ACTING LIKE HUMANS? ANTHROPOMORPHISM AND CONSUMER'S WILLINGNESS TO PAY IN ELECTRONIC COMMERCE

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ACTING LIKE HUMANS? ANTHROPOMORPHISM AND CONSUMER'S WILLINGNESS TO PAY IN ELECTRONIC COMMERCE

Abstract

Anthropomorphism is the attribution of human characteristics to a non-human object. Past research shows that anthropomorphism changes how we perceive objects (e.g., believing them to be more attractive). Does this mean we would be willing to pay more for them? We examined whether displaying a product in an anthropomorphized form influenced how much a consumer was willing to pay. We examined two design aspects, visual (i.e., a face) and auditory (e.g., a voice), in the context of an online auction, and proposed three theoretical routes by which an anthropomorphic product display might affect willingness to pay (emotional, product attachment, and product quality). Results show that adding visual anthropomorphizing features to the way a product was displayed increased the amount bid by 7%, but adding auditory anthropomorphizing features had no effect. The visual anthropomorphizing features increased product attachment but had no effect on emotions or perceptions of product quality. Therefore, we conclude that anthropomorphizing the way a product is displayed increases willingness to pay primarily through the theoretical route of creating attachment to the product. There is an additional, as yet undiscovered, theoretical route through which anthropomorphism influences willingness to pay. The results also suggest that the conventional wisdom that the combination of visual and auditory design features is best for triggering anthropomorphism is not always true.

Keywords: anthropomorphism, online auction, willingness to pay, product attachment

INTRODUCTION

The distinction between humans and artificial technology is growing smaller year by year [24]. Siri and Alexa are commercial products that blur the line between humans and intelligent agents, and newer digital agents are beginning to take visual form in the online world. Many have taken the cartoon route because they are less expensive to create. Figure 1 shows Dewey, a cartoon avatar developed by WisdomTools (https://www.linkedin.com/company/wisdomtools/) for PBS online. Others have used a more realistic form. Figure 2 shows Roman, a digital avatar developed by Soul Machines (https://www.soulmachines.com/) for an online customer service agent – this is not a photograph, it is a computer-generated interactive digital agent.

We know that agents like Siri, Alexa, Dewey, and Roman are not human, but we still anthropomorphize them – that is, we ascribe human characteristics and behavior to them. Anthropomorphism is automatic [40, 61]. When we hear and/or see an inanimate object that has certain features, our brain automatically ascribes human form to it even though we rationally know the object is not human. Anthropomorphism makes us see more than what is actually there and attribute features to an object that we know it does not have [41].

Modern technology brings great freedom in designing how products are displayed online [48]. Not only are companies capable of creating artificial characters to display their products, but they can also make those characters come alive, either through auditory features (like Siri or Alexa) or visual features (like Dewey), or a combination of both (like Roman). Siri, Roman, and Alexa are examples of designing a *product* to induce anthropomorphism. Such products provide additional features compared to their competitors and may increase the amount a consumer is willing to pay.

What if we change the way a product is *displayed* to induce anthropomorphism without actually changing the product itself? Such products would have no additional features, but would you pay more for it versus the same product displayed normally?

The answer to this question has great practical implications for businesses. There is intense price competition in both online and offline markets [67]. Price competition is a major challenge for many e-commerce firms. Lowering prices attracts customers at the cost of reduced profits, ultimately hurting the firm. Finding ways to distinguish themselves in other ways and using multiple methods, including triggering anthropomorphism, to increase consumers' willingness to pay for a product are potentially important paths to increasing profit.

The potential of anthropomorphism in the business world spurs the need to seek answers from theories. Anthropomorphism changes how we think and behave toward the object; we begin to treat it more like a human. When we anthropomorphize intelligent agents or cars, we trust them more [24, 101]. When we anthropomorphize consumer products, we are more likely to lose self-control and consume more [50]. When we anthropomorphize instructional agents, we learn more from them [3, 24]. Designing digital artifacts to induce anthropomorphism is becoming more common for technologies where designers believe the human element could potentially add value, such as intelligent agents. Anthropomorphized objects have the potential to influence individuals' behavior, attitude, and perceptions [22, 53, 24].

Little prior research has examined the impact of anthropomorphism on willingness to pay. Most prior research on e-commerce has used the lens of rational decision making and thus argues that an individual's buying decision is based on maximizing benefits [19, 82] so individuals should not pay more for the same product displayed in an anthropomorphized form versus its normal display. Yet, research suggests that the buying process can be non-rational and emotional [85]. The consumer's emotional attitude towards the product influences its perceived value [88, 104, 105], so a product displayed in a way to influence emotions might influence the willingness to pay. Thus, this study aims to answer the following research question:

RQ: Does the use of visual and/or auditory design factors intended to induce anthropomorphism in the display of products influence individuals' willingness to pay?

To answer this research question, we propose three theoretical routes by which an anthropomorphized product display could influence willingness to pay in the online context: an emotional route, a product attachment route, and a perceived product quality route. We test how the visual and auditory design factors influence these routes through a controlled lab experiment.

THEORETICAL BACKGROUND

Anthropomorphism is the attribution of human characteristics to a non-human being [30]. Anthropomorphism is spontaneous, pervasive, and powerful [40, 61]. A frustrated computer user threatens the computer when it fails to perform as expected. A kid waves at the sky after seeing smiley faces in the clouds. Humans are born with anthropomorphism, rather than developing it as a learned skill; clinical and developmental psychology research shows that humans start to anthropomorphize during infancy and carry it throughout their lifetime [42, 51, 83].

In the sections below, we examine two design factors (visual and auditory) that may influence the extent to which users anthropomorphize products. We then present three different theoretical routes by which anthropomorphism may affect users' willingness to pay (emotion, product attachment, and product quality). We conclude this section by hypothesizing that adding these anthropomorphic design factors to the *display* of a product (not the product itself) will increase the amount a consumer is willing to pay, because if any or all of these three routes are active, then anthropomorphism will increase willingness to pay.

Designing to Induce Anthropomorphism in E-Commerce

While philosophers seek to understand why humans anthropomorphize [13, 40], computer scientists and engineers strive to understand how to design objects that induce anthropomorphism [28, 30]. In this research, we focus on anthropomorphizing the *display* of the product, not anthropomorphizing the *product* itself[1]. In other words, the product does not change, just the way the product is displayed and offered for sale on an e-commerce website changes.

Products are inherently non-human, so most attempts to anthropomorphize the display of products have focused on the use of cartoon-like approaches (see Figure 1), rather than realism-based approaches (see Figure 2). Thus, we will also focus on cartoon-like approaches. Cartoons have long been used to sell products, often as brand mascots [49]. Mascots are different than products, in that they focus on the brand, not a specific product [49]. Some products are easy to anthropomorphize using cartoons because their intended use is to model humans (e.g., dolls) [56], but most consumer products are more "object" than "human" (e.g., car, TV, tablet) [1].

