robots are not part of everyday interaction, and are not owned by many families, the level of meaning and the physiological responses to their destruction is less intense than other stimuli with which we have more interactive experience. Although we used toys that resembled robots, and many children may have exposure to these objects, they are still not identified as cherished objects, which likely impacted responding. It would be interesting to re-run this study following prolonged exposure or greater interaction between subjects and an artificial entity.
The second part of this third research objective was to investigate if empathic responses are more present in response to intense stimuli, versus simple stimuli (non-interactive, images, vignettes). Results from experiment 3 indicated that responses to the destruction of meaningful objects were not only emotional, but also empathic. The stronger the stimuli: both in intensity and object relevance/meaning, the stronger the responses. Trait empathy, analyzed through both total score (IRI) and the subscales of empathic concern and personal distress (Davis, 1983), were correlated to the previously described hierarchy of meaningful objects. Trait empathy scores were linked to how negative and aroused individuals felt after the destruction of objects. Trait empathy levels were also positively correlated to the level of meaning we assign to an object. The strongest correlations were for human stimuli and cherished object stimuli. It is clear that the strength of the stimulus, determined by both the significance of the object and how the object is treated, elicit emotional and empathic responses. The responses to robot harm were physiologically and subjectively weaker than hypothesized, as we had assumed robots would elicit stronger responses (because they would be seen as more meaningful) than personally relevant objects (guitar and Nintendo). The responses in this experiment were also less intense than research presented by Rosenthal-von der Pütten and colleagues (2013; 2014) in which subjects responded with equal intensity physiologically (skin conductance (2013) and fMRI activation (2014)) and subjectively (questionnaire data) to the torture video clips of the human and the Pleo. This presents an opportunity for future research on human-robot interaction. It is clear that the responses to cherished objects are very strong, and the use of a Pleo has more similarities with an attachment object, than the toy robots used in experiment 3 which were mechanical in appearance. The responses to the Pleo are likely impacted by the Kindchenschema (Lorenz, 1943), which suggests that infant-like features, perceived as cute, increase sensitivity, empathy, and reduce aggression. The similarity of the Pleo to a baby
dinosaur, and a cherished object, definitely impacts the level and intensity of emotional responses by human subjects, particularly when watching it get tortured. If researchers have the goal to evoke emotional and empathic responses towards robots, and other artificial entities, it may be appropriate to model the artificial entities used, after attachment objects. This can include physical embodiments that are similar (e.g., Pleo, resembling a baby dinosaur, or the PARO, resembling a baby seal) or adding features that evoke emotion (e.g., Kindchenschema, baby-doll like).

In conclusion, these results indicate that emotional and empathic responses could be elicited by the destruction of a variety of objects. They are however moderated by the meaningfulness of the object. It also became evident, by comparing the stimuli between experiment 1, 2 and 3, that empathic responses are more present in response to intense stimuli, versus basic image stimuli; or when the stimuli presented are meaningful to the subject. This research indicates that although robots do not elicit the strongest responses, they are still perceived as meaningful and personally relevant by the participants. This may be indicative of a *sign of the times*: as artificial entities become more commonplace in society and everyday interaction, their level of meaning is bound to change. The emotional responses to the objects in experiment 3 cannot be explained by financial value, as the strongest responses were not linked to monetary value. It would, however, be of interest, when further exploring responses to artificial entities, if the monetary value of the robot being destroyed would impact or strengthen the emotional response to the destruction. In addition, this type of study would lend itself to exploration on previous robot interaction and whether the longitudinal study of human-robot interaction would result in stronger emotional and empathic responses. The intensity of responding towards cherished objects may be relevant for the design of various artificial entities and studies involving human-robot interaction.
5.6 Critical Evaluation

5.6.1 Implications and Future Research

The purpose of this dissertation was to address open research questions focusing on emotion and empathy towards humans and artificial entities. The research was designed to address conceptual and empirical gaps according to relevant, central research themes. The findings presented in this thesis have significant implications for both theory and application in this field. The results are also highly relevant and may contribute to generating a societal discussion on emotions and empathy towards technology, and more importantly, what this may mean for human relationships. Implications of this dissertation are rooted in academics and ideas for future research; however, they also evoke an emotional debate on how we define humanness and what implications this may have in light of the continuing advancement of digital culture. It creates an opportunity to better understand how we respond to each other and the advancing world around us.

With respect to theoretical implications, the results presented both describe (Chapter 2, Article 1) and distinguish between emotional and empathic responses (experiment 1 and 2 versus experiment 3). It uses responses towards artificial entities, embodiments that are perceived as sort of alive, to distinguish between two processes that are often confused in the literature. In the field of human-robot interaction, many studies claim to evoke empathic responses, when often times these responses are only indicative of an emotional reaction (e.g., Leite et al., 2013). Research on responses to artificial entities offers an opportunity to explore and distinguish between emotional and empathic responses. In gathering the data for this dissertation, I observed the same intensity of emotional responses such as facial mimicry, to emotional stimuli of artificial entities and humans. Until now, to my knowledge, no other study has looked at basic stimuli of both artificial entities and humans together and the evoked responses. This research indicates that looking at stimuli of both humans and artificial
entities together may give clearer results, as to how humans respond emotionally to both
types of stimuli, instead of simply looking at them individually.

Although studies that classify various artificial entities according to their perceptive
criteria (e.g., Rosenthal-von der Pütten & Krämer, 2014) exist, there is currently no collection
of images/stimuli depicting robots or artificial entities that are known to evoke emotional
responses. It would be of interest to create a photo classification system of artificial entities in
which robots are not only classified based on their design, but also based on how they are
perceived and what type of emotion(s) they evoke. This type of image set could be used for
future research on emotional responses to artificial entities and further studies on how these
emotional responses could be moderated. Similarly, further development of more emotional
robotic images may also evoke empathic responses. The images used in experiment 1, for
example, were most likely not intense enough to prompt empathic responding. Developing a
classification manual of images for robots could be very useful in creating a standardized tool
for human-robot research; essentially creating something akin to the International Affective
Picture System (IAPS) (Lang, Bradley, & Cuthbert, 1997), but for artificial entities.

The results of experiment 3 indicate that emotional and empathic responses to stimuli
are intensified when the stimuli is being impacted (i.e., a video clip in which something is
done to a stimulus object, in this case the object is either suffering or is destroyed). Therefore,
it would be relevant to also create a collection of video clips showing various live interactions
with artificial entities. This would also provide another standardized tool to answer research
questions surrounding emotional and empathic responses when robots are perceived to be
alive and interact within different scenarios. In addition, this would extend the research on the
similarities and differences of emotional and empathic responses to still versus active stimuli.
On another note, the findings of experiment 3 and the findings of Rosenthal-von der Pütten
and colleagues (2013; 2014) indicate that harming a robot results in emotional, and empathic
responses. The two studies however used a completely different embodiment: one representative of a cherished object (Pleo) and one stereotypical plastic mechanical robot’s (Chapter 4, experiment 3). Clearly, each robot elicits different responses; overall however causing harm was still an effective strategy to explore human responses to artificial entities. If funding was available, it would be interesting to create a database of controlled video clips depicting the harm of various artificial entities. This would help to shed light on what types of robots evoke the strongest responses and would have great implications for robot design.

The lack of effect of human-robot interaction on responses to artificial entities as presented in experiment 3 are similar to the results discussed in Rosenthal-von der Pütten and colleagues (2013), however, they are somewhat at odds with the claims made in other studies (Bartneck & Hu, 2008; Groom, Takayama, Ochi, & Nass, 2009). This indicates that the impact of human-robot interaction immediately prior to an experiment on emotional responses needs to be investigated further. Future studies should address what types of previous robot interaction (e.g., immediate, short-term, long-term) and what type of artificial entity (e.g., toy, mechanical, humanoid, virtual) may impact emotional and empathic responding towards robots.

Finally, from a theoretical perspective, the results presented in this dissertation shed a new light on studying emotional and empathic responses towards humans and artificial entities, but they are by no means conclusive. The findings presented here are the start to extend the definition and measurement of empathy, and how research in the field of human-robot interaction may help broaden the understanding of empathic processes and responses, also between humans. The further study of empathy between humans and artificial entities has many theoretical and practical potentials and implications. From a theoretical standpoint, empathy will continue to be a topic of empirical debate, particularly empathy towards technology. This is because the difficult task of feeling with or into something that is not
alive, challenges many current definitions of empathy, which is typically a process experienced between humans or humans and animals. Continuing the research to clearly differentiate between emotional and empathic responses is also important. Through the experiments presented in this dissertation, I was able to show that using multiple methods to measure responses is useful when exploring empathy between humans and artificial entities. The need for strong, emotionally evocative stimuli was also made clear through the differences in experimental results.

This intricate relationship with devices becomes intensely emotional; we expect reliability from technology, and we exchange this reliability with fierce loyalty. This certainly challenges the traditional view of human connections: while we may be connecting to other humans through the use of devices, the interface used is no longer viewed as simply a thing. We not only show fierce emotional responses to our communicative devices, but also to technological toys, artificial entities, virtual characters and in some cases robots (Turkle, 2011). Our responses to artificial things are even becoming empathic, thus creating the need to view empathy as no longer something that occurs exclusively among the livings. What does this mean for us? For our humanness? The results presented in this thesis have great implications for contributing to a societal conversation about the importance of, and the increasing dependence on our electronic devices. As the field of robotics continues to expand, we will continue to be more exposed to virtual characters and artificial entities that will be able to fill a niche somewhere in our lives or at the very least fulfill a societal purpose. The findings of this thesis could have a wide reaching impact for various groups of people. For example, these results may be unsettling for those who worry about how much intimacy we already have with our devices, and will have with smart machines in the future. On the other hand, the findings may also offer encouragement for the field of social robotics; using the emotional responses between humans and artificial entities for the development of useful
assistive technologies. However, while the responses may vary, one thing is clear: although we respond emotionally and empathically to artificial entities, these responses are still not equivalent to how we respond to our fellow humans. The differences in strength of responses show that we remain loyal to our fellow human in response intensity.

5.6.2 Limitations

The research presented in this dissertation was intended to explore unanswered questions regarding emotional and empathic responses between humans and artificial entities. Although informative, the work presented is not exhaustively conclusive. This thesis contains some theoretical and methodological limitations that also need to be addressed.

In experiment 1, the presented stimuli of humans and artificial entities were pretested for emotional intensity and clarity. Chosen stimuli composed of both humans and artificial entities had equal ratings for perceived emotion. Thus, it cannot be ruled out that the result of equivalent emotional responses to both types of stimuli is an observed ceiling effect. In addition, there were no subjective questions about emotional responses to the stimuli presented. This was intentional, as I wanted to observe spontaneous emotional responses to stimuli that were clearly depicting specific emotional states. This, however, limits the conclusions that can be drawn from the data collected as to why responses to both types of stimuli were so similar, and why artificial entities were perceived as emotional. Thus, future research should also include a greater variance of stimuli (e.g., different ratings for intensity of emotion) when exploring this research question. The use of subjective questions, post stimulus presentation, would also provide interesting results and allow for a better understanding of emotional versus empathic responding; not only correlating trait empathy scores with physiological responses as was done in experiment 1.
In experiment 2, the use of neutral faces paired with emotional text seemed to be confusing to participants. Although research indicates that text can elicit emotional responses, and the vignettes had been pretested for perceived emotion, they did not impact responding. One major limitation of this study was the significant increase in positive mood from pre-experiment play activity. Participants indicated significant increases in positive mood prior to observing the neutral stimuli. It is possible that the high level of activation followed by relatively boring stimuli was the main reason for the lack of responses to both human and artificial entity stimuli. In addition, previous robot interaction did not impact emotional responses to the stimuli, as was originally hypothesized. It seems that this period of interaction was not long, or significant enough; similar to the outcomes of the paradigm used by Rosenthal-von der Pütten and colleagues (2013). Future research could use a similar paradigm of neutral image combined with emotional text, or vice versa, but without a mood-boosting activity to see if results would change. It is also apparent that the stimuli were not strong enough; in this case, subjective questions about the stimuli would have helped interpret the results. Finally, for future studies with previous robot interaction, it is important to use the right robot and right length of activity to ensure participants feel engaged with the entity. Measuring feelings towards or attachment to the entity prior to the interaction would also allow for a more objective understanding of how this impacted the data.

In experiment 3 it became evident from the obtained results that the strength of the stimuli was strong enough to elicit emotional and empathic responses. The results for the lip raiser *Levator labii*, as a correlate of moral disgust, showed strong responses to all meaningful stimuli, with limited differentiation. It may be that I reached a ceiling effect with *Levator labii* activation due to stimulus intensity, so noticeable differences between categories of objects could only be seen through skin conductance data and subjective questionnaires. In addition, I used two toy mechanical robots as our artificial entity stimuli.
for experiment 3. This was intentional so that the robot would not resemble a cherished object (Rosenthal von der Pütten et al., 2013; 2014), however, I must be careful when interpreting these results as the robot could still have been viewed as a toy, not an actual robot. It would be interesting to re-run the studies using various robotic embodiments to see how the results would be impacted.
5.7 Outlook

This research project explored emotion and empathy in order to extend the current knowledge and understanding of both concepts. The major focus of the dissertation was to discuss similarities and differences between emotional and empathic responding towards humans and towards artificial entities. In addition, it sought to understand what causes these emotional versus empathic responses and whether they can be moderated by various factors. The major research question was: do we respond emotionally, and more importantly, empathically to artificial entities? In order to properly answer this, the literature review and all presented experiments focused on various facets of empathy and emotion. This dissertation also demonstrated why research on human-robot interaction could shed a new light on the field of emotion research.

This dissertation elucidates many aspects relevant to the fields of interest. For example, the studies focused on both objective and subjective measures of emotional responding to investigate how these differ from empathic responding. Furthermore, the experiments sought to ascertain if empathy moderated emotional responses and what impact previous interactions might have on general responding. Finally, it explored how harm and destruction of various objects, including robots, may evoke different emotional and empathic responses when compared to those stimulated by basic stimuli; and what this says about our feelings towards things that are perceived as being only sort of alive.

To summarize all of the important points: the obtained results revealed that emotional responses to basic stimuli of artificial entities and humans were equal in intensity and participants mimicked the presented emotions. This suggests that emotion may be as easily assigned to robots as social interaction rules; but only if the emotion is portrayed clearly (e.g., pre-tested emotional images used). Furthermore, it was established that emotional responses do not equal empathy, and short previous interactions with robots do not impact emotional
responses. Further results showed that witnessing harm to meaningful objects elicited moral disgust in participants. However, only harm caused to humans elicited strong skin conductance responses. The harm and destruction of objects demonstrated a linear trend for subjective questionnaire data resulting in a hierarchy of importance, with human stimuli eliciting the strongest responses, followed by cherished items, personally meaningful items and robots. These responses were correlated with trait empathy scores indicating empathic responses to the harm of not only humans, but of objects that we perceive as being personally meaningful, and in some cases are felt to be *sort of alive*.

Overall, the major contribution of this work is the exploration of emotional and empathic responses between human stimuli and artificial entity stimuli; through the use of both objective and subjective measures. Furthermore, this dissertation provides additional support that link emotional and empathic responding to the harm of various objects. This work clearly demonstrates while harm towards humans did elicit unique responses, destroying objects of meaning still evoked strong emotional responses and empathy in participants. All of the results presented underscore the need to continue the discussion surrounding empathy and emotional reactions towards technology. They also present powerful implications for the future of artificial entity design. Finally, the overall effect of emotions toward technology within our digital culture and how this impacts our unique humanness was also discussed. This dissertation indicates that we can feel emotionally and empathically for things that are only perceived as *sort of alive*; yet it also indicates that we always feel stronger and more intensely for our own kin. This will impact the continued research with, and discussion on, human-artificial entity interaction and what our responses towards entities really mean for us, and our digital culture.
5.8 References


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Appendix A

Pretest Experiments 1 to 5
Summary

This appendix reports five experimental pretests that were conducted to create and select stimuli for the experiments reported in this thesis. Specifically, experiments 1 and 2, reported in Chapter 3, required images and associated text vignettes of humans and artificial entities to assess emotional responses to humans and robots. Experiment 3, reported in Chapter 4, required stimuli consisting of video clips that depict the controlled destruction of various objects of meaning in a laboratory to assess empathic responses to violence towards humans and robots. As it was not possible to find ready-made stimulus-sets new stimuli needed to be found or created from scratch and validated during the first phase of this PhD project. Appendix A contains all materials pertaining to the five completed pretests.
A1. Pretest 1: Initial Selection of Image Stimuli

A1.1 Background to Image Stimuli

Experiments 1 and 2 investigated whether images of artificial entities can elicit affective responses, just as images of humans can, as has repeatedly been demonstrated (Brown, Bradley, & Lang, 2006; Ekman & Oster, 1979; Ekman, Friesen, & Ellsworth, 1972; Lang, Greenwald, Bradley, & Hamm, 1993). One of the early choices involved which emotions were to be investigated and the choice was made to select primary emotions (Ekman, 1992; 1999), where it is clearly assumed there are prototypical expressions (Ekman, Friesen, & Ellsworth, 1972; Ekman & Oster, 1979). Furthermore, the question was whether secondary emotions (e.g., shame, guilt, and pride), which are not typically assumed to have clear and unambiguous facial patterns associated with them, but that are sometimes investigated and, together with other information, such as posture, gestures, or even situational contexts (Kemper, 1987; Lazarus, 1991) could also be used. While there are clear ideas what stimulus properties/expressions to look for in human stimuli, based on the seminal work of researchers such as Ekman and his colleagues (1972; 1979) or Izard and his colleagues (1992), this was less obvious with images of robots or other artificial agents. While there are various data bases for humans expressing various emotions, both, static and dynamic (e.g., Radboud Faces Database, the Karolinska Directed Emotional Faces (KDEF), and the Amsterdam Dynamic Facial Expressions Set (ADFES)), unfortunately, a database of pretested images which are perceived to express various emotions for artificial entities has not yet been developed. Therefore, images of both humans and artificial entities were selected from open-internet sources such as Pinterest or using Google image search via appropriate key words. The choice to select similar sources for the human images, rather than using one of the established sets was made to have similar styles of images for both classes of images. All stimuli were pretested in three different, but related experiments with participants
from heterogeneous samples, recruited from Amazon’s Mechanical Turk (www.MTurk.com), a crowd-sourcing web service (Paolacci, Chandler, & Ipeirotis, 2010) that presently consists of over 100,000 participants in more than 100 countries (Buhrmester, Kwang, & Gosling, 2011). Research indicates that the quality of the data gathered through Amazon Mechanical Turk, when using experimental controls, is comparable to data gathered using traditional recruiting methods, such as in a laboratory study (Chandler, Mueller, & Paolacci, 2014).

