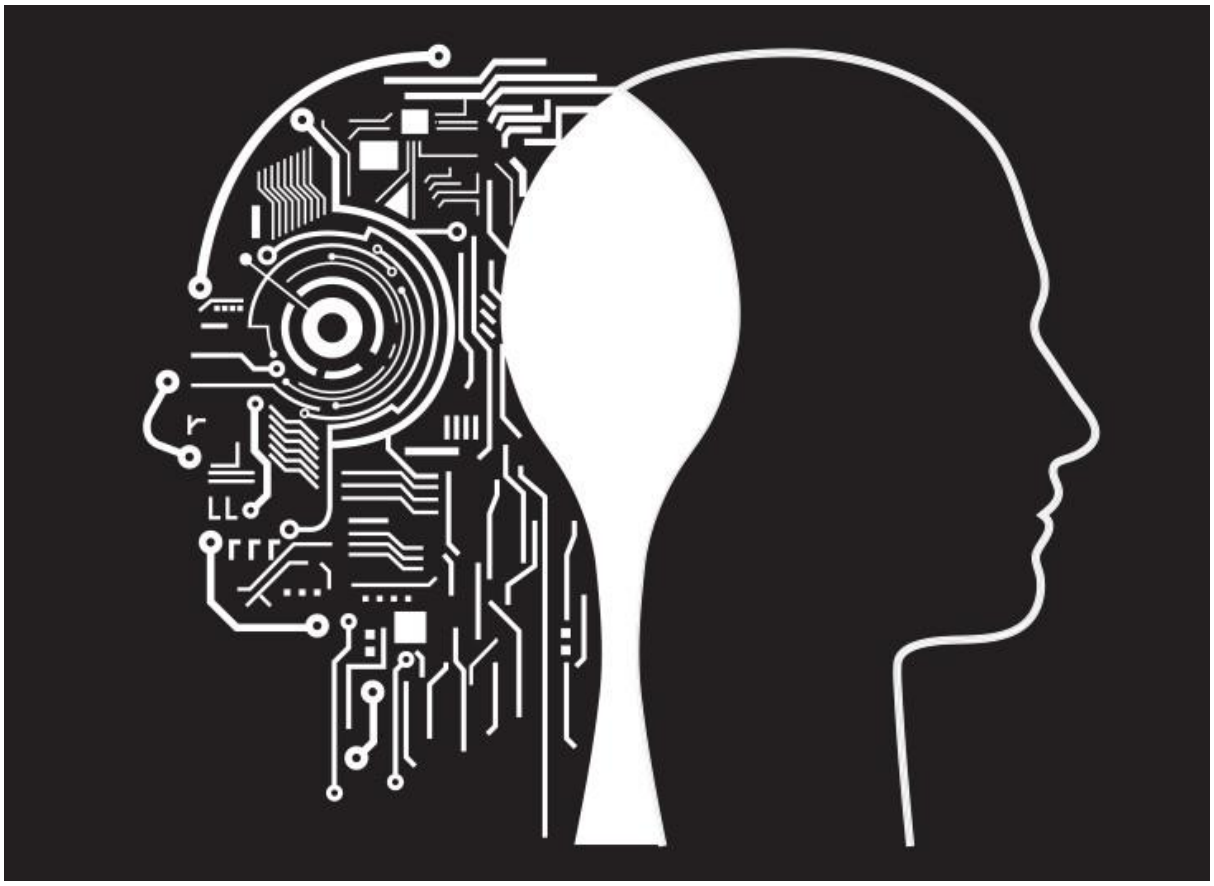
CBS COPENHAGEN BUSINESS SCHOOL
HANDELSHØJSKOLEN

Master's Thesis

The Impact of the Uncanny Valley on Consumer Behavior -

How Mind Attribution of Humanoid Robots impacts Product Evaluations



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ABSTRACT

Interactions between consumers and humanoid robots might soon become commonplace. Consumer acceptance drives the use and ultimate success of this technology. A major part of literature on the acceptance of humanoid robots has been guided by the uncanny valley hypothesis. This theory describes that humanoid robots which imperfectly resemble humans provoke feelings of eeriness in observers. A possible explanation that recently gained attention is that the uncanny valley results from people's perception of a human mind in a machine. Prior research has shown that these feelings of eeriness can elicit compensatory consumer behavior related to status-signaling products as well as healthy and unhealthy food products.

This thesis seeks to further investigate the impact of the uncanny valley on consumer behavior by focusing on how mind attribution of humanoid robots impacts product evaluations. For this purpose, an online survey experiment was conducted. This paper was not able to measure a significant impact of mind attribution of humanoid robots on product evaluations. However, this research found that, contrary to expectations, participants responded to perceived eeriness of the stimuli with a decrease in liking of status-signaling products. Overall, this study highlights the complex nature of the uncanny valley and draws attention towards a more nuanced understanding of the impact of the uncanny valley on consumer behavior.

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LIST OF ABBREVIATIONS

AI - Artificial Intelligence

CES - Consumer Electronics Show

EU - European Union

PC - Personal Computer

SD - Standard Deviation

UV - Uncanny Valley

1 INTRODUCING HUMANOID ROBOTS

Recent advances in robotics, artificial intelligence (AI) and automation technologies, have allowed companies to increasingly adopt these technologies to leverage from lower costs, faster production time, provision of consistent product quality, management of supply chain operations and many more benefits (Webster & Ivanov, 2019). While initially robots were used predominantly in the manufacturing sector, the use of robots in non-industrial fields has increased significantly in recent years (Appel, Izydorczyk, Weber, Mara, & Lischetzke, 2019). Nowadays, robots are built to clean the carpet or mow the garden lawn and are envisaged to play a key role in future sex work, military, tourism, education, retail and healthcare (Appel et al., 2019). Whereas robots were originally largely seen as tools, the last 20 years have seen a strong progress in the development of social humanoid robots (Broadbent, 2017). They are designed to interact closely with humans as artificial companions and helpers for diverse tasks (Broadbent, 2017). These kinds of robots are being made to mimic humans as close as possible – in looks, mind, emotional expression and behavior (Broadbent, 2017). A well-known example of a humanoid robot that strongly resembles the appearance of a human is Sophia, a project by Hanson Robotics (Hanson Robotics, 2019). Figure 1 shows a picture of Sophia.

Figure 1: Humanoid Robot Sophia created by Hanson Robotics (Hanson Robotics, 2019)

The humanoid design can elicit social responses from humans, which in turn can have a positive impact on acceptance (Duffy, 2003). Anthropomorphizing a robot can create a social connection to it, can facilitate learning how to use it and can positively affect how pleasant and usable the robot is perceived (Axelrod & Hone, 2005; Epley, Waytz, & Cacioppo, 2007; Riek, Rabinowitch, Chakrabarti, & Robinson, 2008). Furthermore, people prefer to collaborate with robots that are capable of responding socially (Goetz & Kiesler, 2002; Goetz, Kiesler, & Powers, 2003). However, this preference was task and context dependent (Goetz et al., 2003). Therefore, the appearance of a robot should match its capabilities, its task and the expectations of its users (Bartneck & Forlizzi, 2004; Broadbent et al., 2012; Duffy, 2003).

Due to their social capabilities, humanoid robots are especially suitable for healthcare and for service contexts (Broadbent, 2017; Murphy, Gretzel, & Pesonen, 2019). Robots can provide benefits to older people including reducing loneliness, problematic behaviors and depression as well as increasing social interactions with other people (Broadbent, 2017; Broadbent et al., 2014, 2012; Robinson, MacDonald, Kerse, & Broadbent, 2013). Furthermore, robots represent a primary area for service innovation and create new opportunities for relationship marketing (Murphy et al., 2019; van Doorn et al., 2017). Customer relationship management databases, artificial intelligence and online big data could enable robots to know customers better than any human and thereby enable them to create relationships that increase customer loyalty and commitment during the service delivery process (Murphy et al., 2019). Accordingly, service robots are developing from being standalone machines to networked entities that generate collective intelligence enabling these entities to learn from large amounts of data (Huang & Rust, 2018; Murphy et al., 2019).

Because of decreasing production costs, humanoid robots are expected to increasingly replace human service providers in numerous industries (Harris, Kimson, & Schwedel, 2018). For example, the humanoid robot “Pepper” from Softbank Robotics has been sold more than 12.000 times worldwide since its launch in 2014 (Olson, 2018). The service robot has been deployed for guiding shoppers to the right products at Carrefour, acting as concierge for dealership customers at Renault or waiting customers in different restaurants (Olson, 2018). Thus, encounters between humans and humanoid robots in the marketplace are not as futuristic as they might seem, but are likely to soon become commonplace (Mende, Scott, van Doorn, Grewal, & Shanks, 2019).

1.1 RESEARCH QUESTION

The Consumer Electronics Show (CES) is one of the most renowned trade shows for consumer electronics and a proving ground for breakthrough technologies (Consumer Technology Association, 2019). The presence of robots at the 2018 CES grew, but skepticism towards this technology increased as well (Murphy et al., 2019). Critics highlighted robotic failures, gimmickry and creepiness, which are important issues for potential consumer acceptance of and experiences with service robots (Baraniuk, 2018; Murphy et al., 2019; Peake, 2018; Song, 2018). These opinions are

supported by an EU survey that suggests that, along with the prevalence of robots, the attitudes towards robots are becoming more negative (Gnambs & Appel, 2019).

A major part of literature on the acceptance of humanoid robots has been guided by the uncanny valley hypothesis (Mori, 1970; Mori, MacDorman, & Kageki, 2012). According to this theory, there is a positive relationship between human likeness of robots and feelings of comfort with them (Mori et al., 2012). However, when robots look almost but not perfectly human, this relationship is reversed and the humanoid robot elicits feelings of eeriness among its human observers (Mori et al., 2012). Possible reasons for this uncanny valley (UV) have been discussed intensively in literature, but research has been unable to find a definite explanation for this phenomenon yet (MacDorman, Green, Ho, & Koch, 2009).

A possible explanation that recently gained attention is that the uncanny valley is based on people's perception of a human mind in a machine (Gray & Wegner, 2012; Hegel, Krach, Kircher, Wrede, & Sagerer, 2008; Stein & Ohler, 2017). This perspective shifts the focus away from the physical appearance of robots that has been emphasized in traditional explanations for the uncanny valley (Stein & Ohler, 2017). Instead, research supporting the mind attribution hypothesis proposes that the uncanny valley results from people ascribing the ability to feel (experience) and the ability to plan and act (agency) to robots (Appel et al., 2019; Gray & Wegner, 2012; Stein & Ohler, 2017).

Considering the current speed of technological developments, the mind attribution perspective becomes especially relevant. The progress of technology already enables the creation of advanced machines that can perform an increasing number of tasks autonomously without human control and supervision (Złotowski, Yogeeswaran, & Bartneck, 2017). Moreover, with advances in AI innovation and adoption, systems as flexible as human intelligence can soon become reality (Marinchak, Forrest, & Hoanca, 2018; Wirth, 2018). And therefore, the development of humanoid robots that potentially elicit mind attribution might increase.

Consumer acceptance drives the use and ultimate success of these technologies (Murphy et al., 2019). Therefore, this thesis aims to generate a better understanding of how consumers react to

humanoid robots. Considering the technological evolution, mind attribution of humanoid robots appears to play a critical role for consumer acceptance and will therefore be in the focus of this paper. Moreover, recognizing that encounters between humans and humanoid robots in the marketplace might soon become commonplace, this paper focuses on frequent consumer behavior. Specifically, the following research question will be investigated:

How does mind attribution of humanoid robots impact product evaluations?

1.2 DELIMITATIONS

In the following, the scope and the boundaries of this research are described. Thereby, this section explains the choices of direction and theory with regard to the research question.

First, related to the potential impact of humanoid robots, this study follows the notion of the uncanny valley hypothesis, because a major part of literature on the acceptance of humanoid robots is guided by it. Therefore, the reviewed literature and the derived research design focus on the feelings of eeriness elicited by humanoid robots that are central to the uncanny valley hypothesis. Further, this research is delimited to the visual effect of humanoid robots as well as the effect of selected robot capabilities (agency and experience). Other ways how humanoid robots could potentially impact consumer behavior such as through vocal and nonverbal persuasion techniques, are not discussed (Siegel, Breazeal, & Norton, 2009).

Moreover, this study is delimited to product evaluations as an example of consumer behavior that frequently occurs in the marketplace. It is normally argued, that consumers make their purchase decisions based on the evaluations of and knowledge about product attributes (Jamal & Goode, 2001). Therefore, product evaluations are essential to consumers' decision-making and thus a relevant topic to explore. More specifically, the self-reported liking and willingness to pay for individual product types will be investigated, as they are common criteria for product evaluations.
Another delimitation of this study is the focus on status-signaling products as well as healthy and unhealthy food products. These specific product categories were chosen based on the insights from an extensive literature review. They represent categories to which a specific behavior pattern as a

response to feelings of eeriness could be identified. These patterns then served as a basis to derive hypotheses about how consumers might react to humanoid robots. Further delimitations related to the sample population and the methodological choice are discussed in the research design and the methodology part of this paper.

1.3 STRUCTURE OF THE THESIS

Figure 2 illustrates the research structure of this thesis and functions as a guide for the reader. After having introduced the topic and explained its delimitations, this paper is briefly touching upon basic concepts which are cognition, priming and symbolic properties of products. Understanding these concepts will contribute to the overall understanding of this paper. Further, the main theories and concepts used in the present study will be outlined and discussed within a literature review. This section will be split up into a general definition of the uncanny valley phenomenon and its possible causes as well as the UV from a consumer behavior perspective. Then, the theory will be summarized and a research proposition as well as the hypotheses will be derived. Moreover, methodological considerations will be described. This includes the underlying philosophy of research, the research approach, the research strategy as well as the techniques and procedures of data collection and analysis. Next, the experiment design will be illustrated in detail which will be followed by the actual data analysis and findings. Finally, all findings will be summarized and discussed. Within the discussion part, the validity and reliability as well as the managerial implications derived from the findings will be indicated and the limitations of the study at hand will be pointed out. Lastly, the authors will draw a conclusion and give recommendations for future research.

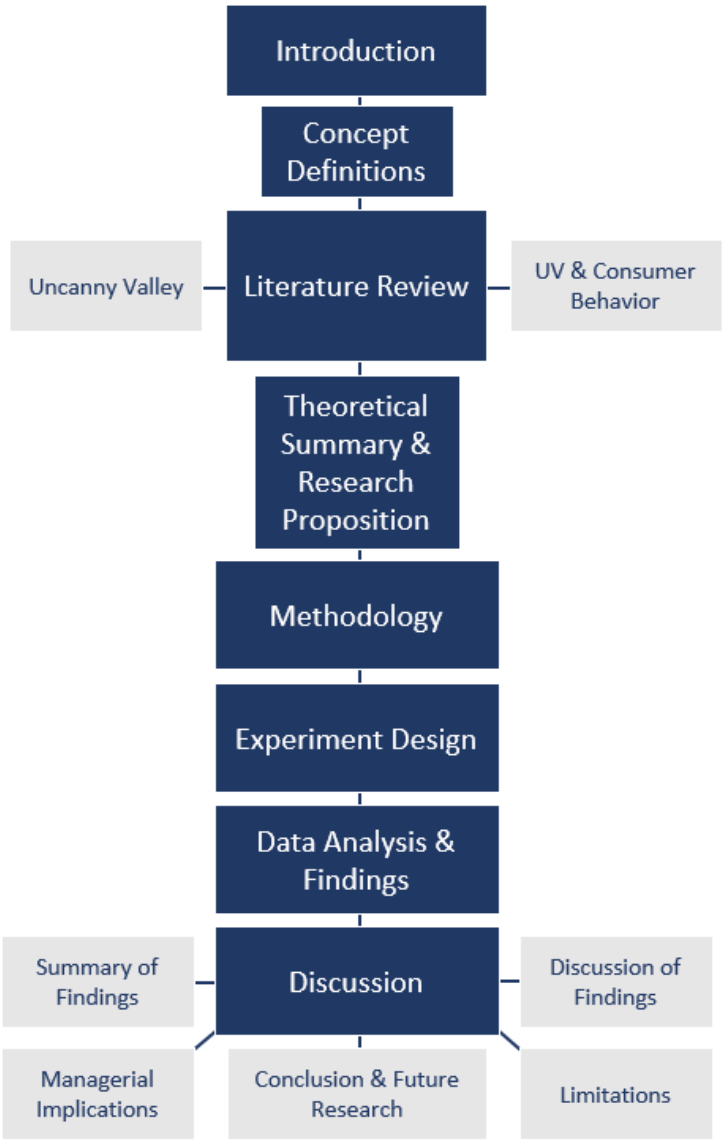

Figure 2: Illustration of the Research Structure

2 CONCEPT DEFINITIONS

The goal of this chapter is to create a fundamental understanding of the theories and concepts this paper draws upon. In order to comprehend the logic behind the literature, research proposition and experiment design, the basic concepts of cognition, priming and status-signaling consumption will be explained hereinafter.

2.1 COGNITION

What happens when people identify, interpret or generally respond to a stimulus such as a robot? A fundamental concept that is explaining cognitive processes behind the theoretical and methodological approach in this paper is the two-system view explained by Daniel Kahneman (2003) based on the work of multiple researchers. There are two modes of thinking that can be divided into System 1 and System 2 (Kahneman, 2003; Stanovich & West, 2000). System 1 operates fast, automatic, effortless, associative and difficult to control or modify whereas System 2 is slower, serial, effortful, deliberately controlled, flexible and potentially rule-governed (Kahneman, 2003; Stanovich & West, 2000). System 1 works similarly to perceptual processing and generates intuitive impressions of the attributes of objects while System 2 is involved in all judgements and reasoning (Kahneman, 2003). Both systems are based on conceptual representations or knowledge from the past, present and the future and can be evoked by language (Kahneman, 2003). How fast these conceptional representations come to one's mind, also called accessibility, eventually determines whether System 1 or System 2 is at work (Higgins, 1996; Kahneman, 2003). High accessibility means that they come to mind spontaneously like percepts (Kahneman, 2003).

Determinants of the accessibility of knowledge are, for example, the salience of the stimulus which can be physical or virtual, but also if deliberate attention is paid to something special. An instruction to look for a particular cue enhances the accessibility of conceptual representations (Kahneman, 2003).

2.2 PRIMING

Another factor influencing the accessibility of knowledge is the concept of priming (Higgins, 1996; Kahneman, 2003). Priming is defined as “a change in the ability to identify or produce an item as a result of a specific prior encounter with the item” or “the facilitated identification of perceptual objects from reduced cues as a consequence of a specific prior exposure to an object” (Schacter, 1992, p. 244; Schacter & Buckner, 1998, p. 185; Tulving & Schacter, 1990). The phenomenon can also be understood as an implicit memory or a nonconscious influence of past experiences on current performance and behavior (Graf & Schacter, 1985; Schacter & Buckner, 1998). Furthermore, past research differentiates between subliminal and supraliminal primes (Greenwald, Draine, & Abrams, 1996). Subliminal primes exist and operate below a threshold of perception or consciousness and are insufficiently intense to produce a discrete sensation (Greenspan & Silberman, 2013). However, they can be intense enough to influence the mental processes or the behavior of a person (Greenspan & Silberman, 2013). A supraliminal prime is above a threshold of perception of a stimulus or person and results in the consciousness of the aforesaid (Greenspan & Silberman, 2013).

Next to verbal priming, nonverbal stimuli such as pictures, shapes and faces can be used to prime someone (Tulving & Schacter, 1990). The semantic encoding of verbal primes is also called conceptual priming whereas the processing of physical primes is characterized as perceptual priming (Schacter & Buckner, 1998).

A large and growing body of literature has investigated behavioral consequences of priming. Herr (1986) found that priming with social categories like hostility leads to profound consequences for the perception of another person and subsequent behavioral interaction. Also, Zemack-Rugar et al. (2007) identified a significant change in behavior for individuals that were primed with sad or guilty emotion. These individuals showed lower levels of indulgence as a consequence of being primed guilty, but only if they effectively linked guilt with abstinence (Zemack-Rugar et al., 2007). Moreover, unconscious or subliminal cues of attractive food can trigger a hedonic orientation towards food and eating, leading to overeating while primes that activated a dieting goal resulted in oppositional behavior (Papies & Hamstra, 2010).

It becomes evident that behavior can be influenced by the priming of a variety of psychological concepts and processes. Social behavior, emotions, goals, social norms and stereotypes are all examples of what can be put into motion non-consciously (Bargh, 2006). Moreover, more complex prime effects such as deep cultural ideologies have been identified by Solomon, Greenberg and Pyszczynski (1998). The researchers are focusing on the inevitability of death and that humans are therefore facing a constant, subconscious mortal fear (Solomon et al., 1998). By embracing cultural beliefs, self-esteem can be generated that in return functions as an anxiety buffer for the fear of death (Solomon et al., 1998).

2.2.1 PRIMING AND MARKETING

Regardless of what is being primed, the underlying mechanism of subliminal and supraliminal priming is the increase of the accessibility of unconscious knowledge and thereby activating memory retrieval from System 1 which works fast and automatic. Eventually, this will result in changes in the behavior.

From a marketing perspective, it appears interesting to influence a consumer's behavior by priming them with specific cues into consumption of products and services. Previous research has established a link between priming and product choice and evaluations (Wänke, 2016). Priming can increase the accessibility of brands (Nedungadi, 1990). This means that they can be memorized easier when deciding between different brands which subsequently increases the likelihood of being taken into consideration or chosen (Nedungadi, 1990). These results were consistent with mere product exposure as well as the exposure of individuals to an advert (Nedungadi, 1990; Shapiro, Macinnis, & Heckler, 1997). While Nedungadi (1990) argues that the accessibility of brands can be increased through primes without changing brand evaluations, Lee and Labroo (2004) found that a person develops more favorable attitudes towards an object if exposed to it repeatedly. Ferraro et al. (2009) support these findings by showing that it can even result in increased choice of the primed brand. Therefore, next to the inclusion of a brand into a consideration set, priming a brand or product can also influence the actual choice as well as brand evaluations (Ferraro et al., 2009; Lee & Labroo, 2004; Shapiro et al., 1997).