There are many aspects to the design of anthropomorphic product display, but the two most fundamental aspects from a business perspective are the visual and auditory aspects [45, 92], because each of these requires different expertise and financial resources to implement. The designers of Siri, for example, chose to use only an auditory design. Creating a visual image requires technical expertise as well as creative expertise to design a cartoon imbued with human form and movements. Creating a voice requires technical and creative expertise to form a voice that conveys human nature. Providing both adds an extra layer of complexity because the voice must match the visual character.

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[1] We cannot really speak of "anthropomorphizing the display of a product" or of an "anthropomorphic product display" because anthropomorphism is a human process that is induced to a greater or lesser extent by how an object is displayed. We should more properly use phrases such as "designing the display of a product to induce users to anthropomorphize it." Such phrasing is long and cumbersome, so we will often use shorter phrasing to simplify our language, but it is important to remember that anthropomorphism is a human process, separate and distinct from the object that induces it.

Visual design involves several aspects collectively, including adding facial features, movements, and intentionality [45, 92]. A static image presenting facial features can trigger anthropomorphism [65]. Attractive anthropomorphic objects can be more persuasive [53], but the facial design of the object may carry a downside if the design is associated with an unhelpful agent [98]. Movement also influences anthropomorphism. Based on results from a lab experiment, researchers found that individuals are more likely to perceive humans and nonhuman objects as possessing mental states when the objects moved at speeds similar to the speed of human movement, compared to when they moved faster or slower than humans [62].

Voice, especially voice clarity and voice consistency, has a large impact on anthropomorphism [38]. Prior research shows that individuals treat different voices on the same computer as different actors and the same voice on different computers as the same actor [75]. The fit between physical appearance and voice is also critical in triggering anthropomorphism. Individuals took longer to process information delivered by virtual agents with human faces and humanoid voices than those with human faces and human voices. They also trust them less [38].

Although visual design and a voice can separately induce anthropomorphism, having a combination of both can be stronger [25, 75]. Synchronizing the voice with the movement of the object also appears to be key in making individuals pay more attention, be more emotionally aroused, and have better evaluations of the object [75].

In summary, design features that induce anthropomorphism can be visual, such as the addition of facial features and motion. Likewise, audio design features (voice) can also trigger anthropomorphism. Combining the visual features and the audio features is believed to be stronger than either visual or audio alone because humans are known for having both a visual appearance and voice that are distinguishable from other non-living objects or animals [25].

Thus, a non-human object with both visual and auditory features is theorized to be more likely to trigger anthropomorphism than either alone, but there is little empirical evidence.

Effects of Anthropomorphism

Anthropomorphism affects attitude and behavior [15, 41, 55, 75], yet little research has examined the effects of anthropomorphism on willingness to pay. Researchers have found that computer users can identify human traits in computer behavior [47], and they prefer computers that exhibit similar personality traits to themselves [75]. They evaluate a computer as significantly better when they are told that they are teamed with a computer to work on a task than when they are told that they are working alone using the computer [75].

Researchers also looked into how individuals treat non-human virtual agents. In a mock job interview, individuals' impression of the interviewer and their emotional state were not significantly different when they were interviewed by a real human versus a virtual agent [2]. As the time of interaction with the virtual agent increases, the likelihood for individuals to anthropomorphize the virtual agent also increases [36]. Individuals perceive virtual agents that are more anthropomorphic as being more attractive and trustworthy [37]. Virtual agents make the sales channels more persuasive and give consumers more pleasure [100].

Prior research has argued that anthropomorphism should influence a consumer's willingness to pay [41], but it is still unclear whether and how it does. Willingness to pay is the maximum amount an individual will pay for a product and it is subjective [102]. Understanding individuals' willingness to pay is crucial in the context of electronic commerce [8, 26, 46]. E-commerce has changed the face of business by enabling consumers to purchase goods from both businesses and individual sellers [18]. Thus, understanding consumers' willingness to pay has become key in estimating demand and designing a pricing strategy [8, 46].

We argue that there are three theoretical routes by which the visual and auditory design features of anthropomorphism may influence willingness to pay: an emotional route, a product attachment route, and a perceived product quality route (Figure 5). We discuss each in turn.

The Emotion Route

The emotional route theorizes that the anthropomorphic product display can be designed to influence emotion and that emotion influences willingness to pay. Emotion is one type of effect and has a clear trigger as well as a short but intense effect on the individuals [34]. It is a subjective feeling related to personal needs, goals, or concerns towards the self or others and is typically triggered by situational events and objects in one's environment, rather than internal factors [34]. Once the stimulus conditions, such as the stimulus itself or the supporting cognition, perceptions or other elicitors are no longer active, emotion will gradually disappear.

Past research in social and cognitive psychology has used two different approaches to conceptualize emotion. One approach conceptualizes emotion as discrete states, often using six basic emotions: anger, disgust, fear, happiness, sadness, and surprise [27, 29]. The other, built upon neuropsychology, conceptualizes emotion on two continuous dimensions of valence and arousal, where valence is the extent of positive or negative emotions and arousal is the intensity of emotion [72, 78]. A third dimension of dominance (i.e., emotional activation) was included in the original theoretical model but has mostly disappeared from empirical research. The two-dimensional model better fits our research setting because subtle differences in anthropomorphic cartoons are likely to influence only one of the six emotional states (i.e., happiness).

Anthropomorphism and emotion. Social contagion theory argues that emotions are highly contagious from person to person [43, 79]. Emotions are shared with others through facial expression, vocalization, posture, and movement. For instance, an individual is likely to smile when he/she sees someone else smile [43, 79]. Emotional contagion also occurs though communication, whether written or verbal. For example, emotions spread through Facebook posts; we are influenced by the positive or negative emotion in the posts of our friends on Facebook, so when we read something positive we become happier, and vice-versa [5].

