Anthropomorphism in Artificial Intelligence: A Review of Empirical Work Across Domains and Insights for Future Research

Keywords: Artificial Intelligence, Anthropomorphism, Personification, Mind Perception.

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ANTHROPOMORPHISM IN ARTIFICIAL INTELLIGENCE: A REVIEW OF EMPIRICAL WORK ACROSS DOMAINS AND INSIGHTS FOR FUTURE RESEARCH

ABSTRACT

Purpose – *Anthropomorphism in AI-powered devices is being used increasingly frequently in consumer-facing situations (e.g., Artificial Intelligence Assistants such as Alexa, virtual agents in websites, call/chat bots, etc.) and therefore it is essential to understand anthropomorphism in AI both to understand consequences for consumers and to optimize firms' product development and marketing. Extant literature is fragmented across several domains and is limited in the marketing domain. In this review, we aim to bring together the insights from different fields and develop a parsimonious conceptual framework to guide future research in fields of marketing and consumer behavior.*

Methodology – *We conduct a review of empirical articles published until November 2021 in FT50 journals, as well as in 41 additional journals selected across several disciplinary domains: computer science, robotics, psychology, marketing and consumer behavior.*

Findings – *Based on literature review and synthesis, we propose a three-step guiding framework for future research and practice on AI anthropomorphism.*

Research Implications – *Our proposed conceptual framework informs marketing and consumer behavior domains with findings accumulated in other research domains, offers important directions for future research and provides a parsimonious guide for marketing managers to optimally utilize anthropomorphism in AI to the benefit of both firms and consumers.*

Originality/value – *We contribute to the emerging literature on anthropomorphism in AI in three ways. First, we expedite the information flow between disciplines by integrating insights from*

different fields of inquiry. Second, based on our synthesis of literature, we offer a conceptual framework to organize the outcomes of AI anthropomorphism in a tidy and concise manner. Third, based on our review and conceptual framework, we offer key directions to guide future research endeavors.

Keywords: Artificial Intelligence, Anthropomorphism, Personification, Mind Perception.

INTRODUCTION

New technologies are transforming marketing practice and the customer experience. Customers can now interact with the companies in a myriad of ways, most recently and markedly through platforms and interfaces that are powered by Artificial Intelligence (AI). Nowadays there are AI-powered voice assistants in millions of homes (Bohn 2019). When thinking about AI, consumers seem to envisage an anthropomorphized entity and marketers have used an anthropomorphic perspective to market AI technology to people (e.g., Amazon's Alexa) (Smith 2020). Even in popular media and culture, AI is often conspicuously in anthropomorphized form (e.g., Terminator, Blade Runner). Perhaps it is because consumers do not exactly know what AI is and they construct it along the line of what they know (i.e., a human). In a way, they need to give it a face, both literally and figuratively. Instilling human-like features in artificial intelligence (AI) has always been a fascination for human beings (Haenlein and Kaplan 2019). Following this seemingly instinctual tendency, we have built a smile, a face, a body, a personality and a voice for the machines (Mende et al. 2019; Shumanov and Johnson 2021). Many anthropomorphic AI machines nowadays surround us (e.g., voice assistants, service robots, conversational chatbots, etc.), but we are far from fully understanding the complexities of human-AI interactions and consequences of using anthropomorphism in AI. Moreover, while the concept of

anthropomorphism in AI has been introduced to the marketing field relatively recently, there is a larger body of literature in the fields of computer science, robotics and psychology. In a broad search of the literature across multiple disciplines, we have identified novel insights regarding the use of anthropomorphism in AI that will be of interest to the fields of marketing and consumer behavior. The goal of this paper is to synthesize the empirical studies in the literature on the use of anthropomorphism in AI and provide a cohesive and parsimonious framework to guide future research in the marketing and consumer behavior domains.

The tendency to anthropomorphize is present very early on in life; children attribute a mind to their toys and to characters in their stories, and this tendency is certainly carried to the adulthood. Research shows that human adults readily anthropomorphize smart objects of our day, such as social robots and AI-powered agents (Chi et al. 2021; Gong 2008). By doing so, people apply the norms of human social interactions to their interactions with the AI. This fundamentally alters the behavior towards the anthropomorphized entity; examples range from trivial (e.g., saying 'I love you' to Alexa) to critical (e.g., assigning responsibility of an accident to a self-driving car) (Lopatovska and Williams 2018; Waytz et al. 2014).

Nowadays, anthropomorphism is not only widespread in the marketplace (e.g., anthropomorphized brands and products), but has also expanded to many fields such as service, hospitality and education industries. However, the relationship between anthropomorphism in AI and consumer responses is complex, and research results are divided and scattered. Anthropomorphism in AI has been studied for a long time, especially in computer science and robotics fields (e.g., Weizenbaum 1966). With increasing exposure of AI to end consumers particularly in business-to-consumer (B2C) settings, the relevance of anthropomorphism in AI has begun to expand into marketing domain, which can be observed in the emergence of recent

thought-leading articles on the topic (Blut et al. 2021; Hildebrand and Bergner 2021; Lin et al. 2021) (see also Figure 1 for the progression over the years).

In this paper, first, we delineate three main shortages in the current state of the literature on anthropomorphism in AI. First, both marketers and innovators tend to be optimistic about technological advancements. Therefore, most information systems and robotics research on anthropomorphism in AI has focused on beneficial effects (e.g., perceived enjoyment, trust, satisfaction), and almost exclusively these are the findings that have been translated to the marketing domain. While the literature has plenty of examples of both positive and negative effects of anthropomorphism in AI, the results are scattered and usually do not inform each other. Most research has focused on a stimulus-response approach in isolated cases of use or exposure and did not assume a relationship perspective between AI and user (see Novak and Hoffman 2019). An integrative yet parsimonious interpretation is needed to understand the disparate effects of anthropomorphism in AI that past literature has identified.

Second, extant literature on the use of anthropomorphism in AI has been shaped by the implicit goals of the research fields. For example, most research in information systems and marketing fields has focused on the idea that anthropomorphism is a strategy to be employed by companies towards consumers, and how this strategy might exploit the acceptance, adoption and use behavior of consumers (Kwak et al. 2017; Liew et al. 2017). While this path of research has identified many insights, consumer interactions with new technologies has transformed dramatically in the last decade. Consumers can engage with technology in different ways and be more involved in the interactions with technology if they want (O'Hern and Rindfleisch 2017). A consumer-centric (rather than a firm-centric) perspective, that is, research on how consumers perceive, engage and react to the anthropomorphic stimuli they are exposed to is scarce.

Third, while a variety of effects demonstrated in the literature may provide insights to practitioners, they may be incomplete. Emerging new research identifies individual customer traits and predispositions, socio-demographics and the context of application (e.g., types of tasks) as potential triggers of anthropomorphism (e.g., Andriella et al. 2020; Liu and Tao 2022). The consequences of anthropomorphism in AI seem to vary tremendously according to individual characteristics and the context it is utilized (Chuah et al. 2021; Kim and McGill 2011). Therefore, it is imperative for the research and practice to consider all use of anthropomorphism in AI interwoven with its surrounding context.

These shortages in the literature and the lack of a coherent framework call for a broad review of the existing literature across research fields. To address this complexity and offer a comprehensive understanding of this phenomenon, we review and synthesize the fragmented empirical research on anthropomorphism in AI in an attempt to integrate insights from different fields of inquiry, namely, computer science, robotics, psychology, marketing and consumer behavior. Our goal is to advance the conversation and information flow between fields by bringing together streams of literature to inform three main research questions:

- What are the benefits and harms of anthropomorphism in AI for both consumers and firms, as informed by extant literature across research fields?
- How might the effects of anthropomorphism in AI differ across contexts of use (e.g., shopping, education) and individual differences (e.g., personality, demographics)?
- Based on a comprehensive conceptualization of anthropomorphism in AI, what are critical future research directions, potential pitfalls and ethical considerations for marketing research?

To answer these three research questions, we review and synthesize extant empirical research regarding anthropomorphism in AI and develop a conceptual framework. In our paper, first, we briefly describe and define the core concept in this research, anthropomorphism. We then review and synthesize the literature across relevant domains, pulling together the scattered research that informs the use of anthropomorphism in AI. Based on the review of the literature, we identify three overarching themes of discussion: (1) benefits and harms of AI anthropomorphism both for consumers and firms, (2) the role of context and individual differences in the potency of AI anthropomorphism and (3) future research directions to explore, which includes a discussion of managerial and strategic implications.

[INSERT FIGURE 1 AROUND HERE: NUMBER OF PUBLICATIONS OVER THE YEARS]

ANTHROPOMORPHISM IN ARTIFICIAL INTELLIGENCE: REVIEW OF RELEVANT LITERATURE

Anthropomorphism has been commonly defined as 'the tendency to imbue the behavior of nonhuman agents with human-like characteristics' (Epley et al. 2007). These characteristics could include physical appearance, emotional and mental states and motivations. For instance, when we are faced with a nonhuman entity that possesses a human-like body or eyes, we may infer that the entity could move or see like a human. We make a behavioral inference based on our observation (e.g., my cat has eyes, so it must be able to see). However, when we attribute intentions, motivations and awareness to nonhuman entities, we go beyond such purely behavioral inferences and attribute a human-like mind to them (e.g., my cat is devious and Machiavellian). A hallmark of being human is having a mental state of one's own and recognizing mental states in others different from one's own (i.e., Theory of Mind) (Premack and Woodruff 1978). Therefore, anthropomorphism is essentially about perceiving a mind in the non-

human entity (Gray et al. 2007), whether it may be elicited through physical (e.g., embodiment, speech, interactivity) or mental (e.g., intentionality, emotions, cognition) human-like features (Waytz et al. 2010).

