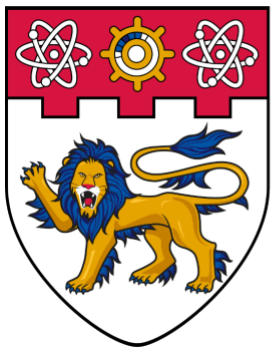

NANYANG TECHNOLOGICAL UNIVERSITY
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INVESTIGATING THE EFFECTS OF SEX-TYPING AND SEX-ROLE STEREOTYPES ON USER EXPERIENCE IN THE CONTEXT OF FINTECH SERVICES

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Investigating the Effects of Sex-Typing and Sex-Role Stereotypes on User Experience in the Context of Fintech Services

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A thesis submitted to the Nanyang Technological University in partial fulfilment of the requirement for the degree of Master of Communication Studies (Research)

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STATEMENT OF ORIGINALITY

I hereby certify that the work embodied in this thesis is the result of original research, is free of plagiarised materials, and has not been submitted for a higher degree to any other University or Institution.

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SUPERVISOR DECLARATION STATEMENT

I have reviewed the content and presentation style of this thesis and declare it is free of plagiarism and of sufficient grammatical clarity to be examined. To the best of my knowledge, the research and writing are those of the candidate except as acknowledged in the Author Attribution Statement. I confirm that the investigations were conducted in accord with the ethics policies and integrity standards of Nanyang Technological University and that the research data are presented honestly and without prejudice.

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Prof. Kwan Min Lee

AUTHORSHIP ATTRIBUTION STATEMENT

This thesis contains material from 1 paper accepted at a pre-conference in which I am listed as an author.

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The contributions of the co-authors are as follows:

- Prof. Kwan Min Lee provided the initial project direction and advised on the study design, writing and analysis of the paper
- I analysed the data, prepared the manuscript drafts, and delivered the presentation
- Xu Yihan was involved in the creation of the experimental stimuli and study design. We co-conducted the experiments at the computer labs of Wee Kim Wee School of Communication and Information.

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ABSTRACT

Front-desk financial service jobs are increasingly being replaced by artificial intelligence conversational agents, or chatbots. However, this presents the challenge of building customer trust and maintaining customer satisfaction, which is particularly important in financial services. Research under the Computers as Social Actors paradigm has shown that people apply social rules to human-computer interactions (e.g., such as sex-role stereotyping, similarity-attraction, consistency-attraction), which can help us understand how customers evaluate chatbots. The present study addresses this issue by conducting critical tests of social rules that apply to human-agent interaction in a financial advice chatbot, focusing particularly on social rules pertaining to sex and gender. Study 1 investigates if users apply a sex-role stereotype to a fintech chatbot, or if they apply the similarity-attraction rule such that they prefer fintech chatbot agents that are represented by the same sex category as themselves. Results of Study 1 show that users generally have better evaluations of the female agent as compared to a male agent. Study 2 extends the findings in Study 1 by additionally manipulating the conversation style of the fintech agent to express either masculine traits or feminine traits. Results of Study 2 further reinforces those of Study 1 by showing that users generally prefer a feminine conversation style. Theoretical and practical implications are discussed.

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CHAPTER 1: INTRODUCTION

The financial services industry is currently undergoing rapid digitalization. It is estimated that by 2030, about 1.2 million front-desk jobs in the banking and finance sector will be automated and replaced by artificial intelligence (AI; Crosman, 2018). This includes the automation of customer service and advisory roles—industry experts have predicted that by 2020, more than 85% of customer interactions with financial institutions will be done through chat (Clarke, 2018). The digitization of services presents many advantages to both customers and companies alike, as automation helps companies cut costs and customers are able to access financial services around the clock without having to pay a hefty fee (Ludden, Thompson, & Mohsin, 2015). Furthermore, despite the fear of biases and errors being built into algorithms, the use of algorithms typically improves accuracy as compared to a human worker (Miller, 2018). With the continual advancements in natural language processing, machine learning, and other computational capabilities, this shift towards conversational agents will only continue to grow in the future (Metz, 2016).

However, with customer service personnel being increasingly replaced by machines and algorithms, there presents a challenge of building quality customer relationships and maintaining customer trust. Traditionally, financial services have operated on the model of relational selling, where the buyer and the seller maintain a long-term interaction and where the quality of the buyer-seller relationship contributes to the success of sales (Crosby, Evans, & Cowles, 1990). Relational selling is particularly important to the financial services because financial advisory and banking services are by nature personalized to the customer, yet complicated and beset with uncertainty, and customers generally lack deep knowledge about the products. These characteristics of financial services call for heightened trust in and satisfaction with the

salesperson in order to achieve successful transactions (Crosby et al., 1990). Indeed, like the selling of other services, the selling of financial services can be conceptualised as a dyadic encounter with a need for the seller to maintain positive interpersonal dynamics between the buyer and the seller (Crosby et al., 1990; Crosby & Stephans, 1987; Solomon, Suprenant, Czepiel, & Gutman, 1985; Parasuraman, Zeithaml, & Berry, 1985).

How can automated customer services build and maintain strong customer relationships? One way is to use embodied conversational agents. Embodied conversational agents, or embodied chatbots, are AI software that are able to interact with customers using natural language processing, and which are represented with a humanlike figure. The conversational method is a primary way of how humans interact with others, thus a conversational interface can also facilitate human's interaction with computers (Cassel, Bickmore, Campbell, Vilhjálmsson & Yan, 2000). Research has shown that using a humanlike figure to represent a virtual communicator and using a conversational interface simulates the experience of talking to an actual person and thus makes users feel that the interaction is more natural, thus helping with relationship-building between the user and the agent (e.g. Bente, Rüggenberg, Kramer, & Eschenburg, 2008; Araujo, 2018).

There have been many studies on human-agent interaction showing that people apply interpersonal social rules to computers and virtual agents, such as politeness (e.g., Mayer, Johnson, Shaw, & Sandhu, 2006) and flattery (e.g., Lee, 2008). This program of research is also known as the Computers are Social Actors paradigm (Reeves & Nass, 1996). This paradigm of research has also been conducted on a range of applied settings, for example, studying the use of virtual pedagogical agents in online learning contexts (e.g., Krämer, Karacora, Lucas, Dehghani, Rüther, & Gratch,

2016), or recommender agents and virtual sales assistants in retail contexts (e.g., Beldad, Hegner, & Hoppen, 2016; Qiu & Benbasat, 2010).

In this study, I investigate the specific context of financial technology. While there has been a robust program of research conducted on virtual sales assistants, the topic of finance has unique characteristics that warrants a separate study for this particular context. Financial products are personalized to the individual, operate on a long-term basis, and have a lot of inherent uncertainty and risk. As a result, people are more sensitive about purchasing financial products and there needs to be a high degree of trust in the seller (Crosby et al., 1990). As compared to usual retail settings, a financial product such as an investment plan, a mortgage plan, or an insurance plan, is a considerably more important purchase with weightier consequences than for example, purchasing a digital camera or laptop (e.g., see Beldad et al., 2016; Qiu & Benbasat, 2010 for studies of such virtual retail settings). When purchasing a larger item, or an item with higher product involvement, the factors influencing people's evaluation of the seller may be different (Churchill, Collins, & Strang, 1975; Pentina & Taylor, 2010). Hence, there is reason to believe that in the context of a financial product purchase, the factors affecting people's interaction quality with the agent may also be different as compared to other kinds of sales contexts. Historically, people also have different impressions of different kinds of sales, and have regarded life insurance selling to be "one of the higher types of 'creative' selling" and different from other forms of sales such as automobile or real estate (Evans, 1963, p. 77). Indeed, the financial selling industry has its own unique history and reputation as compared to other kinds of sales or retail settings.

However, while there have been studies on the digitization of financial selling, i.e. where financial agents conduct sales via telephone or the Internet (e.g. Peevers,

Douglas, & Jack, 2011), there is scant research on *automated* finance selling, i.e. via AI virtual financial agents. Considering that the financial industry has unique characteristics of its own and that public interest in automated financial technology (fintech) is currently booming, coupled with the fact that financial products have important implications for customers, there is great value in conducting human-computer interaction (HCI) research that focuses on the fintech space.

When considering the design of an embodied agent, one of the first considerations would be to consider the sex representation of the agent. A representation of sex is inevitable in the design of an agent because people are socialized to recognize sex and gender is almost everything: people, behaviors, objects, cultures etc. (West & Zimmerman, 1987). Individuals also automatically use sex and gender categories to classify others, which aids the evaluation and impression formation of other people (Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000). Additionally, individuals also use sex or gender categories as a self-categorizing referent group to orientate themselves in society and during interactions with others (Tajfel & Turner, 1986). Indeed, the notion of sex and gender is so pervasive that it also influences people's evaluation of computers and virtual agents, and there is evidence that people practice sex-typing with virtual agents (e.g. Krämer et al., 2016; Lee, 2003; Nass, Moon, & Green, 1997). Thus, designing an embodied financial virtual agent also presents the inevitable question of which sex category the virtual agent should represent—i.e. should it be designed to look male or female? The pervasive nature of gendered evaluations and sex-induced stereotypes means that the sex representation of a fintech agent is also likely to affect users' evaluation of the agent, which has important implications for the users' financial decision-making. Hence, this study investigates the effects of sex-typing in the context

of fintech human-agent interaction with the aim of providing guidelines for designing the optimal fintech user experience.

The notions of sex and gender seem self-explanatory on the surface, but actually hold multiple nuanced concepts. In this paper, I refer to sex as reflecting biological sex, as determined by people's biological sex characteristics (including genitals, gonads and chromosome patterns; United Nations for LGBT Equality [UNFE], n. d.). This can be different from one's sexual orientation. Gender refers to the cultural meanings that surround sex categories (Wood & Eagly, 2015), but the concept is also closely related to the concepts of gender identity and gender expression. An individual's gender identity, gender expression, and sexual orientation do not follow a binary male-female distinction and can be said to lie on a spectrum instead (Clements, n.d.). In comparison, there is less ambiguity in biological sex as sex characteristics can be clearly distinguished into the male and female types. However, biologists are also finding evidence that sex is not categorical or dichotomous (Ainsworth, 2015), and there are intersex individuals who are born with both male and female sex characteristics. Yet, because intersex individuals constitute a minority of society (between 0.05% and 1.7%; UNFE), society is still largely structured around the binary system of male and female sex. As a result, sex-role stereotypes surrounding the male and female sex are most salient in society. Hence, against the backdrop of the current social and cultural context, this research focuses on the male and female sex categories.