The same fundamental elements that spread emotions from one human to another (facial expression, vocalization, posture, movement and communication) are the fundamental features used to create anthropomorphic objects [45, 92]. Thus, these design features can be used to spread an anthropomorphic object's emotional display to the viewer's emotional state. Prior research shows that the emotion expressed by an anthropomorphic object can trigger the same emotion in the viewer. When anthropomorphic products projected a neutral or mild emotion, they did not influence viewers' emotions [1]. When an anthropomorphic product exhibited strong positive emotion, viewers expressed positive valence and high arousal [55]. Thus, anthropomorphic products can be designed to trigger positive emotional valence and increase emotional arousal. Therefore, we hypothesize,

H1a: *Individuals will experience more positive emotional valence for a product displayed with visual features designed to induce anthropomorphism than for a product displayed without them.*

H1b: *Individuals will experience more positive emotional valence for a product displayed with auditory features designed to induce anthropomorphism than for a product displayed without them.*

H1c. *The combination of both visual and auditory design features will have stronger effects on emotional valence than either alone.*

Emotion and willingness to pay. The effects of emotion have been well studied in social psychology and marketing. Multiple social psychology theories emphasize the effect of positive and negative emotions. According to Construal Level Theory, positive emotions can increase individuals' willingness to think about abstract and future goals, while negative emotions make people focus more on immediate and proximal concerns [35, 57]. Individuals are more likely to be influenced by emotions during the formation of first impressions of people and things [74]. Marketing research has found that positive emotions can increase individuals' resistance to temptation compared with neutral emotions [31]. Research in the context of e-commerce has found perceived enjoyment to be positively related to consumers' impulse buying [68] and positive emotional valence to increase consumers' willingness to pay [104].

The importance of emotion as a factor in influencing an individual's evaluation of a target depends on environmental features, such as the accessibility to the target information as well as the quality and quantity of the contextual cues [7]. In e-commerce settings, individuals' emotions can play an important role in evaluating products. Individuals with positive emotions will evaluate a product more quickly and impulsively than those with negative emotions [68].

Positive emotions usually produce a higher self-evaluation compared to negative emotions [32, 33, 81]. This higher self-value will increase individuals' perception of the value of objects in their environment [104]. In an online auction, the product serves as an ideal external object to reflect this overvaluation because the focus of the bidders is on the product they want to purchase [104]. Individuals will project their self-value on these products and thus will be willing to pay more than individuals who are neutral in the online auction context [104]. Thus, individuals with high positive emotional valence and arousal will be willing to pay more. Therefore, we hypothesize that

H4a. *Individuals' positive emotional valence is positively related to willingness to pay.*

The Product Attachment Route

The product attachment route theorizes that the anthropomorphic product display can be designed to influence product attachment and that this attachment influences willingness to pay. Product attachment is defined as the person-product relationship or the association a person experiences with a product [77, 80]. Even though people are likely to have positive emotions towards a product to which they feel attached [77], product attachment is not an emotion or an effect [9, 54, 80]. Likewise, product attachment is not possessiveness [64], product involvement [9, 64], product loyalty [64], brand attitude [91], or brand attachment [64].

Theories of product attachment are based on the attachment theory originally developed to describe the dynamics of long-term relationships among humans. In attachment theory, attachment is defined as “an affectionate bond or tie between an individual and an attachment figure (usually a caregiver)” [14]. Attachment theory was primarily proposed to explain how an infant seeks protection and emotional support from their caregiver and was later expanded to explain adult romantic relationships [44].

Anthropomorphism and product attachment. Several factors influence product attachment, including group affiliation to the product, self-expression, pleasure, and memories related to the product [63, 64]. Product appearance positively affects attachment [64]. However, quite interestingly, product functionality or utility does not necessarily influence product attachment [54, 77]. Product attachment is often highest for very new products in the pre-acquisition stage (i.e., before they are purchased) and those that have been owned for a long time [9, 77]. In the pre-acquisition stage, sellers can use advertising to stimulate product attachment by invoking imagined ownership for potential buyers [9, 66]. The degree of attachment is reflected in thoughts, feelings and behaviors toward a particular object [80].

Attachment theory argues that humans are biologically driven to be "attached" to other humans [14]. Product displays that cause consumers to anthropomorphize products also trigger this biological need for attachment. The process of anthropomorphism is automatic and subconscious [94]. Individuals often are not aware that they are treating a non-human object in the same way as another human, nor stop themselves from anthropomorphizing the non-human object [40, 61]. Therefore, it is possible for individuals to develop attachment towards an anthropomorphic product similar to the attachment towards another human being. Thus, anthropomorphic products are likely to induce product attachment. Therefore,

H2a: *Individuals will experience a higher level of attachment towards a product displayed with visual features designed to induce anthropomorphism than for a product displayed without them.*

H2b: *Individuals will experience a higher level of attachment towards a product displayed with auditory features designed to induce anthropomorphism than for a product displayed without them.*

H2c. *The combination of both visual and auditory design features will have stronger effects on product attachment than either alone.*

Product attachment and willingness to pay. Product attachment influences consumer behavior. Many researchers have explained product attachment through the theoretical lens of cognitive theories of the self and self-extension [9, 11, 54]. The notion of "*What is 'mine' becomes 'me'*" [59] suggests that some objects are eventually viewed as parts of the self when a person can exercise power or control over them (i.e. computers). The need to define the self, to create a sense of identity, to remind themselves and others of who they are or would like to be, and to protect and enhance their self-concept are the internal motives for attachment [9, 11, 54].

High product attachment provides strong motives for protective behaviors to maintain the relationship or association with the product and preserve this self-image [9, 64, 80], that is, to own the product. Attachment serves as a motivation for individuals to maintain close proximity to the attachment target [73]. Once the attachment is built, it is difficult for individuals to sever the attachment voluntarily. Individuals with high product attachment are often willing to do much to keep the attachment, including paying more for the product [9, 64, 80]. Therefore,

H4b. *Individuals' product attachment is positively related to willingness to pay.*

The Perceived Product Quality Route

The perceived product quality route theorizes that the anthropomorphic product display can be designed to influence perceived product quality and that product quality influences willingness to pay. Perceived product quality is defined as the utilitarian value [103], the utility of a product to perform its functional purposes [84, 86]. We adopt the definition from previous research and define perceived product quality as "the consumer's overall assessment of the utility of a product based on perceptions of what is received and what is given" [105]. Perceived quality captures the rational factors and thus is one of the most important factors influencing willingness to pay [84, 95]. Perceived quality reflects a product's ability to satisfy utilitarian purposes [69] and is a key factor in why individuals buy products [95].

Anthropomorphism and perceived product quality. Purchase behavior starts with a desired goal and purpose to be fulfilled by a product. An e-commerce environment provides the consumer with a large amount of information about the competing products, which can lead to uncertainty [97]. Humans have limited memory resources and cognition capability [89, 90]. Individuals are inherently "cognitive misers" [90] who minimize the effort needed to make decisions [17, 23]; we are usually not motivated to expend cognitive effort without reason [90].

As a result, information is prioritized in the decision making process [6]. During the information collection stage, individuals will allocate more attention to important information [71]. Thus, information that is perceived as important to the decision is more accessible to the decision maker [10]. Factors such as product information, product image(s), pricing strategy, and system design influence purchasing behavior and decision making [93]. By directing consumers' attention to certain product information, one can influence what information consumers perceive as important and make that information more accessible during the purchase decision.