In our investigation of anthropomorphism in AI, we adopt this broad conception of anthropomorphism as a perception that AI has a mind of its own. As mentioned above, this perception could be elicited through seeing a moving, talking robot (i.e., physical features) or seeing a robot acting autonomously, seemingly with its own intentions (i.e., mental features). By adopting this definition, we aim to be inclusive of various human-like features studied in the literature that leads people to anthropomorphize, that is, perceive a mind in the AI-agent. Next, we summarize the procedures followed to conduct a comprehensive literature review for identifying and synthesizing the knowledge on AI anthropomorphism.

[INSERT FIGURE 2 AROUND HERE: THE OVERVIEW OF REVIEW PROCEDURES]

Literature Review Procedures

We have searched the literature for all research articles that included the following combinations of keywords: either "anthropomorphism" or "personification" that appeared together with the term "artificial intelligence" (up to November 2021). Since the earlier definitions and seminal works used the word "anthropomorphism", the term that generated most articles was the combination of "anthropomorphism" and "artificial intelligence". However, we also included "personification" as a keyword because we noticed that sometimes this term is used to denote the concept of anthropomorphism. The search terms "anthropomorphism" and "personification" were used in root form as well as full form to ensure all term-related search results were captured (e.g., "anthropomorph*").

In our topic of interest, after an initial search of the keywords, it became apparent that potentially relevant work is scattered across journals in the domains of marketing, consumer behavior, management, psychology, computer science and robotics. Since our aim is to bring together and synthesize the literature across these domains, it is useful to search the literature widely in order to capture the fragmented literature more effectively. Given the relevance of this article primarily for marketing academe and practitioners, we started our search in the FT50 (Financial Times Top 50) journals. In addition, we have complemented this with articles from relevant journals that are not included in that list. The additional journals were selected by consulting the lists and rankings provided by SCImago Journal & Country Rank (i.e., SJR Scientific Journal Rankings). To ensure the quality of included journals, we selected journals that were ranked in the top 5 in Scimago Journal Ranking (SJR) score in four sub-domains of Computer Science (*Artificial Intelligence*, *Computer Science (miscellaneous)*, *Human-Computer Interaction* and *Information Systems*), one sub-domain of Decision Sciences (*Information Systems and Management*), three sub-domains of Business, Management and Accounting (*Management Information Systems*, *Management of Technology and Innovation*, and *Marketing*) and two sub-domains of Psychology (*Experimental and Cognitive Psychology*, and *Social Psychology*). Upon review of these ten sub-domains and removing the duplicates that were top ranked in multiple sub-domains, we identified 28 journals that might be relevant to our topic, based on the sub-domains they were listed by Scimago Journal Rankings. Finally, we included an additional 13 journals that had a focus particularly relevant to our topic (e.g., Computers in Human Behavior, International Journal of Social Robotics). Given the different levels of maturity of literatures in each particular field, we opted for a search that is as wide as possible to capture the scattered literature more effectively. This resulted in a total of 91 journals included in

our literature search. Out of these 91 journals, the keyword search yielded no articles from 52 journals (57%). The full list of journals and the number of articles identified from each journal are provided in Table 1. The full list of articles included in this review is provided in Table 2.

[INSERT TABLE 1 ABOUT HERE: LIST OF INCLUDED JOURNALS]

Each journal was searched with the identified keywords and the resulting abstracts as well as full articles were reviewed for relevance. We had two main criteria for determining the relevance of the articles: First, did the article provide empirical evidence on the use of anthropomorphism in AI? Second, did the article include outcomes that could be relevant for marketing or consumer behavior fields? The second criterion, decidedly, is a more subjective one and at the initial stages we kept our range of inclusion wide. Only after going through full texts, we decided whether any insights for marketing or consumer behavior fields can be extracted. Our initial search identified 48 articles in FT50 journals, 27 articles in the journals selected according to SJR rankings in their respective domains and 212 articles in the selected additional journals, a total of 287 articles.

Given the particular goal of our exploration to synthesize relevant literature with a marketing outlook, a high proportion of the articles were discarded for not being relevant. Specifically, after reading the abstracts, 59 articles (20%) were discarded due to irrelevant context, 16 articles (5%) were discarded due to being categorized as technical work and 101 articles (35%) were discarded due to not presenting any data (i.e., conceptual or review papers). 111 articles were included in the next round of analysis. A further 42 articles were discarded after a detailed read for not having a sufficient anthropomorphism or artificial intelligence focus (see Figure 2 for an overview of the review methodology). The final set of identified relevant articles consisted of 69 articles, with the large majority of the articles appearing in robotics

(39%) and computer science (32%) journals, followed by marketing, management and consumer behavior journals (22%), followed by psychology journals (7%). However, to have a more accurate picture of the entire search, it is important to note that most of the discarded articles were from computer science and robotics journals. Figure 1 depicts the growth of cumulative mentions in the literature over the years and compares this with the mentions in FT50 articles. This variation shows that, even after discarding the context-irrelevant articles that might not inform marketing field, there is still quite a lot of information that marketing field can extract from the neighboring fields. To increase the information flow and establish a strong link between marketing and the neighboring fields in our topic, we discuss the emerging insights from synthesizing this literature next.

Insights Emerging from the Literature

First of all, the distribution of relevant articles over time shows that the anthropomorphism phenomenon in AI has recently been introduced to the fields of marketing, consumer behavior and management. Especially the last three years (2019-2021) has seen a significant increase in the interest of these field to the topic at hand (Figure 1). The increased mention of this topic in FT50 journals captures how seriously and eagerly it is adopted by the marketing and consumer behavior domains as well as its potential in the upcoming years. Despite a larger number of articles overall appearing in computer science and robotics journals, the cumulative distribution of relevant articles over time parallels the increased attention AI anthropomorphism is getting in FT50 journals. A steady growth has been present in the literature roughly since a decade, and the last three years in FT50 journals follow that growing trend.

In our examination of the selected articles for general themes, it became quickly apparent that different research domains have different overarching goals. Majority of articles from

robotics are more concerned with better utilization of anthropomorphism in AI, articles from computer science attempt to experiment in a wide variety of contexts ranging from medical to educational use of anthropomorphism in AI and the articles from marketing and consumer behavior fields largely focus on outcomes for firms. Moreover, there is another conspicuous divide in the literature in relation to positive and negative effects of anthropomorphism in AI. 36 out of 69 articles (52%) reported only positive or negative effects. One of the problems we observed with this group of articles is that their positive or negative effects, in isolation, do not seem to inform any other contexts than their own. While there is no consensus on the prevalence of positive or negative effects, more importantly, approximately half of the articles we reviewed have a single outlook. They do not consider both potential positive and negative effects in the same framework, and the contingencies or the potential individual differences. On the other hand, 33 out of 69 articles (48%) reported positive or negative results that depended on the particular context of use, or the characteristics of the individuals including age, gender and personality.

In summary, across the domains of literature we examined for relevant works, we see an increasing trend for the interest in anthropomorphism and AI. However, the research outlook and questions addressed across different domains cover a wide range. Based on our examination of the emerging themes in the literature, we identified three themes of interest that allow us to draw distinctions between different contingency conditions. The three themes can be summarized as: positive versus negative effects, the particular context of use for anthropomorphism and AI, individual differences in the perception and efficacy of anthropomorphism in AI. It is important to note that these three groups of examination, in a way, build on each other. There is sufficient evidence to show that (1) anthropomorphism in AI has ambivalent effects, which (2) depend on

the context in which it is utilized, which (3) further depend on the individual characteristics of the user. Our reading of this disintegrated literature provides the basis for the conceptual framework of anthropomorphism in AI, which we develop and discuss in line with the three thematic foci we identified.

ANTHROPOMORPHISM IN AI: CONCEPTUAL FRAMEWORK

We can summarize this literature review into a coherent whole by aggregating the three distinguishing perspectives. We begin with a comparison of positive and negative discrete effects of anthropomorphism in AI, followed by the role of contextual factors which brings the first level of granularity to our investigation and finally we end with the role of individual user differences which allow us to arrive at a distinct, refined conceptualization of anthropomorphism in AI. Figure 3 summarizes the progression of our framework in three steps. Our goal in proposing this framework is to highlight the dimensions of anthropomorphism in AI that need to be considered for its optimal use to the benefit of both consumers and firms. Following this layout of examination could be a benefit both for researchers and practitioners in future research designs as well as for applications of anthropomorphism in AI. This conceptual framework, built by the synthesis of relevant literature across research fields, will inform the marketing and consumer behavior domains with findings and insights accumulated in other research domains over a longer period of time.

Anthropomorphism in AI: Beneficial and Harmful Effects

The use of anthropomorphism is widespread and decades of research have attempted to uncover its effects when used in robots, computers, chatbots, virtual agents and even brands (Breazeal 2003; Kim and Sundar 2012; Weizenbaum 1966). While relevant research goes back at least half a century, the fascination with endowing machines with anthropomorphic features expanded

around the turn of the century and has grown immensely ever since (Figure 1). Although there is little consensus about the elicited effects, the literature broadly divides into two, the larger of the two representing beneficial effects, and a relatively smaller stream of research representing harmful effects. While the former stream argues the positive effects of anthropomorphism in AI mostly based on anthropomorphism theory (e.g., Epley et al. 2007), the latter stream of literature argues for negative effects of anthropomorphism mostly based on uncanny valley or expectation confirmation theory (Mori et al. 2012; Oliver 1980).

