Aug 10th, 12:00 AM

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*Emergent Research Forum (ERF)*

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## Abstract

Recently, one of the most popular artificial intelligence (AI) products is the AI-based virtual assistant. To make better products that meet users' needs, manufacturers add anthropomorphic cues to virtual assistants. However, this cue-enabled human-likeness of virtual assistants can lead to unexpected side effects, such as a reliance of users on these products. As a result, users can become overly dependent on virtual assistants' suggestions when making decisions and have negative outcomes. Therefore, in this study, we explore the relationship between virtual assistants' responsiveness and linguistic cues and users' reliance on virtual assistants. To explain the phenomenon, we build our theoretical framework on anthropomorphism and attachment theories. In addition, we hypothesize that virtual assistants' voice pitches and interaction contexts can moderate how anthropomorphic cues impact emotional bonds. The pilot study shows promising results, and we will further test the hypotheses by conducting experiments.

### *Keywords*

Artificial Intelligence, Anthropomorphism, Linguistic cues, Responsiveness cues, Attachment Theory, Reliance

## Introduction

Recently, many artificial intelligence (AI) products have been introduced to the market. One of the most popular products is the AI-based virtual assistant. Nested in various platforms, devices, and appliances, a virtual assistant can provide services to a user with verbal or textual interactions. Thanks to its convenience, the demand for virtual assistants is growing fast, and the market size of the virtual assistant is expected to be USD 50.9 Billion by 2028 (Verified Market Research, 2021).

Virtual assistant manufacturers design products that can yield the most positive responses from users. By programming products to feature more human-like, users can have more satisfying interactions with virtual assistants (Pelau et al., 2021), and human-computer interaction literature supports this approach; when users perceive human-like cues from a virtual assistant, they can anthropomorphize the virtual assistant and form strong emotional bonds with it (Gillath et al., 2021). In this context, cues refer to the attributes that the cue receiver perceives to pick up information about the cue sender (Hegel et al., 2011).

However, such approaches adding anthropomorphic cues to virtual assistants can also lead to unexpected side effects. Highly human-like cues make users perceive that they are interacting with something as smart as a human. Consequently, users can become highly dependent on virtual assistants' suggestions in their decision-making processes, and such reliance can cause negative consequences. The example of autonomous vehicles shows an extreme consequence. Current autonomous cars sometimes cannot make good judgments about hazardous road conditions, and completely relying on the auto-driving function can lead to severe accidents (Brown, 2021). More common examples like being directed to a wrong location are caused by bad decisions of users when they are overly dependent on the virtual assistant.

Although the reliance on virtual assistants can increase the possibility of undesirable outcomes, most studies mainly look at the benefits of virtual assistant usage. Therefore, in this study, building upon anthropomorphism and attachment theories, we investigate how virtual assistants' responsiveness and linguistic cues; we posit that these two major anthropomorphic cues are related to users' emotional attachment to the virtual assistant, which eventually affects users' reliance. In addition, we examine the possible moderating roles of the virtual assistant's voice pitch and the context of interactions in affecting anthropomorphic cues' impact on the emotional bonds.

In summary, we propose the following research questions: 1) *How can virtual assistants' human-like cues influence users' reliance on virtual assistants? and 2) What are the moderating effects of the voice pitch and the interaction contexts?*

# Theoretical Background and Hypothesis Development

## *Impact of Anthropomorphism on Attachment*

Anthropomorphism is a process of inducing human features to nonhuman agents (Epley et al., 2007). Humans instinctively induce human attributes to nonhuman agents and expect them to act as humans do. By anthropomorphizing nonhuman agents, humans can form certainty and predictability about them. In addition, anthropomorphism helps people generate emotional bonds with nonhuman agents.

In information systems literature, researchers discovered that anthropomorphism helps users generate attachment toward products or services (Yuan & Dennis, 2019). Attachment means an affectional bond between individuals and their attached figures such as parents or other family members (Bowlby, 2008). Bowlby (2008) also suggested that nurturance and responsiveness of such caregivers are predictors of a strong attachment.

Virtual assistants do not usually have human-like appearances; they are embedded in platforms and devices. Therefore, users mainly anthropomorphize cues in virtual assistants' speech and verbal expressions in the interactions with the product, rather than anthropomorphizing based on physical features. In this respect, responsiveness and linguistic cues are two of the most common cues that virtual assistant products use for interactions (Kim et al., 2020).