Indeed, society is largely organized around the binary of the male-female sex categorization, and the cultural meanings associated to sex categories is said to be "omnirelevant" (West & Zimmerman, 1987, p. 140). Individuals also have a tendency to process information according to the binary of male and female sex categories,

including assimilating their self-concept into such a schema (Bem, 1981). This study thus investigates the effects of such sex-typing in the context of human-agent interaction in a fintech domain. Specifically, this study investigates the effects of sex-typing through two studies. The first study investigates sex-typing simply through the outward appearance of a fintech virtual agent, examining whether a certain sex representation of the agent is preferred over another, or whether there is a similarity-attraction based on sex categories between the user and the agent. However, given evidence that ingroup favoritism in terms of sex category can be influenced by behavioral realism of the virtual agent (Guadagno, Blascovich, Bailenson, & McCail, 2007), Study 2 goes on to expand on the operationalization of sex representation in a virtual agent. Specifically, an additional factor of conversation styles was included in the study design such that the fintech virtual agents were conversing with more feminine or masculine traits.

The rest of this dissertation is structured as follows: in chapter 2, I further clarify terms relating to sex and gender, and cover social-psychological theories that apply to interpersonal contexts. I also review the literature of sex-typing and similarity-attraction based on sex categories in the traditional financial selling industry.

In chapter 3, I review the program of research on HCI and discuss how the social psychological theories covered in chapter 2 applies to the HCI context and how they may apply to a virtual fintech context.

In chapter 4, I bring together the previous sections to arrive at the conceptual framework and research questions that I will investigate in this thesis.

In chapter 5, I cover the method and design of Study 1.

In chapter 6, I report and discuss the experiment results of Study 1.

In chapter 7, I briefly discuss the motivations and methods of Study 2.

Finally, in chapter 8, I cover my plan of action for the remaining of my candidacy.

CHAPTER 2: SEX, GENDER, AND SOCIAL RULES BASED ON SEX CATEGORIES

As briefly covered in the introduction, the present research is concerned with the male and female sex and gender categories. In this section, the concepts relating to sex and gender are defined and the concepts of interest are further elaborated.

Defining Sex, Sex Orientation, Gender, Gender Identity, Gender Expression

Sex refers to one's biological sex, as determined by people's biological sex characteristics at birth (including genitals, gonads and chromosome patterns; UNFE, n. d.). While majority of people are born as either the male or female sex, between 0.05% and 1.7% of the global population are born as intersex individuals, whose sex characteristics do not fit into the typical categories of male or female sex (UNFE, n.d.). In the social sciences, sex is largely treated as a dichotomous variable consisting the categories of male and female. At times, however, the word "sex" is used even in research that is not focused on biological determinants, but instead focusing on the cultural associations or socializations due to sex. Scholars have recommended that the term "sex-related" be used for such research to avoid the confusion that socially-produced differences between men and women are due to innate, biological differences between men and women, so as to prevent the production of sexist research (McHugh, Koeske, & Frieze, 1986).

Gender has been defined as the "behavioral, social, and psychological characteristics of men and women" (Pryzgoda & Chrisler, 2000, p. 554), or as "consist[ing] of the meanings ascribed to male and female social categories within a culture" (Wood & Eagly, 2015, p. 461). Gender is differentiated from sex in that it is the "psychological meaning ascribed to the sexes" (Abele, 2003, p. 768), or the "culturally established correlates of sex" (Goffman, 1976, p. 69). Gender has even

been described as an act of "enactment" or "doing", wherein differences are created based on the "omnirelevan[ce]" of sex categories in society (West & Zimmerman, 1987, p. 140). In sum, gender—as commonly defined in the social science literature—is recognized to broadly refer to a system of socially and culturally constructed meanings associated with and based on a binary conception of male and female sex categories.

However, these definitions of sex and gender and how they are employed in social science research may also be too simplistic and often ambiguous (Pryzgoda & Chrisler, 2000). In social psychology, "sex" and "gender" have often been used associatively and sometimes interchangeably. For instance, in a paper on self-categorization and social identity theories based on gender, the word "gender" and "sex" were used interchangeably through the article (Abrams, Thomas, & Hogg, 1990). In another example of a well-known theory, Bem (1981) closely associates the words "gender" and "sex", calling her theory the "gender schema theory" and calling the resultant process "sex-typing". In much of communications and HCI literature, the research is seldom theorizing specifically about biological differences in sex and often is about the socializations of sex, and hence frequently uses the term "gender" (e.g. gender differences in attitudes towards technology, see Gefen & Straub, 1997; gender stereotypes in the use of computer agents, see Lee, 2003; gender differences in online language behavior, see Mou, Xu, & Xia, 2019). However, in all of the examples listed above, the variable of "gender" is being measured as a dichotomous category of male and female, presumably based on the biological sex of the research participants. Since it is the biological sex of the participants that is being measured, the research may be communicating the idea that any differences found are based on the biological sex differences of the participants (Pryzgoda & Chrisler, 2000). To avoid "gender" from

being uncritically paired with the word “sex”, Pryzgoda and Chrisler (2000) suggested that the term “sex-related” (instead of “gender”) also be used to describe such research that theorizes about socializations based on sex but categorizes the research participants based on their biological sex.

Before I elaborate on the term that will be used in this thesis, I first go on to briefly clarify other terms related to sex and gender. The following definitions are provided by the Human Rights Campaign (HRC), which is the largest civil rights organization in the United States advocating for lesbian, gay, bisexual, transgender and queer equality (HRC, n.d.):

> Sex orientation: An inherent or immutable enduring emotional, romantic or sexual attraction to other people.
>
> Gender identity: One’s innermost concept of self as male, female, a blend of both or neither – how individuals perceive themselves and what they call themselves. One's gender identity can be the same or different from their sex assigned at birth.
>
> Gender expression: External appearance of one's gender identity, usually expressed through behavior, clothing, haircut or voice, and which may or may not conform to socially defined behaviors and characteristics typically associated with being either masculine or feminine.

To sum up, an individual’s gender identity, gender expression, and sexual orientation do not follow a binary male-female distinction and can be said to lie on a spectrum; they also may or may not be the same as an individual’s sex assigned at birth (Clements, n.d.).

Hitherto in social science research, the terms “gender” and “sex” have both been used to broadly refer to a dichotomous social categorization of people based on

the binary of the male and female sex. However, in the contemporary, conventional context, the word "sex" usually evokes the meaning of "sex assigned at birth" and is typically regarded as a binary option between male and female. On the other hand, the word "gender" may evoke the meaning of "gender identity" or "gender expression", which relates to one's individual psychological conception of one's identity and which can lie on a continuous spectrum. Since this research is concerned with the predominant and most salient categorization of sex and gender as the binary of male and female—which is largely based on people's biological sex assigned at birth—this research will use the terms "sex", "sex-related", or "sex-typing" over the term "gender". However, it is important to note that this research does not focus on biological determinants (e.g. hormones, genes, or other physiological factors) as causal explanations of any differences found between the male and female participants in the context of this study—but instead theorizes about psychological phenomena that arises due to the cultural associations and socializations based on the binary male and female categories, and which are imposed on individuals based on their sex assigned at birth. The theories about these social-psychological processes are elaborated in the following sections.

Gender-Based Schematic Processing and Sex-Typing

Social researchers have long recognised that the dichotomization of sex and gender is ubiquitous in society and that society is organized based on sex and gender divisions (e.g., Barry, Bacon, & Child, 1957; Berk, 1985). Indeed, the male-female dichotomization pervades not only subjects that are directly related to sex (e.g. reproductive function, division of labor, or personality traits), but is also associated with faraway subjects such as shapes or planetary motions (Bem, 1981). This goes to

show that while the dichotomization of sex is biological, many of the gendered traits and practices that are associated with sex are learned.

The gender schema theory (Bem, 1981) describes the process of how such sex-typing is learned. In general, a schema is a cognitive structure that contains a network of associations to represent a particular stimulus domain—in this instance, gender is a particular domain (Bem, 1981; Taylor & Crocker, 1981). Schemata serve as people's mental models of reality, and they guide the processing of information, that is, new information is fit into existing mental models (Taylor & Crocker, 1981). The gender schema theory posits that children are socialized as they are growing up to associate content-based information and behaviors to sex categories, such that they develop a cognitive schema that differentiates information into what is male-associated and female-associated, otherwise known as "gender-based schematic processing" (Bem, 1981, p. 355). In sum, the male-female sex binary is ubiquitous in all aspects of society, including personality traits, behaviors, occupations and social roles, and this binary gender schema is also very much ingrained in how people process information—including their conception of self.

This gender-based schematic processing is posited as a mechanism of how sex-typing occurs. Gender-schematic processing means that individuals encode information that is consistent with existing gender schemata more quickly and are easily able to organize information according to the relevant schematic categories (Bem, 1981). Individuals will also tend to differentiate judgments along schema-relevant dimensions, i.e. along the divisions of male-female sex (Bem, 1981). Specifically, individuals' own self-concepts are also assimilated into the gender schema—individuals, from the time when they were still children, learn to associate various attributes and behaviors to their own sex (Bem, 1981). For example, boys and

men learn to associate masculine traits of strength and dominance to themselves, whereas girls and women learn to associate feminine traits of gentleness and compassion to themselves. The resultant sex-typed behaviors thus serve to reinforce the gender schema, and indeed the organization of society around the male-female sex binary (Bem, 1981; West & Zimmerman, 1987).

Measuring Sex-Typing: Masculinity and Femininity

Features that are associated with the male sex are described as "masculine", whereas features that are associated with the female sex are described as "feminine". And how exactly are masculinity and femininity measured? Early in the tradition of studying masculinity and femininity, the two concepts were regarded as the opposite poles of a single continuum (Terman & Miles, 1936). The bipolar masculinity-femininity scale was constructed by asking men and women to rate a set of diverse items (including word associations, inkblots, and statement of interests) using their own judgments of masculinity and femininity, and aggregating the items that were most strongly differentiated between the men and women's responses (see Wood & Eagly, 2015 for review). However, a closer analysis of these measures showed that the items are often uncorrelated to each other and thus do not constitute a single masculine-feminine dimension (Wood & Eagly, 2015).