A prominent argument in past literature is that anthropomorphism facilitates human-machine interactions by creating familiarity, enabling the human users to understand and predict the behavior of the machine (Epley et al. 2007; Epley et al. 2008). A large body of literature has sprung from this core proposal and anthropomorphism has been shown to foster trust (Foehr and Germelmann 2020), trust resilience (de Visser et al. 2016) and psychological closeness (Eyssel et al. 2012) towards robots and various AI agents, increase their perceived competence (Waytz et al. 2014) and social presence (Etemad-Sajadi et al. 2021), enhance the enjoyment (Konijn et al. 2021; Qiu and Benbasat 2009), usage intentions (Hu et al. 2021) and satisfaction of the customer (Rhim et al. 2022). By increasing the perception of similarity and perhaps bridging the human-machine gap, instilling human-like features in machines have been used as a strategy to facilitate human-machine interactions (Li and Sung 2021; Pitardi and Marriott 2021).

On the other hand, several theories have argued that anthropomorphism is not unequivocally beneficial. When the perceived similarity increases, this may mean that the human-machine gap is bridged, but also that the human-machine distinctions are blurred. The uncanny valley theory suggests that increased human likeness in a non-human entity leads to increased affiliation to the entity up to a certain threshold (Mori et al. 2012). When this threshold

is reached, the affinity plummets dramatically *into the valley*, before increasing again when closer to perfect human likeness (see Thepsoonthorn et al. 2021 for experimental evidence supporting this proposition). This occurs when the entity is highly human-like, but still distinguishable from a human, eliciting a feeling of eeriness and discomfort. Although proposed theoretically, no non-human entity has been able to reach a level of human likeness that results in great levels of affinity, and such hypothetical entities has only been depicted in popular culture (e.g., Philip K. Dick's replicants, Westworld's hosts). Another theory suggesting that anthropomorphism could create ambiguous effects is the expectation-confirmation theory. Nowak and Biocca (2003) argues that more anthropomorphic images set up higher expectations for the interaction partners, which create a disadvantage if the expectations are not met. In our examination of the literature on anthropomorphism in AI, we see plenty of research in similar veins.

Earlier research (2000s) showed that people give social responses to computers with anthropomorphic interfaces. Higher human likeness in computers lead respondents to rate their computer partners more positively, perceive more competence in them and actually had higher reported trust towards the computers (Burgoon et al. 2000; Gong 2008). Similar outcomes have been tested and revealed in many other technological inventions. While providing a humanoid embodiment and a human voice in chatbots elicited a strong social presence and higher trust in humans (Qiu and Benbasat 2009; Rhim et al. 2022), a further look into this effect showed that even subtler cues can succeed in eliciting the similar effects. Simply giving a human name to a virtual conversational agent was sufficient to increase the perception of the agent as being human-like (Araujo 2008).

While this line of research has started with computers and relatively simple robots, recent research has tested much more capable and smarter variants of AI-powered machines. Artificial Intelligence Assistants (AIAs) such as Alexa are prevalent in consumers' homes and recent research shows that anthropomorphism, so to speak, bridges the human-machine gap. When AIAs are perceived to be more human-like, they are regarded as more trustworthy and evaluated more positively overall (Li and Sung 2021; Pitardi and Marriot 2021). When used in a sales context, anthropomorphism was useful in eliciting consumers' trust in relation to the sales recommendations, in a way being perceived as an entity of its own, detached from its manufacturer company (Whang and Im 2020). In other words, people liked it when the recommendations came from Alexa, but not from Amazon. These results point at the potential of using anthropomorphic AIAs to form stronger consumer relationships with the brand.

Recently, however, anthropomorphism has received the most attention in the service industry. Many service robots have found a place for them in the service journey, being utilized increasingly frequently in the closest proximity to consumers. The attitude of the researchers towards anthropomorphism in service agents and robots has been so far overwhelmingly positive. Multiple studies have asserted that anthropomorphism is a critical feature for social agents and robots that are used in the service frontlines involving social interactions (Chi et al. 2021; Delgosha et al. 2020; Zörner et al. 2021). Similar to the results found in chatbots and computers earlier, higher anthropomorphism in humanoid service robots influenced the perceived trustworthiness positively (Christoforakos et al. 2021; Zörner et al. 2021). In some cases, the effect of anthropomorphism on perceived trust and competence was found to be indirect, through perceived animacy, empathy and interactivity of the AI-powered machines (Bartneck et al. 2009b; Pelau et al. 2021). Indeed, when the robots displayed more natural-

looking movements or made appropriate eye contact with the interaction partner, they were perceived more sociable and the quality of the human-robot interaction was rated higher (Kompatsiari et al. 2019; Schillaci et al. 2013). The literature provides plenty of evidence for a positive perception of machines when anthropomorphized.

On the other side of the coin, there is also emerging evidence about negative effects of anthropomorphism in AI. Particularly in humanoid service robots (HSR), research has shown that when the robots are highly anthropomorphic, human interaction partners may rate the robots more negatively, feel greater discomfort and technophobia (Huang et al. 2021; Mende et al. 2019; Sinha et al. 2020). The anthropomorphic appearance of the HSRs lead to a feeling of threat to human identity in the interaction partners, which may be explained by the need to uphold a perception of human distinctiveness (Ferrari et al. 2016; Müller et al. 2021). The same effect was observed in virtual avatars where an online experiment confirmed that highly anthropomorphic virtual avatars elicited a greater feeling of eeriness compared to simpler, cartoonish, less anthropomorphic avatars (Shin et al. 2019). However, there were also studies who took a critical stance against this stream of findings relying on uncanny valley theory and showed no effects of discomfort in highly anthropomorphic androids (e.g., Bartneck et al. 2009a). Another study reported that higher levels of anthropomorphism increased people's perception of the effort required to use anthropomorphic AI devices (Gursoy et al. 2019), which contradicts the beneficial effects found in the literature (Chi et al. 2020).

An account of beneficial and harmful effects of anthropomorphism in various AI-powered machines certainly carries some guidance for future research. However, these two streams of literature (i.e., beneficial vs. harmful effects) seem disconnected from each other, that is, they deal with different constructs and do not inform one another with their findings. From

this section of the literature, one can only infer that there are certain benefits and certain harms of employing anthropomorphism in AI. The findings that show discrete effects, taken without their whole context, are not exceptionally helpful to practitioners. We expand on this issue in the next section.

The Role of Context: Conditions that Impact the Potency of Anthropomorphism in AI

A promising step we observed in the development of the literature on anthropomorphism in AI is the trend in research from investigating discrete effects towards considering the context in which the effects occur. The articles that we review in this section suggest that researchers should clearly delineate the context in which they want to employ anthropomorphism and the effects they want to elicit. Our analysis shows that handling anthropomorphism is a delicate matter. When used appropriately, it can be very advantageous to the wielder in eliciting the desired effects. A second insight that arises from this section is that anthropomorphism in AI should be used in a context-specific way, rather *narrowly*, to elicit a particular effect in a particular context. For example, a study found that people perceived human-like robots and tablet computers essentially the same, showing no effects of anthropomorphism (Leichtmann and Nitsch 2021). While this could indeed be a confirmation of a null hypothesis, it is also a good example of trying to elicit effects in very isolated scenarios. The particular robots used and the particular scenarios that the participants were tested all have impact on the perception of humanness in a non-human entity. Every other study seems to design and test their own idiosyncratic human-like robots, and the outcomes may not be entirely comparable. Even when studies sometimes test the same constructs, their operationalization differs greatly. Therefore, it is necessary to pay close attention to the context in which the studies were carried out, including the minute details of the

experimental procedures. Next, we present a detailed review of findings that attest to the crucial role of context.

Recent research shows that humanoid service robots are better able to recover from service failures thanks to their anthropomorphic nature (Choi et al. 2021). To err is human, as the saying goes, and assigning humanness to a robot, in a way, *excuses* the robot for making a mistake. However, a contrasting perspective is the matter of responsibility. Consumers penalize brands less when an algorithm (rather than a human) causes an error that harms the brand (Höddinghaus et al. 2021; Leo and Huh 2020). Moreover, the perceived harm caused by the algorithm is higher when the algorithm is anthropomorphized (vs. not) (Srinivasan and Sarial-Abi 2021). In this case, consumers seem to perceive that algorithms are objective and deserve less penalty for their errors, but any human likeness brings out the tendency to assign responsibility to the entity. Discovering a human element in a non-human entity, therefore, could elicit a wide range of reactions based on the context (Shank et al. 2019). Another proposition is that people attribute a mind to the AI-agents in a self-serving way, depending on the interaction context and the outcome. In a cooperation task with human-AI teams, people who lost as a team ascribed greater levels of mind to the anthropomorphic AI agent compared to those who won as a team. In such a context, people easily abdicated the responsibility of losing and attributed the responsibility to the perceived humanness of the AI-agent, but were more reluctant to give credit for the success (Lefkeli et al. 2021).

A popular use of anthropomorphism in AI is to elicit more disclosure from the human interaction partners. Pickard and Roster (2020) found that people disclosed more, especially sensitive information, to anthropomorphized conversational agents, compared to a human interviewer. This finding hints at a social desirability bias (Zerbe and Paulhus 1987), where

people felt more comfortable sharing sensitive information when the agent was, in fact, *less* human, since the comparison is to a human interviewer. This finding points to a potential utilization of anthropomorphic AI-agents in the medical context where, for example, patients may disclose sensitive, perhaps embarrassing information more truthfully to an AI-agent compared to a human doctor or nurse. However, this study lacked a comparison with non-anthropomorphized agents. In another study, findings show that when it is desirable to detect if people are lying, the pursuit of a greater human likeness could be counter-productive (Schuetzler et al. 2019). Therefore, even less human likeness could yield the best result in this context, that is, a machine-like AI-agent could elicit the most honest disclosure from people.

