What affects the usage of artificial conversational agents? An agent personality and love theory perspective

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ABSTRACT

Artificial-intelligence (AI) powered conversational (CAI) agents have been growing in popularity. Like human personality, CAI agent personality can also impact the relationship users develop with them. In this work we adopt a multi-methodological systematic approach for generating CAI agent personality descriptors. 235 unique descriptors are obtained grouped into 8 personality dimensions. Having generated the personality framework, we propose a research model based on Stimulus Organism Response framework and Sternberg's Triangular Theory of Love for explaining how these personality traits lead to formation of love with these agents affecting their usage scenario. Results indicate that all the three components of love (passion, intimacy, and commitment) have significant effects on the usage scenario. However, depending upon the agent personality the nature of relationships varies. Cognitive personality results in fatuous love, affective personality results in consummate love, and social personality results in friendly relationship. A conceptual difference is observed between brand love, and the "love for AI." The results of this research will not only help the HCI designers to create suitable machine personality for various AI-based agents, but it will also provide an unconventional approach towards examining adoption of emerging AI-based technologies by exploring the love aspect between man and machines.

1. Introduction

It is a bright sunny Monday morning. "*Good morning – time to wake up baby, I am sure you had a good sleep*"- says Siri to Alex. Alex wakes up and gets ready for work. While having breakfast he converses with Siri. Siri tells him the news highlights, his daily horoscope, and plays his favorite morning music for 5 min. She even reminds him of his appointments and his best friend Bixby's birthday. "*Thank you, what would I do without you, love you !!*" thinks Alex. Siri is neither Alex's secretary nor mother; in fact, she is not even a human. She is an artificial intelligence (AI) powered conversational (CAI) agent. This scenario raises a lot of questions. How humane CAIs are? Do they have personalities like humans? Do humans develop feelings of love for CAI's? How does this feeling of love affect their usage?

As illustrated above, AI-based technology is different from conventional technology due to the presence of humanization and emotional intelligence. Existing research has shown that for CAI agents, humans often develop feelings and relationships due to their conversational nature (Choi & Drumwright, 2021; Tenhundfeld, Barr, O'Hear, & Weger, 2021). Likewise, the mood and emotions expressed by CAI's in terms of their voice responses to the users has shown to be affecting human decision and their usage (Mendes Ferreira, Correia, & Pereira, 2022; Moussawi, Koufaris, & Benbunan-Fich, 2022). This generic anthropomorphic nature of CAI's has been discussed by current research as to how humans personify these agents that leads to such a bond which is a lesser-known aspect. Therefore, from a Human Computer Interaction (HCI) perspective one fundamental issue is how to develop a CAI personality model. Most of the research in this aspect has used current human personality models like Big Five Model (FFM), Stereotype Content Model (SCM), or Meyers-Briggs Type Indicator (MBTI) for describing CAI agent's personality (Aylett, Vinciarelli, & Wester, 2020; Lopatovska, 2020). The problem is that the current frameworks might

not capture some typical machine aspects of these agents, for e.g., artificiality. Therefore, from a HCI perspective it becomes crucial to generate relevant CAI agent personality traits, keeping in mind its potential in shaping the overall user experience.

Once the CAI personality traits are identified, it is important to explore how these traits may explain the human-to-machine (H2M) bonds. Deeper bonds are indicative of greater passion, intimacy, and commitment with these agents that may further translate towards a greater usage intention. Some theories in Information Systems (IS) research like Sternberg's Triangular Theory (STT) have often been used for explaining interpersonal bonds (Sternberg, 1986). Current research has shown that favorable personality generates intimacy and passion towards an object, which is reflected by strong emotions and passionate feelings (Zhou, Mark, Li, & Yang, 2019). It becomes evident that the love-triad of passion, intimacy and commitment makes the conversational AI scenario anthropomorphic. However, it is not clear how love can form between the users and CAI agents.

From the above discussion, the current research gaps are evident. First, there is a lack of systematic approach towards developing a CAI personality model. Second, the very few works that have tried to develop a CAI personality model (Aylett et al., 2020; Lopatovska, 2020; Lopatovska et al., 2021; Poushneh, 2021) are heavily based on human personality models like FFM, SCM and MBTI. Since, these models are based on human personality frameworks, it is unclear that how effective they will be in describing the personality of the CAI agents. For e.g., the CAI agents are non-humane, and human personality models cannot capture such artificialness of these agents. Third, although personality manifestations can have its own set of benefits in the context of human interaction and adoption of these systems, yet majority of the current adoption studies related to CAI agents have taken the conventional approach of user acceptance by investigating factors such as usefulness, ease of use, enjoyment, social influence or playfulness (Dogra & Kaushal, 2021; Ling, Tussyadiah, Tuomi, Stienmetz, & Ioannou, 2021; McLean & Osei-Frimpong, 2019; Pal, Babakerkhell, & Zhang, 2021). In fact, IS researchers have repeatedly called for investigating the adoption scenario of various AI applications from new theoretical perspectives (Hermann, 2022; Schuetz & Venkatesh, 2020). In this regard, although a few studies have considered relevant factors like anthropomorphism, intelligence, and human-likeliness (Guha et al., 2022; Mishra, Shukla, & Sharma, 2021; Moussawi, Koufaris, & Benbunan-Fich, 2021; Munnukka, Talvitie-Lamberg, & Maity, 2022), yet not only the personality aspect of the CAI agents have been overlooked but how these personality traits affect the users' experiences by eliciting feelings of passion, intimacy and commitment is also an under-explored area. These research gaps have provided the motivation for the current work with a dual-purpose objective in mind. Our first objective is to develop a comprehensive model for depicting the CAI personality traits in a systematic manner. The second objective is to use these personality traits to explore the adoption (continuous usage) aspect of the CAI agents. Drawing on the research objectives we propose the following research questions:

RQ1. How to generate a personality model dedicated for the CAI agents that extends the concepts from human personality framework like FFM?

RQ2. How does the CAI agent personality result in the formation of human-to-machine relationship that affects the actual usage?

To answer RQ1 we have adopted a multi-method strategy by using a combination of an initial online survey that generated 79 unique personality descriptors, a lab-based experiment that generated 55 unique personality descriptors and augmented these with 100 personality traits from FFM (Goldberg, 1990), 42 personality traits from brand personality framework (Aaker, 1997), and 38 traits from website personality framework (Chen & Rodgers, 2006). After final refinement, the master pool contained 235 unique personality descriptors of the CAI agents. After carrying out an Exploratory Factor Analysis (EFA) on this master

pool we identified 8 CAI personality dimensions: *intelligent, sincere, sociable, reachable, creative, joyful, offensive,* and *artificial.* These dimensions neither correspond to the human personality framework like FFM (in terms of content or in number), nor they match with the brand or website personality frameworks. Fig. 1 shows the overall procedure for generating the CAI personality. To answer RQ2 we use the identified personality dimensions to explore how such agent personalities can lead to a loving man-machine relationship by applying a combination of two theoretical models: the Stimulus Organism Response (S–O-R) framework (Mehrabian & Russell, 1974), and Sternberg's Triangular Theory (STT) of love (Sternberg, 1986). Drawing on the S–O-R framework we hypothesize that the user experiences with the CAI agent's personality act as a stimulus (*Stimuli*), leading to the development of a consummate loving relationship between users and CAI agents (*Organism*), which in turn promotes the usage of these agents (*Response*). The core aspect of how the loving man-machine relationship is formed is conceptualized using the STT theory and taking into consideration the consummate aspect of love that involves all the three components of love: passion, intimacy, and commitment.

This work makes several contributions to the HCI and IS research communities. Our main contribution for HCI researchers is the master pool of 235 personality descriptors that we have grouped into 8 dimensions. A careful observation of these dimensions show that they do not match exactly with the FFM, since our personality descriptors also include traits that are not associated with the human personality frameworks. This provides evidence that people perceive the CAI agents to be different from the humans (Zhou et al., 2019), due to which the human personality framework like FFM is not directly applicable for the CAI agents. Our proposed personality model should serve as the reference point for future researchers for further validation and extension of the CAI agent personality traits. Likewise, our main contribution for IS researchers is to understand the usage and adoption of the CAI agents from the perspective of love. IS researchers have repeatedly called for investigating the adoption scenario of various AI applications from new theoretical perspectives (Hermann, 2022; Schuetz & Venkatesh, 2020). This work directly responds to such calls, wherein instead of using traditional factors like ease of use, usefulness, trust, or privacy aspects, we demonstrate that humans can develop a loving relationship with CAI agents that promotes their usage. To the best of our knowledge this work is among one of the first ones to use the concept of "consummate love" from STT theory and extend all the three aspects of passion, intimacy, and commitment that promotes the usage of the CAI agents. In doing so this work significantly contributes to the research on love by validating the representativeness of STT theory that is applicable for inter-personal relationships and extending it to human-machine relationships. Additionally, from a theoretical view-point we combined the S–O-R framework with STT theory-a unique mix that allows us to explain how CAI agent personality shapes love towards these devices. We hope that the results of this research will help the HCI, IS, and AI researchers to have a fresh perspective towards the adoption aspects of anthropomorphic systems.

2. Background and related work

2.1. Agent personality in HCI

Like human-to-human communication wherein people assign personalities to their counterpart, unconsciously people tend to imitate this behavior while communicating with machines too by assigning them personality. Current research shows that humans tend to make personification inferences for CAI agents (Cafaro, Vilhjálmsson, & Bickmore, 2016; Isbister & Nass, 2000). To make the personification aspect even stronger researchers have tried using different gesture generation mechanisms paired with verbal communications, which show the importance of giving a unique personality to conversational agents (Ishii, Katayama, Higashinaka, & Tomita, 2018; Wolfert, Robinson, &
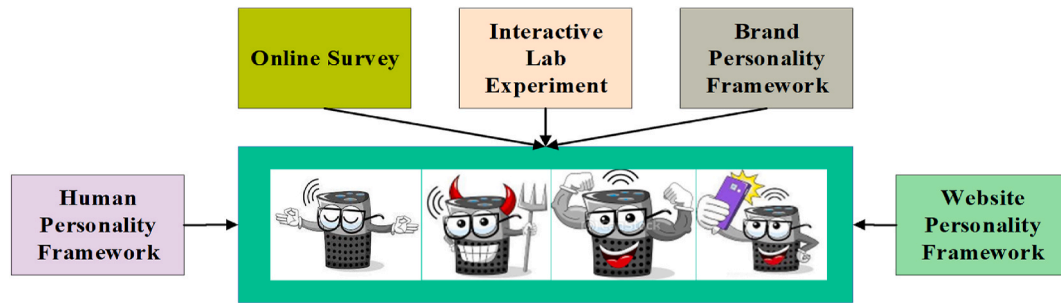
Fig. 1. Generating the CAI personality.