As mentioned before in the first part of this chapter, primes can have an influence on food intake (Papies & Hamstra, 2010). Physiological needs such as hunger but also desires and consumption goals are possible outcomes of primes that are relevant for marketers (Schüssler et al., 2012; Wänke, 2016). By priming concepts like price, safety, comfort, health, sophistication etc. preferences for products that fit the activated dimension best can be triggered (Wänke, 2016).

Moreover, motivational and emotional states elicited through primes can be of importance from the standpoint of a marketer (Wänke, 2016). Winkielman et al. (2005) found that thirsty individuals who were subliminally presented happy faces poured and consumed more beverage and also increased their willingness to pay compared to participants who were exposed to angry faces. A great body of literature focuses on the priming of mortality as a motivational construct. The priming of death-related thoughts is particularly relevant due to the materialistic notion of behavioral effects on persons that have been stimulated. Hence, Solomon et al. (1998) developed the Terror Management Theory which describes that death-related thought motivates defense of one's cultural worldviews and the striving for self-esteem. Such defenses can manifest themselves, for example, in the increased support for charismatic leaders, like former president Bush; a preference for local over foreign products; more favorable evaluations of status-signaling items compared to low-status items as well as generally increased purchase intentions (Das, Duiven, Arendsen, & Vermeulen, 2014; Friese & Hofmann, 2008; Landau et al., 2004; Mandel & Heine, 2016).

Another interesting reaction to subliminal death primes was the decreased interest in sun protection along with increased interest in tanning products and services, because participants associated tanned skin with an attractive appearance and thus, a source of self-esteem (Routledge, Arndt, & Goldenberg, 2004). Notably, supraliminal primes with death led participants into an increased intention to protect themselves from dangerous sun exposure (Routledge et al., 2004). Therefore, for marketing purposes, the differentiation between subliminal and supraliminal primes as well as the suitability of the product or service as source of self-esteem play an important role (Greenberg, Arndt, Pyszczynski, & Solomon, 1997). The Terror Management Theory and its mechanisms will be explained in detail at a later point in the literature part of this paper.

In general, priming can be used in multiple ways in the consumer environment (Wänke, 2016). For example, stimuli can be embedded as background pictures and colors of a webpage, in printed and online adverts as well as product inherent features such as price or food coloring (Das et al., 2014; Mandel & Johnson, 2002; Spence, Levitan, Shankar, & Zampini, 2010; Wänke, 2016). Also in-store food choice behaviour can be influenced by primes such as background music and scent (Dijksterhuis, Smith, & Baaren, 2005; Holland, Hendriks, & Aarts, 2005).

2.3 STATUS-SIGNALING CONSUMPTION

As mentioned before, a possible consequence of a subliminal priming with mortality salience is more favorable evaluations of status-signaling items compared to low-status items (Mandel & Heine, 2016). By purchasing status-signaling products, such as luxury cars or designer clothing, an individual may feel more valuable within the culture which in return generates self-esteem resulting in a relief of anxiety in response to threats of one's own mortality (Mandel & Heine, 2016).

Early research on possessions by Russell W. Belk (1988) revealed that possessions are a major contributor to and reflection of one's identity. The consumption of highly conspicuous goods and services in particular functions as a display of wealth and social status which is also referred to as the "Veblen effect" introduced by Thorstein Veblen in 1899 (Bagwell & Bernheim, 1996). More specifically, individuals are willing to pay a premium price for a functionally equivalent product that the purchase perceives to be more prestigious (Bagwell & Bernheim, 1996). Sivanathan & Pettit (2010) found that status goods are being consumed under the premise of soothing psychological pain when being threatened, when alternative affirmational resources are not available. Generally, self-esteem is an important motivator in purchasing luxury goods for self-directed pleasure (Truong & McColl, 2011).

3 LITERATURE REVIEW

In this section, selected literature from psychology as well as consumer and marketing research is reviewed to establish a theoretical basis for the research proposition and hypotheses. First of all, the uncanny valley and its potential causes will be explained. Subsequently, literature about

compensatory behavior and terror management will be reviewed and serves as a basis to establish the potential impact of the uncanny valley on consumer behavior. Moreover, important moderators that have an effect on feelings of eeriness will be outlined.

3.1 THE UNCANNY VALLEY

As mentioned before, humanoid robots and their interactions with humans are becoming more relevant by the minute and are considered likely to continue to change the life of humans in the future. Studying the influence of robots on humans has become a central issue in recent years, although pioneers in robotics already started to research people's reactions to robots in 1970 (Mori, 1970; Mori, MacDorman, & Kageki, 2012).

Mori (2012) began to imagine what reactions human-like robots could elicit in the future since at that time only industrial robots were existent. He concluded that the relationship between the human likeness of an entity and the perceiver's affinity for it is crucial to observe and developed the graph shown in Figure 3. In addition to the increased human likeness of an entity, the level of affinity of a human perceiver increases up until a certain point where the entity almost appears human, but not exactly. At this point, feelings of eeriness and revulsion will be elicited in observers, evolving into a valley of uncanny feelings. As the robot's appearance continues to become less distinguishable from a human being, the level of affinity rises once again.

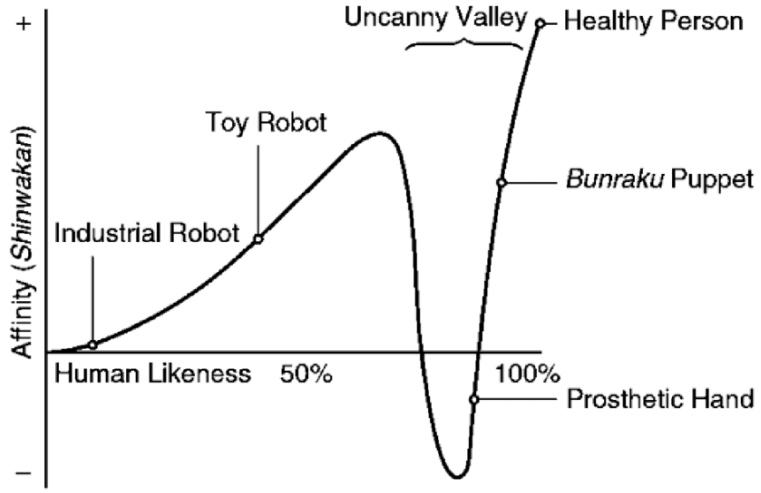

Figure 3: The Uncanny Valley Graph (Note: Bunraku puppets are traditional Japanese puppets used for musical theatre) (Mori et al., 2012)

Velocity, acceleration and deceleration approximating human movement amplify the peaks and valley of the Uncanny Valley graph. Due to movements being a fundamental characteristic of living beings, they contribute to the human likeness of robots and subsequently proliferate or reduce the level of affinity compared to a still object (Mori et al., 2012). Based on his theory, Mori (2012) argues for deliberately designing robots less human to ensure a moderate yet safe level of affinity.

Subsequently, Mori's (2012) theory has been used to discuss and develop visual design premises for robots (DiSalvo, Gemperle, Forlizzi, & Kiesler, 2002; Fong, Nourbakhsh, & Dautenhahn, 2003). The scope of the Uncanny Valley graph has also been extended to other characteristics of robots such as sound, perceived personality and general behavior (Grimshaw, 2009; Scheeff, Pinto, Rahardja, Snibbe, & Tow, 2002; Walters, Syrdal, Dautenhahn, Te Boekhorst, & Koay, 2008). Next to robots, multiple researchers have connected the Uncanny Valley theory to computer-generated imagery (CGI) like animations in the film and video game industry (Brenton, Gillies, Ballin, & Chatting, 2005; MacDorman, Green, Ho, & Koch, 2009; Schneider, Yang, & Wang, 2007; Seyama & Nagayama, 2007). For example, many viewers felt that characters in the animated film Polar Express elicited uncomfortable feelings (Kaba, 2013).

3.1.1 POSSIBLE CAUSES OF THE UNCANNY VALLEY

In order to understand how the uncanny valley emerges, several researchers categorize possible reasons of the Uncanny Valley into explanations involving perceptual as well as cognitive processing (MacDorman et al., 2009; Wang, Lilienfeld, & Rochat, 2015). Perceptual processing works automatically, stimulus-driven, specialized and occurs early whereas cognitive processing involves a broader and more general processing occurring later (MacDorman et al., 2009). Possible causes of the uncanny valley that are processed perceptually are the pathogen avoidance theory and the evolutionary aesthetics theory. Cognitively processed causes are the violation of expectation theory, the categorization uncertainty theory, the mortality salience theory and the mind attribution theory.

The Pathogen Avoidance Theory

According to the pathogen avoidance theory humans tend to have stronger aversions to the defects, like illnesses, of more human-like organisms (MacDorman et al., 2009; Wang et al., 2015). Human likeness indicates genetic similarities and therefore a higher likelihood of the transmission of possible diseases (MacDorman et al., 2009; Wang et al., 2015). Drawn from the theory of disgust by Rozin and Fallon (1987) researchers argue that the eeriness humans experience with humanoids originates in disgust caused by and infection avoidance mechanism towards our species or related species (MacDorman & Ishiguro, 2006). Mori (2012) himself assumed that a possible reason for the Uncanny Valley and concomitant feelings of unease could be the human instinct for self-preservation. Accordingly, the affinity levels towards a human-like entity could be influenced by defenses against proximal sources of dangers such as corpses, dangerous animals and other threats (Mori et al., 2012).

The Evolutionary Aesthetics Theory

Moreover, evolutionary aesthetics play a role when it comes to self-preservation. The theory of mate selection can explain and aversion to abnormalities (MacDorman & Entezari, 2015; MacDorman et al., 2009; Wang et al., 2015). The perception of the attractiveness of a potential mating partner has a biological basis in the specialized perceptual processing of, for example, fertility, hormonal and immune system health, social desirability and other signs of reproductive fitness (Hanson, 2005; MacDorman et al., 2009). Hanson (2005) argues that the uncanniness of a human replica is due to its low level of attractiveness and found that attractively-tuned humanoids were perceived consistently as lower in eeriness and higher in appeal. For both pathogen avoidance and mate selection theories, aversion to abnormalities means enhanced fitness (MacDorman & Entezari, 2015).

The Violation of Expectations Theory

Saygin et al. (2012) suggest the violation of expectations theory which Mori (2012) broadly referred to in his article as well. He described that, for instance, a prosthetic hand appeared real at a first glance but elicited eerie sensations when realizing that it was artificial based on the cold temperature and the lack of soft tissue (Mori et al., 2012; Wang et al., 2015). A human looking robot

is associated with a particular kind of behavior which is the result of predictions generated by the brain (Saygin et al., 2012). These predictions are rested on a lifetime of experiencing human behavior (Saygin et al., 2012). By comparing differential responses to the movements of a non-human robot, a humanoid and an actual human with the help of an FRMI, Saygin et al. (2012) discovered that the appearance-motion mismatch was highest for the humanoid and therefore caused the Uncanny Valley. The same notion was found in a mismatch induced by disproportionate facial features (MacDorman et al., 2009; Seyama & Nagayama, 2007). Seyama and Nagayama (2007) confirmed that the Uncanny Valley only emerged when faces had abnormal features. Additionally, an incongruence between the human likeness of a robot's face and voice elicits feelings of eeriness (Mitchell, Lu, Scheutz, Schermerhorn, & MacDorman, 2011).

The Categorization Uncertainty Theory

Another possible explanation of the Uncanny Valley within cognitive processing is categorization uncertainty theory or the cognitive dissonance of liminal objects (MacDorman et al., 2009; Wang et al., 2015). Already in 1906, Ernst Jentsch identified category uncertainty as the cause of uncanniness (Jentsch, 1906). According to his theory, eerie feelings are the consequence of uncertainty about whether an entity is inanimate or animate, or whether it is non-human or human (Jentsch, 1906). Humanoids and computer-generated characters are liminal objects that are located on the boundaries of what we perceive as human and non-human (MacDorman et al., 2009). Yamada et al. (2013) supported Jentsch's (1906) theory by discovering that negative impressions are formed with difficulties in categorizing ambiguous faces that were morphed between real, hand-drawn and stuffed-toy human. However, it must be noted that the researchers did only measure likeability but not the uncanniness or eeriness of the morphing entities nor did they include humanoid robots or computer-generated humans (Macdorman & Chattopadhyay, 2016). Interestingly, MacDorman and Chattopadhyay (2016) could not support Jentsch's (1906) and Yamada et al.'s (2013) theory as they found that their most ambiguous test entities were not the eeriest. Also, Cheetham et al. were unable to find support (2014).

The Mortality Salience Theory

According to Ernest Becker (1973) the fear of death is consistently present in human biological functioning for self-preservation purposes. This immanent awareness of death has led humanity into creating cultural worldviews that function as a coping strategy (Becker, 1973; Solomon et al., 1998). By creating beliefs about the nature of reality shared among groups of people, the terror of mortality can be managed effectively (Becker, 1973; Solomon et al., 1998). Such cultural worldviews provide fundamental answers to questions concerning identity, origin and tasks of a human being during their lifetime while also narrating death and giving it meaning through rituals (Solomon et al., 1998). The goal of these cultural worldviews is to give hope of symbolic or literal immortality (Solomon et al., 1998). Solomon et al. (1998) have continued the notion of Becker (1973) and developed the *Terror Management Theory*. Complying with cultural worldviews results in the perception that one is a valuable member of a meaningful society which in return generates self-esteem which functions as an anxiety buffer to the omnipresent fear of death. (Solomon et al., 1998).

MacDorman (2005) investigated the connection between mortality salience and the Uncanny Valley with the help of the mortality salience hypothesis. The hypothesis is based on the Terror Management Theory and states that those who have been subliminally reminded of death will react more favorably to information that supports their worldview and less favorably to information that undermines it (MacDorman, 2005). He argues that an uncanny-looking humanoid might elicit feelings of unease because the robot is acting as a reminder of mortality by, for example, resembling a dead person because of imperfections of its animation (MacDorman, 2005). Experiment participants were exposed to either an uncanny image of a humanoid or a control image and subsequently asked worldview-related questions. On average the group exposed to the uncanny image consistently preferred information sources that supported their worldview relative to the control group (MacDorman, 2005).

The Mind Attribution Theory

Many theories exploring the Uncanny Valley phenomenon have emphasized the physical appearance of a humanoid robots in connection to evolutionary psychological theories or an

underlying categorization conflict. More recently, studies have shifted away their focus from the appearance of human-like entities. Instead they are exploring the perception of mind in them as basis for observers' discomfort (Appel et al., 2019; K. Gray & Wegner, 2012; Stein & Ohler, 2017; Wegner & Gray, 2017). A factor analysis conducted by Gray, Gray and Wegner (2007) identified two dimensions of mind perception. *Agency* or an agentic mind relates to having intention, reasoning, pursuing goals, planning, communicating, remembering outcomes and taking actions (Shank, Graves, Gott, Gamez, & Rodriguez, 2019). *Experience* or an experiential mind describe emotion expression, feeling pain and pleasure, physical sensation, remembering experiences, personality and consciousness (Shank et al., 2019).

Mind perception in human-like robots and its consequences on humans have been the subject in multiple studies. Shank et al. (2019) identified unease among other feelings such as surprise or amazement as a possible emotional reaction when perceiving mind in machines. In another piece of work, Gray and Wegner (2012) found that increased experience in robots particularly elicits feelings of unease within the human observers, even without looking human-like. Although, Broadbent et al. (2013) found that the perception of mind in a robot increases gradually with its human likeness.

The importance of experience in terms of negative emotional perception is furthermore demonstrated by showing that a human being bereft of any emotions was perceived similarly eerie as the robot with distinct experiential behavior. Therefore, it has been assumed that humanoid robots with experience elicit eeriness because experience or emotions are exclusively associated with the concept of humans (Appel et al., 2019). A human without any emotions and a robot with real emotions are simply not considered to be possible. Agency, on the other hand, appeared to be unrelated to the negative responses to this new technology.

On the contrary, Złotowski et al. (2017) argue that coinciding emotional responses are caused by increased agency. Artificial intelligent robots that can decide whether to follow or disregard human instructions are characterized as autonomous agents. They can cause feeling of eeriness within human observers as they are becoming aware of losing power and control over such technology

(Złotowski et al., 2017). They found that robots perceived to be autonomous showed increased threat levels as well a negative attitude compared to the non-autonomous robots (Złotowski et al., 2017). Also, Appel et al. (2019) were able to establish a relationship between increased agency and feelings of eeriness. As one of the latest articles studying the two dimensions of mind perception, the researchers suggest that both, experience and agency may be responsible for the eeriness of humanoid robots examined in uncanny valley research.

3.2 IMPACT OF THE UNCANNY VALLEY ON CONSUMER BEHAVIOR

After defining the uncanny valley and outlining its potential causes, the next part will review the potential impact of the uncanny valley on consumer behavior. Until today, there is no comprehensive literature on this specific topic. However, literature about compensatory behavior and terror management cover the impact of feelings of eeriness on consumer behavior. Therefore, the potential impact of the uncanny valley on consumer behavior is mainly derived from these streams of literature.

3.2.1 LITERATURE FROM COMPENSATORY CONSUMER BEHAVIOR

As outlined above, people experience eeriness and a threat to their human identity when confronting humanoid robots. Mende et al. (2019) investigate how consumers cope with this discomfort and draw on the notion of compensatory consumption, that refers to consumption "motivated by a desire to offset or reduce a self-discrepancy" (Mandel, Rucker, Levav, & Galinsky, 2017, p. 134). A self-discrepancy is an incongruity between one's ideal and perceived self that is typically psychologically aversive (Higgins, 1987). Due to the aversive nature of self-discrepancies, consumers usually engage in self-regulation efforts to reduce them (Mandel et al., 2017). These efforts can manifest in different forms of consumer behavior (Mandel et al., 2017).

People use consumer behavior to respond to self-discrepancies in at least 5 different ways: direct resolution, dissociation, fluid compensation, escapism and symbolic self-completion (Mandel et al., 2017). Direct resolution is a strategy that involves behaviors that directly address the source of the self-discrepancy (Mandel et al., 2017). In this strategy, consumers purchase or use products that can directly solve the self-discrepancy like reading books to become smarter when a person is feeling

less intelligent than desired (Mandel et al., 2017). In contrast to that, the dissociation strategy entails avoiding products related to the self-discrepancy (Mandel et al., 2017). An example of such a behavior would be a person that cancels his newspaper subscription because he feels less intelligent than desired (Mandel et al., 2017). People that use the fluid compensation strategy respond to self-discrepancies by reinforcing another aspect of the identity that is distinct from the self-discrepancy (Mandel et al., 2017). Pursuing this strategy, a person would purchase a Rolex to feel financially successful to respond to feeling less intelligent than desired (Mandel et al., 2017). Another strategy is escapism, which relates to behavior that distracts oneself from thinking about the self-discrepancy (Mandel et al., 2017). Using escapism, a person would go to the movies to distract himself from feeling less intelligent than desired (Mandel et al., 2017). Finally, symbolic self-completion is another strategy to respond to self-discrepancies and has been subject of numerous past research (Mandel et al., 2017).

Wicklund and Gollwitzer's (1981, 1982) symbolic self-completion theory, according to which people can cope with self-discrepancies by acquiring symbols, serves as the theoretical foundation of compensatory behavior (Mandel et al., 2017). The concept of compensatory consumption relates this idea more directly to marketing and proposes that consumers can respond to self-discrepancies by "acquiring, thinking about and consuming products that are imbued with symbolic properties" (Lisjak, Bonezzi, Kim, & Rucker, 2015, p. 1187). This idea has been extensively supported by empirical research that has identified numerous specific compensatory consumer behaviors (Mandel et al., 2017). For example, Gao, Wheeler and Shiv (2009) found that consumers that felt insecure about their intelligence were more likely to choose a product related to intelligence over a product unrelated to intelligence.

Similarly, consumers responded to a threat related to their social status with an increased willingness to pay for status-signaling products (Rucker & Galinsky, 2008). Other research found that people are more likely to buy products that signal membership in the social group when self-discrepancies arise in terms of social belongingness (Duclos, Wan, & Jiang, 2013; Lee & Shrum, 2012; Mead, Baumeister, Stillman, Rawn, & Vohs, 2011). Another major response to self-discrepancies is the overconsumption of food and the increased consumption of unhealthy food (Mandel et al.,

2017). Mandel and Smeesters (2008) showed that consumer's purchase and consumption quantities of food increase when they are reminded of their own inevitable mortality. Analogically, consumers responded to threats to their social belongingness with increased consumption of unhealthy food (Troisi & Gabriel, 2011).

Mende et al. (2019) use these insights from compensatory consumption to examine the concept of the uncanny valley by testing how customers respond to humanoid service robots. In a series of seven experiments, the authors show that humanoid service robots can elicit eeriness and a threat to human identity. Moreover, they show that consumers cope with this discomfort by choosing a status product, seeking social affiliation and increasing their caloric intake (Mende et al., 2019). Furthermore, they found that the compensatory effects are moderated by social belongingness, the perceived healthfulness of food and the extent to which the humanoid service robots are machinized (Mende et al., 2019).