Prior research has shown that individuals tend to pay more attention to human faces than objects [99]. Anthropomorphism is an automatic process, so humans will pay more attention to them than to non-anthropomorphic products. Therefore, information delivered through the anthropomorphic product with human-like facial features, expressions, body movements, and verbal communication will receive more attention than information delivered in other ways. If this information emphasizes important functional value provided by the product, then the anthropomorphic product will be perceived to have higher product quality (i.e., utility). Thus,

H3a: *Individuals will perceive a product displayed with visual features designed to induce anthropomorphism to be of higher quality than a product displayed without them.*

H3b: *Individuals will perceive a product displayed with auditory features designed to induce anthropomorphism to be of higher quality than a product displayed without them.*

H3c. *The combination of both visual and auditory design features will have stronger effects on perceived product quality than either alone.*

Product quality and willingness to pay. Rational choice theory argues that perceived product quality influences the value that consumers ascribe to the product and their willingness to pay for it [19, 82]. Consumers' willingness to pay reflects the utility of the product [82] and its ability to perform its functional, utilitarian, or physical purposes [84, 86]. This applies both in the physical world and in e-commerce, including online-auctions. As the functional value of a product increases, bidders' willingness to pay should also increase. Therefore,

H4c. *Individuals' perceived product quality is positively related to willingness to pay.*

METHODOLOGY

To examine the effects of visual and/or auditory features on consumers' willingness to pay, a lab experiment with a 2 (visual manipulation: with vs. without) × 2 (auditory manipulation: with vs. without) factorial design was employed. We use online auctions as the context of our study because of their demonstrated ability as a research instrument to capture willingness to pay [21] and because of their practical impact. Online auctions have become increasingly popular, enabling consumers to purchase goods from both businesses and individual sellers. eBay is the largest online auction site, with more than 175 million active users who sold US $83 billion worth of products in 2017.

Participants

326 undergraduate students from an introductory business course at a large state university business school in the Midwestern United States. participated in the experiment. The 49 participants (18%) who failed the attention test were excluded from the sample, resulting in a sample of 277. The attention check question was randomly placed among the other survey questions and asked subjects to select the response "Somewhat agree." About 59% of the participants were male. The average age was 19.4 (95% of participants were between 19 and 21 years old). Subjects' participation was voluntary, and they received 1% extra credit for their participation. For students who did not wish to participate, a one page essay on how technology

improves people's lives was an alternative opportunity for the same amount of extra credit.

Task and Procedure

The task asked students to use an action website to bid on a tablet. We chose a moderately complex product (a tablet) because past research shows that anthropomorphism is stronger for complex products [30, 41]. The auction website was developed by the researchers and follows a "name-your-own-price" format. We believe such a design will best capture individuals' willingness to pay. The system provided information about the tablet, including the hardware and software, product dimensions, special features, and packages. There were no restrictions on how much the participants could bid or how long they could take. The bidding task lasted about 15-20 minutes. The screenshots of the auction website can be found in Appendix A.2. The task description can be found in Appendix A.4.

Data were collected in a computer lab. Participants were given instructions on the task and use of the auction website. After finishing the bidding task, participants were asked to complete the online survey which measured demographics, dependent variables, control variables, and the attention check.

Treatments

This 2×2 study had four randomly-assigned between-subject treatments: visual+auditory design features, visual+no-auditory, no-visual+auditory, and no-visual+no-auditory (control). The detailed design description can be found in Appendix A.1. The screenshots of the auction website can be found in Appendix A.2.

The no-visual+no-auditory condition was the control treatment intended not to trigger anthropomorphism. The control treatment was a standard product description page modeled after similar pages on Amazon and eBay.

The visual+auditory condition was the most fully anthropomorphized treatment with both visual and auditory design features added to the basic product description page used as the control treatment. The visual design removed the product photographs and replaced them with a full motion video of the tablet with added human physical characteristics (eyes, mouth, hands, and feet) and human-like movements (waving, clapping, jumping, and turning). See the left panel in Figure 3. The auditory design added a human voice recorded by a professional male voice actor using a script written in the first person to have direct communication with the user.

The visual+no-auditory condition included the same visual design video but removed the voice recording. Instead, the script was presented in text subtitles below the video, synchronized to the same speed as the voice recording so as to match the visual design movements.

The no-visual+auditory condition included the human voice recording but removed the visual design video. Instead, a product slideshow presented different still images of the tablet (see the right panel in Figure 3), synchronized to the voice recording so that as the tablet talked about its features, that part of the tablet was shown. Auditory treatment and control scripts are in Appendix A.3.

Ecological validity says that the control treatment should be the standard product description webpage, but a question arises as to whether an alternative control treatment could be the slideshow (no-visual treatment) and text subtitles (no-auditory treatment). Therefore, we developed an alternative control treatment (replacing the tablet photos with the slideshow and subtitles) to test whether the no-visual treatment and no-auditory treatment design features introduced unintended consequences. We conducted a pilot study with 127 undergraduate students comparing the control treatment to this alternate control treatment. There were no significant differences between the two for Willingness To Pay ($F(1, 124)=0.831$, $p=0.364$), Perceived Anthropomorphism ($F(1, 124)=0.502$, $p=0.480$), Emotional Valence ($F(1, 124)=3.858$, $p=0.052$), Emotional Arousal ($F(1, 124)=0.692$, $p=0.407$), Perceived Quality ($F(1, 124)=1.038$, $p=0.311$), or Product Attachment ($F(1, 332)=0.382$, $p=0.537$). Therefore, we concluded that the static webpage was appropriate as the control.

Lukyanenko, et al. [58] argue that technology artifacts that implement theoretical concepts need to provide an acceptable level of instantiation validity. That is, the constructs need to be implemented within the prototype in a manner that are valid representations of the constructs, understanding, of course, that academic prototypes used to test theories do not provide the same level of complexity or features as a commercial product due to cost [58]. They recommend that researchers follow several steps to increase instantiation validity such as multiple artifact designs and pilot tests of different designs [58], which we did, as described in the Appendix A.1.

Ultimately, the test of instantiation validity lies with the users of the experimental artifact. In this study, we focus on anthropomorphism, the extent to which users ascribe human characteristics to the tablet. Thus, one test of instantiation validity is its effects on participants' beliefs. If the experimental condition increased perceived anthropomorphism compared to the control treatment, then our artifact has instantiation validity. We report this in the results section.