Belpaeme, 2022). The commercial CAI agents that are currently available in the market like *Siri, Alexa, Bixby* or *Google Assistant* are used for a variety of purpose ranging from home automation (Pal, Arpnikanondt, Funilkul, & Razzaque, 2021; Pal, Zhang, & Siyal, 2021), seeking information (Choi & Drumwright, 2021), to even in automotive user interfaces (Choi & Drumwright, 2021). Likewise, CAI agents have been built with specific purposes in mind, for e.g., giving health advice to users (Easton et al., 2019), companionship to the elderly (da Paixao Pinto, dos Santos Franca, de Sa Sousa, Vivacqua, & Garcia, 2021), or even providing educational services to students (Winkler, Hobert, Salovaara, Söllner, & Leimeister, 2020). Based on the usage context, it is expected that the CAI agents will show different personalities. For e.g., a CAI agent meant for handling customer calls in an organization may be designed to be reliable, informative, and trustworthy; while that in an automobile could be designed to be helpful, co-operative and funny (J. Kim, Merrill, & Collins, 2021; Tenhundfeld, Barr, O'Hear, & Weger, 2022). Greater personification has been linked with greater attachment and more sociable interactions with the agents that helps in developing a strong H2M bond. Therefore, it becomes clear that there are advantages of generating CAI agent personality.

The problem with current agent personality models is that they are heavily influenced from human personality frameworks. For e.g., Eysenck's Three Factor Model has been used for generating behavioral personality cues (McRorie et al., 2012). Other works have used the Big Five Model focusing on the extraversion personality trait (Cafaro et al., 2016; Isbister & Nass, 2000; Sonlu, Güdükbay, & Durupinar, 2021), or even the neuroticism aspect (Neff, Toothman, Bowmani, Fox Tree, & Walker, 2011). These works show that agent personality can be deliberately shaped, yet it is unclear whether taking cues from human personality dimensions alone will be sufficient and comprehensive for describing CAI agent personality.

Prior studies on H2M interactions suggest that humans perceive these agents to be somewhere between humans and artificial robots (Albarrán Lozano, Molina, & Gijón, 2021; Yang, Zhu, & Chen, 2022). Likewise, in another exploratory study users used the term "*robotic*" for describing a chatbot personality (Zhou et al., 2019). Since personality is supposed to reflect the distinctive traits of a CAI agent, there is a need to look beyond the existing human frameworks to sufficiently capture the present scenario. The commercial companies like Amazon or Apple share little about their process of designing machine personality. For e. g., Amazon describes Alexa as "*approachable, efficient, natural,* and *trustworthy.*" Therefore, neither much is known about the intended design of these commercial agents' personality, nor how humans perceive them.

To reduce the reliance on human personality frameworks, we integrated related concepts from brand personality and website personality frameworks. Brand personality consists of five dimensions: sincerity, excitement, competence, sophistication, and ruggedness (Aaker, 1997). Website personality is also composed of five dimensions: intelligent, fun, organized, candid, and sincere (Chen & Rodgers, 2006). Prior research has shown that brand personality affects various adoption factors like loyalty (Palomba, 2022), attachment (Donvito et al., 2020), and usage

intention (Toldos-Romero & Orozco-Gómez, 2015). Likewise, websites that are warm and competent are perceived to be friendlier and trusted more by the users (Johnson, Bauer, & Singh, 2020). Thus, both the brand and website personality frameworks can capture different dimensions when compared with the human-centric frameworks like FFM or MBTI. However, these frameworks are incapable to model interactive technologies like voice that are unique in terms of their style of conversation, speech rate, pitch, or even mannerisms during speaking (Seaborn, Miyake, Pennefather, & Otake-Matsuura, 2022). To fill up this void that has not been addressed by the current personality frameworks, we conducted an online survey and laboratory experiment for generating the relevant personality traits for the CAI agents, over and above the existing ones. This is illustrated in detail in the methodology section (Section 3).

2.2. Stimulus-organism-response (S–O-R) framework

The S–O-R framework, which was first proposed by (Mehrabian & Russell, 1974) is used as the core theoretical basis in this work. According to this framework there are certain external (environmental) entities that trigger the cognitive and affective state of an individual, which in turn results in some form of behavioral response. As evident there are three key elements: stimulus (the influence that arouses an individual), organism (the cognitive and affective state of the individuals resulting from the arousal), and response (outcome in the form of individuals acceptance or rejection behavior).

Since the current study is based on H2M interactions, the CAI agent personality that is developed provides the stimuli. This is a reasonable assumption since previous research has shown that personality of the AI agent affects users' emotions, perceptions, and judgement with preferences for agents that are warm, supportive or extraverted (Cafaro et al., 2016; Isbister & Nass, 2000; Sonlu et al., 2021). Since the organism element reflects the users cognitive and affective state of mind, we refer to this as the love formation between the user and CAI agent. Specifically, we use the concept of consummate love as introduced in (Sternberg, 1986) by integrating the three aspects of passion, intimacy, and commitment. Therefore, this organism aspect is treated in depth under the theoretical lens of STT theory. Finally, to measure response, the user's attitude towards continuing using the CAI agents is considered.

2.3. The concept of love

Literatures related to love in the context of information technology or AI-based systems is scarce. The concept of love was first described by Sternberg in his STT theory (Sternberg, 1986), and mainly used for describing relationships in various interpersonal contexts. Love is composed of three components: passion, intimacy, and commitment. Depending upon which of the three components are present, love can be of eight distinct types. When none of the components are present it is called "no love," and likewise when all the components are present it is called "consummate/ideal love." We illustrate this concept in Fig. 2.

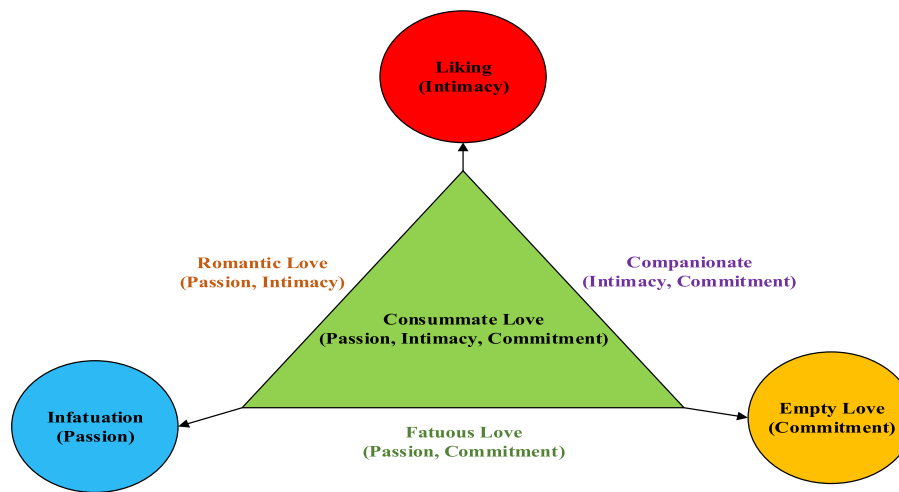Apart from interpersonal scenarios the love theory has been used for

Fig. 2. The concept of love (Sternberg, 1986).

defining brand love, wherein consumers can form emotional attachment and loyalty towards specific brands. Current research has shown that brand love can influence consumer loyalty, purchase behavior, and word of mouth (Albert, Merunka, & Valette-Florence, 2009; Schmid & Huber, 2019). Moreover, this feeling of love has a lifecycle and develops over a period of time (Schmid & Huber, 2019). With reference to IT products in particular, current research has used factors like attachment (Seymour & Van Kleek, 2021), commitment (Li, Browne, & Chau, 2006), passion (Carroll & Ahuvia, 2006), and liking (Langner, Schmidt, & Fischer, 2015) for explaining how consumers develop relationship with these products. Therefore, it becomes evident that although the concept of love has been used in a brand context, or even in general IT products, its usage for explaining consumer relationships with smart-products is limited. In the following section, we highlight the research gaps and consequently how this work positions itself.

2.4. The research gaps and our novelty

From the current literatures the existing research gaps are evident. In terms of HCI, although the importance of developing CAI agent personality is known, however, the current works are heavily based on human personality frameworks. One argument in favor of this is because CAI agents are anthropomorphic, they will better reflect human-to-human communication scenarios, and hence the reliance on human personality frameworks. However, we believe that although this can be a good starting point, but the scope of CAI agent personality is far wider that must include machine aspects too like machine voice, artificiality, machine mannerism, and other factors. Moreover, in several instances lack of any visual interface means that these agents depend only on their voice as the communication modality, which results in weak anthropomorphism (Moussawi et al., 2022; Pal, Roy, Arpnikanondt, & Thapliyal, 2022). Therefore, it becomes even more important to use multiple concepts for evaluating the personality of these CAI agents.

From an IS perspective researchers have repeatedly called for coming up with newer ways for explaining adoption of innovative AI-based technologies like CAI agents (Hermann, 2022; Schuetz & Venkatesh, 2020). In this respect, how CAI agent personality leads to love formation that in turn affects the system usage is a lesser-known aspect. Current literatures on love theory have focused on brands in general, and they have largely ignored how consumer's develop love for a technology. Moreover, CAI agents are representative of smart technology that is based on AI that makes them intelligent, humane, and personalized, and it is expected that humans will develop more intimate and passionate feelings for them. Current IS research that explains such relationships and feelings are too simplistic in the sense that they explore single

factors like passion, liking, loyalty or commitment towards these agents, which do not converge well with the conceptualization of love. Consequently, in this work we consider all the three aspects of love (passion, intimacy, commitment). Moreover, the interplay between agent personality, love, and system usage is an under-explored area that we try to explain by combing S–O–R framework and STT theory.

Based on the above discussion this work provides the following contributions and novelties:

➤ Our first novelty lies in the systematic manner by which we develop the personality model of the CAI agents and try to remove the dependence from human personality frameworks so that the proposed model can capture the uniqueness of these AI-based agents.
➤ We use a comprehensive approach by combining existing personality traits from multiple models like FFM, brand and website personality frameworks, and capturing new traits by conducting online surveys and lab-based experiments.
➤ For examining the adoption aspect of the CAI agents, we follow an unconventional approach by combining S–O–R framework with STT theory with the core objective to examine how the identified personality traits can result in the formation of a "consummate loving" relationship between humans and these AI agents.
➤ By adhering to a socio-psychological approach of love formation between humans and the CAI agents we try to break the current research jinx that heavily emphasizes on the technical capabilities of these agents. Moreover, the scope and validity of STT theory is also enhanced from its traditional human-human relationships to human-machine relationships that may serve as a starting point towards a new way of examining adoption of AI-based smart technologies.