The research on human versus algorithm evaluation mechanisms in an interview setting identifies a contrasting perspective about self-disclosure. In an interview setting, although people thought dehumanizing (opposite of anthropomorphizing) the algorithm allowed to get rid of human biases, they still preferred the "devil they know" (Mirowska and Mesnet 2021). Since they did not have a readily available behavioral framework to engage with an algorithm, they preferred the anthropomorphized algorithm, benefiting from anthropomorphism as an uncertainty reducing mechanism. Reinjecting a semblance of a social relationship into the situation allowed the participants to rely on their existing behavioral frameworks. This is an example of a situation where the marketing managers should decide what effect they want to elicit. If reducing the perception of a human bias is to be prioritized, then imbuing the AI-agent with human-like features could be disadvantageous. If, on the other hand, the managers prefer to achieve the best evaluated AI interviewer, then perhaps anthropomorphism could help achieve that. In a related study with chatbots, it was shown that anthropomorphism was beneficial for transaction outcomes (e.g., conversion rate), but lead to an increase in offer elasticity (Schanke et al. 2021).

As the chatbot became more human-like, consumers shifted to a fairness evaluation or a negotiating mindset. Consumers seem to think that they cannot negotiate with a purely artificial mind. However, when they perceive humanness in the entity, in a way, they switch to the framework of human behavior and believe that they can talk a human-like agent into a desired outcome. Again, the particular effect that marketing managers want to elicit is key and high anthropomorphism will not be necessarily advantageous in all situations.

We find further granularity in relation to the context of using anthropomorphism in AI in the following studies that investigated the role of type of tasks that are carried out by the AI agents. People seem to attribute certain tasks more easily to AI, that is, computational, objective and usually prosaic tasks (Castelo et al. 2019). When AI is used outside the sphere of such presuppositions, apparently, an incongruence occurs. Research has found that higher anthropomorphism afforded greater trust to the robo-advisors, as well as a greater recommendation acceptance (Hildebrand and Bergner 2021). On the other hand, although people perceived a greater familiarity towards the anthropomorphic robot, they evaluated the more machine-like (i.e., less anthropomorphic) robot more positively, exhibited greater purchase intention and willingness to pay (Kwak et al. 2017). It seems like anthropomorphism impacts the agent in each task differently. It could be that machines are stereotypically seen as executers and not planners. In such tasks that require efficiency and objectivity (e.g., execution of a purchase), a machine-like AI could be preferred, while in tasks that require subjectivity and strategy (e.g., planning and recommending a purchase), a more human-like AI could be perceived to be a better fit for the task (cf. Castelo et al. 2019). The congruence of the task type and the agent is so pervasive that even specific anthropomorphic features create a difference in their effect. A study showed that a robot that manifests a gender (male vs. female) and personality (introvert vs.

extravert) that conforms to its occupational role stereotypes (introverted male in a security role vs. extraverted female in a healthcare role) were evaluated most positively in all combinations (Tay et al. 2014). Moreover, a study with frontline service robots shows that the perception of the robot changes according to whether the robot is augmenting or substituting the human in its task (McLeay et al. 2021). Interestingly, people did not like when an anthropomorphic robot replaced a human in a task, compared to a non-humanoid self-service machine. After all, AI agents intend to mimic some aspects of humanness and it seems that creating a collection of human features that is congruent with the context may be crucial in gaining consumer satisfaction (Karimova and Goby 2020). In certain tasks (e.g., medical decisions), people may have stronger biases against anthropomorphism in AI (Fraune 2020; Yun et al. 2021). These findings highlight the delicate nature of employing anthropomorphism in AI-powered machines in various contexts.

In our examination of the literature, a good example of a context-appropriate use of anthropomorphism in AI caught our attention in the domain of e-learning. The following studies used anthropomorphism in AI-agents in education settings successfully and converge on the beneficial effects. Endowing a robot with non-verbal cues (e.g., eye contact, gestures) in human-robot interaction were beneficial in message retention and contributed to the positive perception of a social robot (Striepe et al. 2021; van Dijk et al. 2013). The careful integration of many anthropomorphic features could therefore result in positive learning outcomes. Indeed, Konijn and colleagues (2021) showed increased learning gains over time when training with a social robot, compared to a tablet. However, they argue that this is not a direct effect, but mediated by perceived enjoyment of the learning activity. Another study found that an anthropomorphic robot presence elicited beneficial effects on Stroop test performance, only when the participants

interacted with the robot (Spatola et al. 2019). The effect was, similarly, not directly on learning outcomes but rather was mediated by increased attentional control in participants due to the social nature of this interaction. In these distinct education settings, the studies were able to elicit positive effects for learning outcomes. Of course, the lack of contrasting evidence in the literature to date does not confirm the lack of effects. Future research should investigate the use of anthropomorphism in AI in this particular context in detail, explore further benefits and potential drawbacks. With that said, we think that this is a context which might be particularly suitable for employing anthropomorphism in AI-agents. The interactions with the AI-agent is confined, in a positive sense, to a particular context and this could be the necessary circumstance to elicit desired effects and avoid undesired ones.

After reviewing the illustrations of anthropomorphism in AI in numerous contexts, we suggest that anthropomorphism in AI could be a great facilitator in human-AI interactions, but also a hindrance if used haphazardly. Therefore, managers should precisely delineate the context in which they want to employ anthropomorphism in their AI-powered machines optimally.

Individual Characteristics of AI Users

At this point in our discussion, we go one step further in the level of granularity of our examination of the literature. After reviewing the positive/negative effects and the importance of context, we now turn to the third theme of focus that we identified in our review, the role of individual characteristics. Relevant studies in the past have reported demographics as control variables and sometimes showed significant effects of age and gender on the perception of anthropomorphism (e.g., Stanton and Stevens 2017). However, there has been an expansion in research to investigate the individual characteristics themselves, mostly in the last five years, which we review next.

Research has shown that age is a critical factor in the individuals' tendency to anthropomorphize robots (Jacobs et al. 2021). For instance, anthropomorphism improved people's perception of trust in smart healthcare services and was particularly effective for younger adults (Liu and Tao 2022). These findings might suggest a generational shift towards greater acceptance of robots, but it is not a clear-cut conclusion. Another study showed that older users perceived higher interactivity and trust in the socially oriented (i.e., higher anthropomorphism) digital assistant only when they were high in internet competence, while for users low in internet competence, a less anthropomorphic digital assistant lead to better outcomes (Chattaraman et al. 2019). The new generation of consumers are not just tech savvy, but are natives of technology. Therefore, more research on generational marketing of AI technologies is needed to unveil further effects of age.

Gender differences might also play a role in perception of anthropomorphism. While anthropomorphism in AI-agent resulted in more positive outcomes for females in a medical setting (Liu and Tao 2022), an opposite effect was found in a sales context (Liew et al. 2017). The social presence of an anthropomorphic avatar improved the website trust and patronage intentions among male participants, however, it led to lower information credibility and patronage intentions in females. This study argues that females were more critical towards the shortcomings of the avatar, particularly limited interactivity and low quality of dialogue (Liew et al. 2017). Another study found similar gender effects, showing that females were less likely to trust a robot which stared at them (Stanton and Stevens 2017). The contrasting results could be due to different methods, as the participants in the former study (Liu and Tao 2022) did not interact with the AI-powered agents, but rather read a description about them and provided ratings, while in both of the latter studies the participants actively engaged with the AI-powered

avatars. This difference suggests that the expectations regarding the human-likeness may be elicited only upon interacting with the entity. Future research should take this into account and carefully construct their experimental procedures.

Individual differences that impact the potency of anthropomorphism in AI go beyond age and gender. Kim and McGill (2011) showed that people with high social power think that they can control the outcomes from anthropomorphized entities, which decreases their risk perception. An anthropomorphized entity, in a way, is perceived to be bound by the same social norms and rules as a human, it *behaves*, as a human would. It can be bullied, tricked and convinced. However, one cannot negotiate with a machine-like entity; a machine does not *behave* but *generates*, and is not swayed by the persuasive tactics we are accustomed to use. This result provides an insightful peek into the mechanisms of people's behavior. However, when the individual has low social power, the tables are turned. The individuals with low social power prefer to engage with the machine-like entity because they think they cannot control the outcomes of an anthropomorphized entity, after all, sweet-talking and cajoling others in a social situation is not their forte (cf. Uysal et al. 2020). Similarly, another study shows that the same pattern emerges in individuals with higher versus lower financial status. People with higher financial status afforded more humanness to non-human entities, and expected more favorable treatment from them; in a way, they still expected human social norms to be enacted (Kim and McGill 2018). These findings highlight the crucial role of choosing the target audience appropriately. If targeted incorrectly, anthropomorphism in AI could work in the opposite direction and lead to undesirable outcomes.

An important part of the individual characteristics is people's personality. Our personality, in a way, are the glasses through which we look and perceive the world around us

(Jung 2016) and perception of anthropomorphism is no exception to this. A significant positive relationship between extraversion and the tendency to anthropomorphize the robots was found (Kaplan et al. 2019). Research has shown that extraverted people tended to prefer human-like robots over machine-like robots (Chuah et al. 2021). Moreover, the combinations of multiple personality features could result in different outcomes. When individuals are high in both extraversion and openness to experience, the outward appearance (i.e., the anthropomorphic features) of a robot mattered more than their internal quality. While introverted people tended to prefer more machine-like robots (Syrdal et al. 2006), higher openness to experience predicted more favorable responses to social robots (Allan et al. 2021; Chuah et al. 2021). In addition to personality, even transitory states of the individuals or time constraints for completing tasks could impact the efficacy of anthropomorphism in AI (Reig et al. 2021). For instance, Crolic and colleagues (2022) showed that when the individuals interacted with the chatbots in an angry emotional state, the chatbot anthropomorphism could have a negative effect on customer satisfaction, firm evaluation and purchase intentions. This stream of research lends further support to the notion that the particular audience that anthropomorphized AI agent interacts with can make or break the success of anthropomorphism in AI.