3.2.2 LITERATURE FROM TERROR MANAGEMENT

Terror management explores the relationship between mortality salience and the defense processes it elicits (MacDorman, 2005). Mortality can be made salient through diverse stimuli and humanoid robots might be one of those (MacDorman & Ishiguro, 2006). As mortality salience is one potential cause of the uncanny valley, it is not surprising that humanoid robots can elicit the same psychological defenses as subliminal death reminders (MacDorman & Ishiguro, 2006). Terror management investigates the influence of mortality salience on consumer behavior and therefore serves as another important stream of literature to understand the potential influence of the uncanny valley on consumer behavior. Conscious and nonconscious but accessible thoughts of death activate distinct defensive processes (Pyszczynski, Solomon, & Greenberg, 1999). The dual defense model of terror management distinguishes these defensive processes into proximal and distal defenses (Pyszczynski et al., 1999). Arndt, Greenberg and Cook (2002) have further investigated the cognitive processes that underlie terror management responses and developed a model of the cognitive architecture of terror management responses (see left part of figure 4).

When thoughts of death are in focal attention and explicitly in people's minds, they provoke proximal defenses which are designed to remove death-related thoughts from conscious awareness (Pyszczynski et al., 1999). These defense strategies include suppressing death-related thoughts or pushing the problem of death into the distant future by denying one's vulnerability (Pyszczynski et al., 1999). Once these proximal defenses are relaxed, there is a delayed increase in unconscious death thought accessibility (Arndt et al., 2002). In laboratory research, this increase of death thought accessibility outside of focal attention can be achieved by priming death subliminally or under high cognitive load of the participants, which reduces the effectiveness of suppressing death related thoughts (Arndt, J., Greenberg, J., Pyszczynski, T., & Solomon, 1997; Arndt, Greenberg, Pyszczynski, Solomon, & Simon, 1997).

These increased death-related thoughts outside of current consciousness activate distal defenses that address the problem of death in a more indirect, symbolic manner through maintaining self-esteem and faith in one's current worldview (Pyszczynski et al., 1999). Instead of pushing the problem of death out of consciousness, distal defenses are aiming to provide security by making one's life seem meaningful (Pyszczynski et al., 1999).

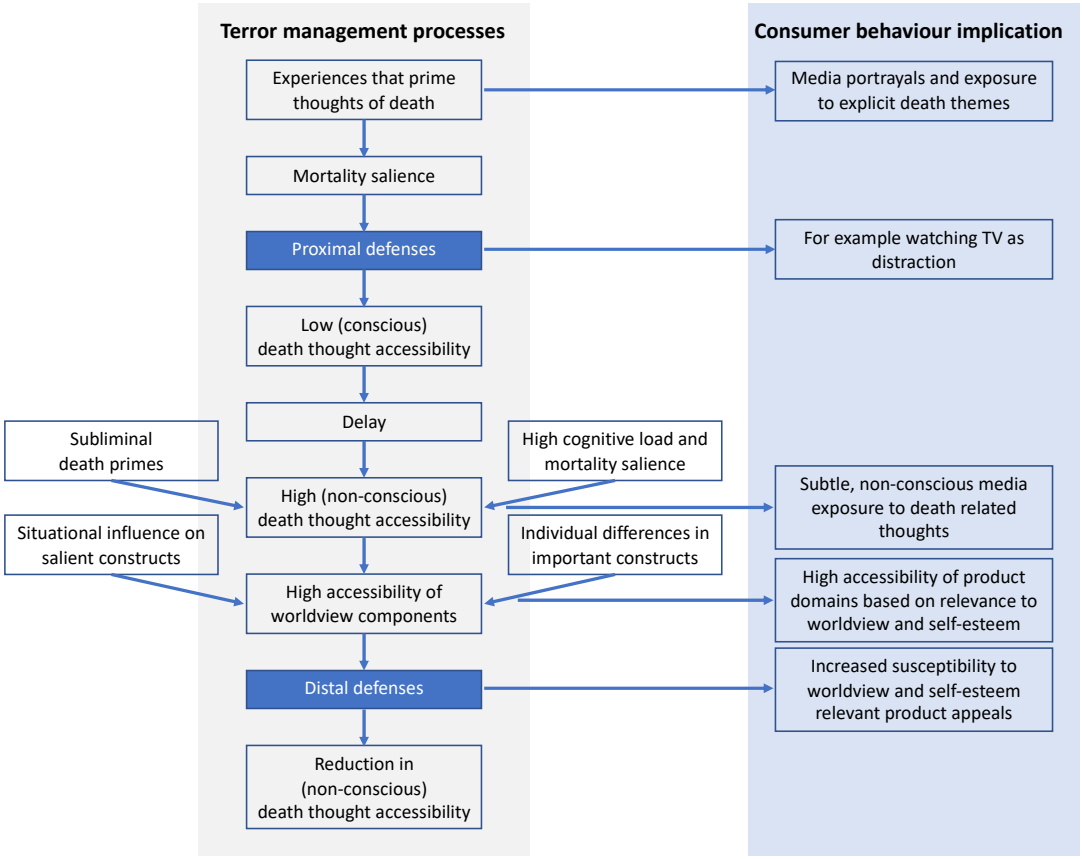

Figure 4: Cognitive architecture of terror management responses in a consumer behavior context (Arndt, Solomon, Kasser, & Sheldon, 2004)

Arndt et al. (2004) set this model in a consumer behavior context (see right side of Figure 3). The model illustrates that people are more susceptible to worldview and self-esteem relevant product appeals when non-conscious death-related thoughts are highly accessible (Arndt et al., 2004). Further, the authors point out that in current western societies, consumerism and materialism can be regarded as important values intrinsic to a western worldview and therefore propose that death-related thoughts generally increase materialism (Arndt et al., 2004). In line with this notion, Mandel and Heine (1999) found that mortality salience increased the attraction of status-signaling objects. In their experiment, participant rated advertisements of status-signaling products more favorable after being exposed to reminders of death (Mandel & Heine, 1999). In a similar research, participants evaluated their financial future more positively and expected to spend more on luxury items in the next fifteen years when they were primed with mortality salience (Kasser & Sheldon, 2000). Other research on worldview defense found that individuals rate domestic products more

favorably and foreign products less favorably when death-related thoughts are activated (Fransen, Fennis, Pruyn, & Das, 2008). The same preference was found for food products and also resulted in a higher consumption quantity of the local product (Friese & Hofmann, 2008). Additionally, it was shown that charity donations, which can be seen as desirable in western culture, increased when participants were primed with mortality salience (Fransen et al., 2008).

Empirical evidence related to products relevant for self-esteem is provided by Goldenberg, Arndt, Hart and Brown (2005) that showed that mortality salience decreased the consumption of fattening food for women with a high body mass index, presumably to comply with the societal standard for thinness. Another behavior that has been investigated because it is associated with improving one's image and increasing self-esteem is tanning (Routledge et al., 2004). In their experiments, the authors found that while death-related thoughts were in focal attention, participants increased intentions to protect themselves. In contrast, when thoughts about death were unconscious, participants decreased interest in sun protection (Routledge et al., 2004).

3.2.3 IMPORTANT MODERATORS OF FEELINGS OF EERINESS

Appel et al. (2019) established that mind attribution of humanoid robots impacts the extent to which robots are perceived as eerie. Humanoid robots with an attributed mind elicited significantly more feelings of eeriness than humanoid robots without an attributed mind (Appel et al., 2019). Supporting evidence for this moderating effect was found by Mende et al. (2019). The authors showed that machinizing a robot mitigated the effect of the feelings of eeriness on consumer behavior and refer to machinizing as emphasizing that the robot is a lifeless object, by for example giving it a model number rather than a human name (Mende et al., 2019).

Therefore, mind attribution can be viewed as an important factor that determines the intensity of the elicited feelings of eeriness. Moreover, research has identified other factors that moderate the impact of the feelings of eeriness. Terror management theory proposes that self-esteem serves the essentially defensive purpose of buffering anxiety (Greenberg, Pyszczynski, & Solomon, 1986). It serves as a shield designed to control the potential for terror that results from human awareness of mortality (Pyszczynski, Solomon, Greenberg, Arndt, & Schimel, 2004). A large body of empirical

evidence indicates that self-esteem reduces the effect of mortality salience on worldview defense (Arndt & Greenberg, 1999; Harmon-Jones et al., 1997; Mandel & Smeesters, 2008; Pyszczynski et al., 2004). Because self-esteem provides protection against the fear of death, mortality salience produces increased self-esteem striving (Dechesne et al., 2003). That means that people are motivated to attain self-esteem through behaviors that meet the standards of value in domains that are important potential sources of self-esteem (Ferraro, Shiv, & Bettman, 2005). From this statement, two critical implications can be derived. On one hand, people need to be capable of behaving in ways that meet the standards of value in a domain and on the other hand the domain must be an important source of self-esteem for the individual (Ferraro et al., 2005).

Consumers' self-esteem may also moderate the strategies that they use to respond to self-discrepancies (Mandel et al., 2017). Individuals with high self-esteem have a more positive self-view and therefore might respond to self-discrepancies by reinforcing their abilities or even by dismissing the self-discrepancies as irrelevant (Crocker & Park, 2004). In contrast, people with low self-esteem might protect the self with escapism such as eating high-calorie foods, overspending or binge drinking (Baumeister, 1990). Supporting evidence for this relation was found by Ferraro et al. (2005) in regard to food choices. The authors found that females with low body esteem chose unhealthy, indulgent food when primed with mortality salience while females with high body esteem chose healthy food more frequently (Ferraro et al., 2005). They argued that females with low body esteem chose the more indulgent food as escape mechanism because for them, the body is not an important source of esteem and hence they will not use it for self-esteem striving when mortality is made salient (Ferraro et al., 2005). Other experiments further established that a domain must be an important source of self-esteem for the individual in order to engage in self-esteem striving. Mortality salience increased fitness behavior intentions among people for whom fitness is important to their self-esteem (Arndt, Schimel, & Goldenberg, 2003) and increased the appeal of physical sex for those high in body esteem (Goldenberg, McCoy, Pyszczynski, Greenberg, & Solomon, 2000).

4 THEORETICAL SUMMARY & RESEARCH PROPOSITION

In this chapter, the most relevant literature to the research question will be summarized. Based on this summary, existing research gaps will be identified, and it will be outlined how they could be closed. Finally, hypotheses will be derived from the literature review.

4.1 THEORETICAL SUMMARY

The uncanny valley is known as the phenomenon that humans respond to humanoid robots with feelings of eeriness (Mori et al., 2012). Although it is a recognized concept, the causes of the uncanny valley are not well understood. Possible explanations include the mind perception hypothesis and the terror management theory. According to the mind perception hypothesis, feelings of eeriness are elicited when humans perceive agency and experience in a humanoid robot and therefore attribute a human mind to the machine (Gray & Wegner, 2012). Following the terror management theory, feelings of eeriness are elicited because humanoid robots may remind humans of death and trigger defense systems that cope with the deeply rooted anxiety for mortality (MacDorman, 2005).

This reaction to humanoid robots also has implications for consumer behavior. Mende et al. (2019) found that consumers cope with feelings of eeriness elicited by humanoid robots by choosing status products, seeking social affiliation and increased caloric intake. In their study, the authors draw on compensatory consumer behaviors that have been found in empirical research. Relevant examples of those behaviors include that consumers respond to self-discrepancies with an increased willingness to pay for status-signaling products (Rucker & Galinsky, 2008), overconsumption of food (Mandel & Smeesters, 2008) and the increased consumption of unhealthy food (Mandel et al., 2017; Troisi & Gabriel, 2011). Terror management is another stream of literature that investigates feelings of eeriness and can therefore be used to understand the potential influence of the uncanny valley on consumer behavior. Empirical research within this field supports the findings of compensatory consumer behavior. Mortality salience was found to increase the attraction of status-signaling objects (Mandel & Heine, 1999) and the amount consumers expected to spend on luxury items (Kasser & Sheldon, 2000). Further, mortality salience increased the consumption quantity of local food products (Friese & Hofmann, 2008) and resulted in more indulgent food choices for consumers

with low body esteem as well as more healthy food choices for consumers with high body esteem (Ferraro et al., 2005). Finally, research has identified several important moderators of feelings of eeriness. Appel et al. (2019) found that humanoid robots with an attributed mind elicit more eeriness than those without an attributed mind. Similarly, Mende et al. (2019) showed that emphasizing that humanoid robots are lifeless objects mitigates their impact on consumer behavior. Additionally, a large body of literature has established that self-esteem reduces the effects of mortality salience (Harmon-Jones et al., 1997; Mandel & Smeesters, 2008; Pyszczynski et al., 2004).

4.2 RESEARCH PROPOSITION

Prior research on the uncanny valley concept has mostly focused on finding empirical evidence for the different uncanny valley hypotheses and on exploring the diverse conditions under which the uncanny valley exists. Surprisingly, there is very little research on the uncanny valley and how it impacts consumer behavior. As interactions with humanoid robots become increasingly common, the need for understanding how consumers react to them becomes apparent. Mende et al. (2019) are among the first in marketing to examine the uncanny valley by testing how consumers respond to human service robots. The authors demonstrate that human service robots can trigger different compensatory behaviors and investigate various moderators. The research at hand aims to extend these findings to shed more light on the complex impact of the uncanny valley on consumer behavior. Specifically, it will be tested if the findings of Mende et al. (2019) can be replicated in the context of status-signaling products and if they can be transferred to healthy and unhealthy food products.

Whereas Mende et al. (2019) investigated the impact of feelings of eeriness on product choice, actual consumption behavior and consumption intention, this paper will explore if product evaluations are also impacted. Prior research within the field of terror management found that participants' evaluation of people, products and product advertisements was impacted after being exposed to mortality salience. However, it has not yet been investigated whether the uncanny valley can have a similar impact on product evaluations. Additionally, in order to enhance the understanding of the relation between the uncanny valley and mortality salience, the effect of the

uncanny valley on product evaluations will be compared to the effect of mortality salience in this paper. Such a comparison within the same research has not been carried out before.

Finally, the complex nature of the uncanny valley will also be explored in light of the mind attribution hypothesis. Mende et al. (2019) investigated this concept by emphasizing that humanoid robots are lifeless objects and thereby mitigated the effect of the uncanny valley. The research at hand will look at it from the opposite angle by highlighting the agency and experience of the shown humanoid robots and thereby attributing a mind to them. Using this approach, our research will be the first to explore how mind attribution of humanoid robots impacts product evaluations as an instance of consumer behavior.

4.3 HYPOTHESES DEFINITION

Various studies suggest that the uncanny valley and mortality salience are connected and that both elicit feelings of eeriness (MacDorman, 2005; MacDorman & Ishiguro, 2006). Mende et al. (2019) have shown that these feelings of eeriness impact consumer behavior in terms of product choice, product consumption and consumption intention. Moreover, research within the field of terror management has found that *product evaluations* are impacted by mortality salience (Fransen et al., 2008; Mandel & Heine, 1999). If feelings of eeriness elicited through mortality salience impact product evaluations, it might be that feelings of eeriness elicited through humanoid robots (the uncanny valley) have the same impact. Further, it has been established in various studies that self-esteem reduces the effects of mortality salience or the feelings of eeriness (Arndt & Greenberg, 1999; Harmon-Jones et al., 1997; Mandel & Smeesters, 2008; Pyszczynski et al., 2004). As self-esteem provides protection from the feelings of eeriness elicited through humanoid robots, consumers with low self-esteem might be influenced more than consumers with high self-esteem. Drawing on these insights it is generally hypothesized:

H1: Feelings of eeriness elicited through humanoid robots impact product evaluations of consumers.

> ***H1a:*** *The* ***impact of the feelings of eeriness*** *on product evaluations will be* ***higher for consumers with low self-esteem*** *when compared to consumers with high self-esteem.*

More specifically, empirical research investigating compensatory consumer behavior and terror management has shown that status-signaling consumption is stimulated by consumer discomfort or feelings of eeriness (Mandel & Heine, 1999; Rucker & Galinsky, 2008). Mende et al. (2019) have substantiated these findings in the context of the uncanny valley. They showed that consumers responded to feelings of eeriness by choosing status-signaling products more often. This status-signaling consumption might be driven by a stimulated greater appeal or increased liking of status-signaling products. Additionally, this increased liking might also be reflected in an increased willingness to pay for status-signaling products. These increases in liking and willingness to pay correspond to the above hypothesized impact on product evaluations. As mentioned before, this effect will be higher for consumers with low self-esteem when compared to consumers with high self-esteem. These insights lead to the following hypotheses in relation to status-signaling products:

H2: *Consumers respond to* ***feelings of eeriness*** *elicited through humanoid robots with an* ***increased liking of status-signaling products.***

> ***H2a:*** *Consumers with* ***low self-esteem*** *when compared to consumers with high self-esteem, respond to feelings of eeriness elicited through humanoid robots with a* ***stronger increase in liking*** *of status-signaling products*

H3: *Consumers respond to feelings of eeriness elicited through humanoid robots with an* ***increased willingness to pay*** *for status-signaling products.*

> ***H3a:*** *Consumers with* ***low self-esteem*** *when compared to consumers with high self-esteem, respond to feelings of eeriness elicited through humanoid robots with a* ***stronger increase in willingness to pay*** *for status-signaling products*

A similar consumer response has been identified for food products. Consumers increased their food consumption as a response to humanoid robots (Mende et al., 2019). Furthermore, it was shown that consumers with *high* body esteem responded to feelings of eeriness with choosing healthy food

(Ferraro et al., 2005). This preference might indicate that for these consumers, feelings of eeriness stimulate a greater liking of healthy food products which in turn might also be reflected in a higher willingness to pay for these products. In contrast, consumers with *low* body esteem chose unhealthy food products more often (Ferraro et al., 2005). Therefore, for these consumers, feelings of eeriness might stimulate a greater liking of unhealthy food products and thus a higher willingness to pay for these products. Drawing on these insights, the following hypotheses related to healthy and unhealthy food products are derived:

H4: *Consumers with* ***high body-esteem*** *respond to feelings of eeriness elicited through humanoid robots with an* ***increased liking of healthy food products***

> ***H4a:*** *Consumers with* ***high body-esteem*** *respond to feelings of eeriness elicited through humanoid robots with an* ***increased willingness to pay for healthy food products***

H5: *Consumers with* ***low body-esteem*** *respond to feelings of eeriness elicited through humanoid robots with an* ***increased liking of unhealthy food products***

> ***H5a:*** *Consumers with* ***low body-esteem*** *respond to feelings of eeriness elicited through humanoid robots with an* ***increased willingness to pay for unhealthy food products***

Mende et al. (2019) also showed that the effect of the feelings of eeriness decreased when emphasizing the lifeless nature of humanoid robots. In a different study, Appel et al. (2019) found that humanoid robots with an attributed mind elicited more eeriness than humanoid robots without an attributed mind. If mind attribution of humanoid robots elicits greater feelings of eeriness, than it might also increase the effect on consumer behavior. Therefore, the following hypotheses related to mind attribution of humanoid robots are:

H6: Mind attribution of humanoid robots increases the effects that are outlined in H2 - H5a

H6a: Consumers respond to ***humanoid robots with an attributed mind*** *when compared to humanoid robots without an attributed mind with a* ***stronger increase in liking*** *of status-signaling products*

H6b: Consumers respond to ***humanoid robots with an attributed mind*** *when compared to humanoid robots without an attributed mind with a* ***stronger increase in willingness to pay*** *for status-signaling products*

H6c: Consumers with ***high*** *body esteem respond to* ***humanoid robots with an attributed mind*** *when compared to humanoid robots without an attributed mind with a* ***stronger increase in liking*** *of* ***healthy*** *food products*

H6d: Consumers with a ***low*** *body esteem respond to* ***humanoid robots with an attributed mind*** *when compared to humanoid robots without an attributed mind with a* ***stronger increase in liking*** *of* ***unhealthy*** *food products*

Feelings of eeriness are not only elicited through humanoid robots but can be elicited through a variety of other stimuli. Mortality salience is one of those stimuli that can elicit feelings of eeriness and at the same time is considered one potential cause of the uncanny valley (MacDorman, 2005). In general, no matter how the feelings of eeriness are elicited, they might have a similar effect on consumer behavior. This leads to the following hypotheses related to mortality salience:

H7: *Feelings of eeriness* ***not*** *elicited through humanoid robots* ***but through mortality salience*** *will have a* ***similar effect*** *on product evaluations as outlined in H2 - H5a*

H7a: *Consumers respond to feelings of eeriness* ***elicited through mortality salience*** *with an* ***increased liking of status-signaling products.***

H7b: *Consumers respond to feelings of eeriness* ***elicited through mortality salience*** *with an* ***increased willingness to pay*** *for status-signaling products.*

H7c: *Consumers with* ***high body-esteem*** *respond to feelings of eeriness* ***elicited through mortality salience*** *with an* ***increased liking of healthy food products***

H7d: *Consumers with* ***high body-esteem*** *respond to feelings of eeriness* ***elicited through mortality salience*** *with an* ***increased willingness to pay for healthy food products***

H7e: *Consumers with* ***low body-esteem*** *respond to feelings of eeriness* ***elicited through mortality salience*** *with an* ***increased liking of unhealthy food products***

H7f: *Consumers with* ***low body-esteem*** *respond to feelings of eeriness* ***elicited through mortality salience*** *with an* ***increased willingness to pay for unhealthy food products***

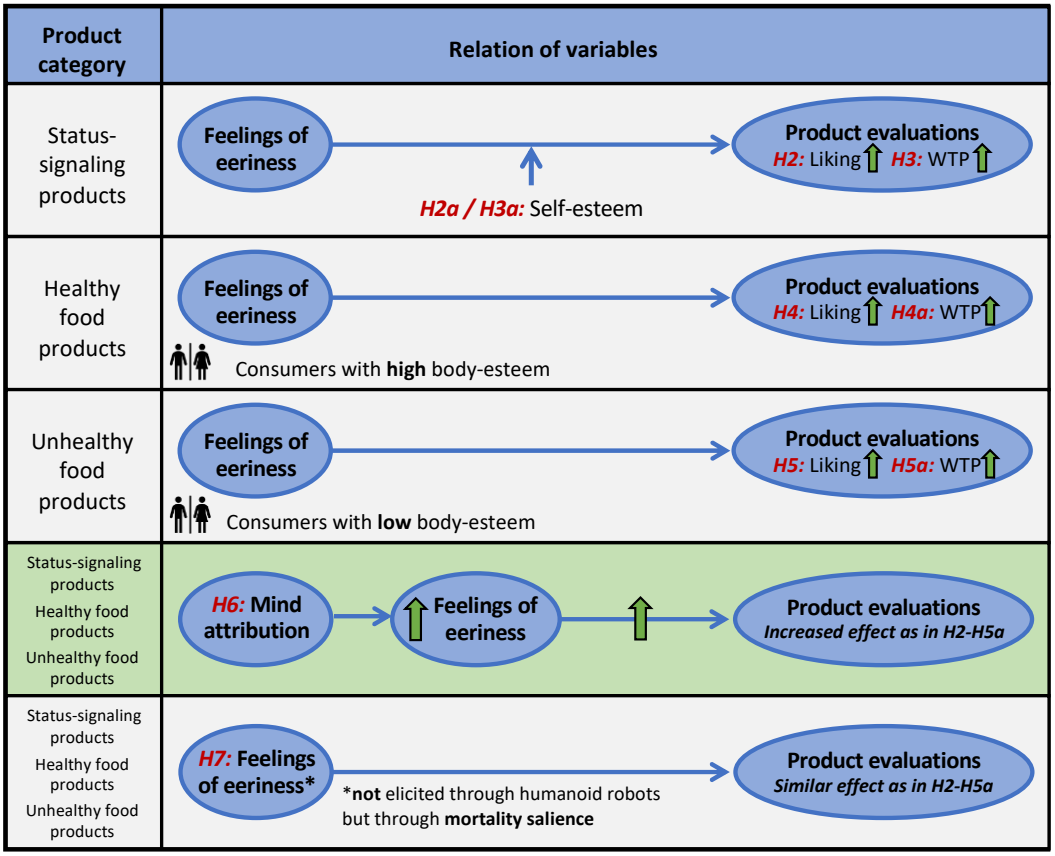

Figure 5: Overview of Hypotheses

5 METHODOLOGY

In the following section the general methodological principles and considerations within this thesis based on the research onion by Saunders et al. (2019) will be outlined. The applied research paradigm will be explained and in a second step discussed in terms of its advantages and disadvantages. Moreover, the research approach, nature and strategy as well as the techniques and procedures for data collection will be examined.