3. Methodology - phase 1: developing the CAI agent personality

All the experiments conducted in this study have been reviewed and approved by the first author's university's Institutional Review Board (IRB), and informed consent has been obtained. For developing the CAI agent personality, first we created a master item pool, followed by an Exploratory Factor Analysis (EFA) for identifying the different personality dimensions. As we mentioned previously also, one of our objectives is to reduce the reliance of the CAI agent personality traits from the human personality frameworks. Consequently, while developing this master pool not only we included existing human traits from personality frameworks like FFM, but we also included traits from brand and website personality frameworks. Additionally, to make our approach systematic and comprehensive we took inspiration from the Test Construction Theory (Tellegen & Waller, 2008) that encourages to use a

multi-dimensional approach while developing personality models. Using a multi-dimensional approach is important and justified in this context because one of the key challenges of this process is to identify and select the best possible set of personality descriptors (Tellegen & Waller, 2008) that will adequately represent the personality of the CAI agents. Therefore, we have decided to collect the personality traits by conducting additional online survey and a lab-based experiment. The online survey provides with a subjective and intuitive approach, which is time and resource efficient. However, being subjective it is open to individual biases, which can be minimized to a certain extent by including people who have considerable experience. On the other hand, the lab-based experiment provides with an analytical/empirical approach that has the advantages of being objective, and structured. Since, these two approaches are different, and our objective is to collect unique personality traits for the CAI agents, the online survey and lab-based interaction experiments were carried out independently in a mutually exclusive manner. After creating the initial master pool, we conducted the EFA for identifying the different dimensions. The overall steps for creating the agent personality are presented below:

(i) An online survey is conducted involving 122 participants (subjective and intuitive approach).
(ii) A lab experiment involving 37 participants and 3 CAI agents (*Siri*, *Alexa*, and *Google Home* – empirical approach).
(iii) Combining all the personality descriptors from FFM model, brand personality, and website personality frameworks to those obtained in the above steps for creating the master pool.
(iv) An online survey involving 673 participants conducted for the purpose of EFA.

While identifying the personality descriptors in each step, we stressed on the unique personality adjectives that we could collect and did not focus on the frequency of occurrence of the descriptors. This is done because our objective was to identify the different personality descriptors, which is more exploratory in nature and conceptually aligned to our research objective, rather than to focus only on those personality traits that occur more frequently.

3.1. Online survey (step 1)

In this initial step we recruited participants from university mailing lists from two universities, one each in India and Thailand. With respect to the research design, we have focused on three main aspects. First, all the participants taking part in this online survey needed to have previous experience of using any type of CAI agent (Google Assistant, Siri, Alexa, Microsoft Cortana, Bixby, or others) as a part of their daily life. This was done by first asking a screening question at the beginning of the survey "*Do you use a CAI agent as a part of your daily life?*" Any participant giving a negative response was eliminated from the remaining survey. Second, the participants were asked to describe the personality of the CAI agent that they were using with three representative adjectives by asking them the following open-ended question "*How would you describe the personality of your CAI agent (please try to describe using a single-word adjective)?*" Third, the participants needed to provide some demographic information.

A total of (N = 122) useable responses were obtained. 68% of the respondents were male, 71% of them were studying some undergraduate course having a mean age of 22.4 years. Most of the participants had usage experience with Alexa (54%), followed by Google Home (35.24%) and Siri (10.66%). During the data analysis, each of the personality descriptors were checked, and the presence of any noun was replaced by its corresponding adjective. For e.g., we replaced *trust* with *trustful*, *fun* with *funny*, and likewise. Additionally, if there were multiple words, then we replaced those by a single word, e.g., *sometimes irritating* was replaced with *irritating*. Finally, irrelevant responses that were not related to CAI agent personality were removed, e.g., *my privacy concerns*

are high, or *I find it useful*. After removing the duplicates, we obtained 79 unique personality descriptors. The top 10 descriptors in terms of their occurrence frequency are presented in Table 1. As evident from Table 1 the set of adjectives obtained in this step have some traits that are not related to human personality frameworks, e.g., *unhuman*, or *robotic*.

3.2. Lab-based experiment (step 2)

We conducted a lab-based experiment so that the participants could interact directly with the CAI agents for simulating a real-life usage scenario. We felt that it is important to understand how users feel after using the CAI agents and how they describe their personality to be. We designed a within-group type of study where three commercial agents (*Siri*, *Alexa,* and *Google Home*) were used by each participant. A similar script was prepared across all the 3 CAI agents (apart from their respective wake-up words) that contained 10 common questions asked to these agents, like "*How is the weather like?*", or "*Please tell me joke*", among others. The presentation order of the CAI agents together with the tasks were counterbalanced to reduce the learning effects. Before starting the experiment, the participants were asked to describe the personality of some person close to them to make them aware of the personality concept. After interacting with each of the CAI agents they were asked to describe their personality. The objective here was not to compare the personality types of the different agents, but to generate as many different personality types as possible. The interviews were recorded and transcribed later for the purpose of data analysis. At the end, the participants had to fill up a short questionnaire for demographic data.

37 participants took part in the experiment (46% male and 54% female with a mean age of 27.3 years). The participants were recruited based on personal contact of the authors and references (combination of convenience and snowball sampling). Majority of them had previous experience (94%) with any one of the CAI agents, and 65% of them used the agent(s) more than 2 times per week. Gift vouchers of Amazon or Lazada were given to all the participants as a token of appreciation. The transcribed data was analyzed jointly by two authors, and wherever possible any negative items were converted to their respective one-word adjectives, e.g., *not cool* was replaced by *uncool*. 92 personality traits were obtained in this experimental stage of which 55 were unique and not found from the previously conducted online survey. Table 1 presents the top 10 descriptors in terms of their occurrence frequency. Only 3 personality descriptors (*friendly*, *funny*, and *honest*) are common among the top 10 for the two different methodologies.

3.3. Creating the master pool (step 3)

In the third step we took all the personality traits from human personality framework – FFM (100 traits) (Goldberg, 1990), brand personality framework (42 traits) (Aaker, 1997), and website personality framework (38 traits) (Chen & Rodgers, 2006), and merged it with the personality descriptors obtained in the above two steps. The initial master pool contained a total of 314 personality descriptors (79 traits

Table 1
Top 10 personality descriptors from online survey and lab-based experiment.

Online Survey	Frequency	Experiment	Frequency
Friendly	42%	Informative	55%
Funny	33%	Friendly	48%
Irritating	19%	Decent	27%
Unhuman	12%	Funny	20%
Robotic	11%	Competent	16%
Honest	11%	Warm	12%
Abusive	11%	Understanding	11%
Gifted	10%	Humorous	10%
Efficient	10%	Honest	10%
Fair	10%	Jolly	9%

from step 1, 55 traits from step 2, 100 traits from FFM, 42 traits from brand personality framework, and 38 traits from website personality framework). This initial master pool was refined in several rounds. For the refinement purpose we created a strict exclusion criterion. First, ambiguous words like *cool, yoyo,* and *spicy* were removed. Second, we removed all those descriptors that were related to the outward appearance/cosmetic beauty and aesthetics of the CAI agents, rather than their personality, e.g., *pretty, beautiful, bulky, small,* and *colorful.* Third, we removed those descriptors that typically represented gender bias or were offensive sounding, for e.g., *feminine, agender, sexy,* and *hot.* Fourth, if lexical opposites were present, for e.g., *honest,* and *dishonest,* we decided to keep only the positive word, and removed the negative word, since negations can easily be misunderstood. 58 entries were eliminated, leaving with 256 personality descriptors. Finally, on this set of 256 descriptors we checked for the presence of any synonyms in the item pool. This was done in two ways. First, a native English language specialist was hired who went through this full list and removed the presence of any synonyms. Second, the first and third authors scraped through the online dictionary Merriam-Webster (https://www.merriam-webster.com/) as it contains all the possible interpretations of a word, together with its synonyms & antonyms. For every synonym, only those definitions were selected that are relevant to the personality context. For e.g., in case of the personality descriptor *synthetic,* we considered the synonyms for the definition "*produced by machines rather than natural processes*" and ignored "*being such in appearance only and made with or manufactured from usually cheaper materials,*" because the later one is irrelevant for the present context. Following this procedure, a further 21 descriptors were removed, the final master set having 235 unique personality descriptors.

3.4. Online survey for EFA (step 4)

For carrying out the EFA, an online survey was conducted through the professional SurveyMonkey platform. This platform was chosen as it allowed us to reach out to a diverse and large sample conveniently. Informed consent was obtained from all the participants. Before beginning the survey, we collected the usage experience of each of the participants together with what CAI agent(s) they were using. If they were using multiple CAI agents, the participants were asked to rate the personality traits only for that agent which was used most frequently. Those not having any prior usage experience were filtered out from the survey. We did not focus on any specific CAI agent since the objective was to develop a general personality model for all these agents. The 235 personality descriptors were presented in a random order to which the participants had to agree or disagree based on a 4-point Likert scale, ranging from "*strongly disagree*", "*disagree*", "*agree*" to "*strongly agree*". The 4-point scale was chosen to avoid the "*neutral*" category and make the participants mark one of the available options.

732 respondents replied, out of which 59 responses were unusable due to missing or incomplete data, thereby giving an effective sample size of 673. 54.68% of the participants were male with a mean age of 34.1 years. More than 60% of the participants had used a CAI agent between 6 months and 1 year.

The EFA was carried out in SPSS for determining the factor structure of all the 235 personality descriptors. Before conducting the EFA we carried out a check on data normality. All the values were within the acceptable range of ±2 and ± 3. Moreover, the Kolmogorov-Smirnov statistic was found to be significant, indicating that data was normally distributed. We also carried out a two-point check to ensure that the collected data was suitable for doing an EFA. First, we conducted a reliability analysis of all the 235 personality descriptors in terms of the Cronbach's Alpha (α) values (should be higher than 0.60), and also checked the corrected item-total correlation matrix (should be higher than 0.30). Following this procedure 9 traits were removed as they did not meet some of the conditions *(indifferent, jealous, biased, gloomy, aggressive, cluttered, clumsy, forceful,* and *reckless).* Second, the Kaiser-

Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of Sphericity were conducted to further assess the suitability of the data for factor analysis. We obtained a significant KMO value of 0.844 ($p < 0.001$), and the Bartlett's test of Sphericity was also significant ($p < 0.001$), indicating the suitability of factor analysis.