Dependent Variables

Willingness to pay refers to the dollar amount an individual would pay in order to obtain possession of a product. It was measured as the amount bid by the participant in a single bid auction. In a real auction, bidders compete against each other, so the amount ultimately paid reflects the behavior of others. We measured each participant's bid independent of other participants, as is traditional in experimental research. The mean of the bid amount is $330.17

with a standard deviation of 93.56. The minimum bid was $99 and the maximum was $680.

We measured *Emotion*, *Product Attachment* and *Perceived Quality* as indicators of the theoretical route by which anthropomorphism could act. Measures were adopted from prior research and modified for this study (see Table 1). We used two self-created items to measure *Perceived Anthropomorphism* as a manipulation check (Cronbach's alpha=0.885). The questionnaire took an average of 5 minutes to complete.

Control Variables

We used two control variables, *gender* and *product knowledge*. Gender has been shown to affect individual decision making [52, 96] and anthropomorphism [100]. Product knowledge has been found to impact consumer behavior [70, 87]. *Product knowledge* was measured using three items from prior research [70]. The items for product knowledge can be found in Table 1.

Manipulation Checks

We conducted two manipulation checks to assess whether our treatments induced anthropomorphism as we theorized. We examined the items used to measure perceived anthropomorphism in past research [30, 60]. Unfortunately, the items apply to non-human living creatures (e.g., dogs, cats) as well as humans, so they actually measure animism, not anthropomorphism. Even though animism and anthropomorphism both capture how humans evaluate non-humans, they are different constructs.

Nevertheless, as the first manipulation check, we adopted nine of these items (Cronbach's alpha=0.96; see Appendix C) and recruited 220 subjects from Amazon Mechanical Turk (US residents with a quality rating of 95%) to rate the perceived animism of our four treatments; each participant rated only one treatment. Out of the 220 subjects, 59% were males and the average age was 38 years old. About 10% of the participants failed the attention check and were removed from the analysis, resulting in a total sample of 198. The treatment means were: control condition 2.762; visual treatment only 3.880; auditory treatment only 3.376; and combined video and auditory treatment 3.749. Results from a Univariate Analysis of Variance using SPSS 24 for these animism items show that the main effect of the video was significant ($F(1, 194)=11.925$, $p=0.001$); the main effect of the audio was not significant ($F(1, 194)=1.231$, $p=0.269$); and there was no interaction effect ($F(1, 194)=2.891$, $p=0.091$).

As a second manipulation check, we developed our own 2-item measure of perceived anthropomorphism (see Table 1). Participants in the main study were asked to rate the treatment they received using these items. We again used Univariate Analysis of Variance with SPSS 24 to test the impact of the visual and audio designs on perceived anthropomorphism. The results (see Table 2) show that the visual design features significantly increased individuals' perceived anthropomorphism ($F(1, 213)=13.784$, $p<0.001$), but the auditory design features had no impact ($F(1, 213) =0.081$, $p=0.776$). There was no significant interaction effect ($F(1, 213) =1.239$, $p=0.267$).

This pattern of results were the same for both manipulation checks. Therefore, we conclude that the visual design features increased perceived anthropomorphism, the auditory features did not, and the combination of both was not stronger than the visual alone.

RESULTS

Both the measurement model and structural model were fitted using lavaan 0.6-1 in R version 3.4.3. A two stage methodology was adopted. We analyze the measurement model first and then the full structural equation model. The models were evaluated separately [4].

For the measurement model, we used maximum likelihood estimation. We standardized the latent factors, allowing free estimation of all factor loading. Based on the reported standardized residuals, items were dropped from the measurement model. Before dropping each item, we verified that removing the item made sense theoretically. Figure 4 shows the tested measurement model. Descriptive data for all observed variables are provided in Table 3.

After dropping items, the CFA showed acceptable model fit with a CFI of 0.980 (>.9, indicating the current model fits the data better than a more restricted baseline model), a TLI of 0.972 (>.9, indicating the current model is not overly complicated yet fits better than the baseline model), a SRMR of 0.039 (<.08, indicating the model is a good fit), and a RMSEA of 0.046 (<.05 and the p-value is 0.586, not rejecting the null hypothesis that RMSEA is smaller or equal to 0.05, therefore indicating the model to be a close fit) with 90% CI (0.022, 0.067). The p-value (χ^2) is 0.011. All the fitness indexes are within the accepted thresholds for CFA. Factor loadings, item residual correlations, and latent variable correlation are in Appendix B.

The structural model was examined on the measurement model after dropping items. The fit indexes are within accepted thresholds with a CFI of 0.974, a TLI of 0.965, a SRMR of 0.058, and a RMSEA of 0.039 with 90% PCI (0.020, 0.055). Figure 6 shows the standardized path coefficients and the overall fit indexes of the structural mode. The R-squared for willingness to pay is about 20%, which is a medium-sized effect.

Figure 6 shows that the visual manipulation increased product attachment (0.408, p<.001), which in turn increased willingness to pay (18.582, p<.001). The visual manipulation also had a direct link to willingness to pay (30.825, p<.001), over and above the three routes we theorized (product attachment, emotional valence, and perceived quality). However, the auditory manipulation had no effect on any construct. Likewise, the visual x auditory manipulation interaction term had no effect.

Therefore, we conclude that the visual manipulation increased willingness to pay through the product attachment route: Hypotheses H2a and H4b are supported. Although Hypotheses H4a and H4c are supported, the first half of both routes were not supported (i.e., the visual design features did not affect emotional valence or perceived product quality).

DISCUSSION

The conventional wisdom is that the combination of visual and auditory design features is best for triggering anthropomorphism [25], yet we found that only visual design features had an impact. Auditory features had no effect on triggering anthropomorphism, when alone or combined with visual features. One possible explanation may be that our implementation of the auditory design was ineffective. We took steps to ensure an effective treatment by using a professional voice actor who had prior professional experience recording voices for cartoon characters and anthropomorphized objects. We had him record several different character voices that he believed were suitable for our anthropomorphized product. We pilot tested these voices with our anthropomorphized product and picked the one that was most highly rated. So while this remains possible, we do not regard it as likely.

Another explanation is the fit between the participants' expectations and our implementation of the auditory design. For instance, some participants may have expected the tablet to have a female voice, such as Siri. Our voice actor was male, although the voice selected by the pilot tests was an androgynous cartoon-like voice, likely because the anthropomorphized product was an androgynous cartoon-like character and the voice matched the product. Nevertheless, it remains possible that the voice did not fit participants' expectations because they are used to hearing female voices on their technological devices.

We used self-developed items to measure anthropomorphism as our manipulation check. Those items are designed to evaluate how "human-like" the objects are with both design aspects taken into consideration. It is possible that anthropomorphism is perceived through factors other than our manipulations, such as media richness. To control for the influence of media richness, we conducted a pilot study comparing two control conditions as described in the methodology section. In addition, we compared the perceived animism measures from prior research to our self-developed perceived anthropomorphism in the manipulation check. We found similar results. So while this remains possible, we do not regard it as likely.