Responsiveness means a caregiver's promptness and frequent responses to the care receiver (DeWolf & van Ijzendoorn, 1997). As a cue, summarizing users' speech and affirming emotional caring for users are examples of responsiveness cues. By simulating human caregivers' responsiveness cues, virtual assistants can give impressions to users that they can correctly understand users' requests and promptly address them, like a human caregiver. As a result, users feel secure with virtual assistants, building strong emotional bonds with virtual assistants. Based on the above argument, we posit the following hypothesis:

*H1. Users have a higher attachment to a virtual assistant with high responsiveness cues, than to a virtual assistant with low responsiveness cues.*

Linguistic cues are related to all linguistic components in sentences (Bates & McWhinney, 1987). For instance, the order of words and morphological cues are examples of linguistic cues (Ćoso & Bogunović, 2019). Utilizing diverse linguistic cues has a positive impact on users' perception of interactions with virtual assistants (Andrist et al., 2013). In addition, the usage of various linguistic cues can be interpreted as signals of warm responses to users (Andrist et al., 2013) because users can induce human caregivers' nurturing features to the virtual assistants. Therefore, users believe that they receive emotional support and care from virtual assistants, like those receiving from human caregivers. Hence, users can build strong emotional bonds with virtual assistants. Deriving from the discussions above, we hypothesize the following:

*H2: Users have a higher attachment to a virtual assistant with high linguistic cues, than to a virtual assistant with low linguistic cues.*

## *Impact of Attachment on Reliance*

Attachment is associated with a possibly negative consequence: reliance (Kobak & Hazan, 1991). Reliance is an individual's willingness to rely on others when making decisions (Lynch, 2013), and it often results in destructive decision-making, especially when the individual is willing to follow others' opinions without

enough evaluation. For instance, in robotics literature, research shows that reliance led users to trust a robot's wrong decisions in a conflagration, although they already realized that the robot was wrong (Robinette et al., 2016). Similarly, users forming an attachment with virtual assistants could prioritize virtual assistants' suggestions, instead of making decisions by themselves. Thus, we hypothesize that attachment and reliance have the following relationship:

*H3: Users having higher attachment with a virtual assistant form more reliance on the virtual assistant, than the user having a lower attachment.*

### *Moderating Roles of Interaction Context and Voice Pitch*

According to Schore (2017), the way the speech is delivered is important to understand the meaning of speeches. For example, gestures, facial expressions, and voice pitch can help the effective delivery of speeches. The robotics literature suggests that users evaluate robots with higher voice pitch as more affective and persuasive (Niculescu et al., 2013). Moreover, a high voice pitch can be interpreted as a signal of enthusiasm and support for care receivers (Schore, 2017). Hence, the voice pitch of virtual assistants can affect the perception of linguistic and responsiveness cues. Therefore, we propose the following hypothesis.

*H4. The high voice pitch of virtual assistants amplifies the positive effects of linguistic and responsiveness cues on attachment.*

By utilizing information systems, users can achieve hedonic and functional values (Wu & Holsapple, 2014). Hedonic values reflect personal and innate standards and are likely to be pleasure-oriented. Therefore, users focus on emotional experiences and look for pleasing elements when using the information systems for hedonic purposes (Wu & Holsapple, 2014). On the other hand, when users focus on the functional values while using information systems, they pay attention to whether they can achieve goals or perform tasks properly (Wu & Holsapple, 2014), prioritizing content or effectiveness to the pleasing elements. Thus, in the context of hedonic-oriented conversations, users may enjoy the anthropomorphism provided by responsiveness and linguistic cues more than when they conduct functional-oriented conversations with the virtual assistant. Accordingly, we propose the following hypothesis.

*H5. Compared to functional-value-based interactions, hedonic-value-based interactions lead to more positive effects of linguistic and responsiveness cues on attachment.*

## Method and Pilot Test Results

To examine the hypotheses, we design a 2x2x2x2 full factorial experiment, in which we examine high versus low linguistic cues, high versus low responsiveness cues, functional versus hedonic contexts, and high versus low voice pitches. Our study focuses on virtual assistant devices that have AI-based virtual assistant nested in physical devices and online platforms.