Next, for the EFA we conducted a Principal Component Analysis (PCA) with direct oblimin rotation since we expected many of our personality traits to be correlated. While doing the EFA, we suppressed small loadings that were less than 0.30. An 8-factor solution was obtained explaining 78.4% of the variance following the general guideline of retaining factors that have an eigen value of greater than 1. We crosschecked the eigenvalue technique by running a parallel analysis that is based on Monte Carlo simulation by creating a random dataset having same number of observations and variables as the original data. Both the eigenvalue and parallel analysis technique indicated an 8-factor solution. Fig. 3 presents the 8 personality dimensions of the CAI agents. Each dimension lists the top 10 personality traits.

3.5. Result – phase 1: the CAI agent personality framework

As evident from Fig. 3 intelligent, sincere, sociable, reachable, creative, joyful, offensive, and artificial are the different personality dimensions. We have presented the implications of these 8 dimensions in Table 2 and tried to establish what to expect (and not to expect) from the CAI agents having a specific personality type.

The "*intelligent*" personality dimension refers to the efficiency, competency, reliability, and effectiveness of the CAI agents when performing tasks. A CAI agent scoring high on this dimension means that they are smart, informative, have rational reasoning capability, and able to learn continuously from newly acquired information from user. This is partially equivalent to the competence dimension of the brand personality framework.

The "*sincere*" dimension reflects how much honest, down-to-earth, loyal, and understanding the CAI agents are. It is a very important trait that can lead to trust formation between man and machines. This dimension is also reported in brand personality framework.

The "*sociable*" dimension reflects the extent to which the CAI agents are available for the users and willing to assist them in completing their tasks. This dimension refers to positive traits like kind, friendly, willing, and likeable, thereby portraying the social aspect of the CAI agents. This personality trait has not been reported in brand or website personality frameworks, however, is similar to the agreeableness trait of the FFM model.

The "*reachable*" dimension refers to the easy availability, welcoming nature, and courteousness of the CAI agents. It includes positive traits like easy-going, approachable, calm, and agreeable. High availability, agreeing to the user's needs and providing with smooth services are the hallmarks of this dimension. This personality dimension has not been reported in any of the previous human, brand, or website personality frameworks.

The "*creative*" dimension portrays how thoughtful, innovative, and trendy the CAI agents are when they respond back to the user's requests. Being creative means that the CAI agents will be able to strike interesting and thoughtful conversations with the users leading to less of boredom. This dimension is similar to the excitement category of brand personality framework.

The "*creative*" dimension portrays how thoughtful, innovative, and trendy the CAI agents are when they respond back to the user's requests. Being creative means that the CAI agents will be able to strike interesting and thoughtful conversations with the users leading to less boredom. This dimension is similar to the excitement category of brand personality framework.

The "*joyful*" dimension captures the humorous and playful aspect of the CAI agents. This dimension includes positive traits like happy, charming, cheerful, warm, and jolly. This aspect therefore represents the hedonic aspect of the CAI agents. It is similar to the fun dimension of the
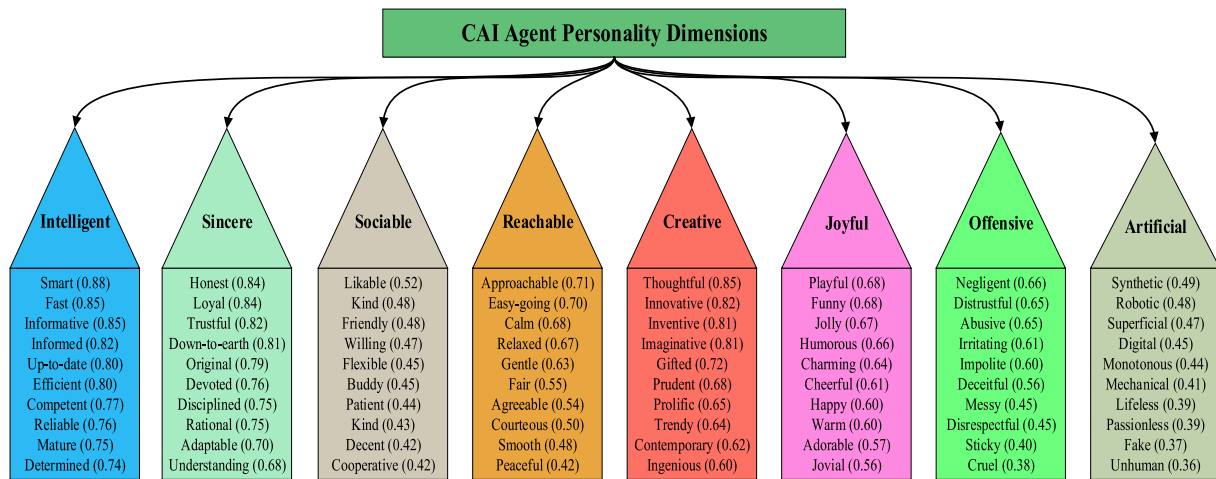
Fig. 3. Eight Personality Dimensions of CAI Agents Identified through Exploratory Factor Analysis (number in bracket represent the top 10 factor loadings).

Table 2
Implications of the 8 personality dimensions.

Dimension	Implication
Intelligent	Scoring high means that the agents are highly competent, matured, reliable, and efficient in providing up-to-date information. High score will mean good usability and UX. This dimension will frame the cognitive aspect of H2M communications.
Sincere	Scoring high means that the agents are trustworthy, honest, and disciplined that will help in establishing trust in them, and also create a loyal user base. Additionally, it will also help to improve the cognitive aspect of H2M communications.
Sociable	Scoring high means that the agents are friendly, and ready to co-operate with the users. This personality type will not only serve the users properly but are also kind enough either by giving detailed responses or being patient to serve more requests. This dimension will typically frame the social aspect of H2M communications.
Reachable	Scoring high means that the agents are available to serve the users always. Agents having this personality type are courteous by nature and give appropriate feedback even if user requests cannot be met. This dimension will frame the social aspect of H2M communications.
Creative	Scoring high means that the agents are thoughtful, imaginative, and trendy during their interaction with the users. They can surprise the users with their innovative answers that will lead to greater user engagement and satisfaction (affective aspect of H2M communications).
Joyful	Scoring high means that the agents can interact with the users in funny and humorous ways that can create joy by providing entertainment. These types of agents are jolly and jovial, making the users feel happy and joyful. It frames the affective aspect of H2M communications.
Offensive	Scoring high means that the agents respond to the users in an unfriendly, or abusive tone. Typically, agents having this personality type may refuse to serve users as per their wishes or may even provide with disrespectful answers. Such agents can cause user frustration.
Artificial	Scoring high means that the agents are not able to position themselves as human proxies and are perceived to be robotic. Such personality will give rise to "weak anthropomorphism" and illustrates the less humaneness of these agents.

website personality framework.

The "*offensive*" dimension contains negative personality traits that highlight the dark aspect of these CAI agents. It contains traits like abusive, impolite, disrespectful, negligent, and deceitful. These personality traits put the CAI agents in a negative state and indicates that sometimes they might not function as expected and behave in a crazy or stubborn manner. This dimension is not present in any of the human, brand, or website personality frameworks.

The final "*artificial*" dimension reflects the artificiality and robotic aspect of the CAI agents. Having negative personality traits like lifeless, unhuman, synthetic, and digital portrays the machineness aspect of these agents. This dimension is also not present in any of the current

human, brand, or website personality frameworks.

4. Phase 2: research model and hypothesis

After identifying the different personality traits of the CAI agents, next, we present our research model explaining the adoption and usage of these systems based on S–O-R framework (Mehrabian & Russell, 1974) and the theory of love (Sternberg, 1986). The S–O-R framework is chosen as it allows us to examine the consumer's experience as perceived from some external stimuli, which in turn generates reaction in the organism that finally results in different behavioral responses. The stimulus in the present case is provided by the personality of the CAI agents that we develop in the first stage. This stimulus creates feelings of love for the CAI agents (organism) that in-turn affects the usage scenario (response). The core part of our research model is the love aspect that is generated from passion, intimacy, and commitment.

Our results suggest that there are two types of CAI agent personality: positive and negative. In Fig. 4 we propose a taxonomy for the same. Since the objective of this work is to investigate the usage of CAI agents from the love perspective, we have decided to drop the negative personality dimensions such as *offensive*, and *artificial* from further model building process. It is natural to expect that these negative personality dimensions would not enhance the relationship of love. For e.g., current research has shown that smartphones speaking impolitely with the users are perceived to be less friendly than smartphones speaking in a polite manner (Carolus, Muench, Schmidt, & Schneider, 2019). Likewise, humans have an uncomfortable or eerie feeling towards synthetic voices (Ciechanowski, Przegalinska, Magnuski, & Gloor, 2019). Among the positive personality dimensions, we classified them into 3 groups: cognitive (*intelligent* and *sincere*), affective (*creative* and *joyful*), and social (*sociable* and *reachable*). Therefore, we consider three distinct stimuli that shapes the love perception between users and the CAI agents. Additionally, we consider the user's age, gender, and duration of using the CAI agents as control variables. Fig. 5 presents the research model.