Our results show that anthropomorphism matters. Our participants were willing to pay more for a product such as a tablet or laptop when it was *displayed* in a manner that triggered anthropomorphism, compared to the same product *displayed* in a traditional form. The products were identical; all we changed was the way in which the product was displayed, not the design of the product itself. Our participants reported seeing no functional quality differences between them. Yet, they were willing to pay a meaningful amount more when the product was displayed in a manner that induced anthropomorphism— about 7%. Willingness to pay is a reflection of the perceived value of the product [76], which means, whether rational or not, participants valued a product more highly when they anthropomorphized it even when they knew it had no additional functional value.

This study shows that anthropomorphism works by increasing consumers' attachment to the product, not by increasing emotional valence or perceived product quality. Attachment is fundamentally a human-to-human process [14], although consumers can develop attachment to products [9, 11, 54]. Anthropomorphism is automatic and subconscious [94], so consumers may have little control over it and its effects on attachment. In contrast, Study 1 found no effects due to changes in perceived product quality or emotions, which may be good, as there were no quality differences and emotions can be fleeting [34, 55].

Perhaps more interestingly, our study suggests there is also an additional – as yet undiscovered – theoretical route by which anthropomorphism affects willingness to pay. The magnitude of this route(s) is substantial, being almost twice as strong as the attachment route. Past research provides little insight into the possible alternate theoretical route(s). We speculate that anthropomorphism might reduce self-control so that consumers are less inhibited and willing to pay more for the product [50]. Alternately, this route may increase trust in the product and the features it offers, thus increasing willingness to pay [39]. Conversely, when consumers have an insufficient sense of connectedness or competence, anthropomorphizing a product may satisfy these deficiencies and increase vitality, leading to an increased willingness to pay [16]. This is a key issue for future research.

Our study suggests that only the visual elements influenced willingness to pay. Focusing on the visual design of product display will likely have the largest impact on revenues, although adding a voice may affect other aspects [38]. We used attractive facial elements and movement because we believe both have value [45, 92]. We pilot tested our design to ensure it was attractive to the target audience because attractiveness influences anthropomorphism [53].

This study suffers from the common limitations of laboratory research. We studied undergraduate students performing artificial tasks that had no effect on their lives outside the study. Student samples are considered to be appropriate for testing theories about phenomena that are expected to hold true across the general population [20]. There is evidence that students both participate in online auctions and that anthropomorphism affects humans of all ages [42, 51], so we conclude they are appropriate study participants. Another limitation is that participants did not actually purchase the product; there were no real consequences to making a bid. The alternative would have been to pay participants a small amount (e.g., $10) and have them bid on a product of low value; this simply substitutes one artificial task for another – people don't usually buy low value products at auctions and few companies could justify the expense to build an anthropomorphized display of a low value product. Research also suggests that people do not anthropomorphize low value products [41].

Implications for Future Research

Notwithstanding the limitations of this study, we believe there are three implications for future research. First, our research shows that visual design features trigger anthropomorphism more than auditory design features. We need more research contrasting visual and auditory design features to support or refute our findings and to identify the conditions under which they hold. Research should especially focus on the need for both visual and auditory design features. We also need more research on specific aspects of design. For example, this study shows that a package of visual design features that include facial features, arms, and legs, plus movement, had a greater impact than the voice. Is movement important, or would a static image have the same impact? Are facial features sufficient, or are arms, legs, and an implied body important? In this study we used a cartoon-like character to avoid approaching the "uncanny valley." Would a more human-like character have different effects, particularly with regard to the voice? Would a female voice have had a different effect?

Second, our research suggests that the primary theoretical route through which anthropomorphism influences willingness to pay is product attachment; emotions and perceptions of product quality did not play a role. We need more research to understand what aspects of visual design influence product attachment and how these play out in consumers' buying decisions. We found no effects due to changes in emotions or changes in perceptions of product quality. We need more research to replicate our results, but in the meantime, future research should focus on attachment and on uncovering the additional theoretical route.

Finally, our study has implications for e-commerce and human-computer interactions in general. Our participants bid more for a product displayed in an anthropomorphized format that they reported had no additional functional value than the same product displayed in a non-anthropomorphized format. This shows that human behavior is a complicated mechanism that is not always what a disinterested bystander would call "rational." We as researchers need to move beyond the theoretical straightjacket of rationality to develop more theories that can better account for the non-rational behavior that we humans exhibit.

Implications for Practice

There are three implications for practice. First of all, for firms selling products in online auctions, spending additional money to create an anthropomorphized display of the product may lead to higher revenue. Our results show that consumers bid 7% to 20% higher when a product was displayed in an anthropomorphized form. This suggests one way to increase revenue for existing products is just to change the way the products are displayed. Anthropomorphism is strongest for complex products [30, 41], so these should be the initial targets.

Second, visual design is more important than auditory design. This may actually be good news for firms wishing to anthropomorphize their products because designing and changing visual images is often straightforward because they are computer generated. Most auditory design today still uses human voice actors, which takes time and makes it almost impossible to revise once the product is released; normally any changes to auditory artifacts requires that the entire segment be re-recorded because the original voice actor is not available or because voices change over time and new recordings do not match the original recordings.

Finally, our research suggests that consumers should be mindful while watching or interacting with a product designed to induce anthropomorphism. There is some probability that consumers will overpay for a product with a human-like face, body features, and movement.

Conclusion

The study of anthropomorphism as a research area is relatively new to the information systems discipline. In this study, we found that simply displaying a product in an anthropomorphized way without changing the product itself increased the amount that consumers were willing to pay by 7%. Changing the visual display of the product (e.g. face and movement) had a greater impact than changing the auditory display (e.g., adding a voice). We proposed three different theoretical routes by which anthropomorphism might influence willingness to pay, both rational (perceived quality) and non-rational (attachment and emotion) routes. Our results show that anthropomorphism acts by increasing attachment to the product. There also exists another undiscovered theoretical route awaiting future research.