The following studies take it a step further and show that not only the personality characteristics of the individual matter, but also that the personalities of the human and the AI in the interaction should be complementary. Tang et al. (2021) showed that human and AI should exhibit complementary (vs. similar) anthropomorphic features: in a human-AI cooperation setting, when a task requires order, if both the human and the AI exhibits conscientious characteristics, in a way, they step on each other's feet. The authors argue that a conscientious employee and a highly intelligent robot may form a suboptimal pairing. Therefore, they suggest

that pairing intelligent machines (i.e., high in orderliness) with employees lower in conscientiousness to reap the optimal benefits in performance increase. However, in contrast to this finding, another study found that participants achieved better performance with a robot helper that had a similar personality to them, or a human that had a different personality (Andriella et al. 2020). In addition to the characteristics of individuals and their complementarity with the AI, the types of tasks carried out in a human-AI cooperation setting should be carefully examined since working with intelligent machines could lead to a greater role ambiguity (Tang et al. 2021).

Finally, research has unveiled cultural differences in acceptance and adoption of anthropomorphized AI (Kaplan 2004). Kamide and Arai (2017) found that Americans perceived more comfort and controllability in anthropomorphic robots, compared to Japanese respondents. Moreover, in a study across 27 countries, it was shown that a country's openness to innovations had an impact on the perception and experience of the individuals with robots (Turja and Oksanen 2019). For example, Dutch people had a greater tendency to anthropomorphize social robots than Germans. In addition, unsurprisingly, the individual's attitude towards technology is also an important determinant in the perception of anthropomorphism in AI (Youn and Jin 2021).

In reviewing the studies in this section, we suggest that individual characteristics create yet another level of complexity in implementing anthropomorphism in AI. Even though managers are able to delineate an appropriate context, the individual characteristics of the audience that are exposed to such anthropomorphism will determine its efficacy. Any use of anthropomorphism without considering the context and the individual characteristics will be largely arbitrary. Practitioners can still elicit advantageous effects, but without meticulous forethought, those effects might be coupled with some undesirable side effects. In fact, we

already see hints of this in the literature, when neutral effects are occasionally reported. This apparent neutral effect might be masking ambivalent attitudes underneath. People report many positive and negative evaluations related to anthropomorphism in AI, and rather than canceling each other and resulting in a neutral attitude, this is an indication of being torn between two attitudes (Stapels and Eyssel 2021).

[INSERT TABLE 2 ABOUT HERE: AN OVERVIEW OF LITERATURE]

Summary

We have reviewed the emerging literature on anthropomorphism in AI and propose a framework of analysis consisting of three steps that provides a guide for future research designs and practical implementations of anthropomorphism in AI (Figure 3). While the marketing literature has largely found anthropomorphism in AI as a beneficial feature, research also shows some downsides of incorporating anthropomorphism in AI. Many studies state that anthropomorphism facilitates engagement with customers, and while certainly true to an extent, such blanket statements are far from capturing the complexity of real life settings and individuals when interacting with anthropomorphic AI. Overall, the findings in the literature are largely inconsistent to the naked eye, but a careful examination shows the complexities and nuances of employing anthropomorphism. Our review of the literature does not offer a list of dos and don'ts, but reveals a way to reconcile the inconsistent findings in the literature, summarizing the circumstances and the populations in which anthropomorphism in AI could be most effective for the firms and the consumers.

In the first layer of our analysis, we found that one literature stream relies on anthropomorphism theory (Epley et al. 2007) and suggests that anthropomorphism in AI has positive effects, while the other literature streams relies on either to uncanny valley theory or

expectation confirmation theory to argue for negative effects. In the second layer of our synthesis, we attempt to resolve these inconsistent findings, clarifying under what circumstances anthropomorphism in AI could be beneficial for firms or customers. Finally, in the third layer, we explored the studies on how the effects of AI anthropomorphism might differ based on individual characteristics. Our review included a large body of empirical work that allows us to provide novel insights for future research in the marketing and consumer behavior fields (see Table 2 for a summary of the literature). Our findings show that the potency of AI anthropomorphism is contingent on contextual and individual characteristics. We suggest that this three-layer analysis is a valuable exercise in guiding managers to the most optimal implementation of anthropomorphism in AI (Figure 3).

While this framework has practical utility when implementing anthropomorphism in AI, another discussion is necessary to understand how and why its effects differ across individuals and contexts. Next, we offer a theoretical lens that might be useful to make sense of this variation.

A Relationship Perspective to Understand The Variation in Harms and Benefits

At the beginning of this chapter, we stated that anthropomorphism is essentially about perceiving a mind in a non-human entity. By doing so, people do not necessarily believe that the entity actually possesses a mind, but their behaviors are nonetheless shaped by the mind they perceive. For example, despite knowing that an AIA, such as Alexa, cannot appreciate gratitude, many people say "Thank you, Alexa" automatically after completing a task with their AIA (Burton and Gaskin 2019). This response is triggered by the anthropomorphic features and is an example of people interacting with anthropomorphized entities as if they were social beings (Lopatovska and Williams 2018). Any attribution of a mind to an anthropomorphized entity exists relative to our

own mind, and therefore might evoke an experience of a relationship (Novak and Hoffman 2019). For example, perceiving Alexa as covertly having sales goals for Amazon might elicit in the user an experience of a salesperson-customer relationship, or perceiving Alexa as capable of emotions might elicit kindness in user responses and create a (quasi) human-human relationship. Therefore, understanding exchanges between consumers and anthropomorphized AI from a relationship perspective could be insightful.

This proposition is in line with recent theoretical (e.g., Huang and Rust 2021a) and empirical (Uysal et al., 2022) work arguing that advanced AI could be used to form relationships with consumers and maintain them across time. By supplementing this perspective with relationship theories (e.g., social exchange theory) (Dwyer et al., 1987), we can conceptualize the interactions between consumers and anthropomorphized AI as an ongoing exchange of benefits and costs in a relationship. The exchange of benefits and costs will differ according to contexts as well as the individuals in question, leading to varying effects, as we have abundantly exemplified in this chapter. Each situation presents a unique relationship context and a different balance of benefits and costs for the consumer. For example, recent research has shown that AIA users who have been using their AIA for a longer time and for more personal tasks (e.g., organization of personal appointments) felt greater threat to their human identity as a result of AIA's anthropomorphism. However, users with a shorter relationship tenure who use their AIAs mostly for menial tasks (e.g., turning on/off the lights) experienced such harmful effects to a lesser degree (Uysal et al. 2022). Therefore, a relationship perspective and the characteristics of such relationships between consumers and anthropomorphized AI could be pertinent in understanding the effects of anthropomorphism.

While our overarching recommendation of carefully studying the context and individual differences (Figure 3) remains the same, we believe that approaching this as an evaluation of potential benefits and costs in a relationship provides a useful theoretical outlook. This perspective creates a clearer understanding of the variations in many discrete effects that are documented in the literature.

[INSERT FIGURE 3 AROUND HERE: FRAMEWORK SUMMARY FIGURE]

FUTURE RESEARCH DIRECTIONS

In this article, we have reviewed the literature on anthropomorphism in AI and proposed a framework to guide researchers and practitioners in the marketing and consumer behavior domains. We suggest that it is useful to benefit from this three-step analysis and taking a relationship perspective to achieve the highest accuracy in understanding the use of AI anthropomorphism in any particular case. Applying this framework will not only help achieve a clearer answer, but will also provide a parsimony in thought process by separating layers of analysis. We structure our discussion of future research in line with these three layers and develop distinct recommendations for each layer: (a) the valence of effects elicited by AI anthropomorphism, (b) the particular context and the task type carried out by the anthropomorphized AI, (c) the characteristics of the individuals that are exposed to anthropomorphized AI. Ideally, a future endeavor of research or practice should strive to take into account all three layers of analysis.

Future Research Directions Related to Effects of AI Anthropomorphism

Our first suggestion for future research is to have broader theoretical frameworks. Combining theories of anthropomorphism to include both potentially positive and negative effects will provide a comprehensive outlook. Many of the articles in our review that showed

positive effects rely solely on the anthropomorphism theory (Epley et al. 2007). While this is a valuable, well-established theory to understand anthropomorphism in AI, we see that the potential negative effects are disregarded in this theoretical framework. Theories relating to psychological costs such as techno-stress, psychological strain and consumer ambivalence (Ayyagari et al. 2011; Edwards 1996) could be integrated into this framework to achieve a balanced perspective of anthropomorphism in AI. With that said, the same problem exists for the opposite stream of research. We see that the articles that show negative effects also choose to zoom in too closely to the matter, relying on theories like uncanny valley and expectation confirmation theory (Mori et al. 2012; Oliver 1980). Similarly, while this is useful in unveiling important effects of anthropomorphism in AI, focusing only on that side disregards the big picture. Research shows that people reported many different positive and negative attitudes and behaviors concerning anthropomorphism in AI, this shows that they are actually being torn between two sides, perceiving both benefits and costs by anthropomorphizing the AI (Stapels and Eyssel 2021). Therefore, to capture this ambivalence, we suggest that utilizing a broader, inclusive theoretical framework is a must.

Second, most studies we reviewed have focused on adoption or intention to use. We suggest future research to investigate the effects of AI anthropomorphism on novel, untested outcomes that might be relevant for the firms such as willingness to pay for a product, purchase likelihood and the overall perception of the provider company. For example, AIAs such as Alexa are a good example of anthropomorphism in AI at a point of purchase and could be a promising avenue for future research. While there is good potential in AI anthropomorphism to be explored from a firm's perspective, a consumer perspective is still largely lacking in extant work. The range of application for AI is increasing tremendously and consumers are exposed to AI-

powered devices for extended periods throughout the day. Seeing the pervasive and nuanced effects of AI anthropomorphism on people, we encourage future research to explore how consumers feel with regard to anthropomorphism in AI. It might be pertinent to assess the effect of AI anthropomorphism on consumers for outcomes such as well-being, privacy concerns and loneliness.