4.1. Stimulus: CAI agent personality

CAI agents are at the forefront of AI technology. They are able to provide a level of personalization that has been unthinkable before because of their intelligence and ability to imitate human conversations. The close association between human personality and love for brands has been well-documented by current literatures. For e.g. (Singh, Bajpai, & Kulshreshtha, 2021), probed the impression of brand experience on brand love with customer's personality traits as moderators and found that customer-brand love may be positively/negatively affected by
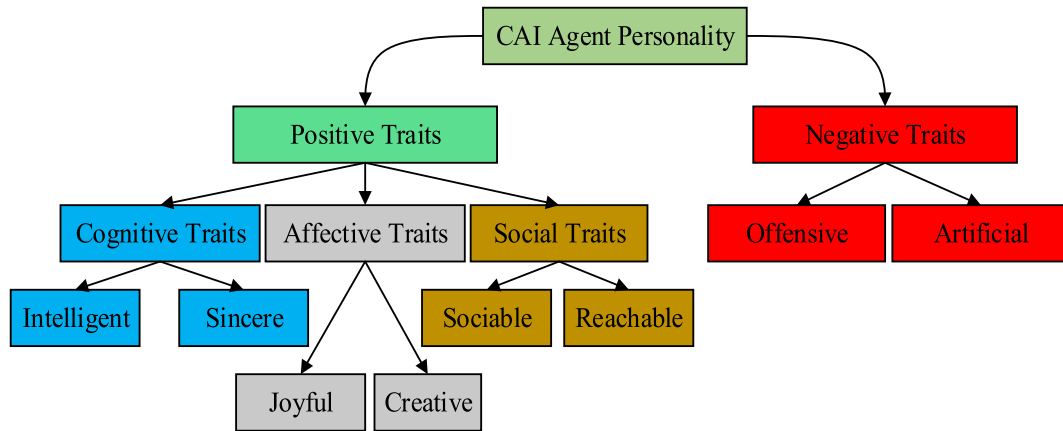
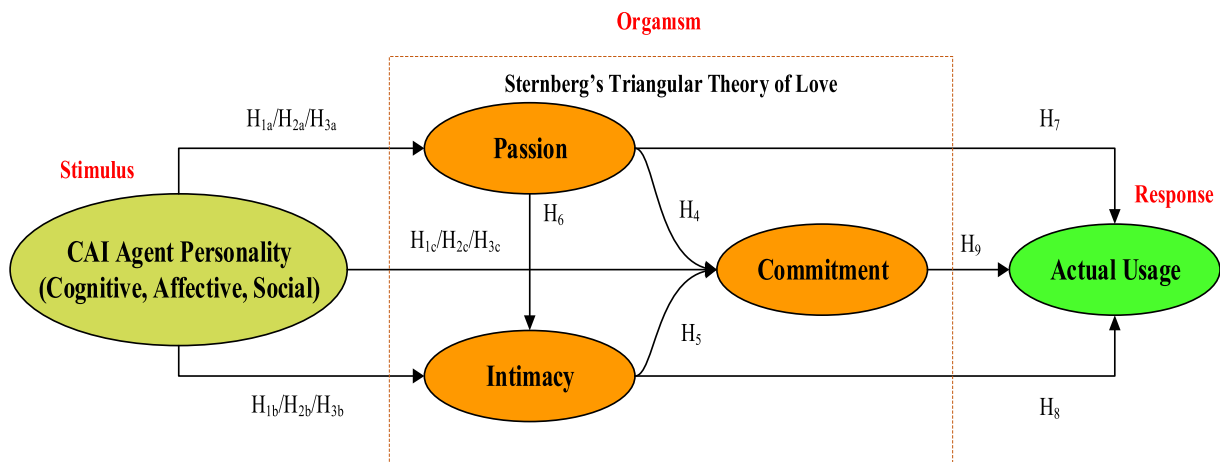**Fig. 4.** Taxonomy of CAI agent personality.

Fig. 5. Research Model showing CAI Agent Personality, Love, and Actual Usage.

personality. Likewise, user personality has also shown to affect the acceptance of various applications and services by fostering the love for brands (Anbumathi, Dorai, & Palaniappan, 2023; Ghorbani, Karampela, & Tonner, 2022). Therefore, although the effects of human personality traits on brand love are known, it is a lesser-known aspect as to whether machine personality too might determine the human-machine relationships.

The cognitive capabilities of the CAI agents have been found to be effective and proficient in various aspects of customer service (Pal, Arpnikanondt, et al., 2021; Yang et al., 2022; Zwakman, Pal, & Arpnikanondt, 2021). For a human being, cognitive trait is considered to be an important asset, and refers to skills such as performing tasks, synthesizing information or making predictions (Serneels, 2008). Similarly, for CAI agents too cognitive traits are important. Generally, these devices have certain advantages, e.g., they are free from human fatigue, make less errors, and can be relied upon (Huang & Rust, 2018; Pal, Arpnikanondt, Razzaque, & Funilkul, 2020). Current research has shown that when people adopt a new technology or product, they give importance to its functionality, and a good usability (Miguel Cruz et al., 2020; Zwakman et al., 2021). Competence is one key aspect in this context that refers to the agent's knowledge, intelligence, responsibility, and sensibleness (Moussawi et al., 2021). If the CAI agents are intelligent, they will be able to understand the user's requests properly, respond back without needing any user intervention, and continuously acquire latest information based on the user's behavior to update itself. Likewise, if the CAI agents are sincere, they will be disciplined, give honest answers, and provide reliable outputs within a reasonable timeframe. Clearly, if the

CAI agents possess these cognitive traits of intelligence and sincerity, the user's will gain much value from them, and their experience with these agents will be characterized by happiness and satisfaction (Hu, Lu, Pan, Gong, & Yang, 2021; Moussawi et al., 2021). Such positive experiences in turn will make the users assign high value to these agents, invoking feelings of love, i.e., passion, intimacy, and commitment. Therefore, we hypothesize:

H1a. The cognitive traits of a CAI agent positively influence users' passion for them.

H1b. The cognitive traits of a CAI agent positively influence users' intimacy with them.

H1c. The cognitive traits of a CAI agent positively influence users' commitment for them.

Another unique feature of any AI application, including CAI agents is their anthropomorphic nature. Researchers have been trying to incorporate emotions when designing the interactions of these devices with humans (Moridis & Economides, 2012). In this regard, the level of empathy and enjoyment that the CAI agents can provide is important, since both these factors are related to user's feelings and emotional state (Chin, Molefi, & Yi, 2020; Pal, Babakerkhell, & Zhang, 2021). Having a joyful personality will allow the CAI agents to interact with the users in funny and humorous ways that may help developing emotional bonds between the two. Such feelings of warmth will come from an individual's affective perception of the CAI agent's friendliness, kindness and joyful nature (Hu et al., 2021). In fact these AI based agents have been proved to be effective to serve as affective companions for elderly

people and reduce their loneliness (Jones et al., 2021). The thoughtful, imaginative, and emotional capability of the CAI agents to understand user's feelings and respond accordingly can surprise the users leading to greater user engagement and attachment. Such a warm perception may stimulate an individual's emotional commitment, passion, dedication, and intimacy with these agents, which helps to enhance the feeling of love. Therefore, the affective personality traits of joyful and creative are expected to result in enhanced feelings of love by developing a strong human-like relationship. Thus, we posit:

H2a. The affective traits of a CAI agent positively influence users' passion for them.

H2b. The affective traits of a CAI agent positively influence users' intimacy with them.

H2c. The affective traits of a CAI agent positively influence users' commitment for them.

Having a positive social personality trait by the CAI agents is also desirable as it reflects their social presence, i.e., the sense of feeling of being with others during a communication. This social aspect has been proven to be very important for AI-based artificial robots that provide service to the humans (Mou, Shi, Shen, & Xu, 2020). Designers of such artificial robots always give priority to make their personality friendly and reachable (Forgas-Coll, Huertas-Garcia, Andriella, & Alenyà, 2022; Mou et al., 2020). Such positive personality is preferred by the individuals and associates these AI agents with desirable social responses. Likewise, being sociable the CAI agents tend to be friendly and co-operative that increases their physical and psychological proximity with the users (Mishra et al., 2021). In fact, they have been used as social agents to foster social cohesion and group harmony among users (Lee, Lee, & Sheehan, 2020), and also provide companionship (S. Kim & Choudhury, 2021). Thus, it becomes evident that possessing social traits make the CAI agents more reachable and friendly that leads to better fulfillment of the social needs of the users. Such favorable experiences will result in increased perceptions of satisfaction, comfort, and love. Thus, we posit:

H3a. The social traits of a CAI agent positively influence users' passion for them.

H3b. The social traits of a CAI agent positively influence users' intimacy with them.

H3c. The social traits of a CAI agent positively influence users' commitment for them.

4.2. Organism: the feeling of love for CAI agents

Similar to interpersonal love, man can develop feelings of love for machines too that is characterized by the presence of passion, intimacy, and commitment (Palusuk, Koles, & Hasan, 2019). AI powered technologies like conversational agents have typical personalities as we found out in the previous section that make them more humane and anthropomorphic. Wang et al., concluded that out of the three components of love, passion is formed first followed by intimacy and commitment (Wang, Qu, & Yang, 2019). When users experience passion for a particular technology, they enter an elevated state of excitement (physiological and psychological) that results in an enhanced intimacy with technology. Therefore, passion brings the users closer towards technology, helps in building a strong attachment, and shapes the intimacy (Batra, Ahuvia, & Bagozzi, 2012; Dong et al., 2020). (Wang et al., 2019) also concluded that initially the users will feel passion that will later result in intimacy with the other party. Likewise, passion can also generate feelings of commitment. Although commitment is a very important aspect in the adoption of a product since it ensures continuous usage (Das, Agarwal, Malhotra, & Varshneya, 2019), however what drives commitment is not clear, and therefore a challenge. In case of brand love research shows that when an individual feels excited about a

brand, he/she wants to stay committed to the brand by repeating similar transactions and feels it is his/her moral obligation to continue support the brand (Das et al., 2019). Thus, the individual becomes passionate about the brand, and such a passion results in greater commitment. A user who is passionate about CAI agents will also exhibit greater intimacy with these, and become committed to them (Wang et al., 2019).

Intimacy is related to a stable feeling and represents perceptions of care, attachment, satisfaction, and trust. If there is intimacy it will encourage the users to be dependent on the CAI agents and enter into a long-term relationship. Committing to a long-term relationship will lead to the overcoming of any barriers, and make the users reduce their variety-seeking behavior and frequent need changes (Sarkar, Ponnam, & Murthy, 2012). Over a period of time the emotional closeness will promote love and make the individuals feel committed (Hatfield, Pillemer, O'Brien, & Le, 2008). Thus, feeling of intimacy that the users develop through their passion helps them remain committed to the CAI agents (Hatfield et al., 2008).

Commitment is the third aspect of love that is important, and it refers to the desire to maintain a valued relationship that is developed over a period of time (Sternberg, 1986). Commitment is derived from both passion and intimacy that creates an attitudinal perception of loyalty in the user's mind (Sarkar et al., 2012). Being committed helps to overcome several obstacles, e.g., remain committed to a particular brand, reduce customer churn, and create loyalty for a specific product. When there is commitment, there will be a sense of obligation that results in a long-term relationship. Based on this discussion we propose the following three hypotheses:

H4. Passion positively influences the user's commitment towards the CAI agents.

H5. Intimacy positively influences the user's commitment towards the CAI agents.

H6. Passion positively influences the user's intimacy with the CAI agents.