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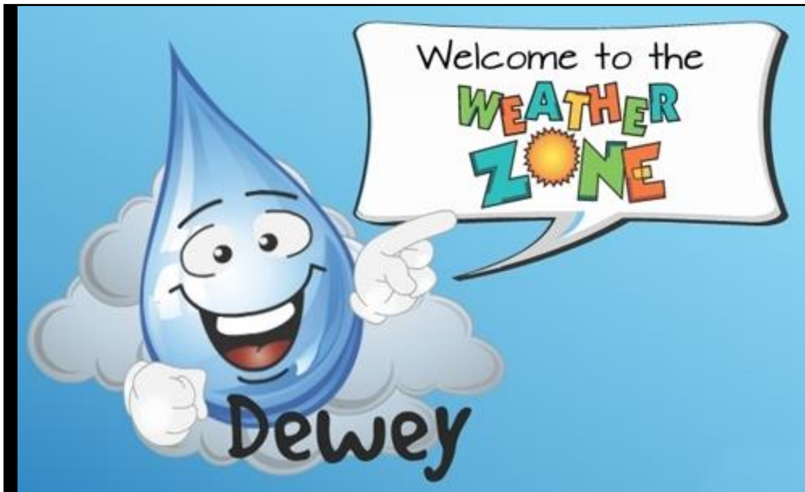

Figure 1. Dewey, a digital avatar for an online educational game. Image by Dr Sonny Kirkley, WisdomTools.
Used with Permission.

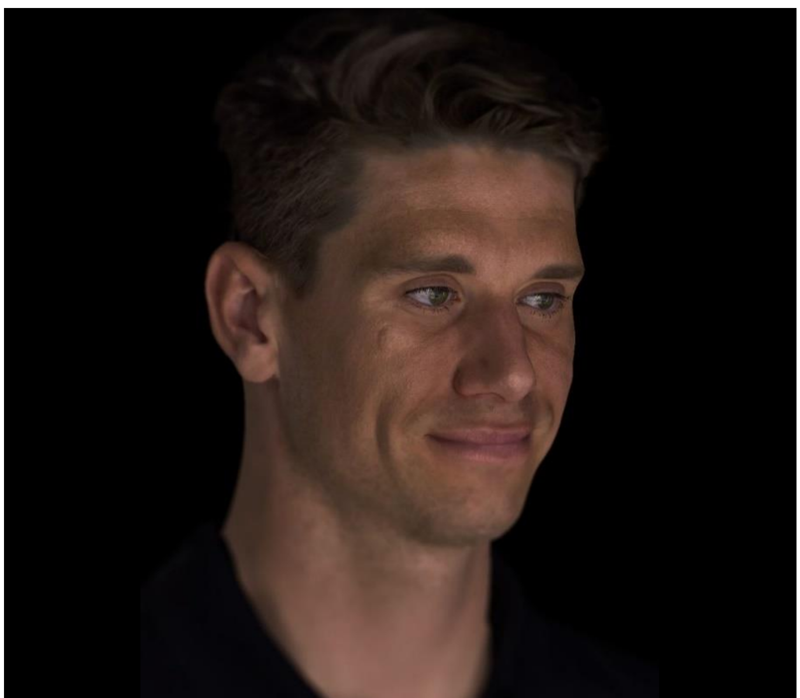

Figure 2. Roman, a digital avatar for an online intelligent agent. Image by Dr Mark Sagar, Soul Machines.
Used with Permission.

Figure 3. The tablet in the visual anthropomorphic design condition (Left) and the tablet in the no-visual design (control) condition (Right)