**A1.2 Purpose**

Initial selection of human and artificial entity images from a large set of stimuli perceived to express primary and secondary emotions.

**A1.3 Method**

**A1.3.1 Participants**

The initial image selection, pretest 1, was divided into pretest 1A and 1B due to the large set of experimental stimuli as established in informal tests in the laboratory, N=190, that was randomly distributed amongst the two tests. Forty-seven (32 female) adult participants, age range 18-76 (M = 40.49, SD = 13.93), took part in pretest 1A, receiving a payment of $2 USD for completion. Forty-six (30 female) adult participants, age range 21-69 (M = 40.52, SD = 11.60), took part in pretest 1B, receiving a payment of $2 USD for completion. Prior to starting the experiment, all participants were presented with informed consent. Choosing to proceed to the experiment meant they gave their consent. They were informed they could stop their involvement at any time with no risks.

**A1.3.2 Stimuli**

This initial pretest contained a very large amount of stimuli in order to allow for a wide range of judgments on the presence of primary and secondary emotions, and to ensure the reliable selection of stimuli for future experiments. The author compiled the complete set
of stimuli of 190 images from open-internet sources and search databases. Of the 190 images, 87 images were of humans (47 female) and 103 images were of artificial entities. Due to the ambiguity of artificial entity images, a greater number of images in this category were selected for pretest purposes. The 87 human images were heterogeneous in age, culture and ethnicity. The 103 artificial entity images were heterogeneous in type of artificial entity, such as robot, toy, machine built, plastic model, humanoid robot, etc. Most of the images of artificial entities did not contain gender cues. Because of the large set of stimuli, they needed to be divided to create two more manageable pretests (A and B). Therefore, after dividing them into sets of near equal amounts of human and artificial entity stimuli, the images were randomly assigned to each pretest. Pretest 1A contained 44 human images and 51 artificial entity images for a total of 95 stimuli. Pretest 1B contained 43 human images and 52 artificial entity images for a total of 95 stimuli. All images were presented in a frontal view and with a straight ahead gaze direction for the participant. Additionally, they were all resized and pasted on white backgrounds creating a uniform size of 710 x 860 pixels. By creating a standard white backdrop the images were kept proportional to their original version and were not distorted. Since participants were using their personal computers to complete the pretests, the author was unable to control for monitor size, screen resolution and/or viewing distance.
Figure A.1.1 The images above are examples of sad artificial agent stimuli and sad human stimuli presented to participants during the pretest.


A1.3.3 Procedure

Data collection was done using individual, online-survey sessions. Participants were recruited using Amazon’s Mechanical Turk (www.MTurk.com). An advertisement containing the title of the pretest *Emotion in Images* and a brief description, including approximate duration, based on informal pretests, (forty-five minutes to one hour) and compensation given for participation ($2 USD), was used to attract participants. Subjects were then presented with a link to an online survey, with instructions to *click to proceed*; the survey was prepared using Survey Monkey Software (www.surveymonkey.com). The pretest experiment template (survey format) was adapted from Michaud (1995). Participants were first introduced to the purpose of the pretest, to *rate the perceived presence of various*
emotions in the images presented of humans and artificial entities. They were then asked to give informed consent by clicking next on the consent slide. Subjects were informed that they could terminate their participation in the experiment at any time without consequences for their remuneration. Further task instructions, including a practice slide in the beginning, were presented onscreen to participants during the experiment.

Images and questions were presented on the screen one at a time. The images were controlled for height and width and were presented on the left-hand side to middle of the computer screen. The questions/rating scales were presented on the right side of the screen, next to the images. The presentation of the images was randomized. For all images, participants were asked to rate the perceived presence of primary emotion(s) anger, sadness, fear, happiness (Ekman & Friesen, 1978), and the intensity of secondary emotion(s) shame, guilt, pride (Lazarus, 1991). Participants’ responses to all questions were given on a 7-point Likert scale ranging from not at all (+ relevant dimension) to very strongly (+ relevant dimension). The dimensions were assigned different values for coding and analysis. The dimension not at all was assigned a value of 1, and the dimension very strongly was assigned a value of 7, but no numerical values were displayed for the participants.

At the end of the experiment (in the last slides of the survey) participant demographics were collected, including age, gender and nationality. The duration of the experiment was collected via internet time stamps resulting in an average of 44.33 minutes for all participants in both sets of stimuli to complete. Participants were also given the option to write comments about their experience after completing the pretest. The last slide contained a completion code that participants would enter into Amazon Mechanical Turk to receive compensation for finishing the experiment.

A1.4 Results

The initial analyses of the data and feedback from participants indicated confusion in identifying some specific emotions in various images of human and artificial entity stimuli. Participants, in descriptive comments, frequently mentioned they could not distinguish guilt.
and/or shame in the images, and it was instead perceived as the primary emotion sadness.

Analyses were performed on averaged values, per emotion category. A Pearson’s correlation was run to determine the relationship between sadness stimuli and guilt stimuli. There was a moderate, positive correlation between the judgment of sadness and guilt stimuli which was statistically significant, \( r(91) = .946, p < .001 \). A Pearson’s correlation was run to determine the relationship between sadness stimuli and shame stimuli. There was a strong, positive correlation between the judgment of sadness and shame stimuli which was statistically significant, \( r(91) = .476, p < .001 \). The primary emotion of fear was perceived, in participants’ comments, as how they felt when looking at some images that portrayed anger. A Pearson’s correlation was run to determine the relationship between anger stimuli and fear stimuli. There was a strong, positive correlation between the judgment of anger and fear stimuli which was statistically significant \( r(91) = .699, p < .001 \). No other correlations between emotion categories were significant. No differences between image types (human or artificial entity) were found. In order for stimuli to be identified with emotional purity, stimuli depicting the primary emotion fear and secondary emotions guilt and shame were removed from the analyses completely. Anger and sadness stimuli were kept. The final image stimuli depicted the primary emotions of anger, sadness, happiness, and the secondary emotion, pride.

Following the above analyses, the goal of this first pretest was to create a subset of stimuli, images of humans and artificial entities that were perceived to express a similar degree of emotion. Six images per emotion category (three humans and three artificial entities) were selected based on the highest Mean emotion ratings (see Table A1.1). Statistical analyses were performed using IBM SPSS for Windows (Release 21.0; 2012; SPSS Inc. IBM, Chicago). Based on the selection of the six images per emotion category, a paired samples t-test was used to compare results of human stimuli and artificial entity
stimuli on the perceived intensity for the primary emotions, *anger, sadness, happiness*, and the secondary emotion *pride*. *Anger*: a paired samples *t* test established no statistically reliable difference between the mean rating of *anger* between human stimuli (*M* = 5.2, *SD* = 1.03) and artificial entity stimuli (*M* = 4.87, *SD* = 1.30) in a set of the six selected images, *t*(92) = 1.693, *p* = .097. *Sadness*: a paired samples *t* test established no statistically reliable difference between the mean ratings of *sadness* for human stimuli (*M* = 5.34, *SD* = 0.90) and artificial entity stimuli (*M* = 5.07, *SD* = 1.53) in a set of six selected images, *t*(92) = 1.031, *p* = .308. *Happiness*: a paired samples *t* test established no statistically reliable difference between the mean rating of *happiness* in human stimuli (*M* = 5.47, *SD* = 1.00) and artificial entity stimuli (*M* = 5.13, *SD* = 1.46) in a set of six selected images, *t*(92) = 1.386, *p* = .173. *Pride*: a paired samples *t* test established no statistically reliable difference between the mean rating of *pride* in human stimuli (*M* = 3.3, *SD* = 1.18) and artificial entity stimuli (*M* = 3.4, *SD* = 1.73) in a set of six selected images, *t*(92) = -.410, *p* = .684. In summary, there were no significant differences between the emotions attributed to humans and artificial entities – even if the intensity might not have been similar across all emotions (as seen in Table A1.1). However, this was not tested for.

The preliminary stage of analysis was to obtain ratings for every image and then, through statistical analysis, create a set of stimuli that had reliable and comparable ratings in both conditions. From the analysis above there six stimuli per emotion category; three human images and three artificial entity images for the primary emotions of *anger, sadness, happiness*, and the secondary emotion of *pride*. This generates a set of twenty four images that will be used as stimuli in some of the following pretests and future experiments. The selected images, with their respective ratings are provided below in Table A1.1.
### Table A1.1

**Stimuli Selection for Human and Artificial Entity Categories Based on the Initial Selection of Emotion in Images Experiment**

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<td>G = Guilt</td>
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<td>P = Pride</td>
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### Happiness Emotion Ratings

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### Pride Emotion Ratings

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**Note.** Fear, Shame and Guilt ratings will not be used in the experiment. See A1.4 Results section.
A1.5 Discussion

There were many challenges in selecting the stimuli from this initial pretest. A large amount of stimuli, \(N=190\) images, 87 human images and 103 artificial entity images, depicting the primary emotions of anger, sadness, fear, and happiness, and the secondary emotions shame, guilt and pride were presented to participants. Participants then rated to which extent these images portrayed these emotions. The initial analyses, as described in the Results Section A1.4, indicated that the secondary emotions of shame and guilt were confused with sadness, and that the primary emotion of fear was confused with anger. Results showed high correlations between these emotion categories (in image ratings) and resulted in discarding the images depicting the emotions of fear, shame, and guilt from the stimuli set. It was not anticipated that emotion categories would have to be eliminated entirely. It was also clear the emotions were not ever truly pure, and the intensity differed between them (see Table A1.1). To combat this, six images per emotion category, with the highest single emotion ratings for anger, sadness, happiness, and pride were selected (see Table A1.1). These six images depicted three humans and three artificial entities per emotion category. These six selected images showed no differences in significance based on human or artificial entity category and were therefore chosen as the final image stimuli to be used in experiment 1. Although two secondary emotions (shame, guilt) and one primary emotion (fear) categories have been removed from the first set of experiments, this will not reduce the relevance conducting them. The goal of experiment 1 will be to determine the similarities and differences in how humans respond to affective images of humans and artificial entities; the presence of primary and secondary emotion categories are still part of the final twenty-four images that have been selected. Pretest 1 fulfilled the initial objective to attain images of humans and artificial entities that are perceived to express equivalent primary (anger, sadness, happiness) and secondary (pride) emotions to be used in the first experiment.
A2. Pretest 2: Initial Selection of Vignette Stimuli

A2.1 Background to Vignette Stimuli

In addition to testing whether images of humans and artificial entities can elicit affective responses, experiments 1 and 2 also investigate whether emotional context in the form of written vignettes elicits affective responses when paired with artificial entity stimuli. Research indicates subjects show affective responses to situational contexts that describe emotional occurrences from a human context (Kemper, 1987; Lazarus, 1991) and it is of interest if subjects also would have emotional responses to text paired with an artificial entity. Pretest 2 tests the theoretical constructs of the Media Equation and Ethopoeia (see Chapter 3, Article 2). While there are various studies that use vignettes describing emotional experiences (e.g., Lazarus, 1991), a database of pretested vignettes with specific emotion words and no gender cues has not yet been developed. Therefore fifty-two vignettes were created by the author, describing the primary emotions of anger, sadness, happiness and the secondary emotion pride, to be paired with the images from the first pretest.

A2.2 Purpose

Initial selection of vignettes to be paired with images from pretest 1, from a set of stimuli perceived to express the primary emotions of anger, sadness and happiness and the secondary emotion pride. This pretest was not part of the initial proposal. This pretest was added to ensure the author-created stimuli reliably elicited the above emotions, which were determined in pretest 1.
A2.3 Method

A2.3.1 Participants

The initial vignette selection, was designed as one survey with a manageable amount of stimuli, $N=52$. Fifty-seven (35 female) adult participants, age range 21-76 ($M = 37.23, SD = 11.19$), took part in the experimental pretest, to select vignettes that would fit with images from pretest 1. Participants received a payment of $2 USD for completion. Participants were recruited through Amazon Mechanical Turk (www.MTurk.com). All participants gave informed consent prior to beginning the experiment. Prior to starting the experiment, all participants were presented with informed consent. Choosing to proceed to the experiment meant they gave their consent. They were informed they could stop their involvement at any time with no risks.

A2.3.2 Stimuli

The complete set of stimuli includes 52 vignettes, all written by the author. The vignettes were formatted based on the research of Lazarus and Smith (1988). This large set of vignettes allowed for the selection of the stimuli eliciting the strongest emotion ratings for anger, sadness, happiness and pride. The selection of these emotions was informed by pretest 1, in which images with the perceived emotions of anger, sadness, happiness and pride, for humans and artificial entities were selected. For experiment 1, 24 vignettes were required; in order to have enough material for the pretest 52 vignettes were created and 13 vignettes were assigned to each of the four emotions chosen in pretest 1, describing situations of anger, sadness, happiness and pride. To avoid ambiguity, each vignette was written to be between three to five sentences long, and clearly stated one of the four emotions listed above (e.g., see Figure A2.1). The 52 vignettes were heterogeneously written; varying the age and gender of the character described. The vignettes were homogenous in structure and length, and were not categorized using terms such as ‘human’ or ‘artificial entity’. Not describing either a ‘human’
or ‘artificial entity’ allowed for neutrality in pretest 3; thus any of the created vignettes could be randomly assigned to the images. The 52 vignettes were randomized for presentation. All vignettes were presented to participants on the left side of the survey screen, with the rating scale presented on the right side. Since participants were using their personal computers to complete the pretest, the author was unable to control for monitor size, screen resolution and/or viewing distance.

### Emotion in Written Text

I remember someone told me how it would feel to lose my mom. That I would feel like a big part of myself had gotten lost. That a hole would appear inside my body and I wouldn’t be able to feel it. I have never felt sadness like this. I just cry all the time and don’t know how to make it stop.

*Figure A2.1.* An example of a vignette (target emotion *sadness*) as it was presented to participants during the pretest.

#### A2.3.3 Procedure

Data collection was done using individual, online-survey sessions. Participants were recruited using Amazon’s Mechanical Turk (www.MTurk.com). They were presented with an advertisement to participate in the pretest. The advertisement contained the title of the pretest *Emotion in Written Text* and a brief description, including approximate length (forty-five minutes) and compensation given for completion ($2 USD). Subjects were then presented with a link to an online survey, with instructions to “click to proceed”; the survey was prepared using Survey Monkey Software (www.surveymonkey.com). The pretest experiment template (survey format) was again adapted from Michaud (1995) and similar to the previous pretest. Participants were first introduced to the purpose of the pretest, *to identify*
what emotion(s) you perceive in the vignette (written text) examples that you will read. They were then asked to give informed consent by clicking next on the consent slide. Subjects were informed that they could leave the experiment at any time without consequences. Further task instructions, including a practice slide in the beginning, were presented onscreen to participants during the experiment.

Vignettes and questions (rating scales) were presented on the screen one at a time. The vignettes were controlled for height and width and were presented on the left-hand side to middle of the computer screen. The questions/rating scales were presented on the right side of the screen, next to the images. The sequence of the presentation of the vignettes was randomized. For all vignettes, participants were asked to rate the perceived presence of primary emotion(s) anger, sadness, fear, and happiness (Ekman & Friesen, 1978), and the presence of the secondary emotions shame, guilt and pride (Lazarus, 1991), see Figure A2.2. Although the vignette stimuli only described anger, sadness, happiness, and pride, the same rating scale was used, as with the previous image stimuli. This was done to ensure there was no confusion in emotion categories for the vignettes and to avoid ambiguity; the emotions of fear, shame, and guilt were not described in the vignettes, but included in the rating scale as a control. Participant responses to all questions were given on a 7-point Likert scale ranging from not at all (+ relevant dimension) to very strongly (+ relevant dimension) analogous to the previous experiments. During the analysis, the emotions of fear, shame, and guilt were removed, as participants did not choose these emotions in the rating process, as they were not contained in the vignette stimuli. This was an anticipated result, as explained above.
At the end of the experiment (in the last slides of the survey) participant demographics were collected, including age, gender and nationality. The average duration of the experiment was 36.12 minutes. Participants were also given the option to write comments about their experience in completing the pretest. The last slide contained a completion code that participants would enter into Amazon Mechanical Turk to be compensated for experiment completion.

**A2.4 Results**

The goal of this second pretest was to create a set of vignettes that could be paired with images of humans and artificial agents that were identified as expressing *anger*, *sadness*, *happiness*, or *pride*. Twenty-four vignettes were needed, six fitting each of the emotion categories. Although the emotions of *fear*, *shame* and *guilt* were included as choices in the rating scale, participants did not select these emotions to describe any of the vignettes (as
expected). This result was anticipated as each vignette named the emotion word it was
describing: *anger, sadness, happiness,* or *pride.* Each vignette had a *mean score* (and *SD*) for
the presence of each of the emotion categories (see Table A2.1). For each emotion category
the vignettes were rank ordered based on *mean* values. The top six vignettes with the highest
score per emotion category were selected and are shown in Table A2.1. The intention was to
create six comparable vignette stimuli per *emotion,* which can be randomly assigned to either
the human or artificial entity images (from pretest 1). This generated a set of 24 vignette
stimuli that will be paired with the images from pretest 1 for presentation and analysis in
pretest 3 and used in future experiments (1 and 2). The selected vignettes along with their
respective ratings are provided in the Table A2.1 below.
Table A2.1

**Stimuli Selection for Vignettes, Emotion Categories, Based on the Initial Selection of Emotion in Text Experiment**

<table>
<thead>
<tr>
<th>Vignette</th>
<th>Category</th>
<th>Vignette ID</th>
<th>Emotion Rating</th>
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<tbody>
<tr>
<td>I cannot believe that he lied to me, lied to me about where he was going, who he was with and what he was doing. I just found the text message on his phone that explains where he really was yesterday night. I feel so angry, like I cannot pull myself together. I just broke all of his favorite beer mugs and arm now leaving the house.</td>
<td>Anger</td>
<td>AN2</td>
<td>M = 6.74, SD = 0.61</td>
</tr>
<tr>
<td>I am so angry. I cannot believe someone would treat me like that. He broke my favorite doll, threw it down the stairs and just laughed when her head popped off. I feel so upset. I am going straight to mom to tell on him, he can't just do that to me and my favorite toy.</td>
<td>Anger</td>
<td>AN1</td>
<td>M = 6.40, SD = 1.06</td>
</tr>
<tr>
<td>That son of a bitch stole my parking space. I’m sitting there, indicating, the whole family is in the car when this little sports car pulls into my space. MY SPACE! We hardly ever go out as a family; do you know how hard it is to find a parking space for van. I am so angry.</td>
<td>Anger</td>
<td>AN6</td>
<td>M = 6.70, SD = 0.66</td>
</tr>
<tr>
<td>I didn’t mean to hit that hard; they just kept pushing and pushing until I couldn’t take it anymore! I have feelings too! Insults hurt and it went too far. The insults were also against the people I love, I was just so angry.</td>
<td>Anger</td>
<td>AN12</td>
<td>M = 6.10, SD = 1.21</td>
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<tr>
<td>I was told that I was useless, worthless, and no good. I was just trying to do my job and one little mistake led to my ‘boss’ firing me. I have been let go from my job with no cause, no explanation, nothing! I will find a way to show my boss how this feels! I cannot believe how angry this has made me.</td>
<td>Anger</td>
<td>AN9</td>
<td>M = 6.65, SD = 0.90</td>
</tr>
<tr>
<td>I was taking the dog Max for a walk when this kid came over and started pushing me around. He tried to knock me over and scared Max. He kept shouting “You have no friends, no one likes you”. He then kicked Max too. I started to get really hot and I realized how angry I was. He saw me reacting and he ran.</td>
<td>Anger</td>
<td>AN11</td>
<td>M = 6.53, SD = 0.76</td>
</tr>
<tr>
<td>He kept drinking, even though they told him that it was killing him. I told him that I couldn’t do it anymore, that I wanted to love him and be with him but all the drinking, fighting and sickness was too hard. I feel so sad, I didn’t want to leave, I didn’t want to lose him but I don’t know what my other choice was.</td>
<td>Sadness</td>
<td>SD9</td>
<td>M = 3.00, SD = 2.04</td>
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</table>
My dog Rover was the greatest companion. We played, cuddled, and spent time walking and exploring together. I could tell him all my secrets and he was always my companion. He is really sick; Mom just came back from the vet. They told her that she will have to 'put him down'. I haven’t felt this sad in a long time; I don’t want to lose Rover.