4.3. Response: actual usage of the CAI agents

Actual usage of the CAI agents that results from the loving relationship developed, which in turn is shaped by the CAI agent's personality is taken to be the final response variable in our model. It is evident from the previous discussion that CAI agents can invoke the perceptions of humanness and anthropomorphism that is supported by current research too (Seymour & Van Kleek, 2021). Although, there might be an argument regarding the degree of anthropomorphism that these agents can invoke (strong vs. weak) (Troshani, Rao Hill, Sherman, & Arthur, 2021), however that is not the scope of the present study, and we feel it is sufficient that these agents have the capability to establish relationship with users. The cognitive, affective, and social personality traits that these agents have, make them capable of providing information, answering questions, and giving various personalized services to the users. The users might in turn feel that they are being assisted and accompanied by another human, which would help in developing an intimate relationship with these devices over a period of time. Prior literatures also suggest that when users form an emotional bond with machines they develop a passion for it and becomes committed towards it's usage (Thomson, MacInnis, & Whan Park, 2005). When there is commitment there is a sense of obligation, which results in a long-term relationship and usage of these devices. Hence, we propose that all the three components of love can sustain the actual usage of the CAI agents.

H7. Passion positively influences the user's actual usage of the CAI agents.

H8. Intimacy positively influences the user's actual usage of the CAI agents.

H9. Commitment positively influences the user's actual usage of the

CAI agents.

4.4. Methodology – phase 2: sample and data collection

An online survey was conducted for collecting data and validating our conceptual model. All the survey participants were frequent internet users and had previous experience with at least one commercially available CAI agent. Screening questions were asked to ensure the above two conditions were met that guaranteed that the included sample belonged to the segment under study. After data cleansing a total of 482 useable responses were obtained. 60.37% of the participants were male having a mean age of 32.4 years. Majority of the participants used *Alexa* (40.46%), while *Bixby* was the least used one (4.77%). In terms of usage experience 62.45% of the participants had used a CAI agent for more than 6 months.

With regards to the measurement items a 7-point Likert scale was used, where 1 indicated complete disagreement, and 7 indicated complete agreement. For the CAI agent personality, we used our previous EFA results from stage 1 for assessing the cognitive (*intelligent* and *sincere*), affective (*creative* and *joyful*), and social (*sociable* and *reachable*) traits. For the sake of feasibility only the top 5 traits (in terms of EFA factor loadings) from each personality type were included, thereby each of the three categories having 10 traits each. The constructs of love theory (passion, intimacy, and commitment) were adapted from the original work by Sternberg in (Sternberg, 1986). Table 3 reports all the measurement items used.

Before proceeding with the data analysis, a Harman's single factor test was conducted to assess the Common Method Bias (CMB). Results indicated that all seven constructs had an eigen value of greater than 1, accounted for 81.3% of the total variance, and the maximum variance explained by a single construct was 28.7% (below the recommended level of 50%) (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Therefore, CMB is not an issue for the current study.

4.5. Result – phase 2: measurement model and confirmatory factor analysis

We chose the Partial Least Squares Structural Equation Modelling (PLS-SEM) approach because it is best suited for investigating relationships that are exploratory in nature, as in the present case. Moreover, it is fairly robust to data normality, and places minimal restrictions on sample size. We followed a two-stage approach by evaluating the measurement model first, followed by the structural model. The factor loadings from CFA are presented in Table 3. The evaluation of the measurement model was done by assessing the construct reliability, and two types of validity (convergent and discriminant). The construct reliability was assessed by evaluating two parameters: Cronbach's Alpha (α) values that indicate the internal consistency (should be greater than 0.70), and Composite Reliability – CR (should be greater than 0.70) (Bagozzi & Yi, 1988).

Table 4 presents the α and CR values for every construct. Next, the convergent validity was assessed by examining the factor loadings (Table 3), and the Average Variance Extracted (AVE) values (Table 4). All the factor loadings and AVE values were greater than the threshold of 0.70 and 0.50 respectively, indicating sufficient convergent validity (Bagozzi & Yi, 1988). For the discriminant validity to be satisfied the square-root of AVE for each of the constructs must exceed the correlation with all other constructs. Table 4 indicates that this condition is also met.

4.6. Result – phase 2: analysis of structural model (hypothesis testing)

In the second stage the structural model was evaluated for testing the hypotheses by following a bootstrap procedure. The PLS algorithm was run using 5000 bootstrapping samples. Table 5 presents the result of hypothesis testing. Our research model explains 76.2% of the variance in

Table 3

Measurement items & confirmatory factor analysis loadings.

Construct	Measurement Item	Factor Loading
Cognitive Personality Traits (CPT- Self developed)	My conversational agent is *smart*	0.91
	My conversational agent is *fast*	0.88
	My conversational agent is *informative*	0.87
	My conversational agent is *informed*	0.82
	My conversational agent is *up-to-date*	0.80
	My conversational agent is *honest*	0.88
	My conversational agent is *loyal*	0.87
	My conversational agent is *trustful*	0.83
	My conversational agent is *down-to-earth*	0.79
	My conversational agent is *original*	0.77
Affective Personality Traits (APT- Self developed)	My conversational agent is *thoughtful*	0.94
	My conversational agent is *innovative*	0.85
	My conversational agent is *inventive*	0.82
	My conversational agent is *imaginative*	0.80
	My conversational agent is *gifted*	0.78
	My conversational agent is *playful*	0.87
	My conversational agent is *funny*	0.82
	My conversational agent is *jolly*	0.80
	My conversational agent is *humorous*	0.79
	My conversational agent is *charming*	0.78
Social Personality Traits (SPT- Self developed)	My conversational agent is *likable*	0.88
	My conversational agent is *kind*	0.86
	My conversational agent is *friendly*	0.83
	My conversational agent is *willing*	0.81
	My conversational agent is *flexible*	0.80
	My conversational agent is *approachable*	0.84
	My conversational agent is *easy-going*	0.81
	My conversational agent is *calm*	0.78
	My conversational agent is *relaxed*	0.75
	My conversational agent is *gentle*	0.72
Passion (PAS- (Sternberg, 1986)	I am passionate about my conversational agent	0.92
	My conversational agent really fascinates me	0.90
	I adore my conversational agent	0.88
	I cannot imagine my life without my conversational agent	0.87
Intimacy (INT- (Sternberg, 1986)	Communication with my conversational agent is intimate	0.83
	I feel emotionally attached to my conversational agent	0.80
	I feel great happiness when I use my conversational agent	0.76
	I feel very close to my conversational agent most of the time	0.75
Commitment (CMT- (Sternberg, 1986)	I am committed to my relationship with my conversational agent	0.79
	I am extremely focused on my conversational agent	0.78
	I intend to maintain relationship with my conversational agent	0.77
	My conversational agent would be my first choice	0.75
	I am confident about the stability of my relationship with my conversational agent	0.74
Actual Usage (ACU- (Pal, Babakerkhell, & Zhang, 2021))	I will continue using my conversational agent in future	0.90
	I will use my conversational agent more in future	0.85
	I will consistently use my conversational agent as much as possible	0.80

actual usage, 64.4% of the variance in commitment, 52.8% of the variance in passion, and 50.6% of the variance in intimacy. Fig. 6 presents the structural model.

The effect of cognitive personality traits is found to be significant on passion ($\beta = 0.18$, $p < 0.05$), and commitment ($\beta = 0.22$, $p < 0.05$), thereby supporting hypotheses H_{1a} and H_{1c}, respectively. However, the
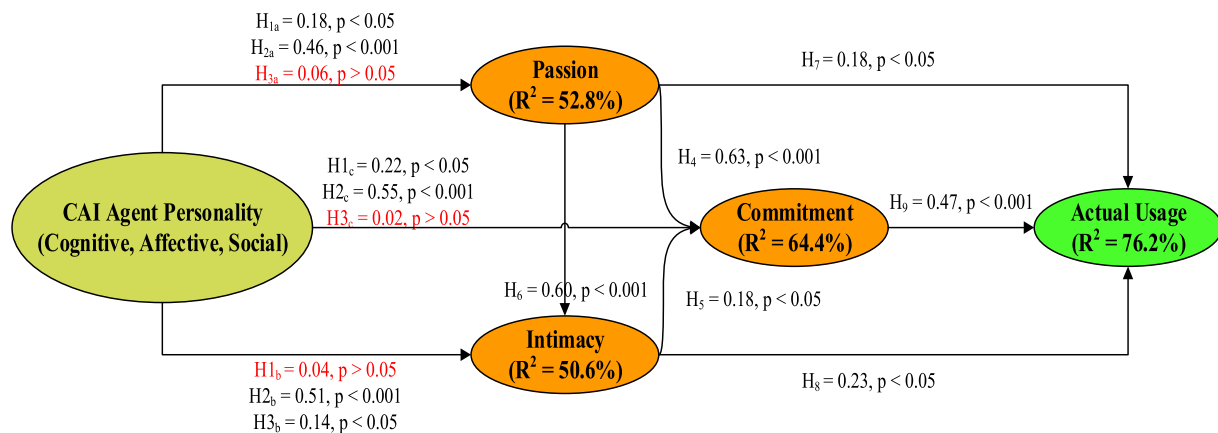
Table 4

Measurement Model reliability And Validity and Correlation Matrix.

Construct	α Value	CR	AVE	CPT	APT	SPT	PAS	INT	CMT	ACU
CPT	0.85	0.96	0.71	**0.84**						
APT	0.88	0.95	0.68	0.55	**0.82**					
SPT	0.91	0.95	0.65	0.52	0.46	**0.81**				
PAS	0.86	0.94	0.77	0.49	0.51	0.52	**0.88**			
INT	0.82	0.86	0.62	0.53	0.49	0.46	0.43	**0.79**		
CMT	0.79	0.88	0.59	0.45	0.45	0.44	0.40	0.56	**0.77**	
ACU	0.85	0.89	0.72	0.50	0.40	0.39	0.38	0.41	0.55	**0.85**

Note: The diagonal elements shown in bold represents the square root of AVE

Table 5

Results of hypothesis testing.