Later, research showed evidence that sex-related stereotypes fall on separate dimensions (Broverman, Vogel, Broverman, Clarkson, & Rosenkrantz, 1972), and new frameworks were conceived to reconceptualize masculinity and femininity as two distinct dimensions. Namely, Bem (1974) developed the Bem's Sex Role Inventory (BSRI) and Spence & Helmreich (1978) developed the Personal Attributes Questionnaire (PAQ). Unlike previous scales which consisted heterogeneous items (e.g. Terman & Miles, 1936), the new frameworks comprised strictly of personality

traits that were stereotypically associated with men and women. These stereotypical traits were derived by asking individuals to describe the personality traits that they deemed to be desirable of either men or women. Femininity came to be described by more social and people-oriented personality traits such as “caring” and “helpful”, whereas masculinity came to described by more action- and achievement-oriented characteristics such as “competitive” and “assertive”. Other labels were also adopted to describe the masculine-feminine comparison, i.e. agentic-communal (Bakan, 1966) and instrumental-expressive (Spence & Helmreich, 1978, 1980).

Implications of Sex-Typing on Finance Occupational Roles

Sex-related stereotypes are so prevalent and distinctive that they become normative prescriptions of how men and women should behave in society. They also influence people’s judgments on the capabilities of individuals based on the target’s sex. Thus, sex-typing can have implications on people’s judgments on a financial advisor based on his or her sex.

In the finance industry, there seems to be a bias that is favoured towards men, as reflected by men enjoying higher career advancements and better career opportunities in the industry (Moorcraft, 2018; Usita, 2017). This could be due to stereotypes that men are better at numerical and quantitative abilities (Spencer, Steele, & Quinn, 1998), have greater influenceability (Eagly & Wood, 1982) and have the assertiveness needed to close deals (Comer & Jolson, 1991). Indeed, the investment industry as an example of the financial industry, is rated to be more masculine (Couch & Siegler, 2005).

However, it is also possible that customers may prefer a female financial advisor over a male financial advisor. Women are perceived to be more other-oriented and as caring more for others’ interests (Abele, 2003), and this may be important to

customers who are entrusting their financial decisions to the guidance of their financial advisor. Furthermore, customer relationships and service quality is particularly important to financial selling. Women are more capable at developing good relationships with their customers (Beetles & Crane, 2005), and the service industry is indeed characterized to be more feminine (Cameron, 2000).

In light of the above discussion on the implications of sex-typing on finance occupational roles, it seems that finance is at the intersection of both male and female sex stereotypes. It is thus unclear whether a financial advisor is deemed to be more feminine or masculine overall, and hence whether it is seen as a more appropriate job for a woman or a man. The present research seeks to investigate this issue, but in the context of a virtual financial agent. The specific research questions will be further elaborated in chapter 4.

Another possible perspective is that instead of the sex category of the finance agent having a main effect on customer evaluations, it could be the interaction between the sex categories of the customer and the salesperson that matters. This is further elaborated in the next section on the similarity-attraction principle.

Similarity-Attraction Principle

The similarity-attraction principle can be expressed through the proverb "birds of a feather flock together" (McPherson, Smith-Lovin, & Cook, 2001). Basically, the principle posits that people are attracted to others who are similar to themselves. This can be seen from social network studies that repeatedly demonstrate homophily—the phenomenon that within social networks, people are more likely to associate with similar others than dissimilar others (Lazarsfeld & Merton, 1954; McPherson, et al., 2001). These social network studies have shown homophily in terms of demographic characteristics such as sex, age, and ethnicity (e.g., Bott, 1928; Loomis, 1946), and

also in terms of psychological characteristics, such as attitudes and intelligence (e.g., Almack, 1992; Richardson, 1940; see McPherson et al., 2001 for review). Indeed, homophily by sex occurs in the friendship networks in schools—which is where people generally learn to socialize (Eder & Hallinan, 1978). In the non-kin social networks of adults, this pattern of homophily by sex also persists (Marsden, 1987), though in some cases not as strongly as compared to other social dimensions, such as race or education (Marsden, 1988).

There are two areas of literature that can explain the phenomenon of homophily: the similarity-attraction paradigm (Byrne, 1997) and the social identity theory (Tajfel & Turner, 1986), which will be further elaborated in the following sections.

Byrne's Similarity-Attraction Paradigm

The similarity-attraction paradigm posits that people are attracted to similar others, and that the attraction is based on a positive linear function of the proportion of similar attitudes (Byrne & Griffitt, 1966). Through a series of experiments, this law of similarity-attraction has been shown to be generalizable to a range of populations, such as across educational levels (i.e. college undergraduates, elementary, and secondary school students; Byrne & Griffitt, 1966), across different nationalities (i.e. Japanese, Indian, and Mexican students, Byrne et al., 1971), across different age groups (i.e. including senior citizens, Griffitt, Nelson & Littlepage, 1972), and across socio-economic status (i.e. including alcoholics and schizophrenic patients; Byrne, Griffitt, Hudgins, & Reeves, 1969).

Under the similarity-attraction paradigm, similarity usually refers to similarity in attitudes. Similarity in attitudes is measured by an attitude questionnaire, which allows respondents to state their attitudes regarding various issues ranging from

religion to movies. Similarity in attitudes between two people is then measured as the proportion of similar responses as indicated on the questionnaires (Byrne, 1961). The other important concept under this body of research, attraction, is typically measured with the Interpersonal Judgment Scale (Byrne & Nelson, 1965), where participants rate "the stranger's intelligence, knowledge of current events, morality, and adjustment and were asked to indicate how much they would like the person and how much they would enjoy working with him" (Byrne, Griffitt, & Stefaniak, 1967, p. 85). The latter two items were later combined and re-conceptualized as a two-item attraction measure (Byrne & Nelson, 1965). Through several decades of research with about 800 participants across different contexts, Byrne and colleagues arrived at a law-like linear function of $Y = 5.44X + 6.62$, where Y refers to attraction, X refers to the proportion of similar attitudes, and 5.44 and 6.62 are empirically derived coefficients (Byrne, 1997). This attraction index has also been shown to be correlated with other measures that are meant to assess attraction, such as social distance scales, voluntary physical proximity, and eye contact (Byrne, 1971).

The law-like relationship between similarity in attitudes and attraction is explained by the reinforcement-affect theory (Byrne & Clore, 1970). People have a learned desire to be correct about their interpretations of reality, which is usually validated through being in agreement with others (Byrne, 1961). Hence, being in agreement with others serves as a rewarding experience. Interpersonal interaction presents the opportunity for such an exchange of reward and punishment, where agreement is perceived as a reward and disagreement is perceived as a punishment. People with similar attitudes tend to agree with each other more, while people with dissimilar attitudes tend to disagree. As a result, through reinforcement learning from repeated social interactions, people learn to associate strangers with similar attitudes

with positive affect, and perceive them as more attractive (Byrne, 1961; Newcomb, 1956).

While most research under the similarity-attraction paradigm focused on similarity in attitudes, the positive linear function of similarity-attraction has also been demonstrated for other types of similarity, such as similarity in economic status (Byrne, Clore, & Worchel, 1966), similarity in personality characteristics (Byrne, Griffitt, & Stefaniak, 1967), and similarity in defensive behavior (Byrne et al., 1967). In these experiments, sex is usually controlled for, and there is little theorizing about the relationship between similarity in sex and attraction. However, as explained above, sex is strongly associated with personality traits (Abele, 2003; Bem, 1981). Hence, it is plausible that people also learn to associate others of the same sex with greater likeability.

Social Identity Theory

While the similarity-attraction paradigm operates at an interpersonal interaction level, the social identity theory focuses on intergroup processes. The social identity theory was originally conceived to explain "the social psychology of social conflict" between social groups (Tajfel & Turner, 1986, p. 277). Tajfel & Turner (1986) posits that it is almost impossible for an interpersonal interaction to be purely determined by the relationship between the two interaction partners and their individual characteristics—that is, social interactions between individuals must be somewhat influenced by the social groups or categories that they belong to. This is because people have a natural tendency to categorize others and themselves, which helps to segment and order the social environment so as to "systematize the social world" (Tajfel & Turner, 1986, p. 283). In the social categorization process, people tend to exaggerate one's similarities to other ingroup members and exaggerate the

differences between groups (Hensley & Duval, 1976). This process not only helps to simplify the complexity of the social world, but the distinctions between groups also allow people to easily apply value systems to different social groups (Tajfel, 1982).

Social categories serve as references for one's identity. The sense of belonging to a certain social group gives one a sense of place and orientation in relation to the rest of society (Tajfel & Turner, 1986). Since one's identity is partly derived from the social categories and social groups that one is a member of, individuals will strive to achieve positive social identity so as to protect one's self-esteem (Tajfel & Turner, 1986). This leads people to form more favourable attitudes towards ingroup members and less favourable attitudes towards outgroup members. Furthermore, it has been shown that people tend to view members of the outgroup as undifferentiated and homogenous, which makes it easier for people to apply stereotypes to members of the outgroup (Tajfel, 1982). People are also more likely to agree with ingroup members as compared to outgroup members (Clark & Maass, 1988; Hensley & Duval, 1976), have more positive feelings towards the ingroup as compared to the outgroup (Allport, 1954, Brewer, 1999), and perceive that ingroup members hold beliefs that are more similar to one's own (Wilder, 1978a).

For intergroup differentiation to occur, individuals must identify with a social group, or in other words, feel that their group membership is part of their self-concept (Tajfel & Turner, 1986). As explained in the sections above, the gender schema is very salient in people's minds and people easily adopt a self-concept according to the dichotomization of the male and female sex categories. Thus, a person's gender and sex category also serve as salient attributes for social categorizing and stereotyping (e.g. Abrams et al., 1990, Hogg & Turner, 1987; Rosenkrantz, Vogel, Bee,

Broverman, & Broverman, 1968; Taylor et al., 1978). Hence, one's self-categorization and social identity can be on the basis of one's sex.