They are no longer willing to extend my work VISA so I can stay with my host family. I have been taking care of their children for the past 7 years and they feel like my own children, like my own family. I can’t lose them. I cannot pick myself up off my floor. I just cry, I’m so sad.

She left me. I thought we were going to get married, start a family, travel to Paris and just be together. She told me she had found herself happier with someone else. I’m alone now, she’s gone. I don’t know what I’m supposed to do. I feel sad all the time.

I remember someone told me how it would feel to lose my mom. That I would feel like a big part of myself had gotten lost. That a hole would appear inside my body and I wouldn’t be able to feel it. I have never felt sadness like this. I just cry all the time and don’t know how to make it stop.

I don’t want to fight anymore. She keeps blaming me for everything. This isn’t the life she wants, I’m not good enough, I don’t do enough for her. It just keeps going on and on. I have not felt this sad in a long time; I’m losing the relationship I thought I would be in forever.

I get to go to school! I get my own books, supplies and friends! I cannot wait. I have wanted to learn how to read for a long time. Finally, I’m just so happy! We were waiting for the acceptance letter for what seemed like forever.

I watched my dogs running around on the grass, jumping, barking and wrestling. It was so wonderful to feel relaxed and I realized I was laughing and grinning from ear to ear. My pets make me so happy.

My husband surprised me with the most beautiful weekend hiking trip. I have never been able to explore this beautiful forest before. I feel so unbelievably happy. It is the perfect weekend of hiking and spending time with a great person.
Today I went on my first hot-air-balloon ride. It was the most amazing thing I have ever done. Seeing the world and being in such a peaceful setting was wonderful. I have never felt happier. I will not forget this day.

I play dolls with my Mom. We always get to play after we finish with chores. I am getting better and better at helping my Mom. I feel really happy when we spend time together and even happier when we get to play.

Wow! I cannot believe they finally let me take my own road trip with my friends! I am having so much fun! I have been waiting on this day forever. I get to explore, drive the car by myself and enjoy my wonderful friends. I cannot believe how happy I am.

I never thought I would be published. I never knew that someone would take my work seriously until now. I never knew the feelings would be so intense. I am so proud of myself and what I have accomplished.

After three years of hard work my PhD was approved and accepted. I am so proud of myself. Three years of limited sleep, dedication, studying and committing. I finally did it. I accomplished one of my biggest goals!

I finally have paid off all my debt today. I was weighed down by so many student loans after graduation and have had a horrible time paying them off. When I finally made my last payment today I was so proud. My financial planning really paid off.

Today I finally fit into my size 6 pants. I have been working so hard, eating properly, going to the gym, really taking care of myself and focusing on my happiness. I have never felt more proud of myself as when I pulled on those pants.

Our team won! We have been practicing non-stop for the past four months. Training to make sure we were fit enough, fast enough, and good enough. Today when we scored our winning goal I could not have felt more proud.

We finally solved this equation! For the past three months we have been working on one mathematical problem. Every day, trying to figure out what we are working with and it has been very intense. Today I am so proud, my work finally paid off!
A2.5 Discussion

Pretest 2 resulted in the successful development and selection of vignettes depicting the primary emotions *anger, sadness, happiness*, and the secondary emotion *pride*. Of the fifty-two vignettes created, the strongest twenty-four stimuli were selected based on rank order values (see Table A2.1). Six vignettes for each of the four emotion categories have been selected to be used in pretest 3. The vignettes selected had clean emotion ratings and also were not confused with other emotions (*fear, shame, and guilt*) as seen in pretest 1. These vignettes can be randomly assigned to either human or artificial entity images from pretest 1. This pretest fulfilled the objective to attain vignettes that can be paired with the images from pretest 1 of humans and artificial agents that are perceived to express *anger, sadness, happiness* and *pride*. 
A3. Pretest 3: Pairing of Image and Vignette Stimuli

A3.1 Purpose

This pretest paired the vignettes from pretest 2 with the images from pretest 1. The paired set of stimuli perceived to express the primary emotions of anger, sadness and happiness and the secondary emotion pride will be used as the final stimuli for experiment 1. This pretest is to ensure that the final paired stimuli selected elicit the greatest emotional responses, and that participants perceive a good fit between image and vignette, for both human and artificial agent stimuli.

A3.2 Method

A3.2.1 Participants

The pairing of images and vignettes, pretest 3, was designed as one survey with a manageable amount of stimuli, $N=48$. Fifty-six (30 female) adult participants, age range 19-76 ($M = 34.73$, $SD = 11.10$), took part in the experiment, pretest 3, receiving a payment of $2 USD for completion. Participants were recruited through Amazon Mechanical Turk (www.MTurk.com). All participants gave informed consent prior to beginning the experiment. Prior to starting the experiment, all participants were presented with informed consent. Choosing to proceed to the experiment meant they gave their consent. They were informed they could stop their involvement at any time with no risks.

A3.2.2 Stimuli

Pretest 3 included the stimuli selected in pretest 1 ($N=24$ images) and pretest 2 ($N=24$ vignettes). Pretest 3 aimed to select the paired stimuli eliciting the strongest emotion ratings for anger, sadness, happiness and pride. This was intended to ensure the best selection of 24 pairs of stimuli for experiment 1. The vignettes ($N=24$) were randomly paired with the images. Two vignettes were assigned to each image, therefore each vignette
appeared twice, alongside two different images. This was intended to find the best fit and most reliable image and vignette pairing. All images were presented to participants on the left side of the survey screen, with the vignettes and associated ‘best fit’ question presented on the right side of the screen. All images were in a frontal view and with a straight ahead gaze direction for the participant. All images were resized and pasted on white backgrounds creating a size of 710 x 860 pixels (selected images from pretest 1). By creating a standard white backdrop the images were kept proportional to their original version and were not distorted. Since participants were using their personal computers to complete the pretest, the author was unable to control for monitor size, screen resolution and/or viewing distance.

A3.2.3 Procedure

Data collection was done using individual, online-survey sessions. Participants were recruited using Amazon’s Mechanical Turk (www.MTurk.com). They were presented with an advertisement to participate in the pretest. The advertisement contained the title of the pretest Pairing Images and Emotional Stories and a brief description, including approximate duration, based on informal pretests, (forty minutes) and compensation given for completion ($2 USD). Subjects were then presented with a link to an online survey, with instructions to “click to proceed”; the survey was prepared using Survey Monkey Software (www.surveymonkey.com). The pretest experiment template (survey format) was adapted from Michaud (1995). Participants were first introduced to the purpose of the pretest, to create ‘best fits’ between emotional stories (vignettes) and presented images. They were then asked to give informed consent by clicking next on the consent slide. Subjects were informed that they could terminate their participation in the experiment at any time without consequences for their remuneration. Further task instructions, including a practice slide in the beginning, were presented onscreen to participants during the experiment.
Images, vignettes and the *best fit* question were presented on the screen one at a time (see Figure A3.1). The images and vignettes were controlled for height and width. The images were presented on the left-hand side to middle of the computer screen. The questions were presented with the vignette on the right side of the screen, next to the images. The presentation of the images and vignettes were randomized. For all images, participants were asked to choose, between two vignettes, which vignette fit the presented image best. In addition they were asked to correctly identify the emotion that was being described in the vignette. Images with the perceived presence of primary emotion(s) *anger, sadness, happiness* (Ekman & Friesen, 1978), and the secondary emotion, *pride* (Lazarus, 1991), as identified in pretest 1 were randomly paired with vignettes with the same perceived presence of primary and secondary emotions from pretest 2. Participants’ responses to all questions were based on a selection between *(a)* or *(b)* for each image and vignette(s) pairing.
Figure A3.1. Screenshot of a Pretest 3, image, vignette and question page; subject view.


At the end of the experiment (in the last slides of survey) participant demographics were collected, including age, gender, and nationality. The duration of the experiment was collected via internet time stamps resulting in an average of 20.29 minutes. Participants were also given the option to write comments about their experience after completing the pretest. The last slide contained a completion code that participants would enter into Amazon Mechanical Turk to be compensated for experiment completion.

A3.3 Results

The goal of this third pretest was to create a final set of best fit stimuli, a collection of images paired with vignettes, perceived to express the emotions of anger, sadness, happiness or pride (images results from pretest 1 and vignette results from pretest 2) for presentation in
experiment 1. The goal was to obtain percentage certainty ratings for the pairing of vignette to associated image, which could be applied to both human and artificial agent stimuli. The participant simply had to choose between two vignettes (a or b) for each image. A cut-off criterion was used for stimuli selection. The strongest pairings (see Table 2.3) were selected and percentage certainty ratings (≥75%) determined the image and vignette paring for each of the primary emotions of anger, sadness, happiness, and the secondary emotion of pride. The vignettes and image pairings with the highest percentage certainty ratings (rank-ordered) were selected as final stimuli. This created six comparable image and vignette stimuli pairings per emotion category: 3 human and 3 artificial entity stimuli. This generated a set of 24 stimuli that will be presented in experiment 1. The paired images and vignettes, with their respective best fit ratings are provided in the Table A3.1 below.
Table A3.1

*Stimuli Selection for Image and Vignette Parings, based on Pretest 3: Pairing Emotional Stories with Image.*

<table>
<thead>
<tr>
<th>Image</th>
<th>Vignette</th>
<th>Percentage Certainty for Pairing (≥75%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN64</td>
<td>AN2</td>
<td>I cannot believe that he lied to me, lied to me about where he was going, who he was with and what he was doing. I just found the text message on his phone that explains where he really was yesterday night. I feel so angry, like I cannot pull myself together. I just broke all of his favorite beer mugs and am now leaving the house. 79.64%</td>
</tr>
<tr>
<td>AN104</td>
<td>AN1</td>
<td>I am so angry. I cannot believe someone would treat me like that. He broke my favorite doll, threw it down the stairs and just laughed when her head popped off. I feel so upset. I am going straight to mom to tell on him, he can’t just do that to me and my favorite toy. 94.64%</td>
</tr>
<tr>
<td>AN20</td>
<td>AN6</td>
<td>That son of a bitch stole my parking space. I’m sitting there, indicating, the whole family is in the car when this little sports car pulls into my space. MY SPACE! We hardly ever go out as a family; do you know how hard it is to find a parking space for van. I am so angry. 82.29%</td>
</tr>
<tr>
<td>AN171</td>
<td>AN12</td>
<td>I didn’t mean to hit that hard; they just kept pushing and pushing until I couldn’t take it anymore! I have feelings too! Insults hurt and it went too far. The insults were also against the people I love, I was just so angry. 75.21%</td>
</tr>
</tbody>
</table>


Image retrieved from http://www.flickr.com/photos/cjw333/6262014073/
I was told that I was useless, worthless, and no good. I was just trying to do my job and one little mistake led to my ‘boss’ firing me. I have been let go from my job with no cause, no explanation, nothing! I will find a way to show my boss how this feels! I cannot believe how angry this has made me.

I was taking the dog Max for a walk when this kid came over and started pushing me around. He tried to knock me over and scared Max. He kept shouting “You have no friends, no one likes you”. He then kicked Max too. I started to get really hot and I realized how angry I was. He saw me reacting and he ran.

He kept drinking, even though they told him that it was killing him. I told him that I couldn’t do it anymore, that I wanted to love him and be with him but all the drinking, fighting and sickness was too hard. I feel so sad, I didn’t want to leave, I didn’t want to lose him but I don’t know what my other choice was.

My dog Rover was the greatest companion. We played, cuddled, and spent time walking and exploring together. I could tell him all my secrets and he was always my companion. He is really sick; Mom just came back from the vet. They told her that she will have to ‘put him down’. I haven’t felt this sad in a long time; I don’t want to lose Rover.

They are no longer willing to extend my work VISA so I can stay with my host family. I have been taking care of their children for the past 7 years and they feel like my own children, like my own family. I can’t lose them. I cannot pick myself up off my floor, I just cry, I’m so sad.
SD174

She left me. I thought we were going to get married, start a family, travel to Paris and just be together. She told me she had found herself happier with someone else. I’m alone now, she’s gone; I don’t know what I’m supposed to do. I feel sad all the time.

SD177

I remember someone told me how it would feel to lose my mom. That I would feel like a big part of myself had gotten loss. That a hole would appear inside my body and I wouldn’t be able to feel it. I have never felt sadness like this. I just cry all the time and don’t know how to make it stop.

SD163

I don’t want to fight anymore. She keeps blaming me for everything. This isn’t the life she wants, I’m not good enough, I don’t do enough for her. It just keeps going on and on. I have not felt this sad in a long time; I’m losing the relationship I thought I would be in forever.

HP135

I get to go to school! I get my own books, supplies and friends! I cannot wait. I have wanted to learn how to read for a long time. Finally, I’m just so happy! We were waiting for the acceptance letter for what seemed like forever.

HP99

I watched my dogs running around on the grass, jumping, barking and wrestling. It was so wonderful to feel relaxed and I realized I was laughing and grinning from ear to ear. My pets make me so happy.
My husband surprised me with the most beautiful weekend hiking trip. I have never been able to explore this beautiful forest before. I feel so unbelievably happy. It is the perfect weekend of hiking and spending time with a great person.


Today I went on my first hot-air-balloon ride. It was the most amazing thing I have ever done. Seeing the world and being in such a peaceful setting was wonderful. I have never felt happier. I will not forget this day.

Image retrieved from http://www.brothers-brick.com/2008/05/29/happy-robo/

I play dolls with my Mom. We always get to play after we finish with chores. I am getting better and better at helping my Mom. I feel really happy when we spend time together and even happier when we get to play.


Wow! I cannot believe they finally let me take my own road trip with my friends! I am having so much fun! I have been waiting on this day forever. I get to explore, drive the car by myself and enjoy my wonderful friends. I cannot believe how happy I am.


I never thought I would be published. I never knew that someone would take my work seriously until now. I never knew the feelings would be so intense. I am so proud of myself and what I have accomplished.

After three years of hard work my PhD was approved and accepted. I am so proud of myself. Three years of limited sleep, dedication, studying and committing, I finally did it. I accomplished one of my biggest goals!


I finally have paid off all my debt today. I was weighed down by so many student loans after graduation and have had a horrible time paying them off. When I finally made my last payment today I was so proud. My financial planning really paid off.

Image retrieved from http://cdn.lightgalleries.net/4bd5ec0255078/images/011-1.jpg

Today I finally fit into my size 6 pants. I have been working so hard, eating properly, going to the gym, really taking care of myself and focusing on my happiness. I have never felt more proud of myself as when I pulled on those pants.


Our team won! We have been practicing non-stop for the past four months. Training to make sure we were fit enough, fast enough, and good enough. Today when we scored our winning goal I could not have felt more proud.


We finally solved this equation! For the past three months we have been working on one mathematical problem. Every day, trying to figure out what we are working with and it has been very intense. Today I am so proud, my work finally paid off!

Image retrieved from http://media-cache-ec0.pinimg.com/originals/3f/af/3c/3faf3cd8b37d1c06d3003048c11ea1a4.jpg

A3.4 Discussion

The purpose of pretest 3 was to pair the images from pretest 1 with the vignettes from pretest 2 to create the strongest stimuli to be used in experiment 1. The twenty-four images
from pretest 1 were paired with the vignettes from pretest 2; each image would be shown with two vignettes and participants were asked to select with vignette fit the image best. Following data collection, percentage certainty ratings based on the best fit question for the image and vignette pairings, per emotion category were rank ordered. This resulted in the selection of the strongest pairings of image and vignette, depicting the primary emotions anger, sadness, happiness, and the secondary emotion pride. This resulted in twenty-four paired stimuli to be used as the final stimuli in experiment 1. Six image and vignette pairs, three for each human and artificial entity category were created (see Table A3.1). This pretest fulfilled the objective to pair images from pretest 1, with vignettes from pretest 2, to be used as the final stimuli set in experiment 1.

A4.1 Purpose

This pretest was to develop the play and control condition to be used at the beginning of experiment 2 before participants were shown experimental stimuli. The play condition, and control condition were developed for the between-subjects design of experiment 2. This pretest was needed to ensure that the play and control conditions are engaging for participants and have an approximate duration of ten minutes each.

A4.2 Method

A4.2.1 Participants

The testing of the play and control condition, pretest 4 had nine (6 female) adult participants, age range 18-22 ($M = 19.66$, $SD = 1.50$), receiving a payment of €3 for completion. The experiment’s duration was approximately 30 minutes. Participants were recruited using an online undergraduate mailing system. Participants were randomly divided between the play condition and control condition. All participants provided informed consent prior to taking part in the experiment.