#	Relationship	T Value	P Value	Regression Weight (β Value)	Status
H_{1a}	Cognitive Personality Trait - > Passion	9.42	< 0.05	0.18	Supported
H_{1b}	Cognitive Personality Trait - > Intimacy	2.20	> 0.05	0.04	Not supported
H_{1c}	Cognitive Personality Trait - > Commitment	9.85	< 0.05	0.22	Supported
H_{2a}	Affective Personality Trait - > Passion	11.56	< 0.001	0.46	Supported
H_{2b}	Affective Personality Trait - > Intimacy	13.26	< 0.001	0.51	Supported
H_{2c}	Affective Personality Trait - > Commitment	14.39	< 0.001	0.55	Supported
H_{3a}	Social Personality Trait - > Passion	3.72	> 0.05	0.06	Not supported
H_{3b}	Social Personality Trait - > Intimacy	7.78	< 0.05	0.14	Supported
H_{3c}	Social Personality Trait - > Commitment	1.26	> 0.05	0.02	Not supported
H_4	Passion - > Commitment	17.11	< 0.001	0.63	Supported
H_5	Intimacy - > Commitment	9.39	< 0.05	0.18	Supported
H_6	Passion - > Intimacy	16.28	< 0.001	0.60	Supported
H_7	Passion - > Actual Usage	9.17	< 0.05	0.18	Supported
H_8	Intimacy - > Actual Usage	10.03	< 0.05	0.23	Supported
H_9	Commitment - > Actual Usage	12.33	< 0.001	0.47	Supported
Control Variables	Age - > Passion	1.96	> 0.05	0.04	Not supported
	Gender - > Passion	2.21	< 0.05	−0.05	Supported
	Usage Duration - > Passion	1.31	> 0.05	0.02	Not supported
	Age - > Intimacy	1.79	> 0.05	0.03	Not supported
	Gender - > Intimacy	1.17	> 0.05	0.02	Not supported
	Usage Duration - > Intimacy	6.98	< 0.05	0.11	Supported
	Age - > Commitment	5.55	> 0.05	0.08	Not supported
	Gender - > Commitment	3.86	> 0.05	0.06	Not supported
	Usage Duration - > Commitment	1.84	> 0.05	0.03	Not supported

Fig. 6. Structural model.

cognitive personality traits do not have any effect on intimacy, thus hypothesis H$_{1b}$ is not supported ($\beta = 0.04$, $p > 0.05$). The affective personality traits of the CAI agents have a significant effect on all the three aspects of love: passion ($\beta = 0.46$, $p < 0.001$), intimacy ($\beta = 0.51$, $p < 0.001$), and commitment ($\beta = 0.55$, $p < 0.001$), thereby supporting H$_{2a}$, H$_{2b}$, and H$_{2c}$ respectively. For the social personality traits its effect on intimacy is supported ($\beta = 0.14$, $p < 0.05$)) making H$_{3b}$ true, however, its effect on passion ($\beta = 0.06$, $p > 0.05$) and commitment ($\beta = 0.02$, $p > 0.05$) is not supported making H$_{3a}$ and H$_{3c}$ false respectively. Among the three hypotheses related to love the effect of passion on commitment ($\beta = 0.63$, $p < 0.001$), intimacy on commitment ($\beta = 0.18$, $p < 0.05$), and passion on intimacy ($\beta = 0.60$, $p < 0.001$) are all significant, supporting H$_4$, H$_5$, and H$_6$ respectively. Finally, all the three components of love significantly affect the actual usage of CAI agent, supporting hypothesis H$_7$ ($\beta = (0.18$, $p < 0.05)$, H$_8$ ($\beta = (0.23$, $p < 0.05)$, and H$_9$ ($\beta = (0.47$, $p < 0.001)$.

With regards to the control variables, we observe that gender has a significant negative effect on passion for CAI agents. This implies that males develop a stronger passion for CAI agents when compared to females. Majority of the commercially available CAI agents have a female voice by default for the purpose of H2M communication that the users need to change specifically if any other voice type is desired. Female voice may be more attractive for males than females, due to which males develop a stronger passion for CAI agents. Second, the duration for which a CAI agent is used has a significant positive effect on intimacy developed with these agents. This means that greater the usage duration of the CAI agents, more will be the feelings of intimacy. Age did not have any effect on any of the components of love.

5. Discussion and implications

5.1. CAI agent personality and contributions to the HCI community

With the rising popularity of AI and AI-supported applications and devices, the notion of H2M communications is gradually changing. The traditional touch-based interaction systems are slowly being taken over by touchless systems like voice, due to which conversational agents have come into the forefront of research. Anthropomorphism is another benefit that AI has provided to humans that makes technology more humanlike. In this aspect machine personality although a critical issue, has been researched to a lesser extent in the context of voice-based systems. The current works on CAI agent personality primarily replicate various human personality frameworks for developing their own models (Cafaro et al., 2016; Lopatovska, 2020). To address this drawback our first contribution to the HCI community is developing a CAI agent personality framework based on multiple dimensions by considering human, brand, and website personality frameworks. Our approach to include multiple dimensions while developing the personality of CAI agents is justified, since our result suggest the existence of some personality traits that have never been captured by any previous work, e.g., the reachable, artificial, and offensive traits. Nevertheless, we do not claim the current results to provide a comprehensive solution, but to serve as a starting point for future research.

Second, our results indicate the presence of 8 personality dimensions, and interestingly each of these dimensions reflect either desirable or non-desirable characteristics that the CAI agents possess. For e.g., the artificial dimension represents the machineness, robotic, and synthetic aspect of these agents that will not fulfill the users' expectations. Likewise, being disrespectful, impolite, and offensive during their interaction with users will also create a negative impact. Therefore, by decoupling our focus from human personality frameworks only, we can generate a more diverse and realistic personality framework for the CAI agents. However, we must mention that the current framework was developed keeping in mind the assistive role provided by the conversational agents since majority of the current HCI research focus on these assistive aspects. If the role of these agents changes from being

predominantly assistive to something else in future, it might impact the current results.

Third, out of the 8 dimensions, some of the traits show similarity with a few descriptors from human personality framework like the FFM model. For e.g., several of our traits from the sociable category like *friendly*, *kind*, *likeable*, and *co-operative* match to some of the traits described in the FFM model. This indicates that users perceive these agents as their social companions, and further research must be done to explore this social aspect of the CAI agents. In terms of the activities that users perform with the CAI agents, current research shows that either they are task-based, or for social conversations. We have tried to create our framework incorporating both these aspects at every stage of data collection, however, if in future some different use-cases arrive our findings should have to be fine-tuned.

Fourth, HCI designers can use our personality traits as a reference tool while designing their agent personality. This will have certain advantages since our proposed personality traits are quite diverse and is not restricted to any personality type. Moreover, the designers may work upon the negative traits such as, offensive and artificial and try to leverage the benefits of natural language processing techniques and machine learning to overcome these drawbacks and improve the societal adoption of these devices.

5.2. The stimulus (personality), organism (love), and response (actual usage) aspect

After developing the CAI agent personality, in the second stage we investigated how these personalities help in love formation that will in turn lead to a better actual usage scenario. To this effect we proposed a total of 15 hypotheses, out of which 12 are being supported. In terms of the control variables (age, gender, and usage duration) and the three aspects of love, only the effect of gender on passion, and usage duration on intimacy are found to be true. There are primarily two main reasons as to why some of our proposed hypotheses are not supported. First, we attribute this to the unconventional research approach that has been undertaken in this work wherein the adoption aspect of the CAI agents is explored from a machine personality and consummate loving relationship perspective. The concept of machine personality is relatively new, although human personality has been in existence for ages. This makes the present work have a strong exploratory flavor, since all the core hypotheses are generated by considering machine personality and the consequent loving relationship. Although, exploratory and confirmatory hypothesis tests have their own advantages and disadvantages, yet the exploratory approach is preferable when a research topic is new (Rubin & Donkin, 2022), like in the present case. Second, the CAI agents being at the forefront of AI-based technologies are updated frequently to have additional features and functionalities. Such, frequent changes might not always necessarily lead to better user experiences. For e.g., there have been reports where companies knowingly/unknowingly have updated their products that has resulted in customer dissatisfaction and a degradation in product usability (Dutsinma, Pal, Funilkul, & Chan, 2022; Fagan, Khan, & Buck, 2015; Zwakman, Pal, Triyason, & Vanijja, 2020, pp. 652–657). Current research on love gives importance to time, which is very important for a relationship to grow and build-up (Rąc-zaszek-Leonardi & Zubek, 2023). However, in a dynamic and fast-paced technological world of the CAI agents, the users do not get sufficient time with these devices to develop a sense of long-term attachment and commitment.

Several interesting results are obtained in this regard. First, we find that the cognitive personality traits (intelligent and sincere) help the formation of passion and commitment towards the CAI agents. This finding is in line with current research (Moussawi et al., 2021; Seymour & Van Kleek, 2021; Yang et al., 2022). Cognitive traits like intelligence and sincerity result in anthropomorphic perceptions (Moussawi et al., 2021; Yang et al., 2022), and such perceived anthropomorphism results in adoption of these products. However, our findings show that the

aspect of man-machine intimacy is missing that is supposed to arise from these cognitive personality traits. This indicates that cognitive personality traits give rise to fatuous love, where passion for technology can motivate commitment, but not intimacy (Sternberg, 1986). Such, similar observations have been documented in current literatures related to brand love. For e.g. (Heinrich, Albrecht, & Bauer, 2012), found out that a considerable number of people exhibited fatuous love in the context of love for brands because their commitment was made on the basis of passion, without stabilizing the element of intimacy. Likewise, brand loyalty is also determined by the presence of passion and commitment, but the absence of intimacy or liking (Berriche, 2022). Technology has matured to such a stage where a basic level of usability and functionality can be expected from these devices. However, there are a wide variety of these agents available commercially for purchase, and the features keep on getting updated in short time spans. Many times, some features are exclusive to specific voice agents. For e.g., currently in India male voice of a celebrity (Mr. Amitabh Bachchan) is an Amazon *Alexa* exclusive. Likewise, certain home IoT products from specific brands can be operated only by specific CAI agents. The effect is it results in a whirlwind type of relationship in which the user gets introduced to a CAI agent, gets engaged with it very quickly, and develops a commitment for it. However, such a commitment is purely made based on passion, and is devoid of any intimate involvement, because it takes time to build intimacy (Rączaszek-Leonardi & Zubek, 2023; Sternberg, 1986). Such relationships are generally short lived, wherein users can move to a new CAI agent if it provides better usage and functionality.

Second, the affective personality traits of creative and joyful results in consummate love, since all the three components of passion, intimacy, and commitment are available in this scenario. It indicates that the CAI agents can generate feelings, empathize with the users,' and provide companionship, which results in high user engagement, satisfaction, and happiness. Similar reportings are available in case of interpersonal relationships too (Neto, 2021). Since consummate love represents the true point of any lasting relationship, our findings highlight the importance of having favorable affective personality traits.