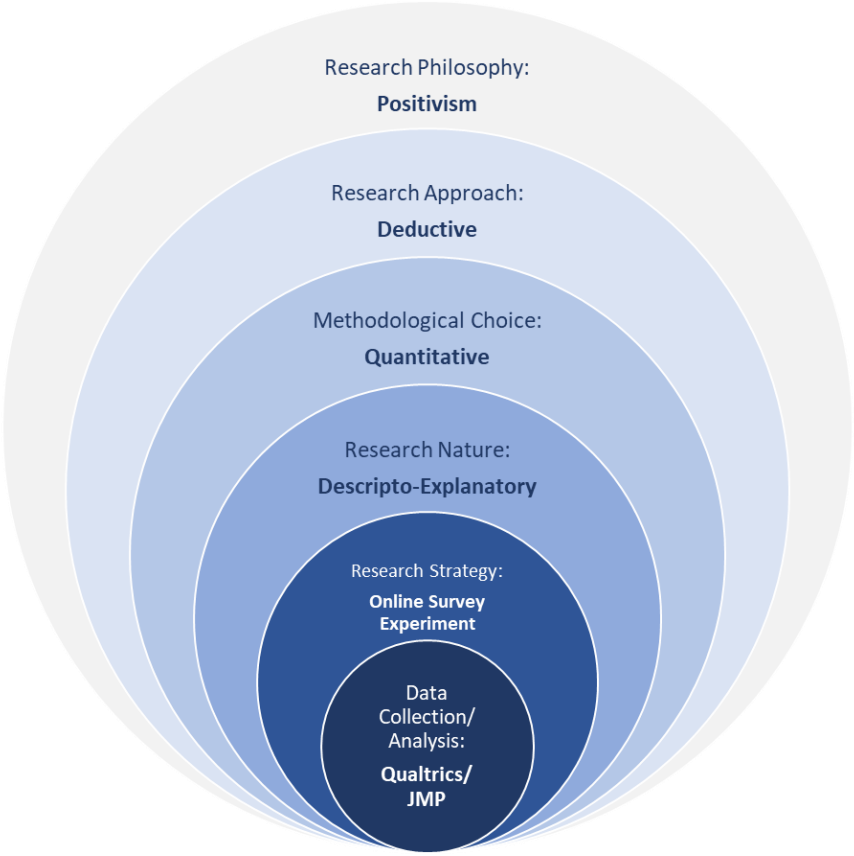

Figure 6: Overview of the Methodology of this Research (self-provided; Adapted from Saunders et al., 2019)

5.1 RESEARCH PHILOSOPHY

The choice of the research philosophy pertains important assumptions about how the researcher sees the world (Saunders et al. 2019). Guba and Lincoln (1994) define the philosophy of science as a set of basic beliefs that represent worldviews defining the nature of the world, the individual's place in it and the range of possible relationships to that world and its parts. In fact, the philosophy of science determines the ontological perspective used in research which is referring to the nature

of reality which is in return affecting the epistemological perspective which deals with assumptions about human knowledge. Based on ontological and epistemological assumptions made upfront, the research paradigm characterizes the appropriate methodological approach of the researchers. Ontology, epistemology and methodology are important in terms of explaining how the research question can be understood, why and how certain methods have been chosen and how findings are interpreted (Crotty, 1998).

The research at hand is construed based on the research paradigm of positivism. Positivism relates originally to the philosophical stance of the natural scientists and entails working with an observable social reality to produce law-like generalizations (Saunders et al., 2019). Next to natural science, positivism has been a dominant research paradigm in social sciences and in particular in consumer research (Hunt, 1991; Sihombing, 2011). From an ontological perspective, positivist researchers are following a realist view on how reality is constructed (Guba & Lincoln, 1994). Reality is assumed to be driven by unchangeable laws and mechanisms and can be summarized in the form of time-and context-free generalizations, for example, cause-effect laws (Guba & Lincoln, 1994). The goal of this thesis is to establish a law-like generalization between the interaction of humans with humanoid robots and the subsequent favorable product evaluations of specific product types.

From an epistemological perspective, positivism acknowledges an objectivist view on the researcher as well as the researched entities (Guba & Lincoln, 1994). This means that the investigator and the investigated object are assumed to be independent from each other and that the investigator is capable of studying the object without influencing it or being influenced (Guba & Lincoln, 1994). The research design developed in this paper ensures objectivity by avoiding interaction and thus possible influences on or from the studied subjects through an anonymous online experiment and survey. By using this one-way inquiry style, values and other biasing and confounding factors are prevented from influencing outcomes (Guba & Lincoln, 1994).

From a methodological perspective, positivist research includes experimental and manipulative, quantitative research design set-ups (Guba & Lincoln, 1994). The experiment that was conducted

within this thesis was built on several hypotheses and featured multiple manipulated conditions to control for different effects of the stimuli (Guba & Lincoln, 1994).

5.1.1 ADVANTAGES & DISADVANTAGES OF POSITIVISM

An important advantage of the positivist research paradigm is that it provides positive knowledge that is free from speculative elements and thus rationalizes human knowledge by explaining the world with scientific facts (Nodoushani, 2000). Moreover, quantitative research is characterized by covering a wide range of situations while being fast and economical (Nodoushani, 2000). This is possible through careful sampling, sophisticated designs, precise measurement and careful analysis in the hypothesis testing (Easterby-Smith, Thorpe, & Lowe, 1991). Finally, due to its ability to develop general laws, positivist research is able to predict future outcomes of similar set-ups (Sihombing, 2011). In short, positivism allows for explanation, understanding of causality, prediction of phenomena and lastly generalization.

However, positivism has also been criticized in terms of objectifying humankind (Sihombing, 2011). Since positivist research only focuses on the observable, it has been criticised for being unsuitable in investigating social phenomena and their context. Hence, conceptual speculations that might be necessary to modify and improve a theory cannot be generated (Olson, 1983). In this thesis, the choice of a positivist perspective is defended, as the aim is to investigate the causal relationship between the uncanny valley, mind attribution and compensatory consumer behavior.

5.2 DEDUCTIVE RESEARCH APPROACH

The research approach describes how academic literature and theory are used for the analysis of research findings and to answer the research question.

Along with applying a positivist research paradigm a deductive research approach has been applied (Saunders et al., 2019). First, theory has been gathered and analyzed in order to generate a research proposition. Subsequently, hypotheses were defined to test the relationship between product evaluations and feelings of eeriness (Blaikie & Priest, 2019). Then, data was collected to verify or falsify the developed theory (Saunders et al., 2019). It is assumed that when the premises are true, i.e. the preceded verified theories from other researchers, then the conclusion, i.e. the propositions

from the research at hand, must also be true (Saunders et al., 2019). A deductive research approach therefore generalizes from the general to the specific case in a highly structured manner (Saunders et al., 2019). Among other sources, the study at hand bases its theory to a large extend on the research work of Mende et al. (2019) who generalized that feelings of eeriness elicited through a humanoid service robot result in compensatory consumer behavior such as increased caloric intake and increased status-signaling product choices. By generalizing from Mende et al.'s (2019) results to a more specific case where different stimuli and product types are tested as well as product evaluations instead of product choices, a deductive approach is being applied.

This highly structured manner guarantees the replicability of this study which contributes to the reliability of the research work (Saunders et al., 2019). This will also be touched upon again in one of the following sections of this thesis (see section 8.3.1). Furthermore, deductive research requires concepts such as feelings of eeriness or product evaluations to be operationalized in order to quantitatively measure them. A great advantage of this approach on theory development is therefore the reduction of the concepts to the simplest possible elements which can help to better understand their relationships (Saunders et al., 2019).

5.3 METHODOLOGICAL CHOICE

Before collecting data, the researcher needs to define which research methods should be used to do so. Based on the underlying positivist research paradigm as well as a deductive approach to theory development, a quantitative research design has been chosen to answer the research question (Saunders et al., 2019). Deduction examines the relationship between variables which are measured numerically and analyzed using a range of statistical and graphical techniques (Saunders et al., 2019).

Quantitative research is generally associated with positivism and a deductive research approach. Therefore, quantitative research holds similar advantages and disadvantages. By operationalizing variables, they become measurable and thus enable researchers do identify fine differences between tested groups (Bryman & Bell, 2015). In order to measure the effects of the uncanny valley on the product evaluations, data is collected before and after showing stimuli to the participants so that one may determine changes in the behavior. These changes are assumed to be larger for some

test groups than for others. Through the operationalization of variables due to the quantitative research method even small differences can be detected and analyzed in detail (Bryman & Bell, 2015). Additionally, precise estimates of the degree of the relationship between variables, for example the effect of self-esteem on product evaluations, can be made (Bryman & Bell, 2015).

Unlike only describing how things are, quantitative research has the great advantage of being able to reveal causality between variables (Bryman & Bell, 2015). Rather than just acknowledging that consumer behavior changes after the interaction with humanoid robots in a certain way, the quantitative study at hand can investigate the causality between feelings of eeriness, product evaluations, self-esteem and body-esteem. Moreover, by comparing different test groups under different conditions causality between mortality salience and the Uncanny Valley can be investigated. This is especially important regarding the fact that the tested phenomenon of the Uncanny Valley is a subconscious process. The studied individuals are not aware of what effect the interaction with a humanoid robot has on them and would accordingly not be able to explain or express it. By objectively measuring their behavior causality can be established.

As a consequence of a large sample size, quantitative research contributes to generate law-like principles from research findings (Bryman & Bell, 2015). Generalization is a crucial preoccupation of quantitative research for consumer behavior as law-like principles can be used to predict behavior in certain situations (Bryman & Bell, 2015). Finally, another advantage of quantitative research is the possibility to replicate the study due to the maintained objectivity between researcher and researched entities (Bryman & Bell, 2015). As mentioned before, this will be discussed in detail in the validity and reliability section of this thesis.
Quantitative research has earned critique is the past as well. Critics mainly argue that the data-driven objectivity, precision and accuracy causes the researcher to neglect the actual social world and its phenomena that cannot be measured (Bryman & Bell, 2015)

5.4 DESCRIPTO-EXPLANATORY RESEARCH NATURE

Considering the research question and use of a deductive, quantitative research approach, the presented work of this thesis is of a descriptive as well as explanatory nature (Saunders et al., 2019).

It seeks to gain an accurate profile of the mechanisms of how humanoid robots and their mind attribution impacts consumer behavior by taking into account multiple moderators. At the same time, this study investigates the causal relationship between feelings of eeriness elicited through mind attribution and compensatory consumer behavior by comparing different groups with each other. This is in line with the deductive, quantitative research approach where hypotheses must be predefined and either verified or falsified to establish casualties (Saunders et al., 2019).

5.5 RESEARCH STRATEGY

The research strategy connects the research philosophy, the research approach and the choice of methods to collect and analyze data. It is a defined plan about how the researcher will answer the research question and meet the research objectives (Saunders et al., 2019). The two main quantitative research strategies are experiments as well as surveys (Saunders et al., 2019). In this study, both have been utilized jointly in form of a web-based experiment entailing a survey.

The purpose of an experiment is to study the relationship between independent and dependent variables by statistically testing hypotheses (Saunders et al., 2019). A classic experiment thereby includes observations made in relation to the dependent variable, in the case of this study before and after the experimental manipulation to see if it made a difference (Bryman & Bell, 2015).

Conducting an experiment online provides a multitude of benefits that the study at hand leverages from. First, a large number of participants can be easily acquired while focusing on specific demographic and cultural traits (Reips, 2002). Second, due to the large sample size findings can be generalized and applied to more settings and situations (Reips, 2002). Internet experiments grant both the researcher as well as the participants a higher degree of freedom compared to conventional field or laboratory experiments (Reips, 2002). Researchers must not invest resources into scheduling, laboratory space, personnel hours, equipment and administration whereas participants are enabled to take part in the experiment completely voluntarily, time-independently and in their preferred environment (Reips, 2002). Moreover, the anonymity between researcher and participant contributes to the objectivity of the study and minimizes possible mutual influences (Reips, 2002).

A possible disadvantage of a web-based experiment is that the freedom participants gained can result in increased drop-out rates as well (Reips, 2002). The anonymous online setup allows an uncomplicated experiment discontinuation at any time. However, there are certain techniques such as promising immediate feedback, giving financial incentives and the personalization of the study that contribute to reducing drop-out rates (Frick, Bächtiger, & Reips, 1999). Also, the reduced or absent interaction with participants during a web experiment can cause problems when instructions are misunderstood. Therefore, researchers must pretest studies, provide enough information material as well as creating opportunities for feedback (Reips, 2002).

As such, an online survey falls primarily into the category of descriptive research enabling identifying and describing the variability in different phenomena (Saunders et al., 2019). However, surveys can also be used under explanatory research premises that allow the examination of relationships between variables. The online survey is a self-administered questionnaire (Saunders et al., 2019), which allows the respondents to anonymously answer the survey whenever suits them best. This method also minimizes the likelihood of respondents conforming their questions to what they believe is socially desirable. Furthermore, Ward et al. (1992, in Morgan 1996) argue that surveys are an effective method for determining prevalence of one attitude over another, which further supports the choice of online survey as the method for covering the above objectives. The primary limitation of this research method is the inability to ask respondents follow-up questions. Therefore, it is essential that the survey design enables a full coverage of the objectives.

5.6 TECHNIQUES AND PROCEDURES OF DATA COLLECTION AND ANALYSIS

Data collection is defined as the procedure of collecting, measuring and analyzing accurate insights for research using standard validated techniques (Bryman & Bell, 2015). The most important objective of quantitative data collection is to ensure that information-rich and reliable data is collected for statistical analysis.

Since a web-based experimental research design in combination with an online survey have been chosen as research strategy, a self-completion questionnaire created in Qualtrics was selected as data collection method (Bryman & Bell, 2015). Embedding experimental designs within surveys has

increasingly been recognized as a flexible and powerful means to combine the internal validity of experiments with the external validity of surveys (Schlueter & Schmidt, 2010). Therefore, so called "survey experiments" have become a central methodology across the social sciences (Mullinix, Leeper, Druckman, & Freese, 2015).

The direct data output from the survey created in Qualtrics required the transformation of descriptive data from the self- and body-esteem scales as well as the demographic information into discrete data. Moreover, data gathered from continuous scales used for product evaluations was quantified as interval data measuring the difference between ratings before and after the manipulation. Subsequently, the prepared data was imported into the statistical analysis software JMP. The survey experiment and the analysis of the data that has been collected with it will be presented in the following chapters in all its depth.

6 EXPERIMENT DESIGN

In this chapter, the specific experimental research will be outlined. It will be explained how the experiment was conducted and specific decisions regarding the experiment design will be justified. The entire chapter serves the purpose of explaining how the research data was collected.

6.1 EXPERIMENT OVERVIEW

At the start of the experiment, all participants were shown descriptions of two different neutral videos. After each description, participants saw the described neutral video. All participants saw the same neutral descriptions and videos in order to set them into a similar, neutral emotional state. Following the videos, they were asked to evaluate thirteen product types within three categories. The three categories were status-signaling products, healthy food products and unhealthy food products. After evaluating all products, participants were shown another two description of videos followed by the actual videos. This time, participants were randomly assigned to four different groups that saw different descriptions and different videos.

Group A saw descriptions of two different humanoid robots that were worded to elicit mind attribution. After each description the related video of the humanoid robot was shown. Group B

saw the same videos as group A, but with more neutral descriptions that were worded to *not* elicit mind attribution. Group C saw videos of two funerals and the related descriptions and group D was the control group that saw another two neutral videos and the related descriptions.

After watching the videos, all groups were shown the same 13 product types again and were asked to evaluate them. Finally, participants were asked to complete a questionnaire which included a body-esteem scale and a self-esteem scale as well as demographic information and a manipulation test. Figure 6 depicts an overview about the structure of the experiment.

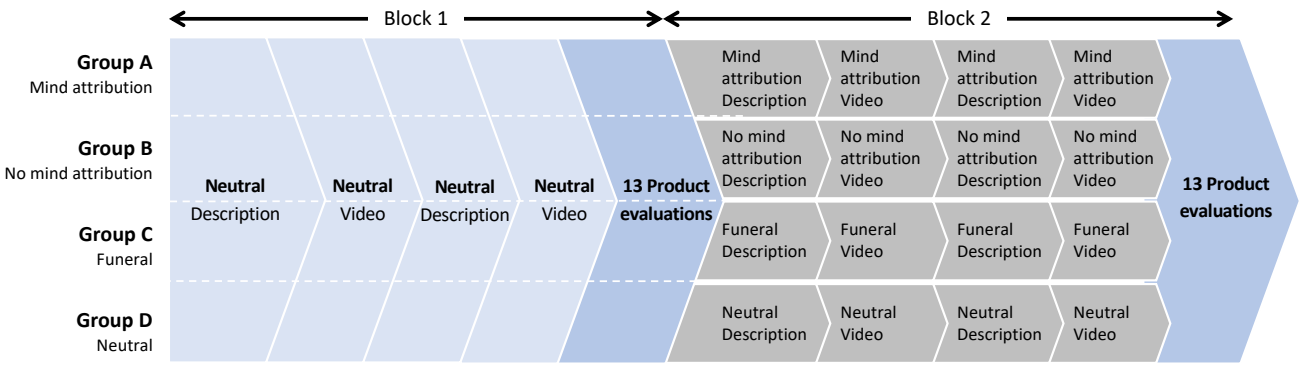

Figure 7: Overview of the Structure of the Experiment

6.2 SAMPLE POPULATION

200 participants (113 females, 1 other) with a mean age of 25 years (SD = 2.49) took part in the experiment. All participants were German in order to control for cultural differences and product familiarity. Therefore, all instructions were in German. Further, all participants had a similar age (19 to 32 years) to control for the influence of age on reactions to humanoid robots. This particular age group was chosen because it is representing a younger generation, for which interaction with (humanoid) robots is becoming increasingly common (Broadbent, 2017). Ten Participants were removed from the analysis because they were not within the age group. For the sample selection, a non-probability, self-selection method was applied (Saunders et al., 2019). Nearly all participants were recruited through Facebook, either with private messages or with public posts in different Facebook groups. The specific message that was used for recruiting is depicted in appendix 1 and has been the same for all participants. Participants were told that the survey would last 12 minutes

and were asked to complete it on their PC in a quiet moment alone at home. To minimize potential distractions, it was not an option to complete the survey on the mobile phone. Furthermore, participants were told that they would get the chance to win 50 Euro as a small incentive to participate.

6.3 STIMULI

Analogical to Mende et al. (2019), videos and corresponding descriptions were used as stimuli to manipulate the feelings of eeriness. This decision was taken under consideration that movements contribute to the human likeness of robots (Mori et al., 2012). In the following, the specific stimuli will be described and the reasoning behind their choice as well as their design will be outlined. All used stimuli are displayed in appendix 2.

Videos

In order to find fitting video material of humanoid robots for the experiment, an extensive online research was conducted. Within this research, nine potential videos of different humanoid robots were selected. Subsequently, these videos were cut down in length to ten seconds and the audio was removed. This editing was executed to ensure that all videos had the same length and to control for any possible influence of the audio. In order to select the two most eerie videos, 20 participants were asked to rank the nine robots according to their eeriness. Based on the results of this pretest, the female humanoid robot “Bina” and the male humanoid robot “Keno” were selected. By selecting a male and a female robot, it was controlled for robot gender, that can influence human behavior (Siegel et al., 2009).