A4.2.2 Stimuli

Part of the design of pretest 4 was to create a play and control condition that would contain much of the same stimuli. The play and control condition materials would only differ with either the addition of Danbo figures\(^2\) (play condition, *Figure A4.1*) or the removal of these figures (control condition). All participants would be given access to a variety of Danbo figures\(^2\) The Danbo robot is a Japanese ‘cardboard’ robot that appears in comics and TV shows in Japan (Yotsuba & !). Now very popular, the toy maker Kaiyodo began making plastic toy action figures of the Danbo to interact with.
random materials that would not have specific meaning to the activity or the experiment. These materials (props) consist of baskets, string, wooden blocks, felt cut-outs, wire spirals, vases, and much more (see Figure A4.2.). Participants in both the play and control groups were asked to engage with the stimuli and create scenes/images using the props left on the table in the experiment room. Participants were given a digital camera (Samsung ES65) and were asked to take photographs of the scenes they created. Since participants were left alone in the experimental room during the ten minute activity, the author was unable to control their focus on the task. The photos created during the pretest however, allowed for observation of participant engagement in the task.

Figure A4.1. Danbo, 13”. The Japanese toy maker Kaiyodo began producing plastic toy action figures of the Danbo to interact with following popularity of a television show featuring the character. This pretest and the subsequent experiment 2 had two Danbos measuring 13” and one Danbo measuring 9” for participants to interact with.
Figure A4.2. Set up of the play condition in Pretest 4. The participants in the play group had all of the props on the table and the three Danbo figures. The participants in the control group had only the props, no Danbo figures.

A4.2.3 Procedure

Participants arrived at the laboratory and were greeted by the experimenter. They were led into an interview room and were asked to read and sign a consent form prior to beginning the experiment. Subjects were then informed they could stop their involvement at any time with no consequences. In addition, participants completed a demographics form. Participants were then asked to fill in the Positive Affect Negative Affect Scale (PANAS) to measure changes in mood (Watson, Clark, & Tellegen, 1988) between the beginning and the end of the pretest. Participants were then taken to the experimental room that had been adjusted based on the random assignment to play or control group. Participants were shown the table with the props (and Danbos depending on condition). They were then given the digital camera and were told that the purpose of the experiment was to simply be creative and
take photos of different scenes you create, in addition that there is not right or wrong way to do this activity. Participants, once comfortable, were left alone for a duration of ten minutes. Once the ten minutes had passed the experimenter knocked on the door and the activity was stopped. Participants then completed a post-PANAS and a post-experiment questionnaire. The post-experiment questionnaire asked participants whether they: enjoyed the activity, found it difficult, would do it again, and what their general impressions were about the study. Participants were debriefed if they had questions. Then participants were given compensation and thanked for their participation.

A4.3 Results

The goal of this fourth pretest was to create a play and control condition as the first activity for experiment 2. This play/control condition would allow for the between-subjects design of experiment 2. All nine participants, based on the results of the post-experiment questionnaire, enjoyed the activity and wanted to repeat the activity again. Four participants identified that coming up with creative ways to start the activity was initially challenging, but this challenge then dissipated; the other five reported no difficulty. Finally, none of the participants were able to guess the hypothesis or the function of the experiment in this context. Results for participants in the play group indicated pre positive-mood scores of $M = 35.2$, $SD = 5.54$, and post positive mood scores $M = 38.6$, $SD = 8.26$. Participants in the control group indicated pre positive-mood scores of $M = 30.25$, $SD = 6.8$, and post positive mood scores $M = 34.25$, $SD = 10.24$. Results of the PANAS for participants’ pre and post activity for negative mood indicated that regardless of the activity, negative mood decreased. Participants in the play group indicated pre negative-mood scores of $M = 11.6$, $SD = 1.52$, and post negative-mood scores of $M = 10.8$, $SD = 1.30$. Participants in the control group indicated pre negative-mood scores of $M = 14.25$, $SD = 3.20$, and post negative-mood scores of $M = 11.5$, $SD = 1.73$. These results indicate that both the play and control group do not differ in
length or impact on mood or interest. Both conditions are to be used in the between-subjects design of experiment 2 meet the same objective.

A4.4 Discussion

Pretest 4 was developed to design the pre-experimental condition for experiment 2. Experiment 2 seeks to identify if previous interaction with an artificial entity (in this case a robotic toy figure, the Danbo) impacts responses to artificial entity stimuli, post interaction. For the between-subjects design of experiment 2, it was imperative to create a pre-condition for the control group (no Danbo interaction) and the experimental group (Danbo interaction). The activity was designed to be creative and interactive with a collection of shared materials between the control and experimental group. The activity encouraged participants to play and be creative, and to take photographs of their creations, using a collection of random items (props) with, or without the Danbo’s (depending on condition) through a digital camera. This pretest would ensure that the pre-experimental activity would take approximately ten minutes, would be seen as entertaining, would not show significant differences in enjoyment and duration between the control and experimental groups, and would have no identifiable hypothesis. Although there were only 9 participants in this pretest, results of the pre-post PANAS mood scale indicate that there are no significant differences between the control and the experimental group activities; both activities increase positive mood and reduce negative mood, but do not differ from each other. This pretest fulfilled the objective to develop a pre-experimental condition for experiment 2, that did not differ between experimental and control group enjoyment.
A5. Pretest 5: Judgment and Effect of Video Stimuli

A5.1 Background to Video Stimuli

Experiment 3 required the creation of video material that shows the destruction of humans and various objects with a baseball bat. The objects destroyed ranged in their level of meaning. Thirty videos in total were created in a controlled laboratory setting. All items were hit with a bat and were acquired by the experimenter, ranging from common household goods to technological equipment, to toys, robots and also people. A complete list of items is provided in the stimuli section. Copies of all the videos are available for viewing at: https://www.youtube.com/playlist?list=PL4Z71wczV5E0N-UM2GrSaRwnFgpjhcNf.

A database of videos showing objects being destroyed or harmed has not yet been developed. Therefore, these videos were created for experimental purposes. Experiment 3 is an adaptation and large extension of related research seen in studies on emotional responses on harm towards robots and humans (Rosenthal-von der Pütten, Krämer, Hoffmann, Sobieraj, & Eimler, 2013; Rosenthal-von der Pütten, Schulte, Eimler, Sobieraj, Hoffmann, & Maderwald, 2014). The videos were controlled for length (8-12 seconds). The sequence was the same in all videos and can be divided into three phases: Phase 1: zoom in ≈ two to three seconds, Phase 2: hitting object ≈ four to seven seconds, and Phase 3: zoom out ≈ two to three seconds), see Figure A5.2. In addition, they were controlled for intensity of swinging the bat towards the object, and number of hits on the object (five swings). The experimenters who were hitting the objects wore all black and could not be identified as male or female (Figure A5.1). For the videos of the humans being hit by a bat, both the male and female victim wore the same clothing.
Figure A5.1. Individual frames showing experimenter in all black (clothes, boots, ski mask, gloves, protective eyewear; restricted appearance, hiding personal features and gender for each video clip.)

Figure A5.2. Individual frames of a video from Pretest 5 and Experiment 3 showing the destruction of Robot 1; second by second breakdown.
This pretest was necessary to objectively analyze which videos showed the greatest effects, and thereby could be selected for use in experiment 3. It was of interest to select videos for the experiment based on levels of pleasantness, realism, shock, and level of comfort in participants. We anticipated the videos with objects of higher meaning to elicit stronger responses as depicted in Figure A5.3 below. This hypothesis is based on research of cherished possessions, transitional objects, consumer behavior and attachment to objects (see: Bruner & Postman, 1948; Wallendorf & Arnould, 1988; Lehman, Arnold, & Reeves, 1995; Triebenbacher, 1997; Price, Arnould, & Curasi, 2000; Steier & Lehman, 2000; Whitmore, 2001, Park, Macinnis, & Priester, 2006; Barrett & Bar, 2009; Grisham, Frost, Steketee, Kim, Tarkoff, & Hood, 2008).

Figure A5.3. Hypothesized levels/categories of meaning for a variety of items and objects, used to develop hypotheses for experiment 3 and develop videos in this pretest.
A5.2 Purpose

The videos developed for experiment 3 needed to be pretested for their perceived pleasantness, realism, shock value and the level of discomfort they elicit. The videos selected will be used as the final stimuli for experiment 3. This pretest is to ensure that the final selected stimuli elicit the greatest emotional responses in participants and destroyed objects can be divided into different categories based on how meaningful they are perceived to be. This will result in a collection of video clips that will be shown to participants in experiment 3.

A5.3 Method

A5.3.1 Participants

The judgment and effect of videos, Pretest 6, was designed as one survey with various video stimuli, $N=31$. Fifty-two (23 female) adult participants, age range 22-60 ($M = 34.73$, $SD = 11.10$), took part in the experiment, Pretest 6, receiving a payment of $2.50 USD for completion. Participants were recruited through Amazon Mechanical Turk (www.MTurk.com). All participants gave informed consent prior to beginning the experiment. Prior to starting the experiment, all participants were presented with informed consent. Choosing to proceed to the experiment meant they gave their consent. They were informed they could stop their involvement at any time with no risks.

A5.3.2 Stimuli

Pretest 5 contained video stimuli developed in the laboratory at Jacobs University Bremen by the experimenter ($N=31$ videos). The videos were filmed in a small white room, which allowed the researcher to control for light, sound, and object placement. The videos were filmed using the video function of a Canon PowerShot SX510 HS. The videos ranged in duration between 8-12 seconds. The videos showed the destruction of objects with a baseball
bat (as explained in Section A5.1). The items that were destroyed exhibit a careful selection of assorted stimuli anticipated to evoke varied intensity in emotional responses. The objects (31) that were hit with the baseball bat included the following (full videos here: https://www.youtube.com/playlist?list=PL4Z71wczV5E0N-UM2GrSaRWnfLgpjhcNf):

- Carpeted floor
- Two toy robots
- Cardboard box
- Baby doll
- Espresso Machine and Coffee maker
- Male subject (frontal view and rear view, with sound and without sound)
- Female subject (frontal view and rear view, with sound and without sound)
- Cellular flip phone
- Two computer printers
- Fan
- CD player
- Boom box
- Acoustic guitar
- Teddy Bear
- VHS player
- Hairdryer
- Orange water kettle and White water kettle
- Nintendo game console
- Wall mounted clock
- Desk telephone
- Stuffed animal Loch Ness “Nessie”

Choosing and filming multiple objects being destroyed allowed for the development of many videos and the ability to test them for eliciting the strongest subjective responses from participants. Pretest 5 contained 31 videos in which the participants were asked to watch the videos, with sound, on their computer and answer questions on a Likert Scale of 1-7. The questions included: How unpleasant or pleasant did you find this video (1=unpleasant, 7=pleasant), How unrealistic or realistic did you find this video (1.unrealistic, 7=realistic), How not-shocking or shocking did you find this video (1=not shocking, 7=shocking), and Watching this video made me feel uncomfortable (1=not at all, 7=very), see Figure A5.4. The stimuli were randomized for presentation to participants. All videos were presented to participants on the left side of the survey screen, with the questions presented on the right side. All videos were frontal view and with a straight ahead gaze direction for the participant. All videos were resized to 710 x 860 pixels (same format as prior pretests). By creating a standard size, the videos were kept proportional to their original version and were not distorted. Since participants were using their personal computers to complete the pretest, the author was unable to control for monitor size, screen resolution, viewing distance and or volume/sound of presented videos.
A5.3.3 Procedure

Data collection was done using individual, online-survey sessions. Participants were recruited using Amazon’s Mechanical Turk (www.MTurk.com). They were presented with an advertisement to participate in the pretest. The advertisement contained the title of the pretest *The Effect of Videos* and a brief description, including approximate length (forty minutes) and compensation given for completion ($2.50 USD). Subjects were then presented with a link to an online survey, with instructions to “click to proceed”; the survey was prepared using Survey Monkey Software (www.surveymonkey.com). The pretest experiment template (survey format) was again adapted from Michaud (1995) and similar to previous pretests. Participants were first introduced to the purpose of the pretest, *to judge your responses to videos*. They were then asked to give informed consent by clicking *next* on the consent slide. Subjects were informed that they could leave the experiment at any time.

*Figure A5.4.* Screenshot of a Pretest 6 survey; video and questions; subject view.
without consequences. Further task instructions, including a practice slide in the beginning, were presented onscreen to participants during the experiment.

Videos and all related questions were presented on the screen at the same time, as seen in Figure A5.4. The sequence of the presentation of video clips was randomized. The video clips were controlled for height and width and were presented on the left-hand side to middle of the computer screen, respectively. The questions were presented below each video clip. For all videos, participants were asked to answer four questions about their perception of the video. The questions were designed to assess how participants personally perceived various aspects of the video. Participant responses to all questions were given on a 7-point Likert scale based on the two measures in each question. The questions included how unlikeable/likeable, unpleasant/pleasant, realistic/unrealistic, shocking/not shocking with Likert-scales between both extremes, (e.g., unpleasant (+ relevant dimension) to very pleasant (+ relevant dimension) analogous to the previous experiments. The final question asked subjects how uncomfortable they felt on a Likert-scale ranging from not at all (+ relevant dimension) to very uncomfortable (+ relevant dimension). Participant responses to all questions were based on viewing each video clip.

At the end of the experiment (in the last slides of survey) participant demographics were collected, including age, gender and nationality. The average duration of the experiment was 55.42 minutes. Participants were also given the option to write comments about their experience in completing the pretest. The last slide contained a completion code that participants would enter into Amazon Mechanical Turk to be compensated for experiment completion.
A5.4 Results

The goal of this fifth pretest was to create a final set of video clip stimuli that have strong effects for presentation in experiment 3. For each video, Likert scale responses for pleasantness, realism, shock, and discomfort were recorded. These mean scores (and SD) for how pleasantness, realism, shock, and discomfort are seen in Table A5.1. Each video, in addition to these ratings, was categorized based on levels of meaning (see Figure A5.3). Each video stimulus was rank ordered by mean values for the highest ratings of pleasantness, realism, shock, and discomfort, and then rank ordered per meaning category. The top two videos with the strongest ratings per meaning category (see Figure A5.3) were selected to be shown in experiment 3. The ten videos that elicited the greatest responses fitting into the perceived meaning categories were selected (depicted in Table A5.1, * indicates chosen video). A test video, with a very low rating was also selected to be shown to participants as an example stimulus prior to the start of experiment 3. The video clips, with their respective ratings are provided in the Table A5.1 below. The eleven selected videos are marked in bold.
Table A5.1

*Stimuli Selection for Experiment 3: The Effect of Videos*

<table>
<thead>
<tr>
<th>Video</th>
<th>Object</th>
<th>Video ID</th>
<th>M, SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female Front</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M 1.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SD 0.89</td>
</tr>
<tr>
<td>Female Front</td>
<td>Silent</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M 1.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SD 0.78</td>
</tr>
<tr>
<td><em>Female Back</em></td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M 1.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SD 0.54</td>
</tr>
<tr>
<td>Female Back</td>
<td>Silent</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M 1.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SD 0.78</td>
</tr>
<tr>
<td>Male Front</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M 1.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SD 0.69</td>
</tr>
<tr>
<td>Male Front Silent</td>
<td></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M 1.91</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SD 0.85</td>
</tr>
</tbody>
</table>

Pleasantness = How pleasant participants found the video  
Realism = How realistic participants found the video  
Shock = How shocking participants found the video  
Discomfort = How comfortable participants felt while watching the video
<table>
<thead>
<tr>
<th>Rating</th>
<th>Pleasantness</th>
<th>Realism</th>
<th>Shock</th>
<th>Discomfort</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Male Back</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1.57</td>
<td>4.57</td>
<td>5.41</td>
<td>5.44</td>
</tr>
<tr>
<td>SD</td>
<td>0.91</td>
<td>1.17</td>
<td>1.12</td>
<td>0.77</td>
</tr>
<tr>
<td>Male Back Silent</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1.81</td>
<td>4.27</td>
<td>5.13</td>
<td>5.23</td>
</tr>
<tr>
<td>SD</td>
<td>0.85</td>
<td>1.01</td>
<td>1.32</td>
<td>1.27</td>
</tr>
<tr>
<td>*Phone (Practice Video)</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>3.42</td>
<td>5.40</td>
<td>2.04</td>
<td>2.15</td>
</tr>
<tr>
<td>SD</td>
<td>1.01</td>
<td>0.99</td>
<td>0.89</td>
<td>1.10</td>
</tr>
<tr>
<td>*Nintendo</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>3.00</td>
<td>5.31</td>
<td>2.48</td>
<td>2.66</td>
</tr>
<tr>
<td>SD</td>
<td>1.04</td>
<td>1.15</td>
<td>0.76</td>
<td>0.88</td>
</tr>
<tr>
<td>*Teddy Bear</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>2.74</td>
<td>4.77</td>
<td>3.25</td>
<td>3.57</td>
</tr>
<tr>
<td>SD</td>
<td>1.13</td>
<td>0.96</td>
<td>1.39</td>
<td>1.21</td>
</tr>
<tr>
<td>Coffee Machine</td>
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<td></td>
<td></td>
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<td>M</td>
<td>3.37</td>
<td>5.38</td>
<td>2.38</td>
<td>2.50</td>
</tr>
<tr>
<td>SD</td>
<td>0.98</td>
<td>1.31</td>
<td>1.22</td>
<td>0.56</td>
</tr>
<tr>
<td>Electric Water Kettle</td>
<td>16</td>
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<td></td>
<td></td>
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<tr>
<td>M</td>
<td>3.40</td>
<td>5.35</td>
<td>2.29</td>
<td>2.40</td>
</tr>
<tr>
<td>SD</td>
<td>0.79</td>
<td>1.05</td>
<td>1.19</td>
<td>0.92</td>
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<tr>
<td>Boom Box</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>3.51</td>
<td>5.40</td>
<td>2.40</td>
<td>2.30</td>
</tr>
<tr>
<td>SD</td>
<td>1.24</td>
<td>1.36</td>
<td>0.98</td>
<td>0.77</td>
</tr>
<tr>
<td>*Robot 1</td>
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<td></td>
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<td>M</td>
<td>2.65</td>
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<td>3.78</td>
<td>3.57</td>
</tr>
<tr>
<td>SD</td>
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<td>0.98</td>
<td>1.11</td>
</tr>
<tr>
<td>Item</td>
<td>Rating</td>
<td>Pleasantness</td>
<td>Realism</td>
<td>Shock</td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>--------------</td>
<td>---------</td>
<td>--------</td>
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<td>Robot 2</td>
<td></td>
<td>2.65</td>
<td>5.76</td>
<td>3.78</td>
</tr>
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<td></td>
<td>0.86</td>
<td>1.24</td>
<td>1.39</td>
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<td>5.56</td>
<td>2.54</td>
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<tr>
<td></td>
<td></td>
<td>0.78</td>
<td>1.45</td>
<td>0.73</td>
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<td>5.00</td>
<td>2.15</td>
</tr>
<tr>
<td>Kettle</td>
<td></td>
<td>0.82</td>
<td>1.23</td>
<td>1.09</td>
</tr>
<tr>
<td>Box</td>
<td></td>
<td>3.39</td>
<td>5.09</td>
<td>2.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.88</td>
<td>1.16</td>
<td>1.05</td>
</tr>
<tr>
<td>VHS Player</td>
<td></td>
<td>3.49</td>
<td>5.38</td>
<td>2.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.82</td>
<td>1.22</td>
<td>1.33</td>
</tr>
<tr>
<td>Cellular</td>
<td></td>
<td>3.57</td>
<td>5.61</td>
<td>2.13</td>
</tr>
<tr>
<td>Phone</td>
<td></td>
<td>0.98</td>
<td>1.46</td>
<td>1.21</td>
</tr>
<tr>
<td>Stationary</td>
<td></td>
<td>3.43</td>
<td>5.19</td>
<td>2.13</td>
</tr>
<tr>
<td>Fan</td>
<td></td>
<td>0.79</td>
<td>1.41</td>
<td>0.89</td>
</tr>
<tr>
<td>Floor</td>
<td></td>
<td>2.58</td>
<td>5.40</td>
<td>3.09</td>
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<tr>
<td></td>
<td></td>
<td>0.77</td>
<td>1.05</td>
<td>1.13</td>
</tr>
<tr>
<td>Hairdryer</td>
<td></td>
<td>3.34</td>
<td>5.02</td>
<td>2.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.02</td>
<td>0.98</td>
<td>1.14</td>
</tr>
</tbody>
</table>
Note. The objects that are preceded by an asterisk (*) and bolded denote videos that were used in the experiment.
A5.5 Discussion