Third, the social personality traits of sociable and reachable results in friendship or a likable relationship that is characterized by the presence of intimacy, but the absence of passion and commitment. This finding illustrates the fact that the social traits possessed by the CAI agents like *approachable*, *calm*, *patient*, or *kind* creates a favorable atmosphere wherein the users can develop friendly bonds with these. However, this aspect of closeness and warmth in relationship is devoid of intense feelings of passion or long-term commitment. Previous research with chatbots has shown that users tend to develop a notion of friendship after interacting with these (Brandtzaeg, Skjuve, & Følstad, 2022; Skjuve, Følstad, Fostervold, & Brandtzaeg, 2021; Youn & Jin, 2021). Our results provide further evidence and validate these prior works by taking the love theory approach, wherein the social traits are found to result only in a likable and friendly relationship. In terms of the CAI agents, one major application area of these is to provide companionship and promote the overall psychological well-being of the users (Arnold, Kolody, Comeau, & Miguel Cruz, 2022; da Paixao Pinto et al., 2021). Our findings re-affirm the competence of these agents towards dispensing such responsibilities in a friendly manner.

From the above discussion it becomes clear that although passion, intimacy, and commitment are the three triangular components of love that are correlated, yet in a H2M communication scenario they have different antecedents. Previous research related to love between man and any object has focused more on the aspect of brand love (Sarkar et al., 2012; Wang et al., 2019). In case of brand love, intimacy and passion for a brand co-exists when the users have a good experience and get good value from the brand (Sarkar et al., 2012). However, in our study passion and intimacy do not co-exist. The cognitive traits fail to develop intimacy, whereas the social traits fail to develop passion for the CAI agents. Since these personality traits are what makes the CAI agents anthropomorphic, it becomes clear that the users have a greater

expectation of such humanlike features. More importantly, only the affective traits of the CAI agents are found to impact all the three love aspects positively, which implies that having higher emotional capabilities is important for the users to develop a consummate loving relationship with these agents. This difference in results from the concept of brand love (Sarkar et al., 2012; Wang et al., 2019) indicates that from a love theory perspective, "*love for AI*" is conceptually different from brand love.

In case of AI applications that are anthropomorphic, e.g., the CAI agents, users may expect more humanness from these agents in the form of emotional and empathetic capabilities. This is because consummate love is formed only in the presence of affective personality traits, while for the other two traits some of the love components are missing. Therefore, when developing a relationship with these agents, users place more importance on the emotional and affective aspect, rather than the intelligence and functional aspect.

Finally, with respect to the actual usage of the CAI agents all the three love components have their respective shares, with the effect of commitment on actual usage being highest, followed by intimacy and passion. Moreover, intimacy and passion affect the actual usage of the CAI agents both through and outside the effect of commitment. Therefore, all these three components can better explain the actual usage, rather than commitment alone.

5.3. Theoretical implications and contributions to the IS community

There are several theoretical implications of the present study. The context of this adoption study is based on AI-based voice technology that is different from traditional IT technology. AI applications are highly anthropomorphized, and they lead to the development of bonds between man and machines, like a H2H interaction scenario. In this respect for understanding the usage and adoption aspect, traditional factors like usefulness, ease of use, attitude, enjoyment, or perceived value may fall short that are typically used in traditional IT adoption studies. Due to the anthropomorphic and humanness of AI-based technologies, IS researchers have repeatedly called for evaluating the AI adoption scenario under new theoretical lenses that are different from traditional IT adoption models like Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and Value-based Adoption Model (VAM) (Hermann, 2022; Schuetz & Venkatesh, 2020). In this work we have attempted to use a novel approach by combining HCI theories for developing CAI agent personality traits, followed by the usage of the S–O-R and STT love theories. While the theories of S–O-R and STT have been around for some time now, yet their usage in an AI context has been almost negligible. Therefore, by successfully integrating these two theories, we are able to advance both by expanding their realm to the AI adoption context. Moreover, we are also able to demonstrate that how traditional interpersonal theories like STT can effectively be ported to an AI adoption scenario, thereby expanding its scope.

Second, this work contributes to the S–O-R framework by proposing novel stimulus of CAI agent personality. Although a few previous studies have focused on developing personality models in the conversational AI context, our approach is more comprehensive and systematic as we integrate concepts from human, brand, and website personality frameworks, together with conducting an online survey, and independent lab-based experiment. In the conversational AI context related to smart speakers or voice assistants to the best of our knowledge this is one of the first works to propose agent personality as a stimulus that generates perceptions of love leading to a continuous usage of these systems.

Third, we contribute to the research on love because our research model shows that the theory of love can be applied to examine the relationships between humans and the CAI agents. Therefore, we are able to extend the STT theory beyond its original use for explaining interpersonal relationships and provide a holistic explanation about how users' form loving relationships with these AI agents. The results

demonstrate that all the three love components of passion, intimacy, and commitment play a significant role in the AI adoption scenario, and these are formed from the cognitive, affective, and social personality traits that the CAI agents possess.

Fourth, our findings also contribute to the love theory by identifying that "*love for AI*" is different from brand love. In case of brand love existing research has shown that intimacy and passion for a brand helps in developing feelings of consumer loyalty and greater purchase behavior (Sarkar et al., 2012). However, in the AI scenario passion and intimacy not always co-exist, and when they do the third aspect of commitment is also present. Moreover, each of the love components are affected differently by the CAI agent personality traits. Overall, the results indicate that the STT love theory can be used not only in interpersonal scenarios, but also for anthropomorphic technologies.

5.4. Practical implications

Keeping in mind the importance of agent personality, the HCI designers must effectively implement the different personality traits. New features can be added to the CAI agents that go beyond the technical attributes and focus on generating a pleasant user experience. While designing these agents it should be kept in mind that these may act as a human proxy and behave as life partners. This is a crucial aspect, especially in countries that have predominantly elderly population living alone, as these AI powered agents have the capability to act as human partners and promote independent assisted living. The designers should provide the CAI agents with an explicit gender, name, age, and personality so that they are able to provide more personalized services to the users. Overall, their services must be more humanized so that users perceive that they are interacting with their loving partner. Additionally, in this aspect the developers must focus on how these agents can understand human emotions and based on that change their personality so as to comfort and show empathy based on their previously acquired knowledge. Having a dynamic personality that can be auto-customized based upon the user's mood and emotions will help in developing strong emotional bonds and provide a superior user experience. For e.g., these agents may use visual sensors that can detect human emotions and depending on the user's mood change the tone, pitch or even the conversational style to respond in a compassionate and emotional manner.

Considering the importance of all the three components of love and how they result in creating deeper bonds between man and machines, focus should be given to improve these factors. Current CAI agent designs have been more oriented towards ensuring a high usefulness and ease of use, i.e., the usability aspects that is fine to start off with when any technology is new. But now that this form of AI has reached a certain level of maturity designers should focus more on improving the relational aspects. For e.g., these conversational agents should know the user's birthday, anniversary, or other special dates, together with knowing their personal details like hobbies or other areas of interests so that they may use this information when needed. Moreover, these agents must speak in a favorable tone with humor when the situation demands, and pleasantly surprise the users. All these will help to stimulate the loving bond and make these agents desirable human partners.

Lastly, we would like to recommend the designers and developers to work upon the negative aspects of the current CAI agents, e.g., the artificial and offensive personality traits. Giving realistic human shapes i.e., embodying the CAI agents might help in reducing the artificiality. Improving the overall visual aesthetics and making them look attractive will also improve their naturalness. Likewise, based on the conversation context and mood, a proper response style should be chosen dynamically, wherein the pitch, tone, and fluency of speaking is continuously adapted. In terms of being offensive, the CAI agents must behave more empathetically, even if the users are arrogant and behave impolitely. In scenarios where the users may verbally abuse the CAI agents, e.g., insulting or threatening them, the response style of the CAI agents might be either of avoidance or empathy, and not aggressive or counter-attacking. These aspects will help the users develop a strong feeling for these agents.

6. Conclusion

In this work we have attempted to systematically represent AI-based conversational agents with different personality traits and dimensions, and how these personality traits lead to formation of love between the users and the agents. We identify 8 distinct personality dimensions that do not match with existing human personality frameworks, like the Big Five Model. Having novel personality dimensions like *offensive* and *artificial* makes our model unique and distinguishes it from other human-based models like FFM. Moreover, our systematic multi-methodological approach also ensures that the generated personality model includes the specialties of the CAI agents, particularly with respect to their artificialness and conversational style. We have further grouped the different personality dimensions into cognitive, affective, and social traits for the purpose of testing our research model.

We further use the generated personality framework for investigating the adoption aspect (actual usage) of the CAI agents. An unconventional approach is followed by combining theories like the S–O-R framework and STT theory of love. Results show that not all the personality types are equally important to generate the trio feelings of love: passion, intimacy, and commitment. In this regard, only the affective personality traits influence all the three love aspects. However, for promoting the actual usage of these agents, the presence of consummate love is necessary.

6.1. Limitations and future work

We believe that the current findings will serve as an initial step for developing personality models for CAI agents based on a multi-disciplined approach involving computer science, psychology, and social science in the future. Future studies may also extend the personality models to other AI-based agents like chatbots and robots. For generating the personality traits all the online surveys and experiment that was carried out was done in English. Future work should investigate different languages and cultural settings as the results might be different.

Although we are able to illustrate the importance of love, how it is formed in terms of personality of the CAI agents, and its effect on the usage scenario, our results are limited only to CAI agents. Other types of AI applications and agents like chatbots or robots are not included in the present scope. In order to provide generalization, throughout our study we did not differentiate between the brands or types of CAI agents. However, future research might try to find out that whether the personality traits and the love aspect for these agents vary with distinct brands like Amazon, Apple, or Google. Finally, one particularly important use case of these CAI agents can be to provide companionship for the elderly that is a big requirement in many countries of the world. In this regard our research falls short, since majority of our participants either in the online surveys or experiment were not elderly people. Therefore, how effective the current CAI agent personality traits will be for developing loving relationships with the elderly need to be examined in future work.

Credit author statement

Debajyoti Pal: Conceptualization, Methodology, Data curation, Writing -original draft, Funding acquisition, **Vajirasak Vanijja**: Methodology, Resources, Investigation, Writing – Review & Editing, **Himanshu Thapliyal**: Methodology, Writing – Review & Editing, **Xiangmin Zhang**: Conceptualization, Writing – Review & Editing, Supervision.

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Declarations of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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