Moreover, similar to other technologies, anthropomorphism in AI may work well only in certain doses. While subtle anthropomorphic cues could elicit desired positive effects, abundantly endowing the AI agent with a variety of anthropomorphic features could elicit opposite effects. Therefore, future research should explore the possibility of non-linear effects of AI anthropomorphism on relevant outcomes. Of course, this also brings the question about how different anthropomorphic features may elicit differing effects. Research shows that behavioral cues affect social attention while human-like appearance induces greater mind perception ratings (Abubshait et al. 2021). Therefore, endowing a human-like body, movement or speech to an AI agent could all have different effects on people and might even work in opposite directions. We suggest future research to build a taxonomy of anthropomorphism to understand exactly which cues impact which outcomes.

Future Directions Related to the Context of Employing AI Anthropomorphism

Our first suggestion for future research in relation to the context of using anthropomorphism in AI is about the task types carried out by the AI. Different types of tasks are entrusted to AI strategically: while "mechanical" AI could do well with repetitive actions, "thinking" AI could be used for decision making by data processing (Huang and Rust 2021b). Therefore, future research should prioritize investigating the potency of anthropomorphism in AI that is used in different types of tasks. While anthropomorphism might be redundant or even incongruent for an

AI agent that is entrusted with repetitive, mundane tasks, it could be much more effective, for instance, in human-AI interactions. Moreover, a perception of humanness in an AI agent might be beneficial in a symbolic consumption context where consumers typically prefer human (vs. robotic) labor (cf. Granulo et al. 2021). The human likeness exhibited by the AI agent should be a good fit for the task it carries out. Therefore, we advise against using anthropomorphism in AI for the sake of using it. In a suitable context it could be beneficial for the firms and the consumer experience, but an arbitrary use could lead to unforeseen effects.

Second, future research should explore whether anthropomorphism in AI is particularly useful in a certain stages of the customer journey. For example, anthropomorphic features could be more advantageous at the pre-purchase stage where the customer is looking for purchase recommendations. The trust elicited by the anthropomorphic cues could result in higher rates of heeding to purchase recommendations. On the other hand, at the post-purchase stage when the customer has a problem or a complaint, refraining from anthropomorphic cues in an AI customer service could be a better idea. While there is nascent evidence in the literature that provides us with these examples (Garvey et al. 2021; Hildebrand and Bergner 2021), further research is necessary to be able to leverage anthropomorphism in AI optimally in pre-purchase, purchase and post-purchase settings. In addition, we discussed in the previous section that human-AI interactions could be conceptualized as a relationship, if the AI agent is anthropomorphized (Uysal et al. 2022). Therefore, integrating relationship theories (e.g., Dwyer et al. 1987) into the study of AI anthropomorphism and drawing parallels from relationship marketing to explore a relationship lifecycle account of human-AI interactions provide a novel lens through which AI can be explored. Analogous to the relationship lifecycles idea, future research could investigate the particular human-AI relationship trajectories and the efficacy of anthropomorphism in

different relationship stages. For example, based on recent research on Artificial Intelligence Assistants (AIA) (e.g., Alexa) (Koike and Loughnan 2021), the experiential value that is brought by the anthropomorphic nature of the AIA might fade away over time, while the perceived functional value remains largely unchanged (see Fink et al. 2013 for a similar effect in vacuum robots). This hints at the possibility that anthropomorphism in AI could be more potent earlier in a human-AI relationship (i.e., exploration phase) (Jap and Ganesan 2000).

Future Directions Related to Individual Characteristics of AI Users

So far, most studies have included individual characteristics as control variables and have reported them as footnotes. However, our review of the literature shows that the impact of individual characteristics is far from trivial. In several studies, we have seen that age, gender and cultural differences could impact the effect of AI anthropomorphism greatly, sometimes even reverse the effect (e.g., Jacobs et al. 2021; Kamide and Arai 2017; Liu and Tao 2022). However, a differentiation based on such basic features could oversimplify individual characteristics. We suggest future research to consider individual characteristics more seriously and systematically explore their role in the perception of AI anthropomorphism. Individuals' personality (e.g., big five dimensions) and psychological attributes such as need for personal space, need for autonomy or self-construal and need for touch should be investigated in combination with age, gender and culture. Only a combination of individual features could lead to the most accurate description of individuals' tendencies in relation to AI anthropomorphism.

In general, the anthropomorphic features seem to be selected arbitrarily in most studies. We see that in many studies with embodied robots, the design is completely random and each study have a different robot used in their experimental procedures. Simply building a body, face, arms and legs is assumed the make a human-like entity. However, every detail of a human-like

entity is likely to elicit a different effect. In line with the expectation confirmation and affordance theories (Gibson 1977; Oliver 1980), each observed quality hints at an affordance. We perceive the world, in a way, in terms of possibilities for action. Endowing a non-human entity with certain anthropomorphic characteristics signals such possibilities. If a robot has legs, people assume the possibility of locomotion. If a robot can speak in natural language, people assume that it can understand and reply like a human being. It is when these expectations are not met that the problem arises (Lankton et al. 2014). Our suggestion to tech designers is to be cognizant about the congruence of the of the anthropomorphic features with the use context and use those features only if they can satisfy the hinted expectations.

Essentially, future research should prioritize an investigation of contingencies and boundary conditions. In recent years, AI has been deployed in many distinct contexts from carrying out job interviews and medical analyses to acting as service agents and salespeople. It is difficult for people to allow to delegate many routine tasks in their daily lives, let alone sensitive, high-stakes ones. Endowing the AI with anthropomorphism seems like a great opportunity to curb the resistance against adoption of AI by acting as a buffer against people's biases. Managers and tech designers should think carefully about what AI represents and what anthropomorphism represents. In contexts where precision, accuracy and impartiality is prioritized, a human likeness may be omitted, and in contexts where an affinity and social presence is required, anthropomorphism can provide an advantage. Without a coherent framework to understand these conditions, new studies will continue to argue for positive and negative effects of AI anthropomorphism in an isolated manner. Therefore we suggest that the framework we propose can be a useful practical guide in the implementation of anthropomorphism in AI. Moreover, taking a relationship perspective in conceptualizing the interactions between consumers and

anthropomorphized AI could pave the way for future research that aims to understand the generalizability of the effects of AI anthropomorphism.

Finally, AI anthropomorphism could play a large role in accurately conceptualizing the role and acceptance of latest AI technologies to our daily lives. Many people hold concerns over whether advanced AI will gradually displace humans not just in mechanical tasks, but also in tasks that require thinking and feeling. One reason for this concern could be the perceived incongruence between the nature of AI and the tasks it is entrusted with. Anthropomorphism, if used prudently, could help bridge this man-machine gap and lead to greater acceptance of AI in our lives, even in tasks that are thought to be reserved for humans (i.e., thinking, feeling). However, a second reason for this concern could be the perception of an intelligent, rival mind in the AI. Being in a psychological competition with AI would question our human nature and our role in the digital world. In this case, any attempt of instilling human likeness in AI which reinforces this mind perception will be counterproductive. A fear of being replaced by a competing artificial mind could drastically change the public attitude towards technology and innovation (Davenport et al. 2020). Therefore, it is essential to understand the role of anthropomorphism in AI thoroughly.

LIMITATIONS

Despite carefully following guidelines for a systematic review, our paper is not without limitations. We limited our scope to empirical journal articles that appeared in the selected journals and did not include any conference proceedings and working papers. In an emerging topic such as anthropomorphism in AI, there is an exponential growth in the number of publications over the last years particularly in conference proceedings. Therefore, the article count in this review may be smaller, but has the advantage of including only high quality

research. It is difficult to systematically include all working papers and much harder to assess their quality. Moreover, there are many recent thought-leading conceptual articles on human-AI interactions which are harbingers of groundbreaking research over the next years (e.g., Huang and Rust 2021b; Novak and Hoffman 2019; Puntoni et al. 2021). In our review, we do not account for these conceptual papers because we purposefully wanted to explore what the data shows about the use of anthropomorphism in AI.

Second, many studies we have reviewed have adopted disparate methodological directions. For example, while some studies rely on online consumer surveys (e.g., Mishra et al. 2021), other studies have carried out laboratory experiments (e.g., Mende et al. 2019). They are essentially different in the sense that participants, in the latter case, might interact and engage with the anthropomorphic AI first hand. Moreover, the design of the stimuli (i.e., robots, virtual agents) hinges on the individual research group. This results in arbitrarily different anthropomorphic designs in each study which reduces comparability of results across studies. Future research could benefit from meta-analyses that compare the empirical work specifically according to their methodological choices.

CONCLUSION

In this review, we attempted to synthesize insights on anthropomorphism in AI. By reviewing 69 articles that were filtered among 287 articles from 39 leading journals across computer science, robotics, psychology, marketing and consumer behavior fields, we offer a greater understanding of the knowledge of anthropomorphism in AI, which currently lacks a coherent framework to organize the identified effects. To this end, we developed a conceptual framework of three sequential steps, aiming to provide a starting point to explore the nuanced effects of AI anthropomorphism in a systematic way. This conceptual framework offers many future

directions to explore. Since anthropomorphism is being used increasingly frequently in AI agents that face the consumers, our review and the conceptual framework contribute to the discussion on how to best utilize this strategy. Particularly for marketing managers, our conceptual framework identifies a key take-home message: there could be great promise in employing anthropomorphism in AI wisely, but a careless use may undermine the potential of cutting-edge new AI technologies for both consumers and firms.