Similarity-Attraction in the Context of Financial Buyer-Seller Relationships

In the context of financial selling, because it has been conceptualized as a dyadic interaction, buyer-seller similarity has been a keen area of interest for marketing scholars. Researchers have largely argued that buyer-seller similarity is advantageous for sales (see Lichtenthal & Tellefsen, 2001 for review). In an early exploratory study, Evans (1963) discovered that successful buyer-seller pairs shared a higher degree of similarity as compared to unsuccessful pairs. Evans (1963) used an all-male sample of insurance sellers and investigated similarity across characteristics of age, height, smoking habits, education, income, religious affiliation, and political orientation. Crosby et al (1990) found that degree of similarity was positively associated with improved short-term sales. Smith (1998) found that gender similarity was related positively with relationship quality measures such as trust, relationship investment, and open communications. However, several studies have also shown that gender-matching has no effect on sales success. Recreating the Evans (1963) study in a retail context and using a composite similarity score (consisting the same characteristics measured by Evans except for smoking habits, and adding nationality and race), Churchill et al. (1975) found that similarity was not a predictor of successful sales. However, the authors did find a positive correlation between similarity and size of purchase. In a lab experiment, Jones, Moore, Stanaland, & Wyatt (1998) also did not find an effect of gender similarity on the participants' assessment of salespeople. There is also some evidence for a complementary-gender attraction effect. In an exploratory study, Dwyer, Orlando, and Shepherd (1998) found that a gender-mismatch actually had positive effects on insurance salespeople's performance.

Synthesising the diverse literature, Lichtenthal and Tellefsen (2001) proposed a framework that differentiates between observable and internal similarity. In their framework, observable characteristics include physical attributes such as age and gender, whereas internal characteristics refer to those such as attitudes and values. The authors synthesised that internal similarity is a more reliable predictor of buyer-seller success as compared to observable similarity. However, as elaborated above, one's sex category does not merely reflect outward similarity. It can also be associated with similarity on internal characteristics such as personality traits, as people of the same sex category are typically associated with the same traits. Furthermore, people have a tendency to identify with others based on outward characteristics such as gender, reflecting a shared internal sense of affinity and mutuality with ingroup members. Hence, it is plausible that in the context of financial buyer-seller interactions, matching based on sex categories can have a positive effect on sales success.

CHAPTER 3: SOCIAL RULES AND HUMAN-COMPUTER INTERACTION

In the previous chapter, several social rules (sex-typed stereotypes, similarity-attraction, social identification) have been introduced and elaborated on to relate to sex-categories. Before I move on to talk about how social rules may be applied to the HCI context, I first explicate on what exactly constitutes the concept of social rules in interpersonal interactions.

Social Rules in Interpersonal Interaction

In situations of interpersonal interaction, people have come to develop certain social rules to facilitate communication with others. These social rules are general principles that govern how people behave or communicate in the presence or in response to other human beings. Social rules can be thought of as having different origins and properties. Here, I delineate two kinds of social rules: 1) socially-constructed social rules and 2) psychologically-constructed social rules.

First, some social rules originate from normative expectations that have developed in society, otherwise known as social norms. Social norms are behaviors that are approved by others in society (Jackson, 1966; Sherif & Sherif, 1956) and define behaviors that are "typical and appropriate" (J. K. Burgoon, 1993, p. 31). For instance, politeness is a societal expectation that requires people to behave in a certain manner to allow for an agreeable social exchange. Not interrupting others and not saying things that would hurt the feelings of others, are a few principles of politeness. Hence, being polite is a social rule that allows people to meet the standards of social norms, so as to communicate competently with others and be socially accepted.

These socially-constructed norms can also be in the form of scripts and schemata. As defined previously, a schema is a cognitive structure that contains a network of associations to represent a particular stimulus domain (Taylor & Crocker,

1981). For example, under the gender-based schema, there is a certain range of behaviors that is deemed appropriate for both sexes. If a woman decides to do dirt bike racing—an activity that is characterized as masculine—she would be going against social norms. Scripts are sequences of events or routines that people come to recognise and learn from their experiences (Neisser, 1976), and they can be considered a subtype of schemata (Schank & Abelson, 1977). For example, engaging a conversation with someone invokes a script where the interlocutors take turns to speak and respond to each other. Thus, dominating a conversation or interrupting others would violate social norms and be deemed impolite.

Another kind of social rules can be said to originate from people's own psychology. Just as with the processing of any type of information, human beings also apply mental shortcuts in the processing of their social environments (Taylor & Crocker, 1981). One consistent psychological characteristic that all human beings espouse is the tendency to engage in social categorization and social identification. Social categorization can be described as a kind of "cognitive tools" that enable individuals to "segment, classify, and order the social environment…to undertake many forms of social action" (Tajfel & Turner, 1986). In other words, social categorization is the automatic tendency of individuals to use categorical representation to make sense of other people (Macrae & Bodenhausen, 2000), and this categorization process is what enables individuals to develop stereotypes of others (Taylor, 1981) and form impressions of another person (Brewer, 1988; Fiske & Neuberg, 1990). For instance, when speaking to a person whom one has no previous encounter with, one might make certain assumptions about the person based on his or her apparent race or gender, and thus use those assumptions to guide one's interactions with and evaluations about the person. Thus, the employment of stereotypes in

impression formation is a social rule that people apply due to their psychological hard-wiring.

The two conceptualizations of social rules that I delineate above are not meant to be mutually exclusive. Indeed, the content of stereotypes that one applies to a certain social category is often socially cultivated and can be said to be a social norm instead of being hard-wired into one's psychology. However, the underlying process of stereotyping is social categorization, which is a capability that is ingrained in human psychology as a by-product of human's information processing mental architecture (Cosmides, Tooby, & Kurzban, 2003). While these social rules are most relevant in interpersonal situations, in the section below, I detail how these social rules have also been found to apply in people's interactions with technology.

Social Rules in Human-Computer Interaction

The field of human-computer interaction (HCI) is a multidisciplinary field that studies how people interact with computers and other forms of virtual or digital objects (Jung & Lee, 2017). In communication studies in particular, scholars studying HCI focus on people's social responses to technologies. An influential paradigm that largely informs this approach of studying HCI is the computers are social actors (CASA) paradigm (Reeves & Nass, 1996). The CASA paradigm (Reeves & Nass, 1996) posits that people automatically respond to technological artifacts in a social manner and apply social rules to human-technology interaction. Under this paradigm of research, experiments that are originally used to study human-to-human interactions are replicated, but with the experiment participants interacting with a computer instead of another person. In the section above, I explicated that social rules can originate from social norms, or from people's psychological hard-wiring. Research under the CASA paradigm has shown that people apply both of these kinds of social rules in

their interactions with technology. For instance, people apply well-established social scripts, such as politeness (e.g., Mayer, Johnson, Shaw, & Sandhu, 2006) and flattery (e.g., Lee, 2008), in their interactions with computers as well. When participants are giving evaluations about a computer's performance, participants who were giving feedback on the computer platform itself tend to give more positive and less honest feedback as compared to participants who were filling up a separate feedback form (Reeves & Nass, 1996). This shows that people practice the social script of politeness even with computers, that is, people tend to avoid giving negative feedback directly to computers even though computers do not have feelings and would not be hurt by negative feedback. In other words, people's interactions with technological media can trigger social scripts and schemata that originate from interpersonal interaction contexts.

The CASA phenomenon can be explained from an evolutionary psychology perspective. Throughout our evolutionary history, human beings were the only species that could behave in an intelligent and social manner. Now, new media and interactive technologies are able to simulate social interactions, but the human brain is not evolved to be able to distinguish virtual simulations from reality (Reeves & Nass, 1996; Lee, 2006). Hence, people will have the automatic response to treat computers as social actors if they display social behaviors, even if consciously, people know that it is illogical to do so (Reeves & Nass, 1996). In other words, it is hard-wired in humans' psychology that social interaction cues will trigger a social response from humans, even if the cues come from a non-social object.

Indeed, people also automatically employ sex-typing rules in the context of HCI. In the following sections, I review research that has shown how people employ sex stereotypes and the rule of similarity-attraction in the contexts of HCI.

Sex-Typing in Human-Computer Interaction

Against the backdrop of CASA, researchers investigated how sex-based stereotyping influences people's evaluations of computer agents. Nass, Moon, & Green (1997) has found that people are more accepting of evaluations from male-voice computers as compared to female-voiced computers, which reflects social psychological research that males are more influential than females (Eagly & Wood, 1982). Individuals also apply the stereotype that computer agents with a female persona are more suitable when dealing with feminine subjects, whereas computer agents with a male persona are more fitting when dealing with masculine subjects. For instance, Beldad et al. (2016) showed that people find a female virtual sales agent more credible when it comes to product advice on a feminine item (solarium) and a male virtual sales agent more credible when it comes to advice on a masculine product (motorcycle). Lee (2003) showed that female agents had more influence in changing participants' answers when it comes to a feminine topic (fashion), whereas male agents had more influence when it comes to a masculine topic (sports). Reflecting the association that the service-economy is more feminine, a study by Zimmerman, Ayoob, Forlizzi, & McQuaid (2005) found that across 15 different tasks, participants on average preferred a female representation for the virtual agent as compared to a male representation. For the specific task of financial advisor, however, they found that there was no difference between the ratings for a male versus a female virtual agent.

Similarity-Attraction in Human-Computer Interaction

Following the similarity-attraction principle and social identification theory, researchers have also investigated the possibility of an interaction effect between the user's sex category and the sex representation of a virtual agent on user experience and

evaluations. Indeed, studies have shown that users have more positive appraisals towards computers (Moon & Nass, 1996; Nass, Moon, Fogg, Reeves, & Dryer, 1995), e-commerce agents (Nass & Lee, 2001) and assistive robots (Tapus, Ţăpuş, & Matarić, 2008) that express a similar personality to themselves. Lee, Nass, and Brave (2000) also found that similarity based on sex categories had effects on ratings of social attractiveness and trustworthiness of the computer. However, Isbister & Nass (2000) has also found that users prefer virtual interactive characters that display a personality that is complementary to theirs. In a study examining the effects of demographic characteristics of virtual agents, Qiu & Benbasat (2010) and Beldad et al., (2016) did not find significant effects of sex category matching on users' appraisals of a virtual recommendation agent. Interestingly, other studies have found evidence of opposite-sex attraction in the similar context of a virtual recommendation agent (Pentina, 2010). This review of the literature shows that while there is evidence for similarity-attraction in an HCI context, the effect of similarity-attraction based on sex categories may not be as strong. This could be due to individuals invoking their psychological identity more as compared to their biological sex in contexts of HCI (Lee & Schumann, 2009).

Recent Updates to CASA Literature

Scholars have also originally labelled the CASA paradigm as the Media Equation (Reeves & Nass, 1996), positing that people equate media experiences with real-life interactions with people and places. However, recently, other scholars are increasingly positing that users employ different social scripts and standards when interacting with technology and media. For instance, Edwards, Edwards, Spence, and Westerman (2016) have found that individuals experienced more uncertainty, less liking, and less social presence when they were told that they were interacting with a social robot as compared to another person. Mou and Xu (2017) also found that

individuals displayed different personality traits when they were communicating online with a human interlocutor as compared to when they were conversing online with an automated chatbot. Additionally, Mou et al., (2019) found that individuals employed more gender-linked language when chatting online with a human interlocutor as compared to when they were chatting online with an automated chatbot.