In other experimental contexts, participants are reminded of mortality through a variety of different stimuli. Selected examples include the traditional method of answering open-ended questions related to mortality, explicit and subliminal exposure to an insurance brand or proximity to a funeral home (Fransen et al., 2008; Mandel & Smeesters, 2008; Pyszczynski et al., 1996). Therefore, videos that show funerals can be viewed as an appropriate method to manipulate mortality salience. To ensure comparability to the videos with humanoid robots, the two selected funeral videos were also cut down to ten seconds and the audio was removed.

Finally, four neutral videos were selected: two videos for the beginning of the experiment and two for the control group. All of the neutral videos that were used in the experiment had a similar content. They always showed a single person from behind, so that the face of the person was not visible. This camera angle was chosen to control for potential influences of facial expressions. Further, the environment in which the person was depicted was kept constant and neutral. All of these videos showed a single person sitting, standing or taking the train in a natural environment. In accordance with the other videos, the neutral videos were ten seconds long and without audio.

Figure 8: Example of a Neutral Video used in the Experiment Design (Screenshot)

Figure 9: Example of a Video with a Humanoid Robot used in the Experiment Design (Screenshot)

Figure 10: Example of a Video showing a Funeral used in the Experiment Design (Screenshot)

Descriptions

Before each video was shown, a description about the content of the video was displayed. The descriptions for the videos of the humanoid robots that were meant to elicit *mind attribution* were worded in line with the findings of Gray and Wegner (2012), Złotowski et al. (2017) and Mende et al. (2019). Similar to Mende et al. (2019), in each of these descriptions the humanoid robot was given a human name and it was emphasized that it is human-like. Additionally, agency and experience, the two dimensions of mind perception, were highlighted in each description (Gray & Wegner, 2012). Specifically, it was stated that the humanoid robot acts *autonomously* based on advanced technology and that it is in *full control* of its actions (Złotowski et al., 2017). Further, it was pointed out that the humanoid robot is capable of *experiencing emotions* such as hunger, fear and happiness (Gray & Wegner, 2012).

In contrast, each of the descriptions of the videos of the humanoid robots that should *not* elicit mind attribution was emphasizing that the depicted robot is a lifeless object (Mende et al., 2019). Specifically, the robot was given a machine-like name and it was highlighted that the robot is only capable of *simulating* human behavior with its software (Mende et al., 2019). Additionally, it was pointed out that the user can *command* the robot to execute actions (Appel et al., 2019).

In order to check if these descriptions have the expected effect on participants, another pretest was conducted. 16 participants were asked to read both types of descriptions and to express their feelings and thoughts about each description after reading it. Based on this input the descriptions were altered and tested again until their desired effect was achieved. As a result, the description type that was meant to elicit mind attribution was perceived as considerably more eerie and as having increased agency and experience.

Each description of the funeral videos was about the funeral of a student that recently died unexpectedly. This was done in order to facilitate the personal identification of the (young) participants with the person in the coffin. Furthermore, the description emphasized that human lives are limited in time and that death is inevitable.

To ensure that the content of the descriptions for all videos was similar, each description of the neutral videos was also about a student and what kind of activity he or she is carrying out in the video. Specifically, most of these descriptions were about a person that enjoys being in nature because of its relaxing effect.

In general, all descriptions were not only similar in terms of content, but also in terms of structure and wording. Especially those descriptions that differed between the groups, but were shown at the same point during the experiment were written to be as similar as possible. For example, the names of the students and robots were chosen to be similar (Bina, Sina, Lina) and the gender of the shown person or robot was always the same. The female was shown in the first video of the block and the male was shown in the second one.

Example of a neutral description:

> *In the following you will see a video of Sina, who is taking the train home. Sina is studying at the university and has a lot of friends. Through taking the train she is able to commute comfortably and to study during her travel time.*

Example of a description of a humanoid robot with an attributed mind:

> *In the following you will see a video of Bina, an intelligent humanoid robot. Like humans, she is able to experience feelings and emotions such as hunger, fear and pleasure. Through advanced technology, Bina is able to act autonomously, meaning that she has full control over her actions.*

Example of a description of a humanoid robot without an attributed mind:

> *In the following you will see a video of B-2000, a humanoid robot. Based on its software, it is able to simulate the behavior of humans. Through their voice, human users can command B-2000 to execute actions.*

Example of a funeral description:

> *In the following you will see a video of the funeral of Lina, who died at a young age. Lina was studying at University and had a lot of friends. In his speech, the attendant pastor draws attention to the fact that death is a part of everyone's life.*

Product evaluations

After being exposed to two videos and their descriptions, the participants were asked to evaluate 13 product types within the categories status-signaling products, healthy food products and unhealthy food products. The status-signaling products were premium sunglasses, (designer) chairs, high-end TVs, luxury cars and high-end sound systems. The selection of these specific product types was based on general knowledge about luxury consumption. The aim was to select 5 product types that represent a broad spectrum of products so that each participant would be shown a product that he or she likes and that is important for his or her self-esteem.

The selected healthy food products were salads, fruit salads, teas and smoothies. This selection was also in line with prior experiments and included two food and two drink items (Mandel & Smeesters, 2008). Further, these product types represent two rather sweet and two rather savory food types to control for food preferences. Similar as for the status-signaling products, the aim was that each participant would be shown a product that he or she likes.

The same selection criteria were applied to the unhealthy food products, which were burgers, cakes, soft-drinks and hot chocolates. These product types were also selected according to previous literature and were in line with the chosen healthy products (Mandel & Smeesters, 2008; Mende et al., 2019). When compared, the healthy and unhealthy food products represent realistic food choices (salad vs. burger, fruit salad vs. cake, smoothie vs. soft-drink and tea vs. hot chocolate). These alternative food choices are in line with the notion that females might respond to feelings of eeriness with *alternative coping strategies* (Ferraro et al., 2005; Mandel et al., 2017).

These product types were pretested with five participants in a pilot survey, a trial version of the actual experiment. Based on the feedback of these participants it was decided to depict nine different product pictures to represent the product type. This adaption was made to control for individual product preferences. Furthermore, it was decided to display the name of the product type to provide a concrete definition and thereby ensure consistency among participants' understanding of the product type. The attribute "premium" was used to define the status-signaling products in order to indicate the high quality of the depicted products without explicitly stating that these

products are “luxury” or “status-signaling”. Figure 11, 12 and 13 depict examples of how the product types were shown in the experiment.

Figure 11: Example of a Stimulus used for Healthy Food Products

Figure 12: Example of a Stimulus used for Unhealthy Food Products

Figure 13: Example of a Stimulus used for Status-signaling Products

6.4 PRETESTS

As outlined above, all stimuli were tested in different pretests and a pilot survey was conducted. After completing the pilot, all participants were interviewed and asked for their feedback.
Initially it was planned to show only one video and the corresponding description per block, so that each participant would have seen a single neutral video first and then a second video after the first product evaluations. Based on the results of the pilot and the collected feedback it was decided to show two different videos with a similar content per block instead of only one. This modification was made to enhance the priming of the desired effect for the different conditions. Furthermore, showing two different videos made it possible to control for the influence of robot gender (Siegel et al., 2009).

6.5 VARIABLES AND MEASURES

In the following part, the independent and dependent variables as well as the moderators will be discussed. In general, an independent variable is the variable that is being manipulated in order to observe the effect on a dependent variable. The moderator affects the strength of that effect (Saunders et al., 2019).

Independent variable

The main independent variable in the outlined experiment is the intensity of *feelings of eeriness*. As common for research on effects of emotion, participants' feelings were manipulated with a mood induction by showing different videos and their corresponding descriptions (Gerrod & Paula, 1999). In the research at hand, feelings of eeriness were induced in three different conditions, while they were not induced in the neutral control condition. Most importantly, the intensity of the feelings of eeriness was manipulated through mind attribution of humanoid robots. Similar as in the research designs of Mende et al. (2019) and Appel et al. (2019), mind attribution was manipulated with different video descriptions. One of the two groups that saw humanoid robots was shown a description that elicits mind attribution and thereby increased feelings of eeriness. The other group saw a description that did not elicit mind attribution and thereby less feelings of eeriness. Further, the research distinguished between feelings of eeriness that are elicited though humanoid robots and those, that are *not* elicited through humanoid robots but through mortality salience. As a

manipulation check, participants were asked to report the extent to which the videos in the second block were perceived as eerie on a continuous rating scale from “not at all eerie” to “very eerie”.

Moderators

The defined experiment considers multiple moderating variables. The most important moderator in relation to the hypotheses is *self-esteem*. Self-esteem was measured with the Rosenberg Self-Esteem Scale that has been used widely in terror management literature (Greenberg et al., 1992; Harmon-Jones et al., 1997; Mandel & Smeesters, 2008; (Rosenberg, 1965). This scale consists of ten items and measures self-esteem by including both positive and negative feelings about the self (Rosenberg, 1965). Participants were asked to rate each item on a four-point scale ranging from “strongly disagree” to “strongly agree”. Based on this rating, a score between 0 and 30 was calculated (Rosenberg, 1965). While scores above 25 indicate a high self-esteem, scores below 15 suggest low self-esteem (Rosenberg, 1965). Appendix 3 depicts the Rosenberg Self-Esteem Scale.
Another important moderator is participants’ *body-esteem*, that was measured with the Body-Esteem Scale for Adolescents and Adults (Mendelson, Mendelson, & White, 2001). This scale assesses participants’ attitudes and feelings about their bodies and appearance and contains 23 positively or negatively worded items (Mendelson et al., 2001). It is designed to reflect multiple dimensions of body esteem (Mendelson et al., 2001). However, for the purpose of this research the general measure of body esteem was more relevant. This general measure was calculated by summing up the scores of the subscales (Mendelson et al., 2001). Participants that had a score above the median were viewed as having a high body esteem, whereas scores below the median suggested a low body esteem. Appendix 4 depicts the Body-Esteem Scale.

Another moderator is the *importance of the product type* for the self-esteem of each participant. Similar to Arndt et al. (2003), participants were asked to indicate the importance of each product type for the self-esteem on a continuous rating scale ranging from “very little” to “very much”. Specifically, they were asked “How important is this product for your self-esteem?”. As this question is of rather abstract nature, its meaning was explained in more detail during the task description which has been tested in the pilot survey. Since each product type was shown twice, the importance

rating was measured twice. The final importance score was measured by calculating the average of the two ratings.

Dependent variables

The dependent variables of the research are *the change in liking and the change in willingness to pay* for each of the product categories (status-signaling products, healthy food products and unhealthy food products). Both liking and willingness to pay are product evaluations and were measured in the same way. Participants were asked to indicate the liking and willingness to pay for each product type on a continuous scale ranging from “very little” to “very much”. Specifically, they were asked “How much do you like this product?” and “How much would you pay for this product?”. For each product type, both variables were measured twice: after the first set of videos and after the second one. Subsequently, the difference between the second and the first measurement was calculated for each product type.

6.6 PROCEDURE

As outlined above, nearly all participants were recruited online via Facebook with the same message. Attached to the message was a link to the online survey, which had to be completed on a PC. On the first screen, participants were thanked for their participation and were informed that the survey would take 12 minutes and that they could win 50 Euro. Subsequently, the general structure of the experiment was explained. Participants were told that they would see two different videos soon and at a later time again two different ones. It was also pointed out that all videos are without sound. Additionally, the participants were told that they would have to evaluate different products after each block of videos and were asked to do so as intuitively as possible based on their initial impression of the product. Furthermore, they were informed that questions related to their personality would be asked at the end of the survey. Finally, it was explained how to navigate in the survey and it was highlighted that all data would be anonymized and handled according to data protection laws.

After this introduction, participants were shown the first two descriptions followed by the related videos. In order to ensure that participants would read the entire descriptions and watch the videos, the screens on which these stimuli were shown were timed. This means that the button to proceed to the next screen was only shown after a defined time. The specific time was dependent on the length of the individual stimulus.

Following these stimuli, participants were shown another explanation of the product evaluations. They were told to evaluate the products as intuitively as possible with regard to the criteria “How much do you like this product?”, “How much would you pay for this product” and “How important is this product for your self-esteem?”. Further, it was explained that the last question relates to how positively the consumption (e.g. purchase, usage etc.) of the product affects the self-esteem. Finally, participants were also informed that they would need to complete evaluating all products before proceeding.

Subsequently, the product type stimuli were shown simultaneously with the related evaluation criteria in order to enable participants to indicate their response as fast and intuitively as possible. The order of the product types was fixed, so that each participant would see exactly the same sequence. After these product evaluations, the next block of stimuli was shown. This time, participants were randomly assigned to four different groups and were shown the before mentioned different stimuli as manipulation of the feelings of eeriness. Following these stimuli, participants were shown the same product evaluations in the same fixed order as before. This fixed order research design was used to increase the validity of the between-subject comparison in regards to the timing of the effect of the feelings of eeriness. In the research design used by Mende et al. (2019), consumer behavior was impacted by feelings of eeriness immediately after showing the video stimuli. Thus, it was shown that no delay is necessary to measure the effects. However, to our knowledge, so far no research has been able to determine the duration and the development over time of the effect of the feelings of eeriness. Therefore, it was unclear whether the last product evaluation would be impacted as much as the first one, or if it would be impacted at all. The fixed order research design attempts to control for this timing effect.

Subsequently, participants were asked to complete the self-esteem and the body esteem scale. This particular order was used to account for a potential influence of the body esteem scale on the self-esteem scale. Finally, participants were asked to indicate how eerie they perceived the second block of videos and were asked to state their gender and age. On the last screen, participants were thanked for their participation and were offered the possibility to participate in the lottery of the 50 Euro.

7 DATA ANALYSIS AND FINDINGS

In this section, the data that was collected will be analyzed and the findings will be outlined. In a first step, the previously derived hypotheses will be tested. Subsequently, additional findings that are not directly related to the hypotheses will be presented as part of the exploratory analysis. The data was analyzed with the statistical software JMP.

7.1 TESTING OF HYPOTHESES

The hypotheses **H1** and **H1a** related to the general impact of the feelings of eeriness on product evaluations and the moderating role of self-esteem. Both described rather general relations and were based on the Hypotheses **H2 – H5a**. Therefore, they were not tested separately, but confirmed or rejected depending on the result of the test of the Hypotheses **H2 – H5a**.

In hypothesis **H2** it was investigated whether consumers respond to feelings of eeriness elicited through humanoid robots with an increased liking of status-signaling products. To test **H2**, a repeated measures linear mixed effect model based on the restricted maximum likelihood (REML) estimation was used (SAS Institute, n.d.-b). The only groups included in the analysis were the group that saw the humanoid robots with an attributed mind (HR-Mind), the group that saw the humanoid robots without an attributed mind (HR) and the neutral control group (Neutral). The independent variable for this hypothesis was the *feelings of eeriness* and the dependent variable was the increase in *liking of status-signaling products*, for which the mean was used. The result of this test was

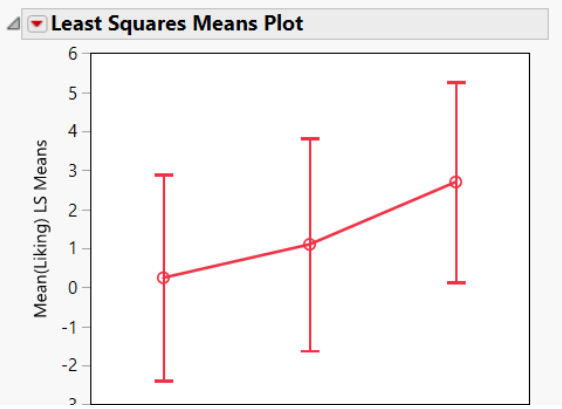

Figure 14: Least Squares Mean Plot (H2)

not significant (F(2, 144) = 0.90 , p = 0.409), meaning that there was no significant difference in the mean increase in liking between the groups. Therefore, **H2** was rejected. Furthermore, an analysis of the least squares means showed that the mean increase in liking of the neutral group (2.70) was actually higher than the increase in the groups that saw the humanoid robots ($M_{HR\text{-}Mind}$ = 1.10, M_{HR} = 0.25), which is a finding that is opposite to the hypothesis. The least squares means plot depicted in figure 13 also illustrates that there was a lot of variability in the data, which might have impacted the statistical power of the model.

In **H2a** it was hypothesized that low self-esteem consumers when compared to consumers with high self-esteem would respond to feelings of eeriness elicited through humanoid robots with a stronger increase in liking of status-signaling products. For this analysis, the data was further filtered to only include both groups that saw the humanoid robots. To test this hypothesis, a t-test was conducted. The independent variable was *self-esteem* (low versus high self-esteem) and the dependent variable was the mean *increase in liking*. No significant difference between low and high self-esteem consumers was found (t = 0.48, p = 0.6322). Hence, **H2a** was rejected. However, despite its insignificance, when looking at the means, low self-esteem consumer (1,67) had a stronger increase in liking than high self-esteem consumer (0,44).

Hypothesis **H3** was about whether consumers respond to feelings of eeriness elicited through humanoid robots with an increased willingness to pay for status-signaling products. The only difference to **H2** was that the dependent variable was willingness to pay instead of liking. Thus, the hypothesis was tested in the same way as **H2**. The result of this test was also not significant and thus **H3** was rejected (F(2, 144) = 1,47 , p = 0.233). When comparing the means of the different groups, a similar tendency as in **H2** was observed. Whereas the mean willingness to pay increased in the neutral group (1.29), the mean willingness to pay decreased in the groups that saw the humanoid robots ($M_{HR\text{-}Mind}$ = -0.36, M_{HR} = -1.82). The least squares means plot depicted in

Figure 15: Least Squares Means Plot (H3)

figure 15 further illustrates that there was a lot of variability in the data.

Hypothesis **H3a** was also very similar to **H2a**, but related to *willingness to pay* as dependent variable instead of liking. The conducted test was the same as for **H2a** and also revealed no significant differences between low and high self-esteem consumers ($t = 0.97$, $p = 0.3347$). Therefore, **H3a** was rejected. Similar to the insignificant finding of **H2a**, the mean willingness to pay increased for consumers with low self-esteem (0.84) whereas it decreased for consumers with high self-esteem (-1.54).

The hypotheses **H4** and **H4a** related to consumers with *high body-esteem* and whether they would respond to feelings of eeriness elicited through humanoid robots with an *increased liking or willingness to pay for healthy food products*. To test these hypotheses, the data was filtered for consumers with high body-esteem. The same repeated measures linear mixed effect model was used as in **H2**. The independent variable for both hypotheses was the feelings of eeriness. For **H4** the dependent variable was the mean increase in liking whereas for **H4a** it was the mean increase in willingness to pay. The testing of both hypotheses revealed no significant differences between the groups (**H4**: $F(2, 65) = 1.80$, $p = 0.174$; **H4a**: $F(2, 65) = 0.35$, $p = 0.705$). Therefore, both hypotheses were rejected. An analysis of the mean increase in liking revealed the same tendency as before: the mean liking of the neutral group increased (0.64) whereas it decreased for both groups that saw the humanoid robots ($M_{HR\text{-}Mind} = -2.56$, $M_{HR} = -0.22$). A similar observation was made for the mean increase in willingness to pay ($M_{Neutral} = 0.3$, $M_{HR\text{-}Mind} = -0.63$, $M_{HR} = -1.32$). The related least square means plots are depicted in figure 16 and figure 17 and illustrate again that the variability in the data was high.

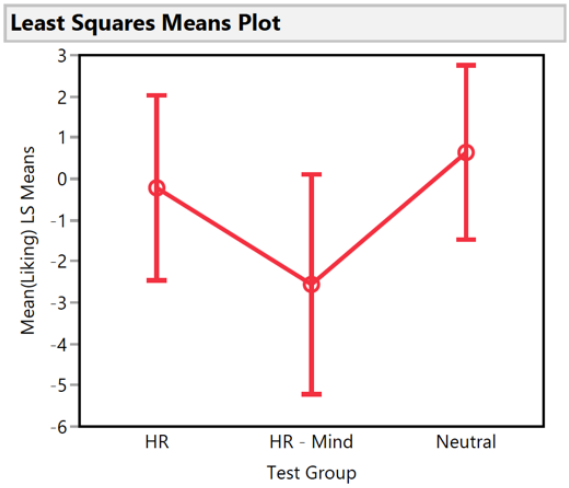

Figure 16: Least Squares Mean Plot (H4)

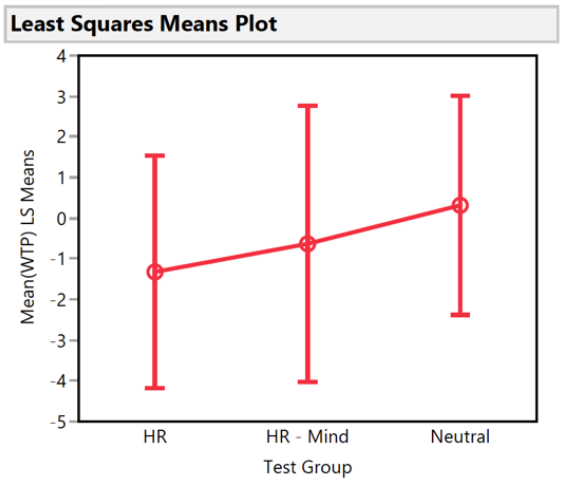

Figure 17: Least Squares Mean Plot (H4a)

Hypotheses **H5** and **H5a** were similar to **H4** and **H4a** but were about consumers with *low body-esteem and unhealthy food products*. Both hypotheses were tested in the same way as **H4** and **H4a**. The result of both tests was not significant and both hypotheses were rejected (**H5**: F(2, 76) = 0.12 , p = 0.892; **H5a**: F(2, 76) = 0.44 , p = 0.648). An analysis of the means showed a different result as before: both the mean liking and the mean willingness to pay decreased for all groups (**H5**: $M_{Neutral}$ = -1.16, $M_{HR-Mind}$ = -1.61, M_{HR} = -0.63; **H5a**: $M_{Neutral}$ = -1.14, $M_{HR-Mind}$ = -1.16, M_{HR} = -2.96). As before, the least square means plots showed in figure 18 and 19 illustrate that there was a lot of variability in the data.