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Figure 1. Cumulative distribution of articles related to anthropomorphism in AI over time.

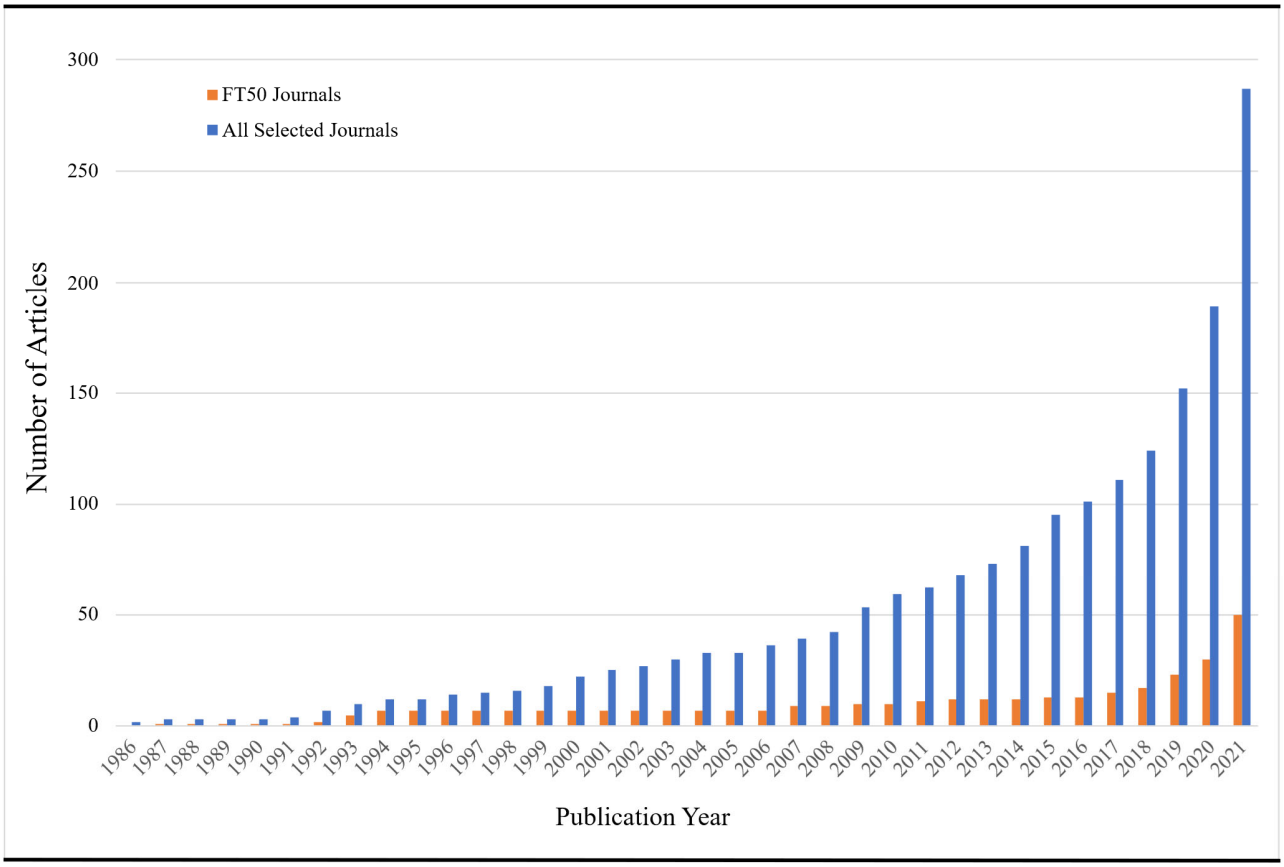
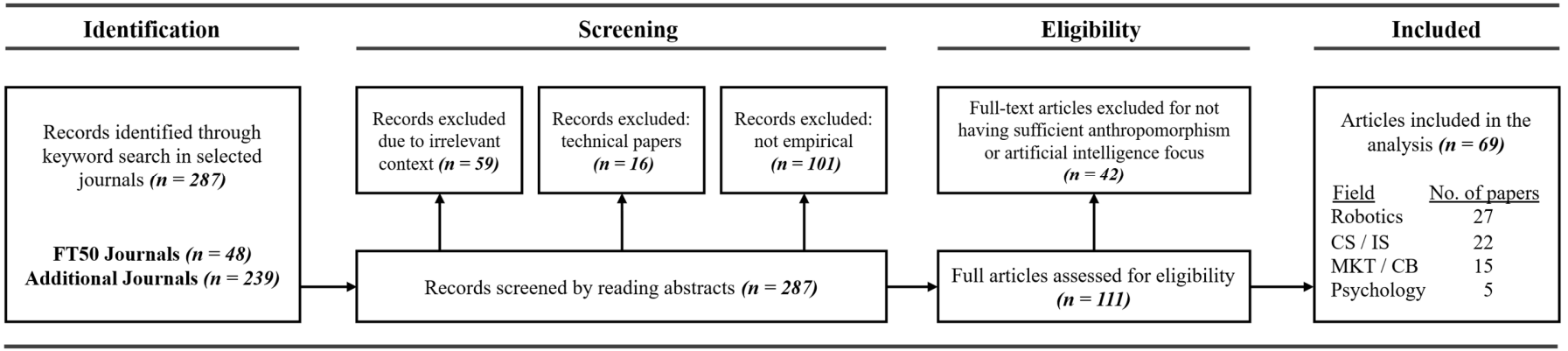


Figure 2. Overview of review methodology.



CS: Computer Science, IS: Information Science, MKT: Marketing, CB: Consumer Behavior.

Figure 3. The three-step framework as a guide for future research designs and practical implementations of anthropomorphism in AI.

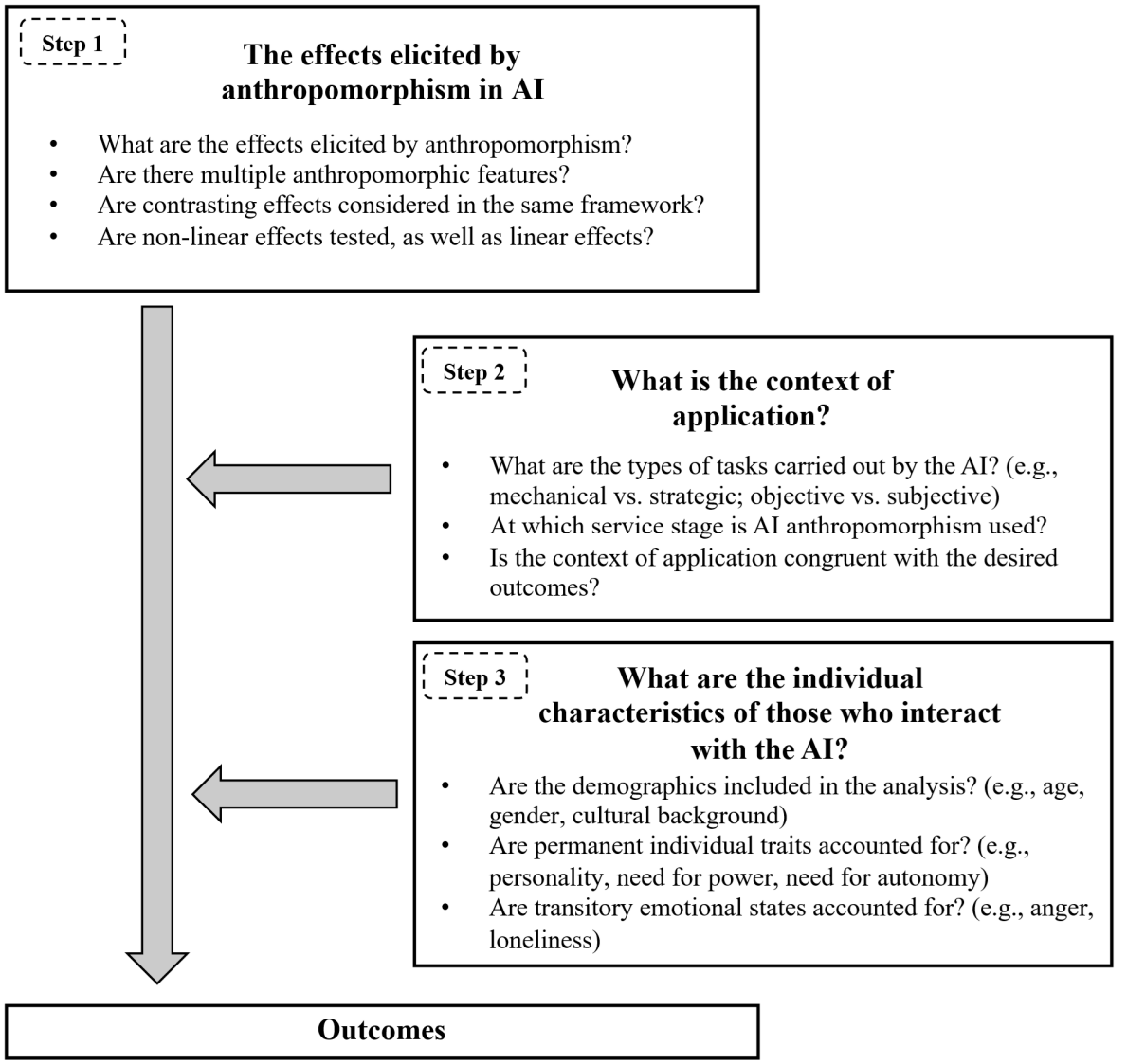


Table 1. Journals included in the literature search.