CHAPTER 4: THEORETICAL FRAMEWORK FOR STUDYING THE SPECIFIC CONTEXT OF HUMAN-AGENT INTERACTION IN FINTECH

The studies in the previous section indicate that while the CASA literature has shown that people are hard-wired to apply a general social interaction script when interacting with computers and virtual agents, the specific standards of what constitutes normative and appropriate in an HCI context could be different from an interpersonal context, and indeed may still be in flux as the norms are constantly being constructed as automated agents get increasingly integrated into society. In the literature review in chapter 2, I have also detailed that conflicting social rules may be at play in the specific context of financial selling even in an interpersonal context. The sections in chapter 3 above have also showed that people commonly apply sex stereotypes to computer agents. However, the effect of similarity-attraction based on sex categories in the context of HCI may not be as strong (Lee & Schumann, 2009). Thus, while it is known that people also engage in sex-typing of virtual agents and have shown evidence of similarity-attraction, it is unclear which of these social rules will apply in the context of a virtual fintech agent. These factors make it difficult to predict which sex representation would be most appropriate for the design of a virtual fintech agent.

Thus, at this juncture, this research aims to conduct a critical test of which sex-related social rules would apply to the particular context of human-agent interaction in the domain of fintech. In this chapter, I elaborate on the relevant variables and constructs that will be used to conceptualize an interaction with a fintech virtual agent and the resultant interaction outcomes. In doing so, I put forward a theoretical framework (see Figure 1) that can be applied when studying human-agent interaction in fintech contexts.

Perceived Interaction Experience Quality—Ease and Positive Evaluation of Interaction

Traditionally, financial selling has been conceptualized as a dyadic relationship, whereby the quality of the communication between the buyer and the seller contributes to the success of a sale transaction (Crosby et al., 1990; Evans, 1963; Parasuraman, Zeithaml, & Berry, 1985). According to the CASA paradigm, it is also plausible that such a mental script of financial selling will be invoked, and a positive communication experience with a virtual financial agent will lead to users having a greater likelihood to use the virtual agent. The design of a chat interface with an embodied conversational agent is to capture this idea of simulating a conversational experience, so as to facilitate a user's experience of interacting with an automated financial advice service (Cassell et al., 2000). Indeed, other HCI studies have shown that variables describing the interaction process, such as an enjoyment of the experience (Qiu & Benbasat, 2010), and perceived ease of use (Wang & Benbasat, 2005) contribute to an intention to use the agent. A meta-analysis by Kim and Peterson (2017) also found that perceived service quality—which refers to a subjective evaluation of an interaction with a website—to be an important antecedent of online trust in e-commerce. Synthesising this literature, this study measures the perceived quality of interaction experience with two variables: ease of interaction and evaluation of interaction.

Ease of interaction refers to the "smoothness and naturalness or difficulty and awkwardness" of an interaction (Burgoon, Bonito, Ramirez, Dunbar, Kam, & Fischer, 2002). An easy interaction means that the communication between two parties flows effortlessly and naturally, such that a communicator perceives that he or she is able to deliver his or her point across easily and after which receive an appropriate response.

The evaluation of an interaction is the overall assessment of an interaction and the assignment of either a positive or a negative valence to that assessment (Burgoon & Hale, 1988). A positively valenced evaluation indicates that the user perceives the interaction favorably; on the other hand, a negatively valenced evaluation means that the user has an unfavorable interpretation of the interaction experience (Burgoon & Hale, 1988). Since people of the same gender are associated with the same traits (Abele, 2003; Bem, 1981), and increased similarity between two communicators is associated with being in mutual agreement and understanding (Byrne, 1961), a match between the user sex and the sex representation of a virtual fintech agent should also increase the perceived ease of interaction and a more positive evaluation of the interaction. Indeed, empirical studies have shown that people communicate more with others who share the same opinions as themselves (Hensley & Duval, 1976). Yet, if the user has a normative expectation that a male or a female character is more suitable to represent a virtual financial agent, the user may perceive an easier and more likable interaction with either a male or female fintech agent respectively. Thus, this research is interested in how the sex representation of the virtual agent or a match in sex categories between the user and the agent may affect the user's perception of ease and the user's evaluation of the interaction with the agent. The following set of competing hypotheses are posited:

H1a: Both male and female users will associate a fintech virtual agent with a more positive perceived interaction experience quality if the representation of the agent is of the same sex as the user, as compared to an opposite-sex representation.

H1b: Both male and female users will associate a fintech virtual agent with a more positive perceived interaction experience quality if the representation of the agent is of the female sex as opposed to a male sex representation.

H1c: Both male and female users will associate a fintech virtual agent with a more positive perceived interaction experience quality if the representation of the agent is of the male sex as opposed to a female sex representation.

Social Judgment of Agent—Competence and Trustworthiness

Besides the quality of the interaction experience, the user's social judgment of the virtual agent also contributes to a user's final intention to use the agent (Wang & Benbasat, 2005). The social judgment of credibility of a virtual fintech agent is particularly important because user trust is instrumental in the proper functioning of financial services. In the conceptualization of credibility, two dimensions are consistently included: competence and trustworthiness (Berlo & Lemert, 1961; McCroskey, 1966; McCroskey & Young, 1981). Competence is associated with the expertise and capabilities that someone possesses (McCroskey, 1996; McCroskey & Young, 1981). The other dimension, trustworthiness, is concerned with the character of a person, including traits such as honesty and being ethical. As established above, a fintech virtual agent seems to be placed in the intersection of the female-oriented role of customer service (Cameron, 2000) and the male-oriented role of advice-giving (Eagly & Wood, 1982). Hence, it is unclear whether a male or a female fintech virtual agent will be regarded as being more credible. Furthermore, past research has found that similarity between a user and a virtual agent improves user evaluations of the virtual agent's credibility. Thus, this research also investigates how the sex representation of the virtual agent or a match between the sex categories of the user and the agent may affect the user's social judgment of the agent. The following set of competing hypotheses are posited:

H2a: Both male and female users will have a more positive social judgment of the fintech virtual agent if the representation of the agent is of the same sex as the user, as compared to an opposite-sex representation.

H2b: Both male and female users will have a more positive social judgment of the fintech virtual agent if the representation of the agent is of the female sex as opposed to a male sex representation.

H2c: Both male and female users will have a more positive social judgment of the fintech virtual agent if the representation of the agent is of the male sex as opposed to a female sex representation.

Social Presence

Social presence is a concept that is central to the CASA paradigm. The concept refers to a psychological state where an individual perceives the salience of a human or a human-like intelligence through a technological medium (Hwang & Park, 2007; Lee, 2004). In other words, social presence can be seen as a concept to measure the extent to which users perceive computers to be like a social actor. The concept of social presence can be applied to HCI scenarios where the technological interface is designed with an explicit social entity, such as a virtual embodied agent (Qiu & Benbasat, 2010), voice agent (Nass & Lee, 2001), social robots (Lee, Peng, Jin, & Yan, 2006), or virtual avatars (Bente et al., 2008). In the context of an embodied chatbot, if a chatbot is perceived to have high social presence, it means that the user perceives the chatbot to be more like an intelligent social entity that is actually talking to the user.

Social presence is an important variable in HCI because it has been shown to be associated with other favorable user experience outcomes such as user trust (Bente et al., 2008) and user liking (Nass & Lee, 2001). It is also useful for commercial

outcomes as it has been shown to increase trust in an online vendor (Gefen & Straub, 2003; Hassanein & Head, 2006), increase customer loyalty (Cyr, Hassanein, Head, & Ivanov, 2007; Kumar & Benbasat, 2006), and also improve buying behavior (Simon, 2001). Thus, it is also important to understand the influence of the gender of a virtual financial agent on its perceived social presence. Previous studies on e-commerce has shown that the ethnicity-match between a user and a virtual product recommendation agent increases social presence (Qiu & Benbasat, 2010), indicating that similarity between the user and the virtual agent may induce heightened social presence. Hence, this research is interested in how the sex representation of the virtual agent or a match between the user sex and the agent sex representation may affect levels of social presence. The following set (H3a – c) of competing hypotheses are posited:

H3a: Both male and female users will perceive a stronger social presence of the fintech virtual agent if the representation of the agent is of the same sex as the user, as compared to an opposite-sex representation.

H3b: Both male and female users will perceive a stronger social presence of the fintech virtual agent if the representation of the agent is of the female sex as opposed to a male sex representation.

H3c: Both male and female users will perceive a stronger social presence of the fintech virtual agent if the representation of the agent is of the male sex as opposed to a female sex representation.

Outcome-Based Evaluation—Quality of Recommendation and Intention to Use

Ultimately, the success of a fintech virtual agent will be determined by the consumer's evaluation of the quality of recommendation from the agent and the consumer's intention to use the agent. Since the function of the virtual agent is essentially to provide recommendations to the customer, a customer's evaluation of

the quality of recommendation from the agent is indicative of a customer's evaluation of the quality of the fintech service platform. Hence, variables that evaluate the quality of recommendation or information given by a virtual agent have been used as an appropriate dependent variable in past studies that evaluate virtual recommender agents (e.g., see Liew & Tan, 2018; Nass & Lee, 2001).

The intention to use a product is regarded as a strong predictor of an individual's actual behavior to use a product (Ajzen, 1991). Hence, this variable is indicative of whether the fintech agent will be successfully adopted by customers if it is released to the market. Similar concepts are frequently used in other HCI studies as an important dependent variable to evaluate virtual agents (e.g. Beldad et al., 2016; Liew & Tan, 2018; Tay, Jung, & Park, 2014).

The evaluation of an agent's recommendation and the intention to use the agent is expected to be influenced by the sex representation of the virtual agent because such evaluations are heavily influenced by heuristics and schemata (Liew & Tan, 2018). In other words, if there is a sex similarity-attraction rule at play, users will heuristically judge the agent to be of a higher quality if the agent is of the same sex as themselves, and should have a more positive evaluation of the recommendation and have a higher intention to use the agent. On the other hand, if there is an existing stereotype that a virtual financial agent is more feminine or more masculine, then users will have a more positive evaluation of the recommendation and have a higher intention to use the female or male agent respectively. The following sets (H4a – c; H5a – c) of competing hypotheses are posited:

H4a: Both male and female users will have a stronger intention to use the fintech virtual agent if the representation of the agent is of the same sex as the user, as compared to an opposite-sex representation.