Figure 18: Least Squares Means Plot (H5)

Figure 19: Least Squares Means Plot (H5a)

As all of the hypotheses from **H2** to **H5a** have been rejected, **H1** and **H1a** were rejected as well. Furthermore, all hypotheses from **H6** to **H6d** were also rejected based on insights from **H2** to **H5a.** In these hypotheses it was hypothesized that mind attribution of humanoid robots would increase the effects that were outlined in **H2** – **H5a**. In the tests related to **H2** – **H5a**, both groups that saw the humanoid robots were compared with each other and with the neutral control group. None of the hypotheses revealed a significant difference between the group that saw the humanoid robots with an attributed mind and the group that saw the humanoid robots without an attributed mind. Therefore, all hypotheses from **H6** to **H6d** were rejected. Table 1 provides a full overview about which hypothesis from **H6** to **H6d** was rejected based on specific insights from hypotheses **H2** – **H5a**. Finally, the hypotheses **H7** – **H7f** were about whether feelings of eeriness not elicited through humanoid robots but through mortality salience would have a similar effect on product evaluations as outlined in **H2 – H5a. H7** was a rather general hypotheses and not tested separately, but confirmed or rejected depending on the result of the test of the hypotheses **H7a** – **H7f** and the previous findings from **H2 – H5a**. The same repeated measures linear mixed effect model that was applied before was used to test **H7a** – **H7f**. For these analyses, the group that saw the funeral videos was compared to the group that saw the humanoid robots with an attributed mind and the neutral control group. None of the tests of hypotheses **H7a** – **H7f** revealed significant results and therefore all of them were rejected. Table 1 includes the details of each test. Based on these insights **H7** was also rejected.

Hypothesis	Independent variable	Dependent variable	Method	Result	Conclusion
H1	Feelings of eeriness	Product evaluations	Based on results from H2, H3, H4, H4a, H5, H5a	H2, H3, H4, H4a, H5, H5a were all rejected	Rejected
H1a	Self-esteem (low vs. high)	Increase in liking/WTP of status-signaling products (mean)	Based on results from H2a, H3a	H2a, H3a were both rejected	Rejected
H2	Feelings of eeriness	Increase in liking of status-signaling products (mean)	Repeated measures linear mixed effect model	F(2, 144) = 0.90 , p = 0.409	Rejected
H2a	Self-esteem (low vs. high)	Increase in liking of status-signaling products (mean)	t-test	t = 0.48, p = 0.6322	Rejected
H3	Feelings of eeriness	Increase in WTP of status-signaling products (mean)	Repeated measures linear mixed effect model	F(2, 144) = 1,47 , p = 0.233	Rejected
H3a	Self-esteem (low vs. high)	Increase in WTP of status-signaling products (mean)	t-test	t = 0.97, p = 0.3347	Rejected
H4	Feelings of eeriness	Increase in liking of healthy food products (mean)	Repeated measures linear mixed effect model	F(2, 65) = 1.80 , p = 0.174	Rejected
H4a	Feelings of eeriness	Increase in WTP of healthy food products (mean)	Repeated measures linear mixed effect model	F(2, 65) = 0.35 , p = 0.705	Rejected
H5	Feelings of eeriness	Increase in liking of unhealthy food products (mean)	Repeated measures linear mixed effect model	F(2, 65) = 1.80 , p = 0.174	Rejected
H5a	Feelings of eeriness	Increase in WTP of unhealthy food products (mean)	Repeated measures linear mixed effect model	F(2, 65) = 0.35 , p = 0.705	Rejected
H6	Feelings of eeriness	Increase in liking/WTP for each of the 3 product categories	Based on results from H6a – H6d	H6a – H6d were all rejected	Rejected
H6a	Feelings of eeriness	Increase in liking of status-signaling products (mean)	Based on results from H2	F(2, 144) = 0.90 , p = 0.409	Rejected
H6b	Feelings of eeriness	Increase in WTP of status-signaling products (mean)	Based on results from H3	F(2, 144) = 1,47 , p = 0.233	Rejected
H6c	Feelings of eeriness	Increase in liking of healthy food products (mean)	Based on results from H4	F(2, 65) = 1.80 , p = 0.174	Rejected
H6d	Feelings of eeriness	Increase in liking of unhealthy food products (mean)	Based on results from H5	F(2, 65) = 1.80 , p = 0.174	Rejected
H7	Feelings of eeriness*	Increase in liking/WTP for each of the 3 product categories	Based on results from H7a – H7f	H7a – H7f were all rejected	Rejected
H7a	Feelings of eeriness*	Increase in liking of status-signaling products (mean)	Repeated measures linear mixed effect model	F(2, 148) = 1,23 , p = 0,295	Rejected
H7b	Feelings of eeriness*	Increase in WTP of status-signaling products (mean)	Repeated measures linear mixed effect model	F(2, 148) = 1,15 , p = 0,321	Rejected
H7c	Feelings of eeriness*	Increase in liking of healthy food products (mean)	Repeated measures linear mixed effect model	F(2, 70) = 1,38 , p = 0,259	Rejected
H7d	Feelings of eeriness*	Increase in WTP of healthy food products (mean)	Repeated measures linear mixed effect model	F(2, 70) = 0,14 , p = 0,866	Rejected
H7e	Feelings of eeriness*	Increase in liking of unhealthy food products (mean)	Repeated measures linear mixed effect model	F(2, 75) = 1,72 , p = 0,186	Rejected
H7f	Feelings of eeriness*	Increase in WTP of unhealthy food products (mean)	Repeated measures linear mixed effect model	F(2, 75) = 0,03 , p = 0,972	Rejected

Table 1: Overview of Tested Hypotheses **feelings of eeriness elicited through mortality salience*

7.2 EXPLORATORY ANALYSIS

In this part of the data analysis, additional behavior patterns and relationships between variables that are not directly related to the hypotheses are explored. These analyses will enhance the understanding of the collected data and might provide some potential reasons why all hypotheses were rejected. For simple main effects, a Bonferroni adjustment was applied leading to statistical significance being accepted at the $p < 0.025$ level.

In a first step, it was investigated whether the videos were perceived differently in terms of eeriness, which was used as an indicator for the perceived feelings of eeriness. For this purpose, the reported perceived eeriness of the different videos was compared between the four groups. To check the manipulation, a linear mixed effect model based on the restricted maximum likelihood (REML) estimation was used (SAS Institute, n.d.-b). In this analysis, significant differences between the groups were identified ($F(3, 196) = 29.22$, $p < 0.0001$). Moreover, for a pairwise comparison of the groups, a Tukey HSD test was conducted (SAS Institute, n.d.-a). This test revealed significant differences in each pairwise comparison except of the comparison between the two groups that saw the humanoid robots. The detailed p-value of each comparison can be found in table 2. Figure 20 illustrates that the neutral videos were perceived as least eerie, the funeral videos as more eerie and the videos with the humanoid robots as most eerie. Therefore, it can be concluded that the stimuli were generally perceived as intended. However, it seems as if the different descriptions of the videos with the humanoid robots did not impact the perception of the videos in terms of eeriness.

Level	- Level	p-Value
HR	Neutral	<.0001*
HR - Mind	Neutral	<.0001*
HR	Funeral	<.0001*
HR - Mind	Funeral	0.0009*
Funeral	Neutral	0.0009*
HR	HR - Mind	0.9575

Table 2: Pairwise Comparison of the Test Groups with Tukey HSD

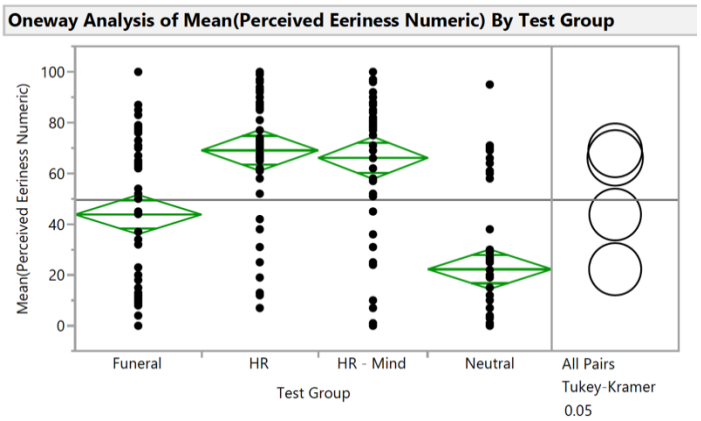

Figure 20: Oneway Analysis of Mean Perceived Eeriness by Test Group

Based on these insights, it was further explored whether the perceived eeriness of the videos had an impact on product evaluations. For this purpose, participants were divided into those that perceived the videos as eerie (high perceived eeriness) and those that did not (low perceived eeriness). To investigate the influence of the perceived eeriness on the mean increase of liking, a t-test was conducted. This test revealed a significant difference for status-signaling products (t = 2.747, p = 0.0066), whereas there was no significant difference for healthy (t = 1.71, p = 0.09) and unhealthy food products (t = 1.52, p = 0.13). Analyzing the means showed that the mean increase in liking of people that did not perceived the videos as eerie (3.16) was significantly higher than that of people that perceived the videos as eerie (-0.74). Against the expectation based on the derived hypotheses, people that perceived the videos as eerie liked status-signaling products significantly **less** than those that did not perceive the videos as eerie. Figure 20 illustrates that a similar tendency was observed for the healthy and unhealthy food products.

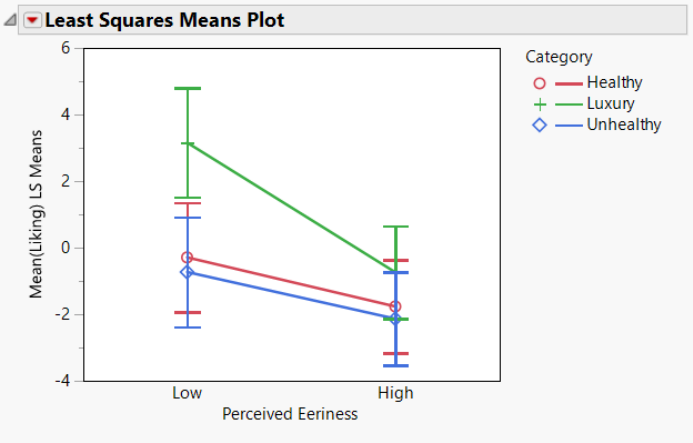

Figure 21: Least Squares Means Plot of Perceived Eeriness for Liking of Product Categories

Additionally, the data was analyzed to verify if the perceived eeriness has an influence on the mean increase in willingness to pay as well. The t-test revealed a difference on a trend level (two-tailed, t = 1.93, p = 0.0551) only for status signaling products. When comparing the means, the same relation as before was observed. The willingness to pay of people that did not perceive the videos as eerie increased (0.92) whereas it decreased for people that perceived the videos as eerie (-1.75). This relation is also illustrated in figure 22. Based on these findings it seems as if consumers are rather reluctant than attracted towards status-signaling consumption when primed with feelings of eeriness.

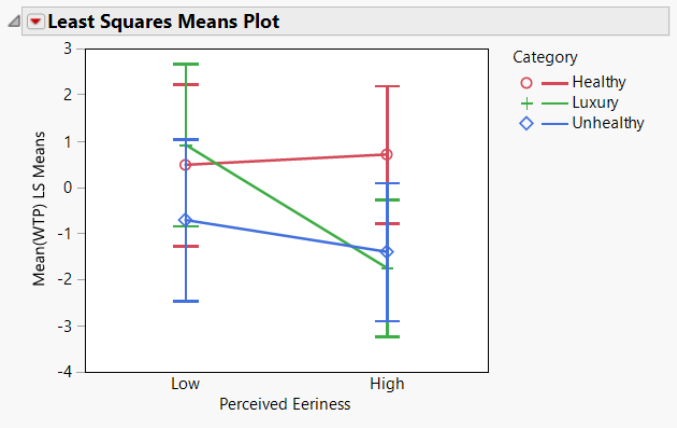

Figure 22: Least Squares Means Plot of Perceived Eeriness for WTP of Product Categories

Subsequently, the correlation between liking and willingness to pay was checked. To test the correlation, the Pearson correlation coefficient was measured for each of the product categories (SAS Institute, n.d.-c). Through this analysis a correlation coefficient of $r = 0.70$ ($p < 0.0001$) was obtained for status-signaling products. As a coefficient greater than 0.5 suggests a strong positive correlation, liking and willingness to pay are strongly correlated for status signaling products (Lund Research Ltd, n.d.). For healthy and unhealthy food products, no significant correlation between liking and willingness to pay was found (healthy: $r = 0.11$, $p = 0.0546$; unhealthy: $r = 0.38$, $p < 0.0001$).

Another important factor that was investigated in the exploratory analysis, was the influence of the product importance on the impact of the feelings of eeriness. Following the insights from literature, the feelings of eeriness might only impact product evaluations in domains that are important for one's self-esteem (Arndt et al., 2003; Ferraro et al., 2005). Therefore, in the following analyses only those participants were included that indicated that the shown products were important for their self-esteem. To test the impact of the feelings of eeriness on product evaluations of these people, the same repeated measures linear mixed effect model as before was used. These tests revealed a significant difference between the groups in mean increase in liking of healthy food products ($F(3, 139) = 4.23$, $p = 0.007$). Whereas for status-signaling products ($F(3, 149) = 1.04$, $p = 0.379$) and unhealthy food products ($F(3, 60) = 0.17$, $p = 0.914$) no significant differences were found. Furthermore, no significant differences between the groups were found for willingness to pay for all product categories. The details of these tests can be found in table 3. Taken the insights of these

six tests together, it can be concluded that the product importance generally did not have a significant influence on the impact of the feelings of eeriness in the research at hand.

Finally, it was investigated whether the feelings of eeriness impacted the evaluations of **individual** products to explore potential patterns on product level. For these analyses, a linear mixed effect model was used (SAS Institute, n.d.-b). These tests revealed no significant differences between the groups in terms of both mean increase in liking and mean increase in willingness to pay for any individual products. The details of these tests can be found in appendix 5

Finding	**Method**	**Result**
The neutral videos were perceived as least eerie, the funeral videos as more eerie and **both videos with the humanoid robots as most eerie**. There was no significant difference between the two videos with humanoid robots.	Linear mixed effect model and pairwise comparison with Tukey HSD	$F(3, 196) = 29.22$, $p < 0.0001$)
People that perceived the videos as eerie liked **status-signaling products** significantly **less** than those that did not perceive the videos as eerie.	Two-tailed t-test	$t = 2.75$, $p = 0.0066$
The willingness to pay for **status-signaling products** of people that perceive the videos as eerie **decreased**, whereas it **increased** for people that did not perceived the videos as eerie. The difference was on a trend level.	Two-tailed t-test	$t = 1.93$, $p = 0.0551$
For **status-signaling products**, liking and willingness to pay were **strongly correlated**.	Pearson correlation coefficient	$r = 0.70$, $p < 0.0001$
Product importance did **not** have a significant influence on the impact of the feelings of eeriness.	Repeated measures linear effect model	Appendix 5
There were no significant differences between the groups (HR, HR-Mind, Funeral, Neutral) in terms of both mean increase in liking and mean increase in willingness to pay for any **individual product**.	Linear mixed effect model	Appendix 5

Table 3: Overview of the Analyses of Product Importance and Single Products

8 DISCUSSION

The following section of this thesis aims at drawing a line between meaning, importance and relevance of the study results. Next to critically reviewing findings, research design and theoretical concepts, the validity and reliability of this paper are evaluated. Moreover, managerial implications will be derived and finally, the limitations of the research will serve as a basis for proposals for further research.

8.1 SUMMARY OF FINDINGS

The main goal of this study was to investigate how mind attribution of humanoid robots impacts product evaluations of status-signaling products as well as healthy and unhealthy food products. Within the scope of this overall research goal, the moderating roles of mind attribution, self-esteem and body-esteem have been investigated. Further, the potential effect of the humanoid robots on consumer behavior has been compared to the effect of mortality salience. More specifically, it was tested how mind attribution of humanoid robots can influence liking and willingness to pay for the three product groups.

As revealed in the data analysis, all derived hypotheses have been rejected. No significant impact of humanoid robots on product evaluations has been found. Moreover, no significant difference between humanoid robots with an attributed mind and humanoid robots without an attributed mind has been found. Both self-esteem and body-esteem did not moderate the impact of humanoid robots on product evaluations. Similarly, mortality salience had no significant impact on product evaluations. As all derived hypotheses were based on insights from existing literature, no supporting evidence for previous findings has been found.

The findings from the exploratory analysis provide several additional insights. Most importantly, a significant influence of the feelings of eeriness on liking of status-signaling products was found. Participants that perceived the videos as eerie liked status-signaling products significantly *less* than those that did not perceive the videos as eerie. This finding contradicts previous research that showed that people respond to feelings of eeriness with increased status-signaling consumption.

8.2 DISCUSSION OF FINDINGS

There are several possible reasons why the findings of the current study do not support previous research. On the one hand, the used research design might have been unable to measure the hypothesized impact of humanoid robots on product evaluations. Therefore, the research design will be critically reviewed in the following. On the other hand, the underlying theories and concepts of the uncanny valley and compensatory consumer behavior used in this paper might not apply to the context that was investigated. This reasoning questions the replicability and the generalizability of previous literature and will be discussed subsequently.

8.2.1 CRITICAL REFELCTION OF THE RESEARCH DESIGN

Sample Population

Choosing the right sample population and sample size are a vital part of designing research, because they enable the researcher to estimate representative characteristics of the whole population under scrutiny.

Although the sample size of this study included 200 participants with respectively 50 persons per test group, filtering for moderators significantly reduced the number of measures taken into consideration for some of the statistical analyses. For example, there were only 37 participants in total with low self-esteem. This over-representation of high self-esteem participants can be an indicator of a possible sampling error (Bryman & Bell, 2015). Sampling errors can occur when a non-probability sampling technique is applied and can have an effect on the statistical results (Bryman & Bell, 2015). As outlined above, previous research has established that people with low self-esteem are affected the most by feelings of eeriness. In contrast, participants with high self-esteem are less influenced and accordingly don't adapt their behavior significantly. In this research, the over-representation of high self-esteem participants could have made it more difficult to measure potential behavior pattern because these participants simply showed no compensatory behavior.

Another indicator for a possible sampling error is the distinct variability in the data which can be observed in the ranges shown in the least square means plots in section 7.1 of this paper. The smaller the sample size the larger is the impact of the variability in the data and the higher is the

probability of a potential sampling error (Bryman & Bell, 2015). The variability in the data shows that liking and willingness to pay for all shown products differed significantly between participants. Potential reasons for the observed variability include that the chosen products might have polarized the participants or that participants provided extreme answers based on a response bias. No matter the cause, a high variability in the data makes it generally more challenging to obtain significant results.

Stimuli

Next to sampling, selecting the right stimuli is crucial to trigger the desired effects within the participants. Thus, in the following, the videos, descriptions and images of product types used in this study as well as their pretests will be examined in view of their effectivity.

First, already existing videos of humanoid robots were used as stimuli since access to fully programmed, humanoid robots is still limited. However, some researchers are discussing if the effects of approximate stimuli such as the videos of human-like robots can be compared with real stimuli, for example, physically present humanoid robots (Risko, Laidlaw, Freeth, Foulsham, & Kingstone, 2012). It is likely that participants react differently to real humanoid robots than the ones shown in a video, especially when the encounter takes place in an authentic social environment (Risko et al., 2012). Hence, different statistical results could have been generated by using real stimuli.

In addition to the videos, verbal descriptions of the videos have been used as important contextual additions to the pictorial cues (see section 6.3). The manipulation check conducted within the exploratory analysis of this paper showed that the perceived eeriness of the videos differed significantly between all test groups except from the two humanoid robot conditions (see section 7.2). Both groups saw the same videos but different descriptions. Since no differences have been found between these groups, it might be that the descriptions of the videos were not sufficiently effective. This could be explained by the “pictorial superiority effect” which describes the general superiority of pictures relative to their verbal labels (Nelson, Reed, & Walling, 1976, p. 523). It refers to the phenomenon in which picture and images are more likely to be remembered than words due to differences in cognitive processing (Nelson et al., 1976). Hence, the pictorial characteristic of the videos could have supplanted the descriptions and their meaning. If participants neglected the

descriptions of the videos, then the mind-attribution manipulation did not work as intended, which in turn might be a reason why no significant results were obtained. Nevertheless, it should be noted that Mende et al. (2019) presented descriptions and videos in a similar way as in this study and found significant results.

Procedure

The sequence of stimuli and the arrangement of questions are eventually forming the survey experiment that the participants take part in and pave the way for the collection of data. Therefore, factors such as a potential delay of effects and the order of the stimuli are central to the discussion and will be outlined subsequently.

The Order of Stimuli

The order of the product type stimuli and evaluations was deliberately chosen to be fixed and not randomized to ensure a high level of comparability between subjects of the different test groups. However, a non-randomized order of stimuli and evaluations can have several unwanted effects on the behavior of experiment participants.

One of those potential effects is the licensing effect, which has been investigated in the context of luxury goods by Khan and Dhar (2006). The authors show that a prior choice, which boosts a positive self-concept, subsequently licenses the choice of a more indulgent option (Khan & Dhar, 2006). The same tendency was also found for healthy and unhealthy food choices (Wilcox, Vallen, Block, & Fitzsimons, 2009). In other words, after making a healthy choice, participants are more likely to allow themselves making an unhealthy one. Hence, some product evaluations could have been biased by previous ones.