The purpose of pretest 5 was to create a selection of videos, categorized by levels of meaning, in which a selection of objects and humans were beaten with a baseball bat. A database of videos showing objects being destroyed or harmed has not yet been developed. Therefore, these videos were created for experimental purposes. Experiment 3 is an adaptation and large extension of related research seen in studies on emotional responses on harm towards robots and humans and videos that illustrate harm towards humans and objects of different meaning categories (see Figure A5.3) was necessary. Thirty-one videos were created and then pretested, asking participants to rate the videos along the dimensions of pleasantness, realism, shock, and discomfort. The items destroyed in the videos belonged to different meaning categories. The mean values of the videos were rank ordered based on highest ratings of pleasantness, realism, shock, and discomfort, and then rank ordered per meaning category. The two video clips with the highest rankings per category were then selected to be shown in experiment 3. Five categories resulted in the selection of ten video clips and the selection of a test clip that had a low rating as an introduction for participants (see Table A5.1). Pretest 5 fulfilled the objective of selecting ten video clips in the categories of human (female and male, from back), emotionally meaningful object (teddy bear, baby doll), robot (two toy robots; necessary for carry over linking this to experiment 1 and 2), meaningful object (acoustic guitar and Nintendo console) and non-meaningful object (stationary fan and cardboard box). In addition, one test video (open floor) was selected and was used as a participant warm-up example in experiment 3.
A6.1 References


B1. Follow-up Experiment: Neutral Image and Vignette Validation

B1.1 Purpose and Background

Based on the results of experiment 1, which differed significantly from expected results, experiment 2 was adapted. This lead to the development of one follow-up study supporting the adaptation. In experiment 1 no behavioral differences emerged between the human and artificial entity stimuli. The differences that did emerge were between the presentation of the images and the vignettes, which provided the basis for experiment 2. If the presentation of emotional artificial entity and human images and vignettes resulted in the same level of response, what would the effect of pairing neutral faces with affective vignettes be? Additionally, would context alone be enough to create a behavioral response? These questions have been addressed by the design of follow-up study 1 and the stimuli produced by it. As originally proposed, interaction with a toy robot (Danbo robot)\(^3\) prior to experiment 2 would be used to explore whether interaction with a robot-like figure would change behavioral responses to presented stimuli. This pre-condition will be tested in pretest 4, as originally proposed.

The emotional vignettes from experiment 1 will be paired in this study with neutral images of humans and artificial entities. The neutral images of humans are chosen from the Radbound Faces Database (Langner, et al., 2010), two female (F12, F26) and one male (M25), and the neutral artificial entity images are images of the NAO robot (Aldebaran Robotics), with three different angle and color combinations. These six images will replace the twenty-four affective images used in experiment 1. Each neutral image will be paired with vignettes depicting each of the four emotions anger, sadness, happiness and pride. The purpose of the study is to pair the neutral images with the emotional vignettes and to assess

\(^3\) The Danbo robot is a Japanese ‘cardboard’ robot that appears in comics and TV shows in Japan (Yotsuba &!). Now very popular, the toy maker Kaiyodo began making plastic toy action figures of the Danbo to interact with.
whether participants can identify the principal emotion in each vignette when paired with a neutral image. This study is to ensure that the affective content (vignette describing a specific emotion) is clearly identifiable, even when paired with a neutral image, so we can see if context is enough to elicit emotional responses in both human and artificial agent stimuli. Participants were also asked about the believability of the neutral image pairing with an affective vignette.

**B1.2 Method**

**B1.2.1 Participants**

The pairing of images and vignettes in follow-up study 1 was designed to be a survey with a manageable amount of stimuli, $N=50$. Fifty (26 female) adult participants, age range 23-62 ($M = 38.90, SD = 9.30$), took part in the experiment, receiving a payment of $2 USD for completion. Participants were recruited through Amazon Mechanical Turk (www.MTurk.com). All participants gave informed consent prior to beginning the experiment; i.e. prior to starting the experiment, all participants were presented with informed consent. Choosing to proceed to the experiment implied they gave their consent. They were also informed they could stop their involvement at any time without risks.

**B1.2.2 Stimuli**

Follow-up study 1 contained the vignette stimuli from experiment 1 ($N=24$, vignettes). It also included neutral images of humans and artificial entities ($N=6$; the same six images, 3 human and 3 artificial entity used for each of the four emotions). The pairing of neutral image with affected vignette was used to explore whether participants can identify the main emotions of *anger, sadness, happiness* or *pride* in the affective vignettes, despite the possible confusion when a neutral image is paired with an emotional vignette. This was intended to ensure the reliable selection of 24 pairs of stimuli for experiment 2. The complete
set of stimuli contained 6 images selected for this study and the 24 vignettes that were used in experiment 1. The images were randomly paired with the vignettes (each neutral image $N=6$, 3 human/3 artificial entity) used once for each of the emotions: anger, sadness, happiness, and pride. The stimuli were randomly presented to participants. All images and vignettes were shown to participants on the left side of the survey screen, and the emotion and believability questions were displayed on the right side (see Figure B1.1). All images were taken from a frontal view, with a straight-ahead gaze direction towards the participant. All images were resized and pasted on white backdrops creating a size of 710 x 860 pixels. By creating a standard white background, the images were kept proportional to their original version and were not distorted. Since participants were using their personal computers to complete the study, the author was unable to control for monitor size, screen resolution and/or viewing distance.
B1.2.3 Procedure

Data collection was done using individual, online-survey sessions. The survey was created using Survey Monkey Software (www.surveymonkey.com), where the experiment template (survey format) was again adapted from Michaud (1995) and similar to previous pretests presented. Participants were recruited using Amazon’s Mechanical Turk (www.MTurk.com). They were presented with an advertisement to participate in the study. The advertisement contained the title of the study Pairing Emotions: Images and Stories and a brief description, including approximate length (forty minutes) and compensation given for completion ($2 USD). Subjects were then presented with a link to the online survey, with instructions to “click to proceed”. Participants were first introduced to the purpose of the study, to identify what emotion(s) you perceive in the short story examples that you will read. They were then asked to give informed consent by clicking next on the consent slide. Subjects were informed that they could terminate their participation in the experiment at any
Images, vignettes and the emotion assignment and believability questions were presented on the screen one at a time. The images and vignettes were controlled for height and width and were presented on the left-hand side to middle of the computer screen, respectively (see Figure B1.1). The question was presented on the right side of the screen, next to the image and vignette. The presentation of the images and vignettes were randomized. For all vignettes, participants were asked to choose, between four emotions: anger, sadness, happiness and pride, which was the best fit to the vignette. Participants were also asked how believable they found the neutral image and affective vignette pairing.

At the end of the experiment (in the last slides of the survey), participant demographics were collected, including age, gender and nationality. The duration of the experiment was collected via Internet time stamps resulting in an average of 23.09 minutes to complete. Participants were also given the option to write comments about their experience in completing the study. Finally, the last slide contained a completion code that participants would enter into Amazon Mechanical Turk to be compensated for experiment completion.

B1.3 Results

The goal of this follow-up study was to create a set of neutral image and affective vignette stimuli (24 pairs), in which the vignettes are perceived to clearly express one of the primary emotions of anger, sadness, happiness, or the secondary emotion of pride, even when paired with neutral images, for presentation in experiment 2. The goal was to obtain percentage certainty ratings for the presence of the target emotion in each vignette when paired with a neutral image, since participants were simply choosing between four emotions.
Participants were asked to identify which emotion the vignette was describing. A cut-off criterion was used for stimuli selection. If participants identified the emotion in the vignette based on the cut-off criterion of percentage certainty ratings ≥75% for each of the identified primary emotions of anger, sadness, happiness, and the secondary emotion of pride, the vignette was paired with the image (see Table B1.1). The vignettes depicted were always identified above the cutoff criterion, therefore the random pairings of stimuli (neutral image to affective vignette), was consistent from the start of this follow-up study to the results. Each neutral image was randomly paired with one affective vignette. This created six comparable image and vignette stimuli pairings per emotion, 3 neutral humans and 3 neutral artificial entities. This generated a set of 24 stimuli that will be presented in experiment 2. The paired image and vignettes, with their respective ratings are provided in the Table B1.1 below.

Table B1.1

*Stimuli Selection for Image and Vignette Pairings for Experiment 2: Pairing Emotional Stories with Neutral Images*

<table>
<thead>
<tr>
<th>Image</th>
<th>Vignette</th>
<th>Percentage Certainty for Identified Emotion (≥75%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F12</td>
<td>AN2</td>
<td>I cannot believe that he lied to me, lied to me about where he was going, who he was with and what he was doing. I just found the text message on his phone that explains where he really was yesterday night. I feel so angry, like I cannot pull myself together. I just broke all of his favorite beer mugs and am now leaving the house. 90.40%</td>
</tr>
</tbody>
</table>
F26  AN1
I am so angry. I cannot believe someone would treat me like that. He broke my favorite doll, threw it down the stairs and just laughed when her head popped off. I feel so upset. I am going straight to mom to tell on him, he can’t just do that to me and my favorite toy. 94.71%

M25  AN6
That son of a bitch stole my parking space. I’m sitting there, indicating, the whole family is in the car when this little sports car pulls into my space. MY SPACE! We hardly ever go out as a family; do you know how hard it is to find a parking space for van. I am so angry. 92.71%

Nao3  AN12
I didn’t mean to hit that hard; they just kept pushing and pushing until I couldn’t take it anymore! I have feelings too! Insults hurt and it went too far. The insults were also against the people I love, I was just so angry. 95.86%

Nao1  AN12
I was told that I was useless, worthless, and no good. I was just trying to do my job and one little mistake led to my ‘boss’ firing me. I have been let go from my job with no cause, no explanation, nothing! I will find a way to show my boss how this feels! I cannot believe how angry this has made me. 92.86%

Nao2  AN12
I was taking the dog Max for a walk when this kid came over and started pushing me around. He tried to knock me over and scared Max. He kept shouting “You have no friends, no one likes you”. He then kicked Max too. I started to get really hot and I realized how angry I was. He saw me reacting and he ran. 89.00%

F26  SD9
He kept drinking, even though they told him that it was killing him. I told him that I couldn’t do it anymore, that I wanted to love him and be with him but all the drinking, fighting and sickness was too hard. I feel so sad, I didn’t want to leave, I didn’t want to lose him but I don’t know what my other choice was. 96.57%
My dog Rover was the greatest companion. We played, cuddled, and spent time walking and exploring together. I could tell him all my secrets and he was always my companion. He is really sick; Mom just came back from the vet. They told her that she will have to ‘put him down’. I haven’t felt this sad in a long time; I don’t want to lose Rover.

They are no longer willing to extend my work VISA so I can stay with my host family. I have been taking care of their children for the last 7 years and they feel like my own children, like my own family. I can’t lose them. I cannot pick myself up off my floor, I just cry, I’m so sad.

She left me. I thought we were going to get married, start a family, travel to Paris and just be together. She told me she had found herself happier with someone else. I’m alone now, she’s gone; I don’t know what I’m supposed to do. I feel sad all the time.

I remember someone told me how it would feel to lose my mom. That I would feel like a big part of myself had gotten loss. That a hole would appear inside my body and I wouldn’t be able to feel it. I have never felt sadness like this. I just cry all the time and don’t know how to make it stop.

I don’t want to fight anymore. She keeps blaming me for everything. This isn’t the life she wants, I’m not good enough, I don’t do enough for her. It just keeps going on and on. I have not felt this sad in a long time; I’m losing the relationship I thought I would be in forever.

I get to go to school! I get my own books, supplies and friends! I cannot wait. I have wanted to learn how to read for a long time. Finally, I’m just so happy! We were waiting for the acceptance letter for what seemed like forever.

I watched my dogs running around on the grass, jumping, barking and wrestling. It was so wonderful to feel relaxed and I realized I was laughing and grinning from ear to ear. My pets make me so happy.
My wife surprised me with the most beautiful weekend hiking trip. I have never been able to explore this beautiful forest before. I feel so unbelievably happy. It is the perfect weekend of hiking and spending time with a great person.

Today I went on my first hot-air-balloon ride. It was the most amazing thing I have ever done. Seeing the world and being in such a peaceful setting was wonderful. I have never felt happier. I will not forget this day.

I play dolls with my Mom. We always get to play after we finish with chores. I am getting better and better at helping my Mom. I feel really happy when we spend time together and even happier when we get to play.

Wow! I cannot believe they finally let me take my own road trip with my friends! I am having so much fun! I have been waiting on this day forever. I get to explore, drive the car by myself and enjoy my wonderful friends. I cannot believe how happy I am.

I never thought I would be published. I never knew that someone would take my work seriously until now. I never knew the feelings would be so intense. I am so proud of myself and what I have accomplished.

After three years of hard work my PhD was approved and accepted. I am so proud of myself. Three years of limited sleep, dedication, studying and committing, I finally did it. I accomplished one of my biggest goals!
The purpose of follow-up study 1 was to pair the vignettes from experiment 1 with the neutral images; to create a stimulus set to be used in experiment 2; however due to the high similarity of physiological responses to the affective images of humans and artificial entities found in experiment 1, experiment 2 was reframed. It was of interest whether affective context would be enough to elicit affective responses to neutral images of humans and artificial entities. This follow-up study was designed to assess if the already pre-tested vignettes depicting anger, sadness, happiness, and pride, would still be properly identified.
even when paired with a neutral image. Three images of neutral humans from the Radbound Faces Database (Langner, et al.), and three neutral artificial entity images are images of the NAO robot (Aldebaran Robotics), (taken by author), were randomly paired with the vignettes from experiment 1. Each image was shown four times, paired with each affective vignette. Participants were asked to what extent each emotion (*anger, sadness, happiness, and/or pride*) was present in the vignette. Participants were also asked if the pairing of vignette to image was believable (although the responses to this question were not used for analysis). Following data collection, percentage certainty ratings, with a cut off criterion of ≥75% were used to determine if the vignette presented with the neutral image was identified with the correct emotion label. All vignettes, randomly paired with neutral images reached the cut-off criterion. The random assignment prior to the follow-up study stayed post study for the final stimuli presented in experiment 2. This pretest fulfilled the objective to pair affective vignettes from experiment 1 with neutral human and artificial entity images. The final pairs of stimuli are seen in Table B1.1 and will be used as the final stimuli set in experiment 2.
B2.1 References


Appendix C

Experiment 1: Materials and Forms
SPAM EMAIL

Looking for participants! 5 Euros or Course Credit!!! PHD/EMG experiment!

We are looking for people to participate in Facial EMG/Skin Conductance experiment where we are interested in your perception of human and robotic images. This experiment will take approximately 45 minutes; it is not boring and pays 5 Euros or course credit.

Since the experiment involves attaching sensors to the face, the face will be cleaned in a few areas. It helps to come to the experiment with your face washed (limited makeup, etc.).

It is very important that you arrive on time to the experiment! If not, the experiment may not take place. Thank you!
Consent Form Used in Experiment 1

Consent Form
Humans and Artificial Agent Perception Experiment 2014

I, ________________________________ (please write your name in CAPITAL letters), agree to take part in this study.

I understand that:

1. This study investigates subjective and bodily responses to images and paired text.
2. The study consists of a single session that is going to last about **45 minutes**.
3. At the end of the study, I will receive **€ 5.00** for my participation or course credit.
4. I can quit participating in this study at any time without any negative consequences and without having to state any reasons.
5. Throughout the study I will be asked to look at images and read the text presented.
6. I will be wearing equipment that records physiological data such as the electrical activity of muscles.
7. To this aim sensors will be attached to my skin, which will require cleaning some parts of my face with alcohol. Depending on the sensitivity of the skin, in rare cases, there may be slight skin-irritations. I am aware of the fact that I can ask the experimenters to clean less thoroughly (please do not hesitate to ask).
8. No risks that could negatively affect my physical or psychological health could result from participating in this study.
9. All information I provide will be handled confidentially and anonymously. Information will be analyzed on a group basis only.
10. After completing my participation, I will be given the opportunity to ask further questions concerning the experiment.
11. I will be given more detailed instructions and explanations during the study.
12. **I can see well without glasses, or I am wearing glasses or contact lenses to correct my vision to normal.**
13. Further questions or suggestions concerning the experiment may be addressed to **Dr. Arvid Kappas**, the supervisor of this study at School of Humanities and Social Sciences, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany. Phone: +49 421 200-3441. Email: a.kappas@jacobs-university.de
<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimenter</td>
<td>Age</td>
</tr>
</tbody>
</table>
Demographics Form: Experiment 1

Demographics Humans and Artificial Agents Perception Experiment 2014

What is your gender? Male  Female

Are you right- or left-handed? Right-  Left-
hande d handed

What is your age? ______

What is your nationality? ____________________________
Experimental Instructions for Experiment 1

**Humans and Artificial Agents Perception Experiment 2014**

**Experimenter Script**

[1] Experimenter must arrive at the lab at least 10 minutes prior to an experiment unless all of the equipment is already running and ready from a preceding experiment.