H4b: Both male and female users will have a stronger intention to use the fintech virtual agent if the representation of the agent is of the female sex as opposed to a male sex representation.

H4c: Both male and female users will have a stronger intention to use the fintech virtual agent if the representation of the agent is of the male sex as opposed to a female sex representation.

H5a: Both male and female users will have a more positive evaluation of the fintech virtual agent's recommendations if the representation of the agent is of the same sex as the user, as compared to an opposite-sex representation.

H5b: Both male and female users will have a more positive evaluation of the fintech virtual agent's recommendations if the representation of the agent is of the female sex as opposed to a male sex representation.

H5c: Both male and female users will have a more positive evaluation of the fintech virtual agent's recommendations if the representation of the agent is of the male sex as opposed to a female sex representation.

Mediation Mechanisms of Heuristic Evaluations

In the above sections, I identified the variables that are critical for studying human-agent interaction in fintech contexts and elaborated how these variables can be influenced by the sex representation of the agent. In sum, depending on the social rule that is relevant in this context (i.e. the sex similarity-attraction rule or the rule of sex-role stereotypes), users will have better or worse evaluations of the interaction experience and of the agent itself, triggered heuristically by the sex-representation of the virtual agent. Additionally, this paper seeks to distill the mechanisms through which these heuristic judgments operate by. While other research has investigated the effects of demographic variables in the human-agent interaction context (e.g. see

Beldad et al., 2016; Tay, Jung, & Park, 2014; Qiu & Benbasat, 2010), this paper seeks to advance the research by testing mediational pathways that underlie the heuristic processes.

Specifically, I hypothesize that the effect of sex representation of the virtual agent on the outcome-based evaluation variables are mediated by the perceived interaction experience quality, social judgment of the agent, and social presence. The nature of finance is inherently beset with uncertainty and occurs over a long time span—hence, in the context of financial advice and recommendations, it is often difficult for users to objectively and definitively assess the quality of a recommendation and decide whether they should use the fintech agent or not. Such evaluations are thus likely to be a composite of more proximal assessments that a user makes based on his or her direct experience of his or her interaction with the agent (i.e. the user's perceived quality of interaction experience and the perceived social presence), or the user's direct judgment based on a sensory perception of the agent (i.e. the user's social judgment of the agent). The following sets (H6a – c; H7a – c) of hypotheses are posited:

H6a: The user's perceived interaction experience quality with the fintech agent is positively associated with the user's intention to use the fintech agent.

H6b: The user's social judgment of the agent is positively associated with the user's intention to use the fintech agent.

H6c: The user's perceived social presence of the fintech agent is positively associated with the user's intention to use the fintech agent.

H7a: The user's perceived interaction experience quality with the fintech agent is positively associated with the user's positive evaluation of the fintech agent's recommendations.

H7b: The user's social judgment of the agent is positively associated with the user's positive evaluation of the fintech agent's recommendations.

H7c: The user's perceived social presence of the fintech agent is positively associated with the user's positive evaluation of the fintech agent's recommendations.

Additionally, I posit the following sets (H8a – c; H9a – c) of mediational hypotheses:

H8a: The user's perceived interaction experience quality mediates the interactive effect of the sex representation of the virtual agent and the sex of the user on the user's intention to use the agent.

H8b: The user's social judgment of the agent mediates the interactive effect of the sex representation of the virtual agent and the sex of the user on the user's intention to use the agent.

H8c: The user's perceived social presence of the virtual agent mediates the interactive effect of the sex representation of the virtual agent and the sex of the user on the user's intention to use the agent.

H9a: The user's perceived interaction experience quality mediates the interactive effect of the sex representation of the virtual agent and the sex of the user on the user's evaluation of the agent's recommendation.

H9b: The user's social judgment of the agent mediates the interactive effect of the sex representation of the virtual agent and the sex of the user on the user's evaluation of the agent's recommendation.

H9c: The user's perceived social presence of the virtual agent mediates the interactive effect of the sex representation of the virtual agent and the sex of the user on the user's evaluation of the agent's recommendation.

By investigating the mediating mechanisms, this research also investigates *how* the sex representation of the virtual agent or a match between the sex category of the user and the agent may affect the user's evaluation of the quality of recommendation and the user's intention to use the agent.

The entire conceptual diagram is presented in Figure 1.

Summary

In the literature review in chapter 2, I first elaborated on certain social-psychological theories that apply to interpersonal contexts. I elaborated on how people automatically engage in schematic processing and stereotyping according to the binary sex categories of male and female. I also elaborated on how people tend to like others who are similar to themselves, and how this can be explained from a social identification perspective. I also explained how sex categories can form a basis for social identification and similarity-attraction. These theories and principles were applied to the finance context to show how the financial industry can be placed in the intersection of masculine and feminine typologies, and how a similarity-attraction according to sex categories can also apply to buyer-seller relationships.

In chapter 3, I explained that people automatically apply social scripts to the HCI contexts, even though certain norms and standards may be different. I also provided some empirical evidence from the literature that shows that people engage in sex-typing and apply the similarity-attraction rule in HCI contexts. The literature review here shows that it is difficult to predict if which sex representation would be preferred for the design of a virtual fintech agent, or whether people will prefer a virtual fintech agent of the same sex category.

In chapter 4, I set out the concepts of interest and the constituting variables that are relevant to studying human-agent interaction in the fintech context. I detailed the

sets of competing hypotheses of the present research, which tests the competing rules of similarity-attraction or that of a sex-role stereotypes in the fintech context. I also put forward mediation hypotheses to advance the understanding of the mechanisms underlying heuristic processes during a fintech human-agent interaction.

CHAPTER 5: STUDY 1 METHOD

Design and Procedure

This research adopted a 2 (sex representation of virtual finance agent) × 2 (sex of user) between-subject experimental design. Participants were recruited from the staff and students of Nanyang Technological University in Singapore. After the first round of data collection, five male participants and three female participants were dropped because they failed the attention check (participants were asked the question: "was your virtual assistant male or female?" and participants who selected the incorrect gender option or the option "I don't remember" were dropped from the analysis). A second round of data collection was conducted to replace the dropped participants and to ensure that each condition had an equal number of participants. The final sample constitutes 124 participants (62 males, 62 females). The participants had an age range from 20 to 43 years, with a mean of 23.12 (SD = 2.87).

During the experiment, the virtual finance assistant was introduced as a conversational virtual assistant that could compute a personalized recommendation for the user based on the information that they provide about themselves. Then, the user was guided by the virtual assistant to go through three financial tasks: choosing a bank savings account, choosing a home loan plan, and choosing a life insurance policy. The virtual assistant asked for the user's information that was relevant to each task, such as their age, monthly income, and monthly expenditure etc. (see Appendix A). These three tasks were chosen as they are common financial tasks that currently engage the use of automated virtual advice. After the completion of each individual task, users were asked to fill in a feedback survey to evaluate the recommendation that was given by the agent. After the completion of all three tasks, users were directed to a post-test

questionnaire to evaluate their perceptions of the virtual assistant and the overall interaction.

Even though the users were told that the virtual assistant was AI-powered, in reality it was pre-programmed to provide the same generic recommendation to every user regardless of the information that they had provided about themselves. Details for each recommendation were adapted from existing financial products that were offered by commercial banks.

Stimuli

A full-body 2D cartoon image of the virtual financial assistant was displayed on the left of the conversation dialog box (see Appendix A). The male version of the assistant had a typically male short hairstyle and a typically male outfit of suit and pants; the female version had a typically female long hairstyle and a typically female outfit of a suit with a skirt. The male agent had slightly more masculine facial features (slightly thicker eyebrows and smaller eyes) as compared to the female agent. The male agent was given the name "Michael"; the female agent was given the name "Michelle".

The images of the male and female agents were pre-tested (n = 64; 32 male participants and 32 female participants) to ensure that they were comparable in terms of their perceived friendliness and physical attractiveness. Perceived friendliness was measured with the items "friendly", "approachable", and "warm", which were averaged into a composite scale (Cronbach's *alpha* = .94). Perceived physical attractiveness was measured with the items "physically attractive", "good-looking", and "nice-looking", which were averaged into a composite scale (Cronbach's *alpha* = .96). Participants were asked to rate the agents on the above adjectives on a 10-point scale, where 1 represents "not at all" and 10 represents "very much". Results showed

that the two agents were comparable in terms of their perceived friendliness ($M_{\text{male agent}}$ = 7.92, *SD* = 2.12; $M_{\text{female agent}}$ = 8.22, *SD* = 1.64; *p* = .53). However, the difference between the two agents in terms of perceived physical attractiveness approached significance ($M_{\text{male agent}}$ = 6.88, *SD* = 2.16; $M_{\text{female agent}}$ = 7.81, *SD* = 1.64, *p* = .055). Based on this result, I later controlled for the agent's perceived physical attractiveness in the main experiment.

Measures

All measures were rated on 10-point Likert scales, with 1 being "not at all" and 10 being "very much".

Social presence. Social presence was measured with a five-item scale adapted from Nass and Lee (2001): "While you were chatting with the virtual assistant, how much did you feel as if someone was talking to you?", "How involving was the whole chatting session?", "How much attention did you pay to what was being said?", "How much did you feel as if you were interacting with an intelligent being?", and "How much did you feel as if you and the virtual assistant were communicating with each other?". The items were averaged into a reliable scale (*M* = 5.87, *SD* = 1.77, Cronbach's *alpha* = .86).

Ease of interaction. The perceived ease of interaction was measured by asking participants to rate the interaction with the virtual agent on the following adjectives: "easy", "effortless", "comfortable", and "natural". This scale was adapted from Burgoon et al. (2016). The four items were averaged into a reliable scale (*M* = 7.45, *SD* = 1.62, Cronbach's *alpha* = .89).

Positive evaluation of interaction. This variable was measured with a five-item scale adapted from Burgoon et al. (2016): "The virtual assistant interacted in a way most people would find enjoyable", "The virtual assistant had a pleasant manner

of communicating", "The virtual assistant's way of interacting was desirable", "The virtual assistant interacted with me in a way I liked", and "The virtual assistant's behavior was appropriate". The items were averaged into a reliable scale (*M* = 6.96, *SD* = 1.73, Cronbach's *alpha* = .94).