For the pilot test, four conversation scripts between a virtual assistant and a user are created. A conversation in which the user asks about the location of gas stations is designed as the functional context, and a conversation in which the user asks about the Billboard top songs is designed as the hedonic context. The responsiveness and linguistic cues are reflected by the style and tone of speech, organization of sentences, and provision of information in the virtual assistant's responses. We have validated these settings by surveying eight doctoral students. For this survey, the participants were requested to evaluate the cues' levels (high vs. low) by reading the given conversations to confirm the research settings.

We record the conversations using a text-to-speech API based on AI-generated voice synthesis functions, which provides various voice pitches for use. To avoid gender biases, we choose high- and low-pitched female voices for the virtual assistant and a female voice for the user. The conversation recordings are embedded in the Qualtrics survey, which has been used for the pilot study.

We invited 16 participants to the pilot study. The participants first answered demographic questions and were randomly assigned to one of the four conversations. Then, the participants listened to the conversation and answered the survey questions based on their perceptions. The measures were developed based on prior studies, and we used a 7-points Likert scale for the questions (see Appendix).

Nine participants were equally distributed to the following 3 experiment settings: High-pitch + Functional + High-responsive + High-linguistic, High-pitch + Hedonic + High-responsive + High-linguistic, and Low-pitch + Hedonic + Low-responsive+ Low-linguistic. Seven participants were assigned to the Low-pitch + Functional + Low-responsive + Low-linguistic setting. We calculated the average attachment and reliance levels for each setting. The pilot test results are as follows (see Table 1).

When the level of attachment increases, the level of reliance also increases. Furthermore, when users interact with high voice pitch virtual assistants, they have higher attachment and reliance levels. However, high responsiveness and linguistic cues in the functional value conversation lead to higher attachment and reliance. On the other hand, in the hedonic value conversation, the high cues are associated with a rather low attachment level, which contradicts our expectation of hedonic context moderating the effects of cues positively.

| | **Average Attachment** | **Average Reliance** |
|---|---|---|
| High-pitch/Functional/High-responsive/High-linguistic | 4.66 | 5.66 |
| High-pitch /Hedonic/ High-responsive/ High-linguistic | 2.33 | 4.58 |
| Low-pitch /Functional/Low-responsive/Low-linguistic | 2.96 | 4.89 |
| Low-pitch /Hedonic/ Low-responsive/ Low-linguistic | 3.66 | 4.91 |
| **Overall** | 3.40 | 5.01 |

**Table 1. Pilot Test Result**

Because of the small sample size in the pilot study, for the next step, we will conduct the full-scale experiment with current settings to collect more statistically solid evidence to examine the hypotheses. We hope the experiment will provide us with more interesting insights and solid results.

## Discussion and Conclusion

We hypothesize that the responsiveness cues and linguistic cues positively influence reliance by the positive mediation of attachment, and the voice pitch (high vs. low) and the context of interactions (hedonic values vs. functional values) can moderate how cues affect attachment. The pilot study has provided some contradicting results to existing theories, and we will further conduct the full-scale experiment and collect the data to test our hypotheses. We expect the collected data to provide sufficient evidence that can explain the mechanism of anthropomorphized cues affecting users' reliance on virtual assistants. Furthermore, for future extension, we plan to test the evolution of attachment between a virtual assistant and a user based on a longitudinal approach.

We contribute to the AI and anthropomorphism literature by investigating the relationships between the perceived anthropomorphism of virtual assistants and users' reliance and uncovering the cognitive mechanisms of users' reliance on virtual assistants. We also hope to provide findings and implications that help virtual assistant manufacturers fully understand the mechanisms of users' reliance and the potential negative outcomes related to reliance. By doing so, the manufacturers can sustain the golden mean in reliance resulting from their virtual assistant product designs, and improve the user experience.

## REFERENCES

Andrist, S., Spannan, E., & Mutlu, B. 2013. "Rhetorical robots: making robots more effective speakers using linguistic cues of expertise," In *2013 8th ACM/IEEE International Conference on Human-Robot Interaction (HRI),* pp.341-348. IEEE.

Bates, E., & MacWhinney, B. 1987. "Competition, variation and language learning." In MacWhinney, B. (Ed.), Mechanisms of language acquaisition, pp. 157–194. Hillsdale, NJ: Erlbaum.

Bowlby, J. 2008. Attachment. Basic books.

Brown, D. 2021. "How should autonomous cars make life-or-death decisions? In the best of worlds, they won't." *The Washington Post*, https://www.washingtonpost.com/technology/2021/08/06/self-driving-ai-death-decisions/

Ćoso, B., & Bogunović, I. 2019. The role of linguistic cues in bilingual negation processing. *International Journal of Bilingualism*, (*23*:1), pp. 21-36.