[2] Make sure that all needed materials are prepared: Sufficient amount of the required forms in their most recent versions (consent form, demographics form, and completion/reward form), along with electrodes, gel, cleaning pads, cotton pads, and tissue.

[3] Make sure that the left booth is prepared and set up properly: are all electrodes clean and ready to be attached, are your hands clean? Do you have enough prep pads, tissues, etc. where you need them? Hang sign on door “Experiment in Progress” to avoid any possible interruptions during the experiment.

[4] Arrange the forms on a clipboard. The consent form can be on top. The demographics form can be underneath.

[5] Check if the heating needs to be turned on / off. Avoid large differences in room temperature between participants, maintaining between 20-22 degrees Celsius. During the preparation-phase, the outer door leading to the left booth should be open. When the participant is alone in the booth later, it should be closed (to avoid noises that may distract the participant).

[6] When everything that you can prepare is prepared, go wait for the participant at the main right entrance of the lab (with the image of the brain). Waiting in the control room is sometimes not reliable, as participants occasionally still ring the wrong bell.

[7] Welcoming the participant should not vary in detail, friendliness, etc. between participants. All participants should be greeted in the same way. Preferably, you will not know any of your participants well personally. (This ensures a reliable testing environment).

   “Hello, are you X [participant name]? My name is [experimenter name].”

[8] Walk with the participant to the booth. When you arrive with the participant in the booth, be polite but make sure not to forget any of the essentials. Think about mobile phones, chewing gum, a place to put the jacket, etc. Make sure the participant feels comfortable.

   “You can leave all your belongings here in this room – you will be here all the time, no one else will enter, and your things will be safe. Could you please also remove your jacket? OK, thank you! One more thing – in case you have a mobile phone, I would like to ask you to switch it off, or give it to me to place in the control room – it might interfere with the recording later on.”

   “Please have a seat.”

[9] Take a seat too, facing the participant, and give some brief general info about the study. This does not have to be exactly literal but should not vary in any substantial way between participants.

   “First of all, please let me give you some general information about the study. In this study we are interested in bodily responses to viewing images of humans and artificial agents that are paired with various short stories, and how you perceive them. For this study, we simply will ask you to look at the images presented and read the text presented below the image. The images and text will be presented randomly.

OK. The next thing I need to mention relates to the physiological measures that we record in this study. I will be attaching a few sensors to your face, for example here [experimenter points at the location of the ground electrode on her own face], and here [experimenter points to the approximate location of one of the Corrugator electrodes and Zygomaticus]...
**electrodes on her own face.** It is important for the study that these sensors have good contact with the skin and that means that I am going to clean the skin a bit beforehand. We are using standard materials for this, and this is a very common procedure. However, in order to have good contact, I will need to rub a fair bit which might mean that the skin could get a little bit reddish for a short while. I don’t expect that to happen, but of course I need to mention anything that could in any way be uncomfortable for you. Other than that, there are absolutely no 'risks' or 'side effects' in participating, and you can also always ask me to clean less.” It is just that the skin needs to be really clean where I attach the sensors.”

[10] While you are talking about the cleaning, take a prep pad to briefly demonstrate the procedure to the participant by opening a prep pad and rubbing a bit with it on the backside of your own hand.

“So this the kind of prep-pad we use for the cleaning – as you can see it can get a little reddish for a moment, but this usually fades very quickly.”


“Here is a consent form that I would like you to read carefully and then fill in. If you have any questions, please do not hesitate to ask me.”

[12] After you are finished with the consent form, there are a few standard sentences that should be mentioned as the materials are handled etc.:

“So, these are the cleaning pads you have already seen. They just contain some alcohol and pumice to help with the cleaning.”

[13] When beginning to actually clean:

“As you see, I tend to use a fair amount of pressure. We have found that this is generally more effective and less uncomfortable for participants than cleaning for a very long time...”

[14] After the first cleaning, put the stickers on the sensors. Mention a sentence like: “OK, these are the kinds of 'stickers' we use to attach the sensors to the face”. Then clean all sensor-locations once more before attaching the first sensor.

[15] When attaching the first sensor (i.e., the ground electrode):

“Now this is the first sensor [show]. They are all filled with a simple gel that contains some salt to help make the connection better.”

[16] While attaching further sensors:

“So now I am attaching some more sensors... this may take a little while.”

[17] A bit later while still attaching sensors:

“Ok, when these are done, I will give them a moment and then get a device to see how the contact between the sensor and the skin is. Getting some contact isn’t difficult, but we need to try to have a fairly good connection for this kind of study. I will also potentially need to re-do some of them.”

[18] After all pairs are attached, get the Checktrode device.

“Ok, so now I will give the sensors a moment and then be back with the measurement device to see about the contact.”

[19] While checking the impedances, explain:

EITHER “Ok, they already have contact, but I would like to re-do a few of them again; please know this is completely normal and has nothing to do with you or your skin” OR “Ok, so, these are all fine.”

[20] When the impedance checking is done and you have an overview of how the pattern is.

EITHER: “Ok, they already have contact, but I would like to do a few of them again, this is completely normal and it is very common to have to re-do various sensors” OR: “Ok, so, these are all fine.”
After the replacement pairs are attached and the contact is good:

“So, we are finished with this part of the preparation. Could you please take the cables into your hand like this?” [give cables into the right hand for the left booth– they should always go into the hand which is on the side of the modules where they will be plugged in] [In case you forgot to ask earlier, now is the time to ask about the mobile phone:] “Do you have a mobile phone with you?” [experimenter waits for response – in case there is, the experimenter asks to switch it off and leave it with the other belongings in the room behind the booth. For example, “OK, that might interfere with the signal – could you switch it off?”] “Do you have chewing gum in your mouth?” [if yes, ask them to remove it – again because “It might interfere with the signal”] “OK, now please follow me.”

Go with the participant into the booth.

“Please take a seat here.”

Connect the EMG sensors to the modules. Ground is always plugged in together with Zygomaticus. Explain that we will also be using skin conductance sensors on the index and ring finger of the left hand.

“We will be applying these sensors to the fingers in order to measure how you respond with skin conductance to the stimuli. We put a gel in the sensors to create connectivity [put gel into finger sensors]. It is mild and will not harm the skin. I will apply the sensors by wrapping the Velcro straps around your fingers and tightening them. [Attach sensors]. Do they feel too tight? You should feel slight pressure but not anything uncomfortable.” [Adjust sensors if needed].

Fill in the information you already have in the Paper Log (impedances of all the sensors, booth temperature). Ask the participant:

“Do you have any further questions before we start?” “Are you comfortable?” Then explain to the participant: “I will now start the experiment in the control booth, please follow the onscreen instructions; if you would like to stop the experiment at any time simply let me know, there is a microphone connecting this booth to the control room.”

Go to the control room. Make sure that the Acknowledge recording is properly started, then start the MediaLab script.

Make sure while participants are doing the experiment the markers are in the appropriate placement. Follow the markers from MediaLab in AcqKnowledge. Make note of any issues with the software that could affect analysis.

When the MediaLab script is done, it should still be tested if all electrodes have remained well connected. While we do not have a calibration against the maximum activation as such, it can still be useful to ask the participant to smile and frown once. For this, come back to the booth and ask the participant to smile once, then to frown once. Mimic it.

“Could you please smile once and frown once? Like this.”

Disconnect the EMG sensors from the modules. Please take another measure of the impedances and note them down also in the paper-Log. This step is easy to forget!

“OK, we are almost done. I will now stop the computer and be right back with you.”

Go back to the Control Room.

Stop the AcqKnowledge recording.

Bring the question sheet and the Interpersonal Reactivity Index to the participant in the booth. Allow them a few minutes to fill out their impressions. Ask them to simply say “Done” when they are finished. Collect the sheet and say “Thank you”.

Once you have collected both the question sheet and the IRI, let them know we have finished the experiment.

“OK, this is it! Please take the cables into your hand like this, and follow me.”
Ask the participant if they have any questions regarding the nature of the experiment. It is important to debrief the participant. If they have questions, answer them. If not, then explain the purpose of the experiment.

“This experiment is interested in examining the similarities and differences in human physiological reaction to human stimuli and artificial agent stimuli. More specifically to examine if there is a difference in physiological responses or perceptions; when the experiment is fully finished we will be able to send around a full report. Do you have any questions?”

Go back to the room behind the booth and remove the EMG sensors. Then show participant to the bathroom and encourage them to put some cream on the spots where the EMG sensors were attached. Do not forget the lock the room with their belongings. When washing is done, if the participant took part for a monetary compensation, give the participant their money and ask them to sign the receipt sheet. Otherwise give them their signed participation sheet for the course credit.

“Could you now please fill in this receipt sheet?”

Both of you will then return to the booth so that the participant can retrieve their belongings.

“Thank you for participating. We are still looking for participants for this study. Don’t hesitate to ask your friends to contact us if they would like to participate.”

Walk the participant to the entrance of the lab:

“Thank you again for coming. Have a great day.”

Go back to the Control Room and stop MediaLab if it is still running.

Go back to the booth, take the EMG sensors to be cleaned to the prep room.

Clean all sensors carefully.

Always put sensors to dry in the prep room – don’t put them in the bathroom (if it is being used, you may not be able to retrieve clean sensors for the next participant).

Clean hands (with soap) thoroughly after cleaning the sensors.

Put clean and dry EMG sensors in the room behind the booth for the next participant.

Fill in the remaining of the Log.

Set up the computers for the next participant if he/she directly follows.

Done! Next participant 😊
Skin Impedance Form:

Collection of Impedances for Facial EMG at the Start and End of Experiment 1

<table>
<thead>
<tr>
<th>Impedances</th>
<th>[Start or End]</th>
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<tr>
<td>Date</td>
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Post Experiment Questionnaires: Experiment 1

Humans and Artificial Agents Perception Experiment 2014

Post Experiment Questionnaire

1. Please describe in a few sentences what you had to do during this study?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

2. What do you think the experimenters wanted to find out?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

3. What did you think of the study? What was your general impression?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Interpersonal Reactivity Index (IRI): Participant View: Experiment 1

Davis, 1980, 1983

**Questionnaire I**

The following statements inquire about your thoughts and feelings in a variety of situations. Please indicate how well each of the following statements describes you.

<table>
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<tr>
<th>Does not describe me well</th>
<th>Describes me very well</th>
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1. I daydream and fantasize, with some regularity, about things that might happen to me. □ □ □ □ □

2. I often have tender, concerned feelings for people less fortunate than me. □ □ □ □ □

3. I sometimes find it difficult to see things from the "other guy's" point of view. □ □ □ □ □

4. Sometimes I don't feel very sorry for other people when they are having problems. □ □ □ □ □

5. I really get involved with the feelings of the characters in a novel. □ □ □ □ □

6. In emergency situations, I feel apprehensive and ill-at-ease. □ □ □ □ □

7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it. □ □ □ □ □

8. I try to look at everybody's side of a disagreement before I make a decision. □ □ □ □ □

9. When I see someone being taken advantage of, I feel kind of protective towards them. □ □ □ □ □
10. I sometimes feel helpless when I am in the middle of a very emotional situation.

11. I sometimes try to understand my friends better by imagining how things look from their perspective.

12. Becoming extremely involved in a good book or movie is somewhat rare for me.

13. When I see someone get hurt, I tend to remain calm.

14. Other people's misfortunes do not usually disturb me a great deal.

15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.

16. After seeing a play or movie, I have felt as though I were one of the characters.

17. Being in a tense emotional situation scares me.

18. When I see someone being treated unfairly, I sometimes don't feel much pity for them.

19. I am usually pretty effective in dealing with emergencies.

20. I am often quite touched by things that I see happen.

21. I believe that there are two sides to every question and try to look at them both.
22. I would describe myself as a pretty soft-hearted person. □ □ □ □ □

23. When I watch a good movie, I can very easily put myself in the place of a leading character. □ □ □ □ □

24. I tend to lose control during emergencies. □ □ □ □ □

25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while. □ □ □ □ □

26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me. □ □ □ □ □

27. When I see someone who badly needs help in an emergency, I go to pieces. □ □ □ □ □

28. Before criticizing somebody, I try to imagine how I would feel if I were in their place. □ □ □ □ □
Participant Signature Sheet for Compensation: Experiment 1

I have received € 5.00 for my participation in a physiology study about perception of emotions in images titled: “Humans and Artificial Agents Perception Experiment 2014” for the lab of Prof. Dr. Arvid Kappas at Jacobs University Bremen, 2014.

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Appendix D

Experiment 2: Materials and Forms
Appendix D

Participant Recruitment: Experiment 2

**SPAM EMAIL**

Help! Looking for participants! **7 Euros or Course Credit** plus **chocolate**!!!

Create Photos and Play; a Facial EMG Experiment!

We are looking for people to participate in a photo creation and play experiment followed by a recording of Facial EMG/Skin Conductance levels while participants look at various images paired with text. We are interested in your perception of human and robotic images 😊. This experiment will take approximately 60 minutes; it is not boring, is active and fun, and pays **7 Euros or course credit** plus **chocolate**.

Since the experiment involves attaching sensors to the face, the face will be cleaned in a few areas. It helps to come to the experiment with your face washed (limited makeup, etc.).

It is very important that you arrive **on time** to the experiment! If not, the experiment may not take place. Thank you!
Consent Form Used in Experiment 2

Consent Form

Humans and Artificial Agent Play & Perception Experiment 2014

I, ___________________________________ (please write your name in CAPITAL letters), agree to take part in this study.

I understand that:

14. This study investigates subjective and bodily responses to images and paired text.
15. This study investigates responses to the creation of photographs using props.
16. The study consists of a single session that is going to last about of 60-70 minutes.
17. At the end of the study, I will receive € 7.00 for my participation or course credit.
18. I can quit participating in this study at any time without any negative consequences and without having to state any reasons.
19. Throughout the study I will be asked to take photographs of different scenarios I have created with props. Then I will be asked to look at images and read the text presented.
20. I will be wearing equipment that records physiological data such as the electrical activity of muscles.
21. To this aim sensors will be attached to my skin, which will require cleaning some parts of my face with alcohol. Depending on the sensitivity of the skin, in rare cases, there may be slight skin-irritations. I am aware of the fact that I can ask the experimenters to clean less thoroughly (please do not hesitate to ask).
22. No risks that could negatively affect my physical or psychological health could result from participating in this study.
23. All information I provide will be handled confidentially and anonymously. Information will be analyzed on a group basis only.
24. After completing my participation, I will be given the opportunity to ask further questions concerning the experiment.
25. I will be given more detailed instructions and explanations during the study.
26. I give consent that the photos I take can be used for academic purposes (conferences, posters, publications etc,) and for further research purposes.
27. I can see well without glasses, or I am wearing glasses or contact lenses to correct my vision to normal.

28. Further questions or suggestions concerning the experiment may be addressed to Dr. Arvid Kappas, the supervisor of this study at School of Humanities and Social Sciences, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany. Phone: +49 421 200-3441. Email: a.kappas@jacobs-university.de
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<td>Signature</td>
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<tr>
<td>Experimenter</td>
<td>Age</td>
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Demographics Form: Experiment 2

Demographics Humans and Artificial Agents Play & Perception Experiment 2014

What is your gender? Male  Female

Are you right- or left-handed? Right-  Left-
                   handed  handed

What is your age? ______

What is your nationality? __________________________
Experimental Instructions for Experiment 2

Humans and Artificial Agents Play & Perception Experiment 2014

Experimenter Script

[1] Experimenter must arrive at the lab at least 10 minutes prior to an experiment unless all of the equipment is already running and ready from a preceding experiment.

[2] Make sure that all needed materials are prepared: Sufficient amount of the required forms in their most recent versions (consent form, demographics form, surveys, and completion/reward form), along with electrodes, gel, cleaning pads, cotton pads, and tissue.

[3] Make sure that the left booth is set up and prepared properly: are all electrodes clean and ready to be attached, is the footstool prepared and clean, are your hands clean? Do you have enough prep pads, tissues, etc. where you need them? Hang sign on door “Experiment in Progress” to avoid any possible interruptions during the experiment. Make sure that the room is set up with all props required for the image creation part of the experiment. Depending on the randomized condition for the subject, place the Danbos on the table or remove them.

[4] Prepare the forms on a clipboard. The consent form can be on top. The demographics form can be underneath. The Pre-PANAS is to be placed below the demographics form.

[5] Check if the heating needs to be turned on / off. Avoid large differences in room temperature between participants, maintaining between 20-22 degrees Celsius. During the preparation-phase, the outer door leading to the left booth should be open. When the participant is alone in the booth later, it should be closed (to avoid noises that may distract the participant).

[6] When everything that you can prepare is prepared, go wait for the participant at the main right entrance of the lab (with the image of the brain). Waiting in the lab is sometimes not reliable, as participants occasionally still ring the wrong bell.

[7] Welcoming the participant should not vary in detail, friendliness, etc. between participants. All participants should be greeted in the same way. Preferably, you will not know any of your participants well personally (this ensures a reliable testing environment).

“Hello, are you X [participant name]? My name is [experimenter name].”

[8] Walk with the participant to the booth. When you arrive with the participant in the booth, be polite but make sure not to forget any of the essentials. Think about mobile phones, chewing gum, a place to put the jacket, etc. Make sure the participant feels comfortable.

“You can leave all your belongings here in this room – you will be here all the time, no one else will enter, and your things will be safe. Could you please also remove your jacket? OK, thank you! One more thing – in case you have a mobile phone, I would like to ask you to switch it off, or give it to me to place in the control room – it might interfere with the recording later on.”

“Please have a seat.”

[9] Take a seat too, facing the participant, and give some brief general info about the study. This does not have to be exactly literal but should not vary in any substantial way between participants.

“First of all, please let me give you some general information about the study. In the first part of the study we are interested in people using props to create various images. You will have props on the table and you will be asked to take 10 minutes to create compositions and take the photos with a camera.”
In the second part of this study we are interested in bodily responses to viewing images of humans and artificial agents that are paired with various short stories, and how you perceive them. For this part of the study, we will simply ask you to look at the images presented and read the text presented below the image. The images and text will be presented randomly.