Perceived competence of agent. The perceived competence of the agent was measured by asking participants to rate the virtual agent on the following adjectives: "competent", "expert", "intelligent", and "well-trained". This scale was adapted from McCroskey and Teven (1999). The four items were averaged into a reliable scale (*M* = 7.03, *SD* = 1.65, Cronbach's *alpha* = .92).

Perceived trustworthiness of agent. The perceived trustworthiness of the agent was measured by asking participants to rate the virtual agent on the following adjectives: "ethical", "genuine", "honest", and "trustworthy". This scale was adapted from McCroskey and Teven (1999). The four items were averaged into a reliable scale (*M* = 6.49, *SD* = 1.49, Cronbach's *alpha* = .85).

Perceived quality of recommendation. The perceived quality of recommendation was measured with the following items: "What was the quality of the recommendation given by the agent?", "How much do you trust the recommendation?", and "How likely are you to follow the recommendation?". As this variable was measured at the end of every individual task The three items were averaged across all three tasks into a reliable scale (*M* = 6.60, *SD* = 1.57, Cronbach's *alpha* = .77). This was the only variable that was measured at the end of every individual task. All other variables were measured once at the end of all three tasks.

Intention to use agent. The intention to use the agent was measured by asking participants to rate the virtual agent on how likely they are to do the following: "use it

for financial advice" and "recommend it to others". The two items were averaged into a reliable scale (M = 5.93, SD = 2.40, Spearman-Brown coefficient = .92).

A correlational analysis found that there were high correlations between ease of interaction and positive evaluation of interaction, and between perceived competence of agent and perceived trustworthiness of agent (see Table 1). Hence, in the subsequent analyses, the correlated variables were merged: the variables ease of interaction and positive evaluation of interaction were averaged to form a single index of perceived interaction experience quality; the perceived competence of agent and perceived trustworthiness of agent were averaged to form a single index of social judgment of agent.

Analytic Approach

As the difference in the perceived physical attractiveness of the male and female agents approached significance, I conducted a series of Analysis of Covariance (ANCOVA) controlling for the perceived physical attractiveness as a covariate. Perceived physical attractiveness was measured by asking participants to rate the agent on the item of "good-looking".

A series of full-factorial 2×2 between-subjects ANCOVA tests were conducted to test whether there was a similarity-attraction effect or just the main effect of a particular sex category of the agent (H1 – 5). A similarity-attraction effect would be detected by a significant interaction effect in the ANCOVA test, and further ascertained using post-hoc comparisons. A main effect of a particular sex category of the agent would be determined by a significant main effect of agent sex representation in the ANCOVA test. Table 2 shows the means and standard deviations for these dependent variables at the different experimental conditions, and the ANCOVA results.

Additionally, a series of regression models were used to measure the effects of the mediator variables on the outcome-based dependent variables (H6 – 7). All moderated mediation hypotheses (H8 – 9) were tested with Model 7 using PROCESS macro. However, when the moderated mediation index showed non-significant effects, I then tested for simple mediation as recommended (PROCESS Model 4, Hayes, 2013). The covariate of physical attractiveness was also included in the PROCESS Models.

CHAPTER 6: STUDY 1 RESULTS

Results—ANCOVA Tests of Manipulated Factors on Dependent Variables (H1 – H5)

For the first dependent variable, perceived interaction experience quality, the results show that there was a significant interaction effect between the agent sex representation and the user sex, F (1, 120) = 5.98, $p < .05$, $\eta^2 = .048$ (see Figure 2). Further post-hoc analysis of the interaction effect revealed that for the female agent, there was a significant effect of user gender, with female users perceiving higher ease of interaction as compared to male users, $M_{\text{male user}} = 6.61$, $SE = 0.271$; $M_{\text{female user}} = 7.86$, $SE = 0.271$, F (1, 119) = 10.76, $p < .01$, $\eta^2 = .083$. For the male agent, there was no significant effect of the user sex. This indicates that there was a similarity-attraction effect with the female agent, but not the male agent. Additionally, the covariate of perceived physical attractiveness of the agent had a marginally significant effect on the perceived interaction experience quality, F (1, 120) = 3.74, $p = .056$, $\eta^2 = .030$. In sum, H1a was partially supported and a similarity-attraction effect was found for the female agent with regards to users' perceived interaction experience quality; H1b and H1c were not supported.

For the second dependent variable, social judgment of agent, there was no significant interaction effect between the agent sex representation and the user sex, F (1, 120) = 1.09, $p = .30$, $\eta^2 = .009$. There was a significant main effect of agent sex representation, with female agents being judged more favorably as compared to male agents, $M_{\text{male agent}} = 6.36$, $SE = 0.192$; $M_{\text{female agent}} = 7.15$, $SE = 0.192$, F (1, 120) = 5.96, $p < .05$, $\eta^2 = .048$. There was also a significant covariate effect of perceived physical attractiveness of the agent, F (1, 120) = 10.25, $p < .002$, $\eta^2 = .079$. Here, H2b was supported while H2a and H2c were unsupported, which means that when it comes to

users' judgment of a fintech virtual agent, a female agent was judged to be more credible.

For the third dependent variable, social presence, the results show that there was a non-significant interaction effect between the agent sex representation and the user sex on social presence, F (1, 120) = 0.24, p = .63, η^2 = .002. Also, there was non-significant main effect of the agent sex representation, F (1, 120) = 0.25, p = .62, η^2 = .002. However, there was a significant main effect of user sex, with female users perceiving higher social presence as compared to male users, $M_{\text{male user}}$ = 5.49, SE = 0.217; $M_{\text{female user}}$ = 6.25, SE = 0.217, F (1, 120) = 6.07, $p < .05$, η^2 = .049. There was also a significant covariate effect of the perceived physical attractiveness of the agent, F (1, 120) = 5.87, $p < .05$, η^2 = .047. In sum, H3a, H3b, and H3c were all not supported.

For the fourth dependent variable, intention to use agent, there was no significant interaction effect between the agent sex representation and the user sex, but there were significant main effects of both the user sex and the agent sex representation. Female users (M = 6.41, SE = 0.288) have a significantly higher intention to use the agent as compared to male users (M = 5.44, SE = 0.288), F (1, 120) = 5.69, $p < .05$, η^2 = .046. Also, users have a higher intention to use female agents (M = 6.52, SE = 0.291) as compared to male agents (M = 5.34, SE = 0.291), F (1, 120) = 7.90, $p < .01$, η^2 = .062. There was no significant covariate effect. In sum, H4b was supported while H4a and H4c were unsupported; a female fintech virtual agent is associated with a stronger intention to use the fintech agent as opposed to a male fintech virtual agent.

Finally, results for the fifth dependent variable, perceived quality of recommendation, showed no significant interaction effects or significant main effects

of user sex or agent sex representation. There was, however, a significant covariate effect, F (1, 120) = 9.25, $p < .01$, $\eta^2 = .072$. H5a, H5b, and H5c were all not supported.

All results from the above ANCOVA tests are displayed in Table 2.

Results—Regression Models Testing Effects of Mediators (H6 – 7)

I posited that the users' perceived interaction experience quality (H6a), the user's social judgment of the agent (H6b), and the user's perceived social presence of the fintech agent (H6c) would be positively associated with the user's intention to use the agent. Indeed, the perceived interaction experience quality was positively associated with the intention to use the agent ($b = .84$, $p < .001$; H6a supported), the social judgment of the agent ($b = 1.01$, $p < .001$; H6b supported), and the social presence of the agent ($b = .73$, $p < .001$; H6c supported).

Similarly, I also posited that the users' perceived interaction experience quality (H7a), the user's social judgment of the agent (H7b), and the user's perceived social presence (H7c) of the fintech agent would be positively associated with the user's perceived quality of the agent's recommendations. As expected, the perceived interaction experience quality was positively associated with the perceived quality of the agent's recommendations ($b = .62$, $p < .001$; H7a supported), the social judgment of the agent ($b = .76$, $p < .001$; H7b supported), and the social presence of the agent ($b = .47$, $p < .001$; H7c supported).

Results—PROCESS Models Testing Mediational Processes (H8 – 9)

I posited that the user's perceived interaction experience quality (H8a), the user's social judgment of the agent (H8b), and the perceived social presence of the agent (H8c) will mediate the interactive effect of the sex representation of the virtual agent and the sex of the user on the user's intention to use the agent.

Using the PROCESS Model 7 for testing moderated mediation, I found significant interaction between the sex representation of the virtual agent and the sex of the user (b = 1.32, p < .05). Similar to the ANCOVA test results for H1, further probing of the interactions show that there is a marginally significant difference in perceived interaction experience quality when the agent is female (b = 0.714, p = .068), whereas there the difference is not significant when the agent is male (b = 0.604, p = .119). Results for the conditional indirect effects through perceived interaction experience quality were marginally significant when both the agent and the user are female (b = –.589, Boot SE = .30, 95% Boot CI = [–1.21, 0.01], but non-significant when the agent was female and the user was male (b = .499, Boot SE = .37, 95% Boot CI = [–0.19, 1.27]. This difference was statistically significant (*Index* = 1.09, Boot SE = .47, 95% CI = [0.21, 2.04]). H8a is thus supported; the user's perceived interaction quality mediates the partial similarity-attraction effect found with the female agent on the user's intention to use the agent (see Figure 3).

In the sections above, the results for H2 indicate that there was a main effect of the sex representation of the virtual agent on the user's social judgment of the agent. Since there was no interaction in this case, Model 4 of the PROCESS macro was used to test H8b. Results show that the user's social judgment of the agent does mediate the positive effect of the female sex representation of the agent on the user's intention to use the agent ($b_{indirect\ effect}$ = 0.63, Boot SE = .28, 95% CI = [0.11, 1.21]. H8b was supported (see Figure 4).

Following the results for H3, since there were no interaction effects nor main effects of the sex representation of the agent found on the variable of social presence, I did not examine mediation effects through social presence.

Similarly, I also posited that the user's perceived interaction experience quality (H9a), the user's social judgment of the agent (H9b), and the perceived social presence of the agent (H9c) will mediate the interactive effect of the sex representation of the virtual agent and the sex of the user on the user's perceived quality of the agent's recommendations.