DeWolf, M. S., & van Ijzendoorn, M. H. 1997. "Sensitivity and attachment: A meta-analysis on parental antecedents of infant attachment," *Journal of Marriage and the Family*, 68, pp. 571-591.

Epley, N., Waytz, A., & Cacioppo, J. T. 2007. "On seeing human: a three-factor theory of anthropomorphism," *Psychological review*, (114:4), pp. 864-886.

Hampton, C. 2005. "Determinants of reliance: An empirical test of the theory of technology dominance," *International Journal of Accounting Information Systems*, (*6*:4), pp.217-240.

Hegel, F., Gieselmann, S., Peters, A., Holthaus, P., & Wrede, B. 2011. "Towards a typology of meaningful signals and cues in social robotics," In *2011 RO-MAN,* pp. 72-78. IEEE.

Kim, K., de Melo, C. M., Norouzi, N., Bruder, G., & Welch, G. F. 2020. "Reducing task load with an embodied intelligent virtual assistant for improved performance in collaborative decision making." In *2020 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 529-538. IEEE.

Kobak, R. R., & Hazan, C. 1991. "Attachment in marriage: Effects of security and accuracy of working models." *Journal of Personality and social* Psychology, (60: 6), pp.861-869.

Lynch, M. F. 2013. "Attachment, autonomy, and emotional reliance: A multilevel model." *Journal of Counseling & Development*, (*91*:3), pp. 301-312.

Niculescu, A., van Dijk, B., Nijholt, A., Li, H., & See, S. L. 2013. "Making social robots more attractive: the effects of voice pitch, humor and empathy," *International journal of social robotics*, (*5*:2), pp.171-191.

Pelau, C., Dabija, D. C., & Ene, I. 2021. "What makes an AI device human-like? The role of interaction quality, empathy and perceived psychological anthropomorphic characteristics in the acceptance of artificial intelligence in the service industry." *Computers in Human Behavior*, 122, 106855.

Robinette, P., Li, W., Allen, R., Howard, A. M., & Wagner, A. R. 2016. "Overtrust of robots in emergency evacuation scenarios." In *proceedings of 2016 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, Christchurch, New Zealand, pp. 101-108.

Schore, A. N. 2017. "Modern attachment theory. In S. N. Gold (Ed.), *APA handbook of trauma psychology: Foundations in knowledge*," pp. 389–406. American Psychological Association.

Schifferstein, H. N., & Zwartkruis-Pelgrim, E. P. 2008. "Consumer-product attachment: Measurement and design implications," *International journal of design*, (*2*:3), pp. 1-13.

Verified Market Research. 2021. "Intelligent Virtual Assistant Market size worth $ 50.9 Billion, Globally, by 2028 at 30% CAGR: Verified Market Research," *PRNewswire*, https://www.prnewswire.com/news-releases/intelligent-virtual-assistant-market-size-worth--50-9-billion-globally-by-2028-at-30-cagr-verified-market-research-301414041.html

Wu, J., & Holsapple, C. 2014. "Imaginal and emotional experiences in pleasure-oriented IT usage: A hedonic consumption perspective," *Information & Management*, (51:1), pp. 80-92.

Yuan, L., & Dennis, A. R. 2019. "Acting like humans? Anthropomorphism and consumer's willingness to pay in electronic commerce," *Journal of Management Information Systems*, (*36*:2), pp.450-477.

## *Appendix: Measurement Items*

| **Construct** | **Items** |
|---|---|
| Attachment (Schifferstein& Zwartkruis-Pelgrim, 2008) | 1. The virtual assistant is very dear to me.<br>2. I like the virtual assistant very much; to me, it is like a friend.<br>3. The virtual assistant is just a machine; it has no special meaning to me.(-)<br>4. I have an emotional connection to the virtual assistant.<br>5. Interacting with my virtual assistant, I feel that the virtual assistant, and form an emotional bond. |
| Reliance (Hampton, 2005) | 1. I agree with what the virtual assistant suggests to me.<br>2. I am confident that the virtual assistant is competent at making suggestions.<br>3. I prefer to make decisions without using the virtual assistant's suggestions.(-)<br>4. I am reliant on virtual assistants' suggestions when I am forming a decision.<br>5. I am dependent on the virtual assistant's suggestions. |