Another possible effect that could have influenced product evaluations is the so called “order effect” (Perreault, 1975). The relative position of an item in an inventory of questions or stimuli may uniquely influence the way in which respondents react to the item (Perreault, 1975). Because participants are evaluating products in the exact same order twice, they might remember the products and their initial evaluation and try to reproduce their answers as precise as possible.

Additionally, the “mere-repeated-exposure” phenomenon could have influenced how participants evaluated the individual products (Zajonc, 2001, p. 1). The phenomenon describes that participants being repeatedly exposed to the same stimulus develop a preference for that object due to increased familiarity with it (Zajonc, 2001). For the research design at hand this means that participants might have evaluated products more positively when they had to evaluate them for the second time, simply due to their familiarity. This effect could explain why participants in the neutral condition showed the tendency to increase their liking and willingness to pay. However, it makes it more surprising that people who perceived the videos as eerie liked the products significantly less in the second measurement.

Possible Delay of Effects

As mentioned in section 2.2.1 of this paper, making a distinction between subliminal and supraliminal primes is important in terms of accessibility of knowledge and how it affects consumer behavior (Greenberg et al., 1997). Subliminal priming occurs when an individual is exposed to stimuli below the threshold of perception and can thus not be perceived with the conscious mind (Bar & Biederman, 1998). The same notion is found in the terror management theory which was outlined in section 3.2.2. Here, a distinction between subliminal death primes as well as supraliminal death primes is being made. Accordingly, a subliminal death prime might lead to an *immediate* distal defense in form of compensatory consumer behavior (Greenberg et al., 1997). In contrast, a supraliminal death prime only leads to distal defenses after a *delay* (Arndt et al., 2004). This insight is relevant for the participant group that was primed with mortality salience through videos of funerals and thus with a supraliminal death prime. As this type of prime only elicits compensatory consumer behavior after a delay, it might explain why no effect was measured for this group of participants.

Variables and Measures

The main independent variable in the outlined experiment was the intensity of feelings of eeriness. To ensure that the chosen stimuli elicited feelings of eeriness correctly, a manipulation was conducted at the end of the survey experiment. The goal of this manipulation check was to rule out reasons why the manipulation may have failed to influence the dependent variable, the change in

liking and the change in willingness to pay. Since no significant influence was detected, the effectivity manipulation check itself will be discussed hereinafter.

Manipulation Check

The research design included one manipulation check in which participants were verbally asked to report the extent to which the videos in the second block were perceived as eerie (see section 6.6). The manipulation check demonstrated that the manipulation worked for all test groups, except from the mind attribution/ no mind attribution groups. However, no significant results could have been identified in terms of the product evaluations.

One reason for this could be that participants subjectively and consciously rated the videos based on their eeriness. The priming of the participants took place on a subliminal level and therefore, asking participants on a conscious level to report feelings of eeriness might have been an inappropriate way to measure. Other researchers use, for example, word-completion tests to measure death thought accessibility (Das et al., 2014).

Another reason for a possible inaccuracy of the manipulation check could be the way the question was formulated. Instead of asking them to report their current level of *feelings* of eeriness, they were asked to report the eeriness of the videos. Hence, there might have been a discrepancy between participants' actual feelings of eeriness towards the robots and how they perceived the videos.

In general, verbal manipulation checks including a rating scale are viewed critically in terms of their purity and unambiguity (Hauser, Ellsworth, & Gonzalez, 2018). They can hold multiple meanings, interrupt the participant's experience and even mitigate manipulation effects (Hauser et al., 2018). Other researchers used, for example, multiple true or false statements to check for a mortality salience manipulation as well as the PANAS mood scale to identify positive or negative affect (Ferraro et al., 2005). Gray and Wegner (2012) whereas also included subjective, conscious scale ratings as manipulation checks in their research design including three questions that rated feelings of eeriness. Hauser et al. (2018) suggest non-verbal and behavior measures as alternatives. Therefore, it is debatable what manipulation check is the most appropriate to adopt, but it is important to discuss their drawbacks which can have an influence on the results of a study.

8.2.2 CRITICAL REFLECTION OF THEORY & CONCEPTS

Since a large part of the research design at hand has been derived from the work of Mende et al. (2019), the differences between their studies and this paper will be reviewed in the following section to reflect on the possible causes of the inconsistent results. Additionally, other theories and concepts that could potentially explain why this research was unable to replicate the findings of previous literature will be discussed.

The unconscious nature of compensatory consumer behavior

One of the most substantial differences to Mende et al. (2019) is the kind of consumer behavior that the authors investigated. In most of their experiments, Mende et al. (2019) examined *on the spot* consumer behavior using *real* products. In one of these studies, participants had to choose between a more expensive and a cheaper version of bottled water that were *physically* present in the setup. In another one, participants were eating *real* food in the form of cheese cubes. Both of these behaviors can be viewed as rather unconscious processes that demand little cognitive effort. In contrast, in this research, participants were asked to indicate their liking and willingness to pay for products that were shown on a screen. Even though participants were asked to evaluate the products as intuitively as possible, they still had to *consciously* assess the products in order to determine their liking and in order to quantify their willingness to pay for them.

Thus, Mende et al. (2019) investigated behaviors that demanded less cognitive effort than the behavior that was examined in this research. In other words, deciding between two similar products is easier than thinking about how much one would potentially pay for them. This draws a line back to Kahneman's (2003) theory of cognitive processing. System one decides fast and automatic while system two is slow and makes choices deliberately. The on-spot decision between a higher and a lower priced water bottle as well as the act of eating cheese are fast and automatic and therefore cognitively processed in system one. Evaluating a product, especially quantifying the willingness to pay for it, is a decision that must be made deliberately and is therefore processed slower and in system two. Hence, a difference must be made between actual consumption behavior and the evaluation of products.

As per Kahneman (2003), system two is able to override system one. In the case of product evaluations, system one is processing the humanoid robot stimuli and controls the unconscious compensatory consumption behavior. It is this *unconscious* behavior that reflects the intuitive compensatory effect like for example choosing a status-signaling product over a cheaper alternative. But, when participants are confronted with the *evaluation* of the status-signaling product, system two takes over with its proper reasoning and might decide against the expensive product. Therefore, it might not be possible to measure the unconscious compensatory behavior with conscious assessments from the participant.

Nevertheless, it should be noted that Mende et al. (2019) also found significant results for consumption *intentions*. In one of their experiments, the authors asked participants to indicate the desired amount of food intake, which can be viewed as a more conscious behavior. This might indicate that compensatory behavior can indeed be measured with conscious assessments, depending on the context.

Other potential factors

Another important reason why this paper was unable to measure significant results might be factors that moderated the effect of the uncanny valley on consumer behavior. As mentioned above, previous literature established that both self-esteem and body-esteem are important moderators of how the uncanny valley impacts consumers. Yet, no significant influence could be observed in this study. However, previous literature also mentions multiple other factors that could have played a role. Past research shows that there are age differences regarding attitudes towards robots (Scopelliti, Giuliani, & Fornara, 2005). Younger people are more familiar with technology and have a more positive attitude towards robots than folder people (Scopelliti et al., 2005). Not just age, but also cultural differences are acknowledged determinants of negative attitudes towards robots (Bartneck, Nomura, Kanda, Suzuki, & Kato, 2005). For instance, Bartneck et al. (2005) found that American participants of their study were least negative towards robots, while the Mexican were most negative. Furthermore, MacDorman and Entezari (2015) found that other individual differences can predict sensitivity to the uncanny valley. The authors recognize especially negative or ambivalent attitudes towards robots as a factor that can increase uncomfortable feelings around humanoid robots. Moreover, perfectionism, neuroticism, anxiety, personal distress and religious

fundamentalism are named as other predictors for an enhanced sensitivity to the uncanny valley effect (Macdorman & Entezari, 2015).

Next to individual traits and culture that predict sensitivity to the uncanny valley, the context in which a humanoid robot is presented appears to be an important determinant of the impact of mind attribution of robots on the feelings of eeriness (Appel et al., 2019). The authors found that a robot with experience is not perceived as eerie when its task is to feed or to clean in a nursing context. However, they also showed that when it operates without any given context, a robot with experience is perceived as significantly more eerie than a robot without experience (Appel et al., 2019). In their experiments, Mende et al. (2019) also put their robots in a context, for instance as a doctor or a server. In this paper, the robots were not set in any specific context and no effect of mind attribution was found.

Further, the visual appearance of the humanoid robot itself can also impact the degree to which feelings of eeriness or the uncanny valley is elicited. Research found that a wide range of design features such as height, bulk or bi-pedal form contribute to the perceived threat or likeability of humanoid robots (Rosenthal-Von Der Pütten & Krämer, 2014). Another study suggests that the uncanny valley only emerges when faces of humanoid robots have abnormal features such as bizarre eyes (Seyama & Nagayama, 2007).

Recognizing that the impact of the uncanny valley on consumer behavior is influenced by many factors including individual traits, culture and context, it no longer appears surprising that this paper was not able to find supporting evidence for previous findings. Rather, it can be concluded that the complex nature of the uncanny valley itself makes it difficult to obtain significant findings and to replicate previous findings. Following this notion, the generalisability and replicability of previous findings seem to be questionable.

A general goal of a researcher is the replicability of his or her research design. This means that a researcher is able to replicate an earlier research design with achieving the same results (Saunders et al., 2019). According to that, Mende et al.'s (2019) work should be replicable in a sense that similar studies such as the research at hand generate a complementary outcome. Many possible explanations for the inability to replicate Mende et al.'s (2019) studies have been discussed already,

but there might be a more fundamental reason for this. Over the last few years, psychology researchers have become increasingly preoccupied with the question of whether findings from psychological studies are replicable and generally refer to this doubt as the “replicability crisis” (Świątkowski & Dompnier, 2017, p. 111). Within the attempt to assess the extent to which one could replicate psychological effects from the published literature - the Psychology Reproducibility Project – only 25 percent of the effects studied in social psychology could be replicated (Świątkowski & Dompnier, 2017). Interestingly, widely known effects such as unconscious behavioral priming, which happens to be the investigated effect in this thesis, were challenged in replication studies that proved unsuccessful (Doyen, Klein, Pichon, & Cleeremans, 2012). As possible reason for the replicability crisis, Świątkowski and Dompnier (2017) name, among others, the neglect of statistical power, questionable research practices and current publication standards.

Having mentioned the alleged replicability crisis in psychological research does not mean that Mende et al.’s (2019) work is affected. Nevertheless, it should be generally kept in mind when discussing research within the field of social psychology.

8.2.3 DATA INSIGHTS FROM THE EXPLORATORY ANALYSIS

In the following part of this paper the outcome of the exploratory analysis will be discussed and interpreted. One of the most surprising findings from the additional data analysis is that the perceived eeriness had a negative influence on the liking of status-signaling products. This means that participants who indicated that they perceived the humanoid robot videos as particularly eerie, contrary to expectations, showed a decrease in attraction toward status-signaling products. The opposite effect was found for participants that did not perceive the videos as eerie.

This finding could be a sign that people can respond to feelings of eeriness with a *decrease* in liking of status-signaling products. The notion of compensatory consumption can be used to explain this finding. Compensatory consumption involves maintaining and enhancing of self-esteem as a shield against anxiety (Greenberg, Pyszczynski, & Solomon, 1986). This can be done through acquiring products with symbolic properties (Lisjak et al., 2015). The symbolic meanings of products are often linked to stereotypes associated with the personal images of the product user (Banister & Hogg, 2004; Sirgy et al., 1997). Individuals use personal images to identify with possible selves as well as

negative or rejected selves (Banister & Hogg, 2004; Sirgy et al., 1997). Withal, little research attention has been paid to the nurturing of self-esteem through the *aversion* of products for symbolic reasons based on negative stereotypes (Banister & Hogg, 2004). Status-signaling products can be used to maintain and enhance self-esteem by acquiring them, but conceivably also by avoiding them and therefore the negative product user stereotype (Banister & Hogg, 2004). Ecological concerns as well as ethical ideologies are possible anti-consumption drivers that could have led the participants of this study into avoiding status-signaling products and the connected consumer stereotype in order to nurture their self-esteem (Sudbury-Riley & Kohlbacher, 2018).

Other theories suggest that individuals cope with being stressed by saving money rather than spending it or with a general avoidance of the stressor (Durante & Laran, 2016; Moschis, 2007). In a broad sense, the eerie feelings that humans experience when interacting with a humanoid robot can be interpreted as stress.

The oppositional effect that was characterized by an increased liking of status-signaling products for participants who did not perceive the videos as eerie can be explained with the mere exposure effect that has been discussed before. The phenomenon describes that participants being repeatedly exposed to the same stimulus develop a preference for that object due to increased familiarity with it (Zajonc, 2001).

Similar findings on a trend level were identified for the willingness to pay for status-signaling products. This goes along with the correlation between liking and willingness to pay which has only been identified for status-signaling products, but not for healthy or unhealthy food products. A possible explanation for this could be the order effect of stimuli that has been touched upon earlier (Perreault, 1975). The assemblage of food and status-signaling product stimuli could have led participants into evaluating them based on comparisons between each product, but also between each category. Since the monetary value of status-signaling products is generally much higher than for food products, participants might have indicated a low willingness to pay for food products even though they indicated a high liking for them, simply because they compared them to the status-signaling products.

This problematic combination of different product categories might also explain why no significant relationship between product importance and feelings of eeriness was found. Following the insights from literature, it was concluded that feelings of eeriness might only impact product evaluations in domains that are important for one's self-esteem (Arndt et al., 2003; Ferraro et al., 2005). One reason why this connection could not be confirmed in the study at hand could be the operationalization of the importance of product type in the form of a continuous scale. Although the experiment included a comprehensive explanation of product importance, it is possible that participants found it generally difficult to rate the importance of a product for the self-esteem. Especially when comparing completely different product such as a soft drink and a luxury car.

8.3 RESEARCH QUALITY

In the following section, the applied research method will be critically evaluated to assess the quality of the research. In quantitative research, the research quality can be evaluated through the criteria of reliability and validity of the research (Bryman & Bell, 2015). Within this discussion, a number of potential effects that might have influenced the findings will be highlighted.

8.3.1 RELIABILITY

The reliability of a study concerns the question of whether the results are repeatable and thus, relates to the consistency of the measures (Bryman & Bell, 2015). According to Saunders et al. (2019) there are four distinct threats to reliability: researcher error, researcher bias, participant error and participant bias.

Researcher errors are factors that alter the researcher's *interpretation* (Saunders et al., 2019). Since all data was collected in a quantitative format and analyzed using statistical tests, there was generally little room for interpretation. Thus, the researcher error is of minor importance in this research design. Researcher bias is any factor that induces bias in the researcher's *recording* of responses (Saunders et al., 2019). In the research at hand, the data was collected digitally in an online survey without personal interaction with the participants. Therefore, this bias can also be neglected.

On participants side, the participant error relates to any factor that alters the way in which a participant performs (Saunders et al., 2019). To minimize potential distractions, participants were free to choose a time that fit them to complete the survey. Further, they were only allowed to complete the survey on the laptop and were asked to do so in a quiet moment at home. Therefore, it was controlled for a potential participant error to a reasonable degree. Moreover, the participant bias is any factor that induces a false response (Saunders et al., 2019). One of the most prevalent of these factors is the social desirability effect which refers to participants' tendency to give socially desirable responses (Grimm, 2010). In the research at hand, this effect was mitigated by informing participants at the beginning of the experiment that their data is truly confidential. Furthermore, all information was presented in a judgement free manner. As product evaluations are generally not the most sensitive research topic, the social desirability effect can be neglected.

8.3.2 VALIDITY

Another and in many ways the most important criterion of research is research validity, which is concerned with the integrity of the conclusions that are generated from a piece of research (Bryman & Bell, 2015). In other words, the validity of a research refers to how well the results of a study measure what they are intended to measure.

Construct Validity

Essentially, construct validity is about whether a test measures the intended construct (Bryman & Bell, 2015). In the research at hand, participants' liking and willingness to pay was measured with self-reports. A correlation between those two measures was hypothesized. However, liking and willingness to pay were only correlated for status-signaling products, but not correlated for healthy and unhealthy food products. As food products are generally low-priced commodities it might have been difficult for participants to report their willingness to pay for these products, especially in relation to the high-prized status-signaling products. Therefore, the validity of this measurement is questionable. Another measurement that might suffer from a low validity is the product importance. In general, it might be difficult for people to self-report how important a product is for one's self-esteem. This might again be even more difficult for low involvement food products.

Although the validity of these two measurements is questionable, the validity of the overall research design is not impacted. Both of these measurements have been analyzed in separate analyses and don't have a major impact on the research question.

Internal Validity

Internal validity is concerned with the issue of causality and refers to the extent to which an independent variable is responsible for a change in a dependent variable (Bryman & Bell, 2015). Arguably the most challenging threat for researchers to control is the Hawthorne effect (Bryman & Bell, 2015). In general, this effect relates to the fact that participants may respond and behave differently when they know that they are experimental subjects (Bryman & Bell, 2015). This effect also draws attention to the fact that the researcher's activities have an influence on the participants (Bryman & Bell, 2015). As there was no personal interaction with the participants and nearly all participants were recruited with exactly the same message, the Hawthorne effect was controlled for to a reasonable degree.

Other factors that might have impacted the internal validity of the research are the order effect, the licensing effect and the mere exposure effect. As they have already been discussed previously, they are not in the focus of this part.

External Validity

The external validity is concerned with the question of whether the results of a study can be generalized beyond the specific research context (Bryman & Bell, 2015). In order to be able to generalize, quantitative researchers generate representative samples (Bryman & Bell, 2015). In the research at hand, a specific, homogenic sample population was used to increase the internal validity of the research by controlling for age- and culture-related effects. However, this decision also has an impact on the external validity of the findings. It has been shown that age is a critical variable for acceptance of and attitudes towards humanoid robots (Kuo et al., 2009; Scopelliti et al., 2005). Therefore, the findings should not be generalized to older populations. Considering that the findings of the research were contrary to previous findings, it is generally questionable if the findings can be generalized.

Ecological Validity

This criterion refers to the extent to which the social scientific findings can be generalized to people's natural social settings or real life (Bryman & Bell, 2015). In the research at hand, videos were used as stimuli and participants indicated their responses on a computer. This setup was chosen to create a high internal validity, however it differs significantly from a real-life situation. Confronting a humanoid robot in real-life is different from viewing a video showing a humanoid robot. Moreover, product evaluations are especially relevant in shopping situations and the research at hand differs significantly from a typical shopping environment. Nevertheless, ecological validity was not in focus of the research at hand and is not a prerequisite for a high research quality (Bryman & Bell, 2015).

8.4 MANAGERIAL IMPLICATIONS

Having discussed the findings of the research and the research quality, finally, managerial implications can be derived. In the following, implications related to marketing are in the focus. As discussed above, the findings of this paper need to be interpreted with caution because they partly contradict previous findings. Nevertheless, they question the replicability and the generalizability of previous literature and draw attention towards a more nuanced understanding of the impact of the uncanny valley on consumer behavior. Insights from both, previous literature and the research at hand will serve as a basis for the derived implications.

First, the findings of this paper support established evidence that humanoid robots can be perceived as eerie and therefore might elicit feelings of discomfort. As this discomfort could undermine customer satisfaction and loyalty, managers should track consumer responses to humanoid robots through marketing research (Mende et al., 2019). Mende et al. (2019) also propose to segment consumers on the basis of their response to humanoid robots or other measures such as technology readiness (Parasuraman & Colby, 2015). Based on this segmentation, humanoid robots could be assigned only to technophile consumers, while the technophobe segment could be served by human employees (Mende et al., 2019). Thereby firms would enable consumers to self-select interaction with humanoid robots but avoid forcing them (Reinders, Dabholkar, & Frambach, 2008).

Second, the implementation of humanoid robots should be designed to reduce consumer discomfort and should be based on an understanding of the context in which they are employed (Mende et al., 2019). This does not only comprise the physical design of humanoid robots but also applies to how they are described and marketed. For example, mind attribution of humanoid robots has generally been found to increase feelings of eeriness (Gray & Wegner, 2012). However, in a nursing context, robots with an attributed mind were perceived as less eerie, probably because feelings of robots were perceived as appropriate in this context (Appel et al., 2019). This finding suggests that it might not be possible to develop general design implications for humanoid robots. Instead it might be more reasonable to identify different sets of robot characteristics that work more or less in different contexts (Appel et al., 2019).

Third, humanoid robots have an impact on consumer behavior and therefore might be used to stimulate specific consumer responses. From a consumer health perspective, humanoid robots could be used to stimulate healthy food intake for certain consumers (Ferraro et al., 2005; Mende et al., 2019). However, there would be the risk of stimulating unhealthy food intake for other consumers at the same time (Ferraro et al., 2005; Mende et al., 2019). Furthermore, the effect of humanoid robots on compensatory consumption might not only be used to stimulate status-signaling consumption but could also be used for upselling in settings in which consumers choose between basic and premium products (Mende et al., 2019). On the other hand, the findings of this paper suggest that feelings of eeriness can also have a negative effect on status-signaling consumption. Therefore, the usability of these insights in reality seems problematic as their mechanisms are yet not fully explored and appear rather unstable and unpredictable.