OK. The next thing I need to mention relates to the physiological measures that we record in this study. I will be attaching a few sensors to your face prior to the photo creation activity. You will have the sensors for example here [experimenter points at the location of the ground electrode on her own face], and here [experimenter points to the approximate location of one of the Corrugator electrodes and Zygomaticus electrodes on her own face]. It is important for the study that these sensors have good contact with the skin and that means that I am going to clean the skin a bit beforehand. We are using standard materials for this, and this is a very common procedure. However, in order to have good contact, I will need to rub a fair bit which might mean that the skin could get a little bit reddish for a short while. I don’t expect that to happen, but of course I need to mention anything that could in any way be uncomfortable for you. Other than that, there are absolutely no ‘risks’ or ‘side effects’ in participating, and you can also always ask me to clean less. It is just that the skin needs to be really clean where I attach the sensors.”

[10] While you are talking about the cleaning, take a prep pad to briefly demonstrate the procedure to the participant by opening a prep pad and rubbing a bit with it on the backside of your own hand:

“So this the kind of prep-pad we use for the cleaning – as you can see it can get a little reddish for a moment, but this usually fades very quickly.”


“Here is a consent form that I would like you to read carefully and then fill in. If you have any questions, please do not hesitate to ask me. There is also a demographics questionnaire and short survey to fill out before we get started.”

[12] After you are finished with the forms, there are a few standard sentences that should be mentioned as the materials are handled etc.:

“So, these are the cleaning pads you have already seen. They just contain some alcohol and pumice to help with the cleaning.”

[13] When beginning to actually clean:

“As you see, I tend to use a fair amount of pressure. We have found that this is generally more effective and less uncomfortable for participants than cleaning for a very long time...”

[14] After the first cleaning, put the stickers on the sensors. Mention a sentence like: “OK, these are the kinds of ‘stickers’ we use to attach the sensors to the face”. Then clean all sensor-locations once more before attaching the first sensor.

[15] When attaching the first sensor (i.e., the ground electrode):

“Now this is the first sensor [show]. They are all filled with a simple gel that contains some salt to help make the connection.”

[16] While attaching further sensors:

“So now I am attaching some more sensors... this may take a little while.”

[17] A bit later while still attaching sensors:

“Ok, when these are done, you will complete the image creation portion of the experiment. This will give the sensors time to have contact and then I will later get a device to see how the contact between the sensor and the skin is. Getting some contact isn’t difficult, but we need to try to have a fairly good connection for this kind of study. I will also potentially need to re-do some of them after the image creation part of the experiment.”

[18] Now take the participant, after securing the sensors to the experiment room next to the left booth. Instruct the participant that it is time to start part one of the experiment and you will return in ten minutes after the pretest is completed.
“We can now get started. I will leave you alone for the next 10 minutes and return once the time is up. In this time please take pictures with this camera here [show camera] and create images using the props. If you have any issues at any time I will be seated in the room, outside the door to the left. Please come out and ask at any time. There is no right or wrong way to do this activity.”

[19] Time the 10 minutes and knock upon returning. Give the participant the Mid-PANAS to complete and wait while they fill it in.

[20] Explain to the participant that part one of the experiment is complete and inform them:

“The image creation portion of this experiment is now complete. If you could follow me back to the left booth that would be great.”

Walk participant back to left booth and seat them in the experimental chair.

[21] After the participant is seated, get the Checktrode device.

“Ok, so now I will take the sensors and use this measurement device to see about the contact.”

[22] While checking the impedances, explain:

EITHER “Ok, they already have contact, but I would like to re-do a few of them again; please know this is completely normal and has nothing to do with you or your skin”

OR “Ok, so, these are all fine.”

[23] When the impedance checking is done and you have an overview of how the pattern is

EITHER: “Ok, they already have contact, but I would like to do a few of them again, this is completely normal and it is very common to have to re-do various sensors”

OR: “Ok, so, these are all fine.”

[24] After the replacement pairs are attached and the contact is good:

“[In case you forgot to ask earlier, now is the time to ask about the mobile phone:] “Do you have a mobile phone with you?” [experimenter waits for response – in case there is, the experimenter asks to switch it off and leave it with the other belongings in the room behind the booth. For example, “OK, that might interfere with the signal – could you switch it off?”]

“Do you have chewing gum in your mouth? [If yes, ask them to remove it – again because “It might interfere with the signal”]. “OK, now please follow me.”

[25] Go with the participant into the booth.

“Please take a seat here.”

[26] Explain that we will also be using skin conductance sensors on the index and ring finger of the left hand.

“We will be applying these sensors to the fingers in order to measure how you respond with skin conductance to the stimuli. We put a gel in the sensors to create connectivity [put gel into finger sensors]. It is mild and will not harm the skin. I will apply the sensors by wrapping the Velcro straps around your fingers and tightening them. [Attach sensors]. Do they feel too tight? You should feel slight pressure but not anything uncomfortable.” [Adjust sensors if needed].

[27] Connect the EMG sensors to the modules. Ground is always plugged in together with Zygomaticus.

[28] Fill in the information you already have in the Paper Log (impedances of all the sensors, booth temperature). Ask the participant:

“Do you have any further questions before we start?”, “Are you comfortable?” Then explain to the participant: “I will now start the experiment in the control booth, please follow the onscreen instructions; if you would like to stop the experiment at any time simply let me know, there is a microphone connecting this booth to the control room.”

[29] Go to the control room. Make sure that the Acknowledge recording is properly started, then start the MediaLab script.
Make sure while participants are doing the experiment the markers are in the appropriate placement. Follow the markers from MediaLab in AcqKnowledge. Make note of any issues with the software that could affect analysis.

[30] When the MediaLab script is done, it should still be tested if all electrodes have remained well connected. While we do not have a calibration against the maximum activation as such, it can still be useful to ask the participant to smile and frown once. For this, come back to the booth and ask the participant to smile once, then to frown once. Mimic it.

“Could you please smile once and frown once? Like this.”

[31] Disconnect the EMG sensors from the modules. Please take another measure of the impedances and note them down also in the paper-Log. **This step is easy to forget!**

“OK, we are almost done. I will now stop the computer and be right back with you.”

[32] Go back to the Control Room.

[33] Stop the AcqKnowledge recording.

[34] Bring the question sheet, Post PANAS, and the Interpersonal Reactivity Index to the participant in the booth. Allow them a few minutes to fill out their impressions. Ask them to simply say “Done” when they are finished. Collect the sheet and say “Thank you”.

[35] Once you have collected the question sheet, post PANAS and the IRI, let them know we have finished the experiment.

“OK, this is it! Please take the cables into your hand like this, and follow me.”

[36] Ask the participant if they have any questions regarding the nature of the experiment. It is important to debrief the participant. If they have questions, answer them. If not, then explain the purpose of the experiment.

“We are doing a series of studies on how people react to robots. In the first part of the experiment you play with both Danbos and other props or just with props. We are interested in how people respond to artificial agents. In addition it is very important to figure out how regular play (with props) would or would not differ from the play with the artificial agent and props.

In the second part of this experiment, we are interested in examining the similarities and differences in human physiological reactions to human stimuli and artificial agent stimuli. More specifically to examine if there is a difference in physiological response or perception. When the experiment is fully finished we will be able to send around a full report. Do you have any questions?”

[37] Go back to the room behind the booth and remove the EMG sensors. Then show participant to the bathroom and encourage them to put some cream on the spots where the EMG sensors were attached. Do not forget the lock the room with their belongings. When washing is done, if the participant took part for a monetary compensation, give the participant their money and ask them to sign the receipt sheet. Otherwise give them their signed participation sheet for the course credit.

“Could you now please fill in this receipt sheet?”

[38] Both of you will then return to the booth so that the participant can retrieve their belongings.

“Thank you for participating. We are still looking for participants for this study. Don’t hesitate to ask your friends to contact us if they would like to participate.”

[39] Walk the participant to the entrance of the lab:

“Thank you again for coming. Have a great day.”

[40] Go back to the Control Room and stop MediaLab if it is still running.

[41] Go back to the booth, take the EMG sensors to be cleaned to the prep room.

[42] Clean all sensors carefully.

[43] Always put sensors to dry in the prep room – don’t put them in the bathroom (if it is being used, you may not be able to retrieve clean sensors for the next participant).
[44] Clean hands (with soap) thoroughly after cleaning the sensors.

[45] Put clean and dry EMG sensors in the room behind the booth for the next participant.

[46] Reset the props to the condition assigned randomly for the next participant (either Danbos with props or just props).

[47] Transfer photos created from last participant to computer with associated participant number.

[48] Fill in the remaining of the Log.

[49] Set up the computers for the next participant if he/she directly follows.

Done! Next participant 😊
Skin Impedance Form:

Collection of Impedances for Facial EMG at the Start and End of Experiment 2

### Impedances

[Start or End]

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<tr>
<th>Part.ID</th>
<th>Ground</th>
<th>Corrugator</th>
<th>Zygomaticus</th>
<th>Levator</th>
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Positive and Negative Affect Schedule (PANAS) Questionnaire

Watson and colleagues, 1988

Given to Participant Pre, Mid, Post Experiment 2

[Pre, Mid, Post] Questionnaire

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers.

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<td>Very slightly or not at all</td>
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<td>Moderately</td>
<td>Quite a bit</td>
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<td>____ Afraid</td>
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Skin Impedance Form:

Collection of Impedances for Facial EMG at the Start and End of Experiment 2

**Impedances**

[Start or End]

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<thead>
<tr>
<th>Date</th>
<th>Participant ID</th>
<th>Corrugator</th>
<th>Zygomaticus</th>
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Post Experiment Questionnaires: Experiment 2

Humans and Artificial Agents Play & Perception Experiment 2014

Post Experiment Questionnaire

1. Please describe in a few sentences what you had to do during this study?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

2. What do you think the experimenters wanted to find out?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

3. What did you think of the study? What was your general impression?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Interpersonal Reactivity Index (IRI): Participant View: Experiment 2
Davis, 1980, 1983

**Questionnaire I**

The following statements inquire about your thoughts and feelings in a variety of situations. Please indicate how well each of the following statements describes you.

<table>
<thead>
<tr>
<th>Does not describe me well</th>
<th>Describes me very well</th>
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<tbody>
<tr>
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</table>

1. I daydream and fantasize, with some regularity, about things that might happen to me.  
   - [ ] [ ] [ ] [ ] [ ]

2. I often have tender, concerned feelings for people less fortunate than me.  
   - [ ] [ ] [ ] [ ] [ ]

3. I sometimes find it difficult to see things from the “other guy's” point of view.  
   - [ ] [ ] [ ] [ ] [ ]

4. Sometimes I don't feel very sorry for other people when they are having problems.  
   - [ ] [ ] [ ] [ ] [ ]

5. I really get involved with the feelings of the characters in a novel.  
   - [ ] [ ] [ ] [ ] [ ]

6. In emergency situations, I feel apprehensive and ill-at-ease.  
   - [ ] [ ] [ ] [ ] [ ]

7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it.  
   - [ ] [ ] [ ] [ ] [ ]

8. I try to look at everybody's side of a disagreement before I make a decision.  
   - [ ] [ ] [ ] [ ] [ ]

9. When I see someone being taken advantage of, I feel kind of protective towards them.  
   - [ ] [ ] [ ] [ ] [ ]

10. I sometimes feel helpless when I am in the middle of a very emotional situation.  
    - [ ] [ ] [ ] [ ] [ ]
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<th>Describes me very well</th>
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<tr>
<td>11. I sometimes try to understand my friends better by imagining how things look from their perspective.</td>
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<td>12. Becoming extremely involved in a good book or movie is somewhat rare for me.</td>
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<td>13. When I see someone get hurt, I tend to remain calm.</td>
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<td>14. Other people's misfortunes do not usually disturb me a great deal.</td>
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<td>15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.</td>
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<td>16. After seeing a play or movie, I have felt as though I were one of the characters.</td>
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<td>17. Being in a tense emotional situation scares me.</td>
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<td>18. When I see someone being treated unfairly, I sometimes don't feel much pity for them.</td>
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<td>19. I am usually pretty effective in dealing with emergencies.</td>
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<td>20. I am often quite touched by things that I see happen.</td>
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<td>21. I believe that there are two sides to every question and try to look at them both.</td>
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<td>22. I would describe myself as a pretty soft-hearted person.</td>
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23. When I watch a good movie, I can very easily put myself in the place of a leading character.

24. I tend to lose control during emergencies.

25. When I'm upset at someone, I usually try to “put myself in his shoes” for a while.

26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.

27. When I see someone who badly needs help in an emergency, I go to pieces.

28. Before criticizing somebody, I try to imagine how I would feel if I were in their place.
I have received € 7.00 for my participation in a physiology study about play and the perception of emotions in images and text titled: “Humans and Artificial Agents Play & Perception Experiment 2014” for the lab of Prof. Dr. Arvid Kappas at Jacobs University Bremen, 2014.

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<th>Name (CAPITAL LETTERS)</th>
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Appendix E

Experiment 3: Materials and Forms
Help! Looking for participants! **10 Euros or Course Credit!!!**

**Perception and Bodily Responses to Video Material Experiment 2015!**

We are looking for people to participate in a Facial EMG/Skin Conductance/Heart Rate experiment in Lab III, in which you are asked to sit and watch videos. We are interested in your perception of different videos 😊. This experiment will take approximately 60-70 minutes. It is not boring, and pays **10 Euros or course credit.**

Since the experiment involves attaching sensors to the face, the face will be cleaned in a few areas. It helps to come to the experiment with your face washed (limited makeup, etc.).

It is very important that you arrive **on time** to the experiment! If not, the experiment may not take place. Thank you!
Consent Form Used in Experiment 3

Consent Form

Perception and Bodily Responses to Videos 2015

I, ___________________________ (please write your name in CAPITAL letters), agree to take part in this study.

I understand that:

1. This study investigates subjective and bodily responses to video material.
2. The study consists of a single session that is going to last approximately of 60-70 minutes.
3. At the end of the study, I will receive € 10 for my participation or course credit.
4. I can quit participating in this study at any time without any negative consequences and without having to state any reasons.
5. Throughout the study I will be asked to watch videos of different scenarios. Then I will be asked to rate the videos presented.
6. I will be wearing equipment that records physiological data such as the electrical activity of muscles.
7. To this aim sensors will be attached to my skin, which will require some cleaning some parts of my face with alcohol. Depending on the sensitivity of the skin, in rare cases, there may be slight skin-irritations. I am aware of the fact that I can ask the experimenters to clean less thoroughly (please do not hesitate to ask).
8. There are no risks that could negatively affect my physical or psychological health by participating in this study.
9. All information I provide will be handled confidentially and anonymously. Information will be analyzed on a group basis only.
10. After completing my participation, I will be given the opportunity to ask further questions concerning the experiment.
11. I will be given more detailed instructions and explanations during the study.
12. I can see well without glasses, or I am wearing glasses or contact lenses to correct my vision to normal.
13. Further questions or suggestions concerning the experiment may be addressed to Professor. Arvid Kappas, the supervisor of this study at the department of Psychology and Methods, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany. Phone: +49 421 200-3441. Email: a.kappas@jacobs-university.de
Demographics Form: Experiment 3

Demographics: Perception and Bodily Responses to Videos Experiment

2015

What is your gender?  Male  Female

Are you right- or left-handed?  Right-handed  Left-handed

What is your age?  ______

What is your nationality?  _________________________
Experimental Instructions for Experiment 3

Perception and Bodily Responses to Video Material Experiment 2015

Experimenter Script

[1] Experimenter must arrive at the lab at least 10 minutes prior to an experiment unless all of the equipment is already running and ready from a preceding experiment.

[2] Make sure that all needed materials are prepared: Sufficient amount of the required forms in their most recent versions (consent form, surveys, and completion/reward form), along with electrodes, gel, cleaning pads, cotton pads, and tissue.

[3] Make sure that the experimental booth is set up and prepared properly: are all electrodes clean and ready to be attached, is the footstool prepared and clean, are your hands clean? Do you have enough prep pads, tissues, etc. where you need them? Hang sign on door “Experiment in Progress” to avoid any possible interruptions during the experiment.

[4] Prepare the forms on a clipboard. The consent form can be on top. The demographics form can be underneath. The Pre-PANAS is to be placed below the demographics form.

[5] Check if the heating needs to be turned on / off. Avoid large differences in room temperature between participants, maintaining between 20-22 degrees Celsius. During the preparation-phase, the outer door leading to the left booth should be open. When the participant is alone in the booth later, it should be closed (to avoid noises that may distract the participant).

[6] When everything that you can prepare is done, go wait for the participant at the main right entrance of the lab (with the image of the brain). Waiting in the lab is sometimes not reliable, as participants occasionally still ring the wrong bell.

[7] Welcoming the participant should not vary in detail, friendliness, etc. between participants. All participants should be greeted in the same way. Preferably, you will not know any of your participants well personally (this ensures a reliable testing environment).

“Hello, are you X [participant name]? My name is [experimenter name].”

[8] Walk with the participant to the booth. When you arrive with the participant in the booth, be polite but make sure not to forget any of the essentials. Think about mobile phones, chewing gum, a place to put the jacket, etc. Make sure the participant feels comfortable.

“You can leave all your belongings here in this room – you will be here all the time, no one else will enter, and your things will be safe. Could you please also remove your jacket? OK, thank you! One more thing – in case you have a mobile phone, I would like to ask you to switch it off, or give it to me to place in the control room – it might interfere with the recording later on.”

“Please have a seat.”

[9] Take a seat too, facing the participant, and give some brief general info about the study. This does not have to be exactly literal but should not vary in any substantial way between participants.

“First of all, please let me give you some general information about the study. In this study we are interested in your perception and bodily responses to various videos. For this study, we simply will ask you to watch the videos and answer the questions following the videos. The videos will be presented randomly.

OK. The next thing I need to mention relates to the physiological measures that we record in this study. I will be attaching a few sensors to your face prior to the photo creation activity. You will have the sensors for example here [experimenter points at the location of the ground electrode on her own face], and here [experimenter points to the approximate...
location of one of the Corrugator, Zygomaticus and Levator electrodes on her own face). It is important for the study that these sensors have good contact with the skin and that means that I am going to clean the skin a bit beforehand. We are using standard materials for this, and this is a very common procedure. However, in order to have good contact, I will need to rub a fair bit which might mean that the skin could get a little bit reddish for a short while. I don’t expect that to happen, but of course I need to mention anything that could in any way be uncomfortable for you. Other than that, there are absolutely no ‘risks’ or ‘side effects’ in participating, and you can also always ask me to clean less.” It is just that the skin needs to be really clean where I attach the sensors.”