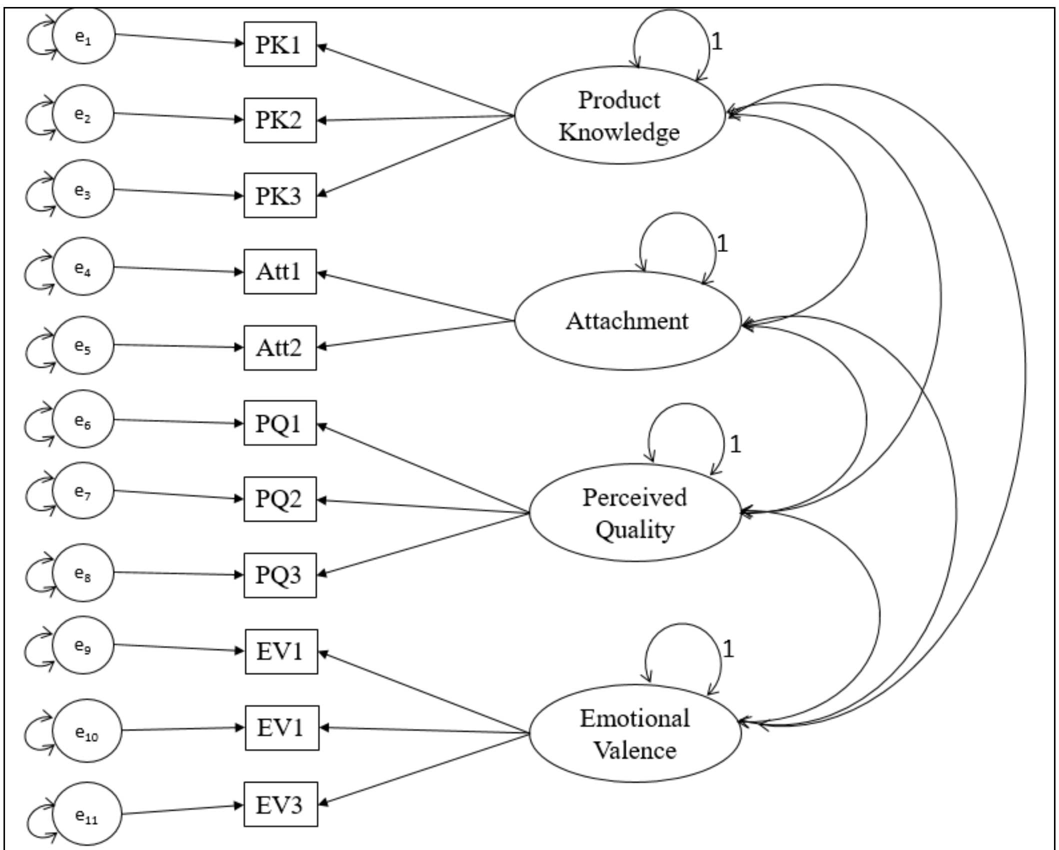

Figure 4. Tested Measurement Model

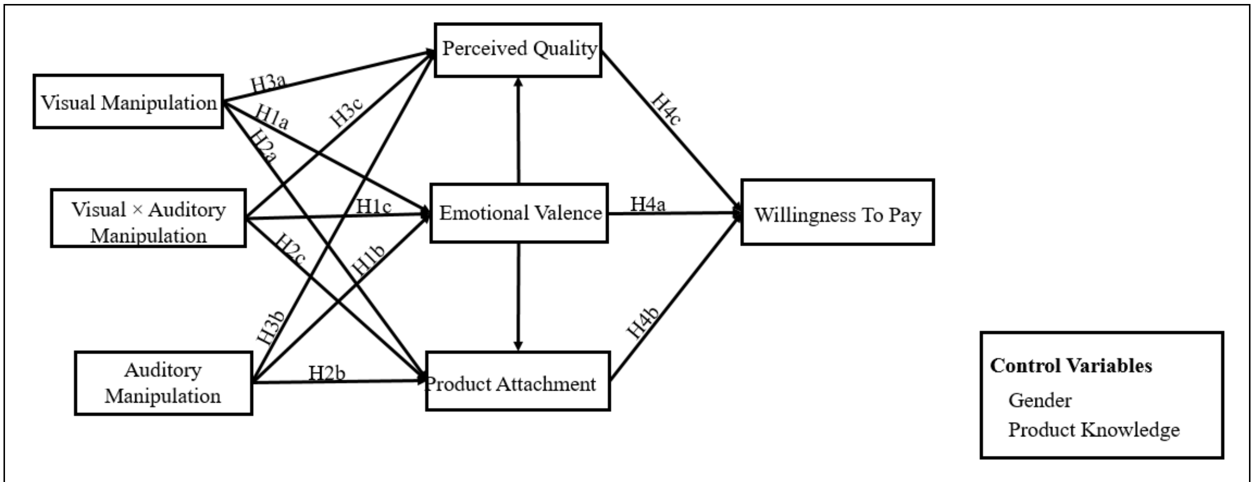

Figure 5. Research Model

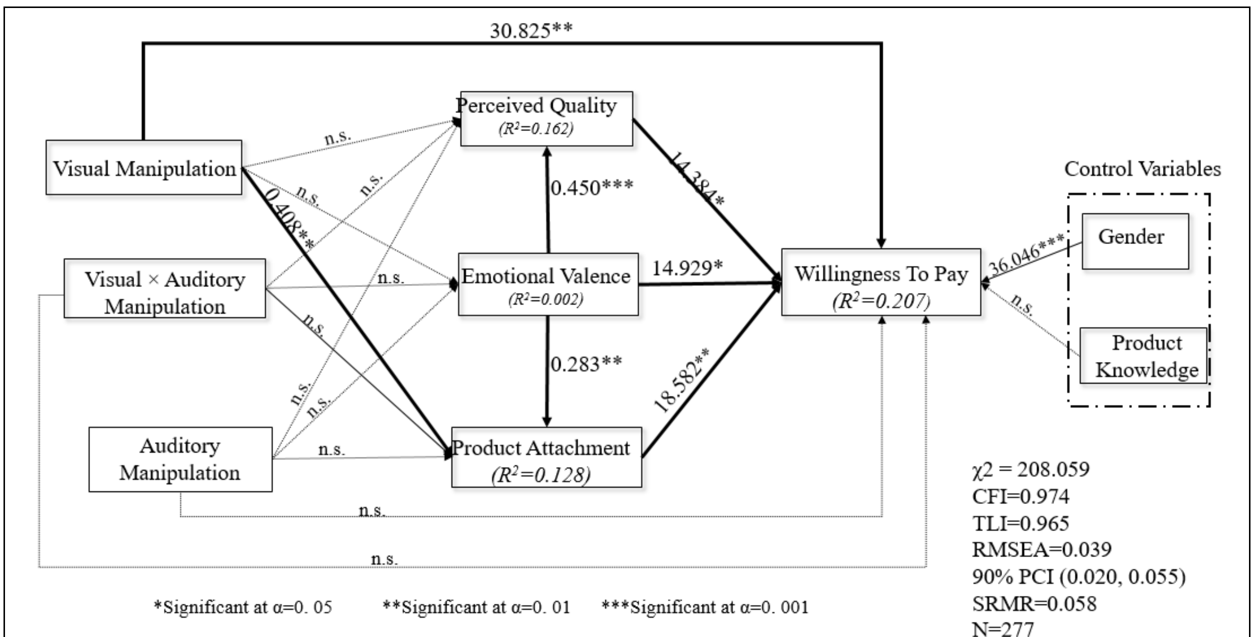

Figure 6. Structural Model with Standardized Coefficients and Fit Indexes

Table 1. Measurement Items	
Constructs	**Items**
Perceived Anthropomorphism (Self-created)	On a scale of 1-7, to what extent do you agree/disagree to the following statement with 1 indicating most strongly disagree and 7 most strongly agree, I felt like I was interacting with a human during bidding for the tablet. I don't think the tablet I bid on looks like a real person. *(Reverse)*
Emotional Valence (Adapted from [12])	On a scale of 1-7 with 1 indicating the least amount and 7 the most, Please indicate how *Positive* you are feeling. Please indicate how *Happy* you are feeling. Please indicate how *Pleased* you are feeling.
Product Attachment (Adapted from [63])	On a scale of 1-7, to what extent do you agree/disagree to the following statement with 1 indicating most strongly disagree and 7 most strongly agree, The tablet I bid on is very dear to me. I feel emotionally connected to the tablet I bid on.
Perceived Quality (Adapted from [88])	On a scale of 1-7, to what extent so you agree/disagree to the following statement with 1 indicating most strongly disagree and 7 most strongly agree, The tablet I bid on is well made. The tablet I bid on has an acceptable standard of quality. The tablet I bid on would perform consistently.
Product Knowledge (Adapted from [70])	Regarding the tablet, I am: 1 representing not knowledgeable at all while 7 representing very knowledgeable. Relative to the rest of the populations' knowledge about tablet, you are: 1 representing not knowledgeable at all while 7 representing very knowledgeable. Please indicate your knowledge level regarding tablet, with 1 presenting the lowest level of knowledge and 7 representing the highest level.

Table 2. Means (and Standard Deviations) of each treatment group for Perceived Anthropomorphism			
		Auditory Design	
		No	**Yes**
Visual Design	**No**	1.880 (1.313) *N=69*	1.686 (1.233) *N=57*
	Yes	2.409 (1.399) *N=56*	2.678 (1.649) *N=95*

Table 3. Descriptive Statistics for Observed Variables (N=277)							
Construct	**Cronbach's Alpha**	**Item**	**Mean**	**Std**	**Min**	**Max**	R^2
Product Knowledge	0.85	PK1	4.65	1.08	1	7	0.71
		PK2	4.61	1.05	1	7	0.73
		PK3	4.26	1.38	0	7	0.62
Product Attachment	0.81	Att1	2.22	1.33	1	7	0.75
		Att2	2.15	1.29	1	6	0.47
Perceived Quality	0.86	PQ1	5.01	1.20	1	7	0.67
		PQ2	5.40	1.16	1	7	0.71
		PQ3	5.07	1.21	1	7	0.60
Emotion Valence	0.74	EV1	4.14	1.23	1	7	0.51
		EV2	4.63	1.22	1	7	0.72
		PEV3	4.14	1.38	0	7	0.32