Journal Name	# identified (# included)	Journal Name	# identified (# included)
International Journal of Social Robotics	113 (24)	Academy of Management Annals	1 (0)
Minds and Machines	45 (0)	Academy of Management Journal*	1 (1)
Computers in Human Behavior	34 (16)	Annual Review of Organizational Psychology and Organizational Behavior	1 (0)
Journal of Consumer Research*	11 (2)	Contemporary Accounting Research*	1 (1)
Journal of the Academy of Marketing Science*	11 (1)	European Journal of Operational Research	1 (0)
Journal of Service Research	8 (3)	Frontiers in Psychology	1 (1)
Journal of Marketing*	7 (2)	Human-centric computing and information sciences	1 (1)
Frontiers in Robotics and AI	5 (3)	Human Resource Management*	1 (1)
International Journal of Information Management	5 (4)	IEEE Transactions on Pattern Analysis and Machine Intelligence	1 (0)
Organization Studies*	4 (0)	Information and Organization	1 (0)
International Journal of Research in Marketing	3 (0)	Information Systems Research*	1 (1)
Journal of Consumer Psychology*	3 (0)	Journal of Consumer Marketing	1 (1)
Psychology and Marketing	3 (3)	Journal of Marketing Research*	1 (1)
Science Robotics	3 (0)	Journal of Personality and Social Psychology	1 (0)
Trends in Cognitive Sciences	3 (0)	Journal of Retailing	1 (0)
Artificial Intelligence	2 (0)	Marketing Science*	1 (0)
IEEE Transactions on Systems, Man, and Cybernetics: Systems	2 (0)	Nature Machine Intelligence	1 (0)
Journal of Business Ethics*	2 (0)	Organization Science*	1 (0)
Journal of Experimental Psychology: General	2 (1)	The Accounting Review*	1 (1)
Journal of Management Information Systems*	2 (1)	TOTAL	287 (69)

* FT50 Journals. Note: The keyword search yielded no articles from the following FT50 journals: Academy of Management Review, Accounting, Organisations and Society, Administrative Science Quarterly, American Economic Review, Econometrica, Entrepreneurship Theory and Practice, Harvard Business Review, Human Relations, Journal of Accounting and Economics, Journal of Accounting Research, Journal of Applied Psychology, Journal of Business Venturing, Journal of Finance, Journal of Financial and Quantitative Analysis, Journal of Financial Economics, Journal of International Business Studies, Journal of Management, Journal of Management Studies, Journal of Operations Management, Journal of Political Economy, Management Science, Manufacturing & Service Operations Management, MIS Quarterly, Operations Research, Organizational Behavior and Human Decision Processes, Production and Operations Management, Quarterly Journal of Economics, Research Policy, Review of Economic Studies, Review of Finance, Review of Financial Studies, Sloan Management Review, Strategic Entrepreneurship Journal.

Table 2: Overview of literature on anthropomorphism in AI.

Article	Type of AI	Relevant Variables Examined	What kind of effects are reported?	Did the study investigate a contingency of a context?	Did the study focus on individual characteristics of participants?
Abubshait et al. 2021	Robots	Social attention	Positive	Types of humanlike features	None
Allan et al. 2021	Social robots	Robot anxiety, Attitude	Positive and Negative	None	Personality traits
Andriella et al. 2020	Robots	Cooperation performance	Positive and Negative	None	Personality traits
Araujo 2018	Conversational agents	Social presence	Positive	None	None
Bartneck et al. 2009b	Robots	Perceived Intelligence	Positive	None	None
Burgoon et al. 2000	Computers	User evaluation, Sociability	Positive	None	None
Chattaraman et al. 2019	Digital assistants	Interactivity, Trust	Positive and Negative	Level of internet competence	Age differences
Chi et al. 2021	Social robots	Trust, Effort Expectancy	Positive	None	None
Choi et al. 2021	Humanoid service robots	Warmth, Failure recovery	Positive	None	None
Christoforakos et al. 2021	Humanoid service robots	Competence, Trustworthiness	Positive	None	None
Chuah et al. 2021	Robots	User preference	Positive and Negative	None	Personality traits
Crolic et al. 2022	Chatbots	Purchase intentions, customer satisfaction, firm evaluation	Negative	None	Emotional state
de Visser et al. 2016	Virtual agents	Trust resilience	Positive	None	None
Delgosha et al. 2020	Robots	Competence, predictability	Positive	None	None
Etemad-Sajadi et al. 2021	Robots	Usefulness, Trust, Intention to use	Positive	None	None
Ferrari et al. 2016	Social robots	Threat to human distinctiveness	Negative	None	None
Fink et al. 2013	Vacuum robots	Social presence	Positive	Decay of effect over time	None
Fraune 2020	Robots	Attitude, Moral behavior	Positive	Group membership	None
Gong 2008	Virtual agents	Social responses, Trustworthiness	Positive	None	None
Gursoy et al. 2019	Adoption of AI devices	Effort expectancy, emotion	Positive and Negative	None	None
Hildebrand and Bergner 2021	Chatbots, Robo-advisors	Trust, Firm perception, Recommendation acceptance	Positive	None	None
Hodge et al. 2020	Robo-advisors	Recommendation acceptance	Positive and Negative	Task complexity	None
Hu et al. 2021	AIAs	Continuance usage intention	Positive	None	None
Huang et al. 2021	Social robots	Identity threat, Usage intention	Negative	None	None
Jacobs et al. 2021	Robots	Acceptance of robots	Positive and Negative	None	Age differences
Kamide and Arai 2017	Robots	Comfortableness, controllability	Positive and Negative	None	Cultural differences
Kaplan et al. 2019	Robots	Tendency to anthropomorphize	Positive and Negative	None	Personality traits
Karimova and Goby 2020	AI-based products	Trust	Positive	None	None
Kim and McGill 2011	Slot machines	Risk perception	Negative	None	Social power
Kim and McGill 2018	Products	Agency, User evaluation	Positive and Negative	None	Financial status
Kompatsiari et al. 2021	Humanoid service robots	Socialness, Quality of interaction	Positive	None	None
Konijn et al. 2021	Robots in education	Learning, Enjoyment	Positive	None	None
Kwak et al. 2017	Robots	Purchase intention, Willingness to pay, Familiarity	Positive and Negative	Congruence of functions with design	None
Lefkeli et al. 2021	Robots	Mind scale	Positive and Negative	Cooperation vs. competition	None
Leichtmann et al. 2021	Robots	Social desirability	No effect	None	None
Li and Sung 2021	AIAs	Psychological distance	Positive	None	None

Liew et al. 2017	Virtual avatars	Website trust, information credibility, patronage intentions	Positive and Negative	None	Gender differences
Lin et al. 2021	Virtual salesperson	Social presence, Conflict	Positive	None	None
Liu and Tao 2022	Medical AI	Trust	Positive	None	Gender differences
McLeay et al. 2021	Service robots	Service experience, Usage intent	Positive and Negative	Role of service robot	Innovativeness, Openness
Mende et al. 2019	Humanoid service robots	Consumer discomfort, compensatory consumption	Negative	None	None
Mirowska and Mesnet 2021	AI evaluation	Objectivity of AI	Positive and Negative	None	None
Mishra et al. 2021	AIAs	User attitude, Usage	Positive	None	None
Müller et al. 2021	Robots	Identity threat, Distinctiveness	Negative	None	None
Pelau et al. 2021	AI service agents	Acceptance, Trust	Positive or No effect	Empathy and Interaction Quality	None
Pickard and Roster 2020	Virtual interviewers	Self-disclosure	Positive	None	None
Pitardi and Marriott 2021	AIAs	Social presence, Trust	Positive	None	None
Qiu and Benbasat 2009	Chatbot recommendation agents	Trust, Social Presence, Perceived Enjoyment, Intention to use	Positive	None	None
Reig et al. 2021	Robots, virtual agents	User preference	Positive and Negative	Time pressure	None
Rhim et al. 2022	Chatbots	Interaction time, user satisfaction	Positive	None	None
Schanke et al. 2021	Chatbots	Offer elasticity, Fairness	Positive and Negative	None	None
Schillaci et al. 2013	Robot movement	User satisfaction, Interactivity	Positive	None	None
Schuetzler et al. 2019	Conversational agent	Disclosure, Deception	Negative	None	None
Shank et al. 2019	Encounter with AI	Emotional reactions	Positive and Negative	None	None
Shin et al. 2019	Virtual avatars	Eeriness, Information processing	Negative	None	None
Sinha et al. 2020	Robots	Intention to use, Technophobia	Positive and Negative	None	None
Spatola et al. 2019	Social robots	Stroop task, Attentional control	Positive	None	None
Srinivasan and Sarial-Abi 2021	AI-algorithms	Penalization of brands for errors	Positive and Negative	Task type	None
Stanton and Stevens 2017	Robot gaze	Trust, Persuasion	Negative	None	Gender differences
Stapels and Eyssel 2021	Robots	User attitude	Positive and Negative	None	None
Striepe et al. 2021	Robots	User experience	Positive	None	None
Tang et al. 2021	AI-agents	Work performance	Positive and Negative	Task type	Personality traits
Tay et al. 2014	Social robots	User acceptance	Positive and Negative	Congruence of gender and personality with tasks	None
Thepsoonthorn et al. 2021	Robots	Affinity	Positive and Negative	Non-linear effect	None
van Dijk et al. 2013	Robots in education	Verb retention	Positive	None	None
Whang and Im 2020	Voice assistants	Product evaluation	Positive	None	None
Youn and Jin 2021	Chatbots	Behavioral intention, Trust, Satisfaction	Positive and Negative	Brand personality type	Ideological views
Yun et al. 2021	Medical AI	Intention to use	Positive and Negative	None	None
Zörner et al. 2021	Robots	Trust, Robot perception	Positive	None	None

AIA: Artificial Intelligence Assistant (e.g., Alexa).