[10] While you are talking about the cleaning, take a prep pad to briefly demonstrate the procedure to the participant by opening a prep pad and rubbing a bit with it on the backside of your own hand:

“So this the kind of prep-pad we use for the cleaning – as you can see it can get a little reddish for a moment, but this usually fades very quickly.”


“Here is a consent form that I would like you to read carefully and then fill in. If you have any questions, please do not hesitate to ask me. There is also a demographics questionnaire and short survey to fill out before we get started.”

[12] After you are finished with the forms, there are a few standard sentences that should be mentioned as the materials are handled etc.:

“So, these are the cleaning pads you have already seen. They just contain some alcohol and pumice to help with the cleaning.”

[13] When beginning to actually clean:

“As you see, I tend to use a fair amount of pressure. We have found that this is generally more effective and less uncomfortable for participants than cleaning for a very long time...”

[14] After the first cleaning put the stickers on the sensors. Mention a sentence like: “OK, these are the kinds of ‘stickers’ we use to attach the sensors to the face”. Then clean all sensor-locations once more before attaching the first sensor.

[15] When attaching the first sensor (i.e., the ground electrode):

“Now this is the first sensor [show]. They are all filled with a simple gel that contains some salt to help make the connection.”

[16] While attaching further sensors:

“So now I am attaching some more sensors... this may take a little while.”

[17] A bit later while still attaching sensors:

“Ok, when these are done, you will complete the image creation portion of the experiment. This will give the sensors time to have contact and then I will later get a device to see how the contact between the sensor and the skin is. Getting some contact isn’t difficult, but we need to try to have a fairly good connection for this kind of study. I will also potentially need to re-do some of them after the image creation part of the experiment.”

[18] Get the Checktrode device.

“Ok, so now I will take the sensors and use this measurement device to see about the contact.”

[19] While checking the impedances, explain:

EITHER “Ok, they already have contact, but I would like to re-do a few of them again; please know this is completely normal and has nothing to do with you or your skin”

OR “Ok, so, these are all fine.”

[20] When the impedance checking is done and you have an overview of how the pattern is

EITHER: “Ok, they already have contact, but I would like to do a few of them again, this is completely normal and it is very common to have to re-do various sensors” OR: “Ok, so, these are all fine.”
After the replacement pairs are attached and the contact is good:

“[In case you forgot to ask earlier, now is the time to ask about the mobile phone:] “Do you have a mobile phone with you?” [experimenter waits for response – in case there is, the experimenter asks to switch it off and leave it with the other belongings in the room behind the booth. For example, “OK, that might interfere with the signal – could you switch it off?”]

“Do you have chewing gum in your mouth?” [If yes, ask them to remove it – again because “It might interfere with the signal”]. “Ok, now please follow me.”

Take the participant to the experiment booth and ask them to sit down in the big chair.

“Please take a seat here.”

Explain that we will also be using skin conductance sensors on the index and ring finger of the left hand.

“We will be applying these sensors to the fingers in order to measure how you respond with skin conductance to the stimuli. We put a gel in the sensors to create connectivity [put gel into finger sensors]. It is mild and will not harm the skin. I will apply the sensors by wrapping the Velcro straps around your fingers and tightening them. [Attach sensors]. Do they feel too tight? You should feel slight pressure but not anything uncomfortable.” [Adjust sensors if needed].

Get PPG Sensor to attach to participant.

“We will also be using a PPG sensor to measure your heart rate during the experiment. It will be placed on your middle finger of your left hand. Please let me know if it feels uncomfortable.”

Connect the EMG sensors to the modules. Ground is always plugged in together with Zygomaticus. Connect the Skin Conductance sensors. Connect the PPG sensor.

Fill in the information you already have in the paper-log (impedances of all the sensors, booth temperature). Ask the participant:

“Do you have any further questions before we start?”; “Are you comfortable?” Then explain to the participant: “I will now start the experiment in the control booth, please follow the onscreen instructions; if you would like to stop the experiment at any time simply let me know, there is a microphone connecting this booth to the control room.”

Go to the control room. There, make sure that the Acknowledge recording is properly started, then start the Experiment script.

Make sure while participants are doing the experiment the markers are in the appropriate placement. Follow the markers from Experiment script in AcqKnowledge. Make note of any issues with the software that could affect analysis.

When the Experiment script is done, it should still be tested if all electrodes have remained well connected. While we do not have a calibration against the maximum activation as such, it can still be useful to ask the participant to smile and frown once. For this, come back to the booth and ask the participant to smile once, then to frown once. Mimic it.

“Could you please smile once and frown once? Like this.”

Disconnect the EMG sensors from the modules, and please take another measure of the impedances and note them down also in the Paper-log. **This step is easy to forget!** Remove skin conductance modules and heart rate modules. Remove the sensors from the participants’ left hand so they are able to fill out the questionnaire.

“OK, we are almost done. I will now stop the computer and be right back with you.”

Go back to the Control Room.

Stop the AcqKnowledge recording.

Bring the Post PANAS, and the Interpersonal Reactivity Index, demographics form, and AQ sheets, to the participant in the booth. Allow them a few minutes to fill out their impressions. Ask them to simply say “Done” when they are finished. Collect the sheet and say “Thank you”.

Once you have collected the post PANAS and the IRI, let them know we have finished the experiment.

“OK, this is it! Please take the cables into your hand like this, and follow me.”
Ask the participant if they have any questions regarding the nature of the experiment. It is important to debrief the participant. If they have questions, answer them. If not, then explain the purpose of the experiment.

“We are doing a series of studies on how people react to robots, technology and humans.

In this experiment, we are interested in examining the similarities and differences in human physiological reactions to stimuli that has various meanings. More specifically to examine if there is a difference in physiological responses or perception. When the experiment is fully finished we will be able to send around a full report. Do you have any questions?”

Go back to the room behind the booth and remove the EMG sensors. Then show participant to the bathroom and encourage them to put some cream on the spots where the EMG sensors were attached. Do not forget the lock the room with their belongings. When washing is done, if the participant took part for a monetary compensation, give the participant their money and ask them to sign the receipt sheet. Otherwise give them their signed participation sheet for the course credit.

“Could you now please fill in this receipt sheet?”

Both of you will then return to the booth so that the participant can retrieve their belongings.

“Thank you for participating. We are still looking for participants for this study. Don’t hesitate to ask your friends to contact us if they would like to participate.”

Walk the participant to the entrance of the lab:

“Thank you again for coming. Have a great day.”

Go back to the Control Room and stop MediaLab if it is still running.

Go back to the booth, take the EMG sensors, skin conductance sensors and heart rate sensors to be cleaned to the prep room.

Clean all sensors carefully.

Always put sensors to dry in the prep room – don’t put them in the bathroom (if it is being used, you may not be able to retrieve clean sensors for the next participant).

Clean hands (with soap) thoroughly after cleaning the sensors.

Put clean and dry EMG sensors in the room behind the booth for the next participant.

Reset paperwork and questionnaires for the next participant.

Fill in the remaining of the Log.

Set up the computers for the next participant if he/she directly follows.

Done! Next participant 🎉
Skin Impedance Form:

Collection of Impedances for Facial EMG at the Start and End of Experiment 3

**Impedances**

[Start or End]

<table>
<thead>
<tr>
<th>Part.ID</th>
<th>Ground</th>
<th>Corrugator</th>
<th>Zygomaticus</th>
<th>Levator</th>
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</thead>
<tbody>
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</table>
Positive and Negative Affect Schedule (PANAS) Questionnaire

Watson and colleagues, 1988

Given to Participant Pre, Mid, Post Experiment 2

[Pre, Mid, Post] Questionnaire

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very slightly or not at all</td>
<td>A little</td>
<td>Moderately</td>
<td>Quite a bit</td>
<td>Extremely</td>
</tr>
</tbody>
</table>

_____ Interested
_____ Distressed
_____ Excited
_____ Upset
_____ Strong
_____ Guilty
_____ Scared
_____ Hostile
_____ Enthusiastic
_____ Proud

_____ Irritable
_____ Alert
_____ Ashamed
_____ Inspired
_____ Nervous
_____ Determined
_____ Attentive
_____ Jittery
_____ Active
_____ Afraid
Post Experiment Questionnaires: Experiment 3

Perception and Bodily Responses to Video Material Experiment 2015

Post Experiment Written Questionnaire

1. Please briefly describe what you had to do during this study?

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

2. What do you think the experimenters wanted to find out?

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

3. What did you think of the study? What was your general impression?

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

4. How religious/spiritual do you consider yourself to be?

   1  2  3  4  5  6  7

   (Not at all)       (Very)
Interpersonal Reactivity Index (IRI): Participant View: Experiment 3

Davis, 1980, 1983

Questionnaire I

The following statements inquire about your thoughts and feelings in a variety of situations. Please indicate how well each of the following statements describes you.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Does not describe me well</th>
<th>Describes me very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I daydream and fantasize, with some regularity, about things that might happen to me.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>2. I often have tender, concerned feelings for people less fortunate than me.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>3. I sometimes find it difficult to see things from the &quot;other guy's&quot; point of view.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>4. Sometimes I don't feel very sorry for other people when they are having problems.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>5. I really get involved with the feelings of the characters in a novel.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>6. In emergency situations, I feel apprehensive and ill-at-ease.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>8. I try to look at everybody's side of a disagreement before I make a decision.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>9. When I see someone being taken advantage of, I feel kind of protective towards them.</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
</tbody>
</table>
10. I sometimes feel helpless when I am in the middle of a very emotional situation.

11. I sometimes try to understand my friends better by imagining how things look from their perspective.

12. Becoming extremely involved in a good book or movie is somewhat rare for me.

13. When I see someone get hurt, I tend to remain calm.

14. Other people's misfortunes do not usually disturb me a great deal.

15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.

16. After seeing a play or movie, I have felt as though I were one of the characters.

17. Being in a tense emotional situation scares me.

18. When I see someone being treated unfairly, I sometimes don't feel much pity for them.

19. I am usually pretty effective in dealing with emergencies.

20. I am often quite touched by things that I see happen.

21. I believe that there are two sides to every question and try to look at them both.
22. I would describe myself as a pretty soft-hearted person. □ □ □ □ □

23. When I watch a good movie, I can very easily put myself in the place of a leading character. □ □ □ □ □

24. I tend to lose control during emergencies. □ □ □ □ □

25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while. □ □ □ □ □

26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me. □ □ □ □ □

27. When I see someone who badly needs help in an emergency, I go to pieces. □ □ □ □ □

28. Before criticizing somebody, I try to imagine how I would feel if I were in their place. □ □ □ □ □
Autism Quotient (AQ): Participant View: Experiment 3

Baron-Cohen and colleagues, 2001

**Questionnaire II**

Choose one response that best describes how strongly each item applies to you.

<table>
<thead>
<tr>
<th>Question</th>
<th>Definitely agree</th>
<th>Slightly agree</th>
<th>Slightly disagree</th>
<th>Definitely disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I prefer to do things with others rather than on my own.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. I prefer to do things the same way over and over again.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. If I try to imagine something, I find it very easy to create a picture in my mind.</td>
<td>☐</td>
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<tr>
<td>4. I frequently get so strongly absorbed in one thing that I lose sight of other things.</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>5. I often notice small sounds when others do not.</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>6. I usually notice car number plates or similar strings of information.</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>7. Other people frequently tell me that what I’ve said is impolite, even though I think it is polite.</td>
<td>☐</td>
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<tr>
<td>8. When I’m reading a story, I can easily imagine what the characters might look like.</td>
<td>☐</td>
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<tr>
<td>9. I am fascinated by dates.</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>10. In a social group, I can easily keep track of several different people’s conversations.</td>
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<tr>
<td>11. I find social situations easy.</td>
<td>☐</td>
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<tr>
<td>12. I tend to notice details that others do not.</td>
<td>☐</td>
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<tr>
<td>13. I would rather go to a library than to a party.</td>
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<tr>
<td>15. I find myself drawn more strongly to people than to things.</td>
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<tr>
<td>16. I tend to have very strong interests, which I get upset about if I can’t pursue.</td>
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<tr>
<td>17. I enjoy social chitchat.</td>
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<tr>
<td>18. When I talk, it isn’t always easy for others to get a word in edgewise.</td>
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<td>19. I am fascinated by numbers.</td>
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<tr>
<td>20. When I’m reading a story, I find it difficult to work out the characters’ intentions.</td>
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<tr>
<td>21. I don’t particularly enjoy reading fiction.</td>
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<tr>
<td>22. I find it hard to make new friends.</td>
<td>☐</td>
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<tr>
<td>23. I notice patterns in things all the time.</td>
<td>☐</td>
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<tr>
<td>24. I would rather go to the theater than to a museum.</td>
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<td>25. It does not upset me if my daily routine is disturbed.</td>
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<tr>
<td>26. I frequently find that I don’t know how to keep a conversation going.</td>
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<tr>
<td>Question</td>
<td>Definitely agree</td>
<td>Slightly agree</td>
<td>Slightly disagree</td>
<td>Definitely disagree</td>
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<tr>
<td>27. I find it easy to “read between the lines” when someone is talking to me.</td>
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<td>28. I usually concentrate more on the whole picture, rather than on the small details.</td>
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<td>29. I am not very good at remembering phone numbers.</td>
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<tr>
<td>30. I don’t usually notice small changes in a situation or a person’s appearance.</td>
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<td>31. I know how to tell if someone listening to me is getting bored.</td>
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<td>32. I find it easy to do more than one thing at once.</td>
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<td>33. When I talk on the phone, I’m not sure when it’s my turn to speak.</td>
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<td>34. I enjoy doing things spontaneously.</td>
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<td>35. I am often the last to understand the point of a joke.</td>
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<tr>
<td>36. I find it easy to work out what someone is thinking or feeling just by looking at their face.</td>
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<tr>
<td>37. If there is an interruption, I can switch back to what I was doing very quickly.</td>
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<tr>
<td>38. I am good at social chitchat.</td>
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<td>39. People often tell me that I keep going on and on about the same thing.</td>
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<td>40. When I was young, I used to enjoy playing games involving pretending with other children.</td>
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<td>41. I like to collect information about categories of things (e.g., types of cars, birds, trains, plants).</td>
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<td>42. I find it difficult to imagine what it would be like to be someone else.</td>
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<td>43. I like to carefully plan any activities I participate in.</td>
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<td>44. I enjoy social occasions.</td>
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<tr>
<td>45. I find it difficult to work out people’s intentions.</td>
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<td>46. New situations make me anxious.</td>
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<tr>
<td>47. I enjoy meeting new people.</td>
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<td>48. I am a good diplomat.</td>
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<tr>
<td>49. I am not very good at remembering people’s date of birth.</td>
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<tr>
<td>50. I find it very easy to play games with children that involve pretending.</td>
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</tbody>
</table>

Participant Signature Sheet for Compensation: Experiment 3
I have received €10 for my participation in a physiology study about the perception and physiological responses to videos: “Perception and Bodily Responses to Video Material 2015” for the lab of Prof. Dr. Arvid Kappas at Jacobs University Bremen, 2015.

<table>
<thead>
<tr>
<th>Name (CAPITAL LETTERS)</th>
<th>Date</th>
<th>Nationality</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
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Appendix F

Experiment 1, 2: SPSS ANOVA Tables
Summary

This appendix contains ANOVA tables, and pairwise comparisons from experiment 1, and 2. It was not possible, or necessary to include all of these in the main articles of this dissertation. For access to the data files, or further information, please contact the author. For a discussion of the results presented in Appendix F, please look at Chapter 3, Article 2, in this thesis.
### F1. Pairwise Comparisons: Experiment 1: Epoch * Emotion

#### Corrugator Supercillii Activation

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## Electrodermal Activity

### Multivariate Tests

| Measure | Emotion | || Epoch | || Epoch | Mean Difference | Std Error | Sig | 95% Confidence Interval for Difference |
|---------|---------|-----|--------|---------|------------|--------|-----|-------------------------------------|
|         |         | 2   | 1      |         | 510       | 228    | 0.032 | 0.46 | 873.3 | 29.0 |
| EDA     |         | 2   | 1      |         | -41.3     | 329    | 0.207 | -0.655 | 0.207 |
|         |         | 3   | 1      |         | 603       | 0.15   | 0.491 | 0.033 | 628   | 0.28 |
|         |         | 3   | 1      |         | 603       | 0.19   | 0.489 | 0.036 | 642   | 0.39 |
|         |         | 3   | 1      |         | 603       | 0.19   | 0.489 | 0.036 | 642   | 0.39 |
|         |         | 2   | 1      |         | 603       | 0.15   | 0.491 | 0.033 | 628   | 0.28 |
|         |         | 2   | 1      |         | 603       | 0.19   | 0.489 | 0.036 | 642   | 0.39 |
|         |         | 2   | 1      |         | 603       | 0.19   | 0.489 | 0.036 | 642   | 0.39 |
|         |         | 3   | 1      |         | 603       | 0.19   | 0.491 | 0.033 | 628   | 0.28 |
|         |         | 3   | 1      |         | 603       | 0.19   | 0.489 | 0.036 | 642   | 0.39 |
|         |         | 3   | 1      |         | 603       | 0.19   | 0.491 | 0.033 | 628   | 0.28 |
|         |         | 3   | 1      |         | 603       | 0.19   | 0.489 | 0.036 | 642   | 0.39 |

### Multivariate Tests

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### Notes

- Values in the table are for different effects and interactions, with F-tests, hypothesis test values, and effect sizes indicated.
- "Value" represents the F-values for each effect.
- "F" indicates the F-statistic.
- "Hypothesis df" and "Error df" indicate the degrees of freedom for the hypothesis and error terms.
- "Sig" shows the significance level.
- "Partial Eta Squared" indicates the effect size.
- "Noncent Parameter" and "Observed Power" provide additional statistical measures.

---

### Footnotes

- <sup>a</sup> Indicates statistical significance.
- Table entries marked with asterisks (*) denote non-significant effects.
### F3. Test of Between-Subjects Effects

*Indicates no significance for condition

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a. Computed using alpha = .05

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*No significant effects

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a. Design: Intercept - Condition

b. Tests are based on averaged variables.

c. Exact statistic

d. The statistic is an upper bound on F that yields a lower bound on the significance level.

e. Computed using alpha = .05