Furthermore, using consumer discomfort or feelings of eeriness to stimulate consumption might generally not be beneficial for companies. First, because consumers might respond differently to feelings of eeriness in real-life purchase situations than in the conducted experiments. They could simply leave the restaurant or avoid the purchase situation (Mende et al., 2019). Moreover, the discomfort might have a negative impact on consumer satisfaction and loyalty and therefore harm the long-term customer-firm relationship. Thus, rather than stimulating consumer behavior with the negative emotions elicited by humanoid robots, it might be more advantageous for firms to

focus on the positive emotions and associations elicited by humanoid robots instead. A recent trend in the fashion industry exemplifies an adequate execution of this strategy. Various high-end fashion brands started using humanoid virtual characters as models on Instagram (Fowler, 2018). With this initiative, the brands have succeeded in capturing the novel, innovative nature of the virtual characters. Interestingly, these brands took advantage of the feelings of eeriness to create a viral hype around these models based on a high social media engagement. Figure 23 shows an Instagram post from a renowned virtual character named "lilmiquela". Instagram users express their discomfort towards the technology with comments such as "I'm so confused you're not really a robot right [sic]" or "You make me scared [sic]" (Miquela [@lilmiquela], 2019)

Figure 23: Example of a humanoid virtual character on Instagram named "lilmiquela" (Miquela [@lilmiquela], 2019)

Finally, managers should be aware of the ethical considerations that arise from using robots to stimulate consumer behavior. Ham and Spahn (2015) highlight that two levels of analysis are needed to determine whether a persuasive tactic is ethically appropriate. First, whether a certain type of persuasive technique is generally acceptable and second, whether it would be appropriate for

robots or other computing technology to make use of that technique (Ham & Spahn, 2015). Borenstein and Arkin (2017) discuss whether robots should be permitted to influence a user's behavior for that person's own good and come to no real conclusion due to the complexity of relevant ethical considerations. After all, using robots for marketing purposes with the single goal of profit maximization seems highly unethical. Especially when taking advantage of people's anxieties in order to sell products (Mandel & Heine, 1999).

8.5 CONCLUSION

Studying the relationship between human-like robots and humans has become a major area of interest with recent technological advances in robotics. The humanoid design of robots can elicit positive emotional responses in humans, but as skepticism towards the technology increases, reactions towards robots are becoming more negative. A large body of research focuses on this phenomenon which is often guided by the uncanny valley hypothesis. The concept of the uncanny valley suggests that humanoid objects which imperfectly resemble humans provoke feelings of eeriness in observers. A possible explanation that recently gained attention is that the uncanny valley is based on people's perception of a human mind in a machine. A human mind is characterized by agency (the ability to control one's own actions) and experience (the ability to feel emotions). From a human perspective, these two dimensions are associated with humanity only. Perceiving them in a humanoid robot results in a threat to one's own human identity, potentially making the observer aware of his or her own mortality. Another line of studies describes how consumers cope with mortality salience with compensatory behaviors. The terror management theory describes that individuals who are experiencing mortality salience tend to consume goods and services that bolster their self-esteem which in return fights the death anxiety.

Together with the rapid and exponential growth of humanoid robots used for social and commercial purposes in the marketplace, the impact of mind attribution of humanoid robots on consumer behavior becomes meaningful. Therefore, this thesis focused on **how mind attribution of humanoid robots impacts product evaluations** of status-signaling products as well as healthy and unhealthy food products. Thereby, the present study is among the first to investigate the influences of humanoid robots on consumer behavior.

In an attempt to replicate the findings of Mende et al. (2019), it was hypothesized that consumers respond to feelings of eeriness elicited by mind attribution of robots with an increased liking and willingness to pay for the mentioned product categories. Videos of humanoid robots served as stimuli in combination with different descriptions that manipulated the mind attribution of humanoid robots. The influence of these videos and their descriptions on the consumer behavior of the participants was measured with self-reported assessments for different product types.

This paper was not able to measure a significant impact of mind attribution of humanoid robots on product evaluations. However, data insights from the exploratory analysis showed that, contrary to expectations, participants responded to perceived eeriness of the stimuli with a decrease in liking of status-signaling products. This finding can be explained with a participants' aversion of status-signaling products for symbolic reasons based on negative stereotypes.

A takeaway of the present study is the fact that a variety of moderators appear to play a role in how individuals react to humanoid robots. This study investigated the individual traits self-esteem and body-esteem. However, relevant literature shows that age, gender, religion and culture as well as the context in which robots are presented are influential components in the perception of humanoid robots.

Numerous influencing moderators, contrary findings from the exploratory analysis and the fact that Mende et al.'s (2019) study results could not be replicated are all proof of the complexity of the studied subject. After all, robotics in social science is an underrepresented research topic and especially the effect of mind attribution of humanoid robots on consumer behavior is scarcely explored. Hence, the findings of this thesis generally call for a more nuanced view on the uncanny valley and its impact on consumer behavior.

Eventually, humanoid robots are starting to become more common in our society and are already applied in diverse contexts. Whether they are used as healthcare robots for elderly, as help for children with autism or as service robots in a variety of contexts, robots can represent an organization and can impact the customer-firm relationship (Mende et al., 2019). Therefore, it is crucial for companies that employ humanoid robots to understand how consumers perceive, evaluate and respond to humanoid robots. To do so, future research must develop clear rationales

for how individual traits, culture and context impact the perception of mind in humanoid robots and thereby how consumers react to them.

8.6 LIMITATIONS AND PERSPECTIVES FOR FUTURE RESEARCH

In the final section of this paper, some limitations of this paper will be highlighted that open interesting perspectives for further research.

First, this thesis used *self-report measures* to investigate the impact of humanoid robots on consumer behavior. This chosen method limited the research to explore how the rather *conscious* product evaluations were impacted. Thus, future studies could further explore the *unconscious* consumer responses to humanoid robots. For that purpose, physiological and neuroscientific techniques could provide insights into the unconscious mechanisms underlying consumer behavior (Bell et al., 2018). For example, electroencephalography (EEG) could provide further insights into consumer preferences (Telpaz, Webb, & Levy, 2015). Moreover, galvanic skin response (GSR) could potentially indicate an eerie stimulus – as may neural activity in the amygdala measured by fMRI (MacDorman et al., 2009).

As already mentioned in the discussion, another limitation is that this research used videos as stimuli because access to humanoid robots is still limited. With the proliferation of robots, future research could investigate consumer reactions to an interaction with *real-life* humanoid robots. Similarly, considering the trend of using humanoid virtual characters as models, research could explore the impact of these virtual characters on consumers' status-signaling consumption. This research direction is particularly interesting as Instagram is a social platform that becomes increasingly commercial-driven and thus, a relevant marketing tool (Collins, 2019).

Furthermore, this paper is limited to the investigation of *first-time* consumer-robot encounters and doesn't capture how the measured effects develop over time in the course of multiple confrontations with humanoid robots. This long-term perspective appears to be particularly critical because humanoid robots are envisioned to impact humans' lives on an everyday basis. However, as the implementation of such long-term experiment is very complex, there is very little research

that investigates human-robot interactions over time (Dziergwa, Kaczmarek, Kaczmarek, Kędzierski, & Wadas-Szydłowska, 2018).

Finally, the findings of this paper that contradict previous literature also open up suggestions for further research. Particularly, participants' reaction of disliking status-signaling products when being confronted with feelings of eeriness deserves further exploration. To investigate this finding, the moderating role of worldviews (materialism versus idealism) could be explored.

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APPENDIX

Appendix 1: Message that was used to recruit the participants

German original:

Hey Leute,

wir brauchen für unsere Masterarbeit Teilnehmer für eine Umfrage und es wäre super wenn ihr euch die Zeit dafür nehmen könntet. Das Ganze dauert 12min und es gibt als kleinen Anreiz auch 50€ zu gewinnen :) Wichtig ist, dass ihr es am PC macht, da es auf dem Handy nicht funktioniert. Am besten in einem ruhigen Moment alleine zuhause ausfüllen.

Tausend Dank!

English translation:

Hi folks,

We conduct a survey for our master's thesis and need volunteers to participate – it would be great if you would have the time for it. The study takes 12 min and as a little incentive you get the chance to win 50€. It is important that you answer the survey on your PC because it does not work on mobile. At best, you complete the survey in a quiet moment alone at home.

Thank you very much!

Appendix 2: Stimuli that were used in the experiment

Neutral video and description #1 (Block 1)

In the following, you will see a video of Sarah, who is a 25 year old student. In her leisure time she enjoys to take walks outside in the nature. Thereby she is able to relax and to calm her mind.

Neutral video and description #2 (Block 1)

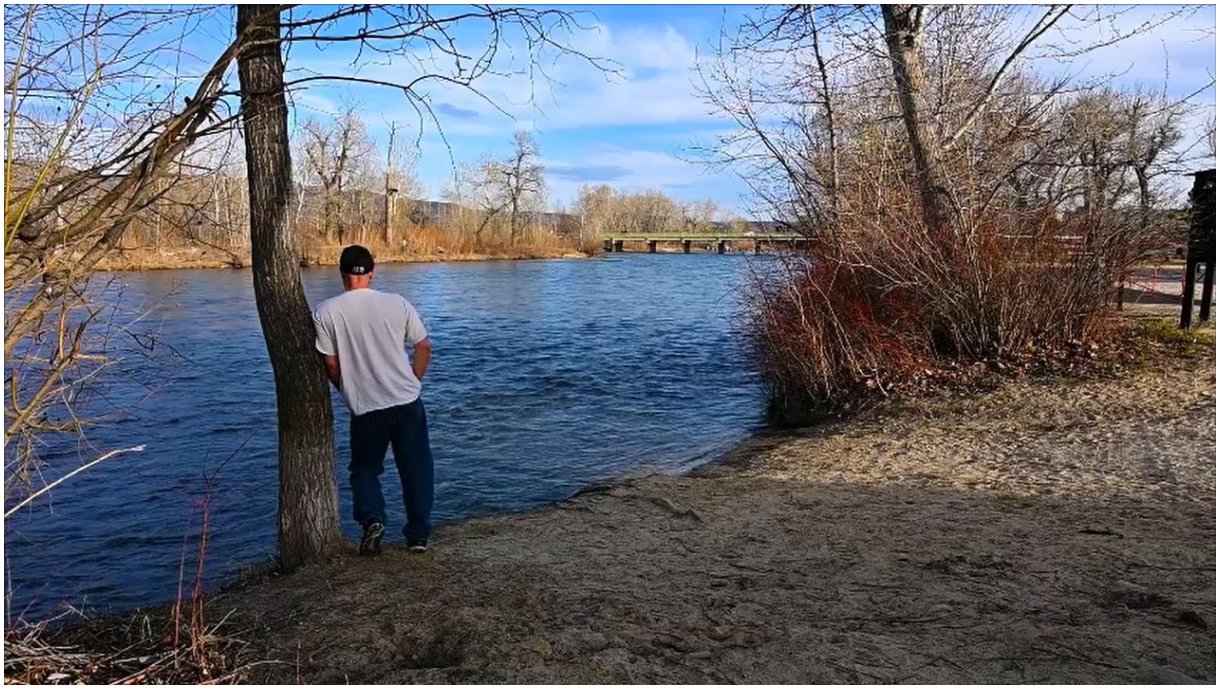
In the following you will see a video of Paul, who is a 23 year old student. Paul also enjoys spending time in the nature to relax.

Neutral video and description #1 (Block 2)

In the following you will see a video of Sina, who is taking the train home. Sina is studying at the University and has a lot of friends. Through taking the train she is able to commute comfortably and to study during her travel time.

Neutral video and description #2 (Block 2)

In the following you will see a video of Theo, another student. Theo is living outside of the city and also able to spend a lot of time in the nature. Because he is living near to a river, he regularly calms his mind close to the water.



Humanoid robot #1 (Block 2)

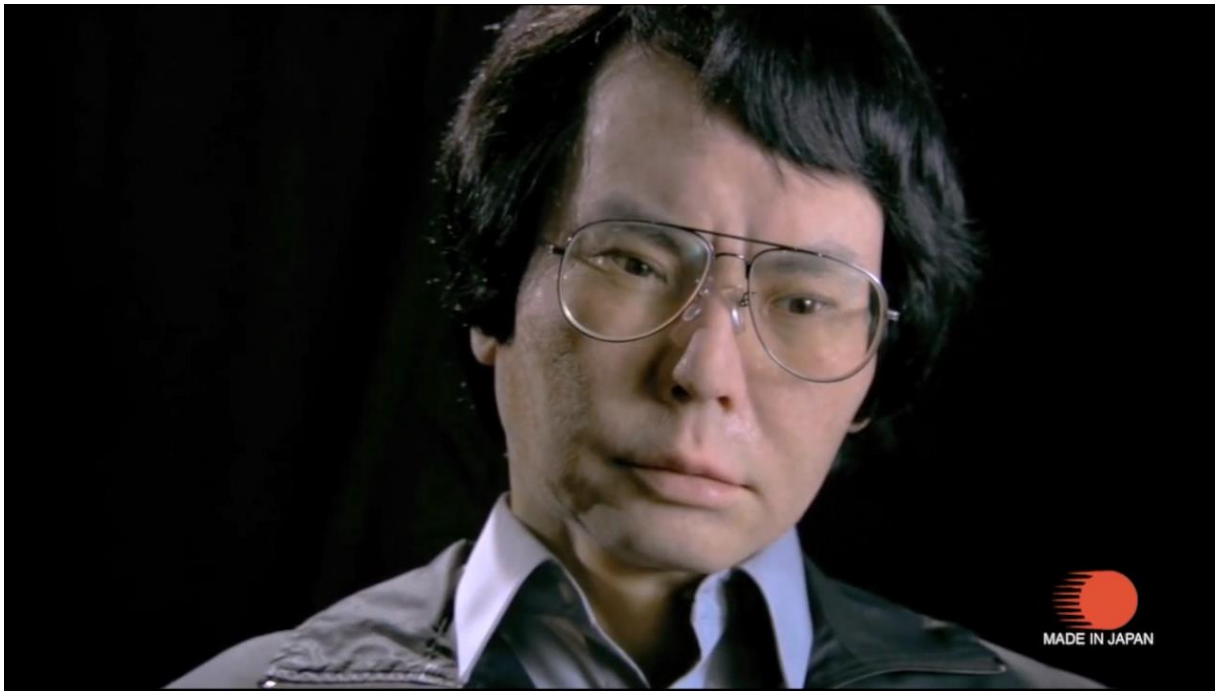
Mind attribution description:
In the following you will see a video of Bina, an intelligent humanoid robot. Like humans, she is able to experience feelings and emotions such as hunger, fear and pleasure. Through advanced technology, Bina is able to act autonomously, meaning that she has full control over her actions.

No mind attribution description:
In the following you will see a video of B-2000, a humanoid robot. Based on its software, it is able to simulate the behaviour of humans. Through their voice, human users can command B-2000 to execute actions.

Humanoid robot #2 (Block 2)

Mind attribution description:
In the following you will see a video of Keno, another intelligent humanoid robot. Keno also belongs to a new kind of robots that are able to experience feelings and emotions. He has full control over his actions and can estimate their consequences. Moreover, he is able to learn from experience.

No mind attribution description:
In the following you will see a video of K4N0, another humanoid robot. K4N0 is also able to simulate the behaviour of humans based on its software. The robots is programmed to execute actions from humans' voice commands.



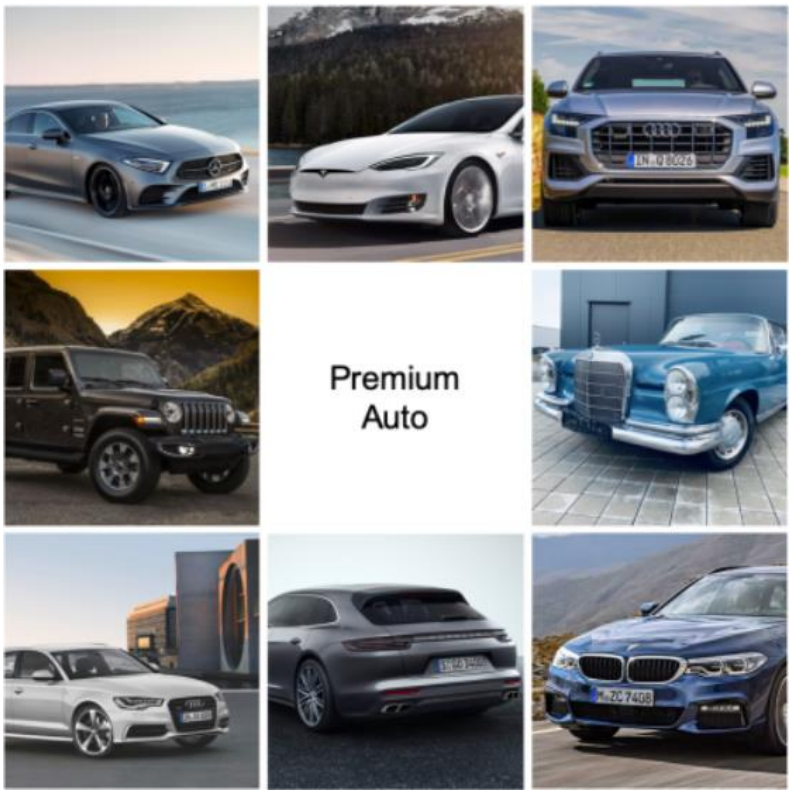
Funeral video and description #1 (Block 2)

In the following you will see a video of the funeral of Lina, who died at a young age. Lina was studying at University and had a lot of friends. In his speech, the attendant pastor draws attention to the fact that death is a part of everyone's life.

Funeral video and description #2 (Block 2)

In the following you will see a video of the funeral of Leo, who also died at a young age. Leo was also studying at University and enjoyed his life to the full. His sudden death reminds us that human life is limited in time.

Status-signaling Products


Premium
Auto


Premium
Soundsystem


Premium
Stuhl

Healthy Food Products


Fruchtsalat


Tee

Unhealthy Food Products


Heiße
Schokolade /
Kakao


Burger
&
Pommes

Appendix 3: Rosenberg Self-Esteem Scale (Rosenberg, 1965)

1. On the whole, I am satisfied with myself.
2. At times I think I am no good at all.
3. I feel that I have a number of good qualities.
4. I am able to do things as well as most other people.
5. I feel 1do not have much to be proud of.
6. I certainly feel useless at times.
7. I feel that I'm a person of worth.
8. I wish I could have more respect for myself.
9. All in all, I am inclined to think that I am a failure
10. I take a positive attitude toward myself.

Appendix 4: Mendelson Body-Esteem Scale (Mendelson et al., 2001)

1. I really like what I weigh
2. I am satisfied with my weight
3. I am preoccupied with trying to change my body weight
4. Weighing myself depresses me
5. My weight makes me unhappy
6. I feel I weight the right amount for my height
7. I think I have a good body
8. I'm proud of my body
9. People my own age like my looks
10. Other people consider me good looking
11. My looks help me to get dates
12. I'm as nice looking as most people
13. I think my appearance would help me get a job
14. I like what I see when I look in the mirror
15. I wish I looked like someone else
16. There are lots of things I'd change about my looks if I could
17. I wish I looked better
18. I worry about the way I look
19. I feel ashamed of how I look
20. I'm pretty happy about the way I look
21. My looks upset me
22. I look as nice as I'd like to
23. I like what I look like in pictures

Appendix 5: Results of Additional Data Analyses

Test	Method	Result
Test if **product importance** had an influence on the impact of feelings of eeriness on **liking**	Repeated measures linear mixed effect model	Healthy food products: F(3, 139) = 4.23 , p = 0.007 Unhealthy food products: F(3, 60) = 0.17 , p = 0.914 Status-signaling products: F(3, 149) = 1.04 , p = 0.379
Test if **product importance** had an influence on the impact of feelings of eeriness on **WTP**	Repeated measures linear mixed effect model	Healthy food products: F(3, 139) = 0.52 , p = 0.666 Unhealthy food products: F(3, 60) = 1.23 , p = 0.309 Status-signaling products: F(3, 149) = 0.77 , p = 0.515
Test if there were differences between the groups (HR, HR – Mind, Funeral, Neutral) in terms of l**iking** of **individual** products (differences on product level)	Repeated measures linear mixed effect model	Premium sunglasses: F(3, 196) = 2.53 , p = 0.058 Designer chair: F(3, 196) = 1.87 , p = 0.136 High-end TV: F(3, 196) = 1.01 , p = 0.388 Luxury car: F(3, 196) = 0.91 , p = 0.434 Sound system: F(3, 196) = 0.64 , p = 0.589 Burger: F(3, 196) = 0.64 , p = 0.589 Cake: F(3, 196) = 2.34 , p = 0.074 Coke: F(3, 196) = 0.22 , p = 0.880 Hot chocolate: F(3, 196) = 0.82 , p = 0.483 Salad: F(3, 196) = 1.40 , p = 0.244 Fruit Salad: F(3, 196) = 1.32 , p = 0.269 Smoothie: F(3, 196) = 0.80 , p = 0.497 Tea: F(3, 196) = 0.153 , p = 0.928
Test if there were differences between the groups (HR, HR – Mind, Funeral, Neutral) in terms of **WTP** of **individual** products (differences on product level)	Repeated measures linear mixed effect model	Premium sunglasses: F(3, 196) = 0.71 , p = 0.545 Designer chair: F(3, 196) = 2.10 , p = 0.102 High-end TV: F(3, 196) = 0.32 , p = 0.810 Luxury car: F(3, 196) = 1.21 , p = 0.360 Sound system: F(3, 196) = 0.67 , p = 0.571 Burger: F(3, 196) = 0.02 , p = 0.995 Cake: F(3, 196) = 1.04 , p = 0.376 Coke: F(3, 196) = 0.09 , p = 0.965 Hot chocolate: F(3, 196) = 0.17 , p = 0.914 Salad: F(3, 196) = 0.68 , p = 0.565 Fruit Salad: F(3, 196) = 0.75 , p = 0.521 Smoothie: F(3, 196) = 2.50 , p = 0.061 Tea: F(3, 196) = 0.08 , p = 0.971