Again, I used the PROCESS Model 7 for moderated mediation to test H9a, where the significant interaction effects found between the sex representation of the agent and the sex of the user on the perceived interaction experience quality were repeated from the results from H8a. Results for the conditional indirect effects through perceived interaction experience quality were significant when both the agent and the user are female (b = –.426, Boot SE = .22, 95% Boot CI = [–0.88, –0.02], but non-significant when the agent was female and the user was male (b = .361, Boot SE = .26, 95% Boot CI = [–0.14, 0.90]. This difference was statistically significant (*Index* = 0.79, Boot SE = .35, 95% CI = [0.14, 1.53]). H9a is supported and the user's perceived interaction quality mediates a similarity-attraction effect of the sex category of the agent and the user on the user's perceived quality of the agent's recommendation (see Figure 3).

Again, since there were no interaction effects of the sex representation factors found on the user's social judgment of the agent, Model 4 of the PROCESS macro was used to test H9b. Results show that the user's social judgment of the agent does mediate the positive effect of the female sex representation of the agent on the user's perceived quality of the agent's recommendations ($b_{indirect\ effect}$ = 0.45, Boot SE = .21, 95% CI = [0.07, 0.89]. H9b was supported (see Figure 4).

Also, following the results for H3, since there were neither interaction effects nor main effects of the sex representation of the agent found on the variable of social presence, I did not examine mediation effects through social presence.

CHAPTER 7: STUDY 1 DISCUSSION

This study extends the CASA paradigm, sex-typing, and the principle of similarity-attraction to the context of fintech services, investigating how the effects of agent sex representation and user sex may interplay in affecting user experience in fintech human-agent interaction. This study was motivated by two purposes. One, to conduct a critical test of which social rule applies to human-agent interaction in the fintech services context. As such, I had posited sets of three competing hypotheses that: a) there will be a sex similarity-attraction effect, b) users will prefer a female fintech virtual agent, or c) users will prefer a male fintech virtual agent, as assessed based on the dependent variables of social presence, perceived interaction experience quality, social judgment of the agent, intention to use the agent, and perceived quality of the agent's recommendations. The second purpose was to put forward mediation mechanisms through which a user's heuristic evaluations occur. In doing so, I had argued that the two important evaluation outcomes are the user's intention to use the fintech agent and the user's perceived quality of the agent's recommendation, and that these evaluations occur through more proximal judgments, i.e. perceived interaction experience quality, social judgment of the agent, and perceived social presence of the agent. In this section, I discuss the results in relation to these two motivating purposes.

Critical Test of Social Rules

Overall, results show that users had more positive evaluations towards female fintech virtual agents as opposed to male ones. Users judged that the female agent was more competent and trustworthy as compared to the male agent, rated the female agent's recommendations more positively and also had a higher intention to use the female agent as compared to the male agent. These results indicate that in the context of fintech human-agent interaction, the schema of sex-typing is automatically

triggered, and people show a preference towards the female sex stereotype. While the fintech service industry seem to be at an intersection where both feminine traits and masculine traits have a part to play, results show that users ultimately perceive that the female sex-role type is more suitable for a fintech agent.

While there was some indication of a similarity-attraction effect on the user's perceived interaction experience quality with the female agent, the results show that generally, there is no similarity-attraction effect at play. One explanation could be that similarity-attraction is most important in situations of friendship-building or other contexts of developing social relationships (e.g. Byrne, 1997; Eder & Hallinan, 1978), and may not be so relevant to the context of financial advice—the focus of this study. In the literature of advice-giving, researchers have found that similarity-attraction may play a role in trusting advice regarding subjective issues that concerns tastes and value judgments, but not for advice regarding issues that have demonstrably correct answers (van Swol, 2011). In the context of financial decisions, optimal solutions can be demonstrated quantitatively (Gort & Gerber, 2008), and one of the reasons why users opt for virtual financial advisors over human ones is to avoid subjective human biases in financial recommendations (Abraham, Schmukler, & Tessada, 2019). Since users are looking for a virtual assistant that can give sound financial advice that is objectively correct, a similarity to the agent would not confer any benefit. Instead, users would want advice from an agent whom they perceive as a suitable expert for the task at hand, which the results show would be a female agent.

Yet, the results do show some indication of a similarity-attraction effect on the user's perceived interaction experience quality. In other words, while users generally attribute the female sex-role type to a fintech virtual agent and trust a female agent more for financial advice, there is still some similarity-attraction at play in terms of

how users perceive the ease and pleasantness of interaction with a female agent. This result contributes to the theory of similarity-attraction in HCI, where past studies have found effects of similarity-attraction mainly on internal traits such as personality (e.g., Nass & Lee, 2001; Tapus et al., 2008), and the past findings of similarity-attraction in terms of sex categories have been mixed (e.g. Beldad et al., 2016; Pentina, 2010; Qiu & Benbasat, 2010).

However, this study is not conclusive on why only female agents induce a perception of an easier and more pleasant experience from female users, but such a similarity-attraction effect was not present for male agents. One possible reason could be that women tend to have a greater need for affiliation (Drescher & Schultheiss, 2016) and thus also expect other women to be more affiliative, hence female users felt more at ease interacting with the female agent. Indeed, there is some evidence of women benefiting more from affiliation in a single-gender therapy group as opposed to a mixed-gender therapy group (Valeri et al., 2018). Further research is needed to better investigate this phenomenon.

Assessment of Mediation Mechanisms

Indeed, results have shown that the three proposed mediators (perceived interaction experience quality, social judgment of the agent, and perceived social presence of the agent) are strong predictors of a user's intention to use the fintech agent and the user's perceived quality of the agent's recommendations. Mediation analyses show that perceived interaction experience quality mediates the interactive effect between the sex of the agent and the user on the outcome variables of intention to use and perceived quality of the agent's recommendation, while the social judgment of the agent mediates a main positive effect of the female representation of the agent on the two outcome variables. There is no mediational pathway through social

presence as the sex of the agent had no effect on the perceived social presence of the agent.

The results show that to drive adoption of a fintech chatbot, designers should take note of the interaction quality, users' social judgment of the agent, and the social presence of the agent. While it was found that the sex representation of the agent had no effect on social presence, there is a large body of research on how designers can increase the social presence of virtual agents, for instance by making the virtual agent more vivid by adding a realistic voice or animations (Lee, 2004). Hence, by adding these features, designers can make the agent more socially authentic and salient for users, which increases positive evaluation of the agent's recommendations and drives intention to use.

Limitations of Study 1 and Extensions in Study 2

In this study, I only explored sex category as manifested through the appearance of the agent. This method allowed us to focus on the most obvious display of gender, which is through the outward appearance of a character. However, gender (as referring to the social constructions based on sex categories) is also displayed through the interactions between people, as essentialized expressions of femininity and masculinity (Goffman, 1976; West & Zimmerman, 1987). One way of expressing femininity and masculinity is through the way an individual converses with others. In Study 1, the conversation style used by the agents was controlled for and was deliberately crafted to be neutral in expression and devoid of any masculine or feminine tones. Hence, in this investigation of similarity-attraction or role typing based on sex categories, there was only an *implicit* association to the gendered traits that pertains to each sex category. For instance, when users gave better evaluations of the female agent, I assumed that it was because the outward sex representation

triggered the schema of stereotypically feminine traits, which users deemed more appropriate for fintech virtual agents.

Study 2 aims to overcome this limitation by explicitly manifesting the stereotypically feminine and masculine traits through the conversation style of the agents. Men and women are associated with different stereotypical traits, where men are expected to be more agentic and women are expected to be more communal (Bakan, 1966; Spence & Helmreich, 1978, 1980), and these expectations also apply to the way that men and women speak. By manipulating masculinity and femininity through conversation styles, Study 2 can explicitly test if people indeed prefer a fintech virtual agent to express feminine-communal traits over masculine-agentic ones. In doing so, Study 2 also explores a more holistic conceptualization of gender of the virtual agent.

Additionally, Study 2 extends this research to test another social rule that is commonly used in HCI: the consistency-attraction principle. In Study 1, I have found that users have a general preference towards the female representation of the virtual agent. Study 2 aims to answer the question of whether users will prefer a feminine conversation style regardless of the sex representation of the agent, or whether users will prefer the conversation style to be consistent with the sex representation of the agent.

Furthermore, as chatbots are increasingly being designed with personality traits to appeal to customers (Bennett, 2018), adding expressions of masculinity or femininity to the experimental stimuli also serves to increase the external validity of this research.

CHAPTER 8: STUDY 2

Gendered Conversation Styles and the Consistency-Attraction Principle

As natural language abilities of computers are getting more advanced, chatbot designers are increasingly keen on adding personality traits and more social conversational styles in chatbot scripts. Research has also shown that a more social style of conversing can improve people's trust towards conversational agents, particularly for users who are more extroverted (Bickmore & Cassell, 2001). This indicates that it can be advantageous for designers to incorporate certain personality traits into the conversational scripts of virtual agents.

There are clear differences in the use of language by men and women. Gendered language differences have been found across various contexts. For instance, in dyads, men were found to interrupt more and use more directives, whereas women were found to ask more questions and use more personal pronouns (Mulac, Wiemann, Widenmann, & Gibson, 1988). These differences have also been found in written texts and written art forms, such as books, poems, and song lyrics (Newman, Groom, Handelman, & Pennebaker, 2008), where women were found to use more social words and refer to emotions more, among other differences. Such gendered language differences also manifest in computer-mediated communication contexts (Schwartz et al., 2013; Thomson & Murachver, 2001). The wide-ranging evidence demonstrates that there are clear gender norms in language use, which should also apply to gendered conversational agents given that people do apply sex stereotypes to computers (Reeves & Nass, 1996).

People prefer to interact with others who behave in a consistent manner as compared to people to behave in an inconsistent manner. People who behave in manners consistent with what is expected of them reduces cognitive load as consistent

behaviors are more predictable than inconsistent ones, which makes social interaction easier and thus more pleasant (Fiske & Taylor, 1991). This phenomenon is known as the consistency-attraction principle (Field, 1994; Thomas & Johnston, 1981). Past studies under the CASA paradigm have also found that the consistency-attraction principle applies to human-computer interactions. For instance, Nass & Lee (2001) found that users prefer interacting with computers with a voice personality that matches its text personality, as compared to computers with a voice personality that does not match its text personality.

In the present study, I investigate if the consistency-attraction principle also applies to the context of sex-related norms enacted by virtual fintech agents. In the context of this study, there are two sources of expectations for the norms of language use: first, the sex representation of the agent and second, the sex-type association (i.e. masculine-oriented or feminine-oriented) of the industry. In other words, users may have the expectation of a male virtual agent to converse in a masculine way and a female virtual agent to converse in a feminine way. However, on the other hand, users may also have the expectation of both the male and female virtual agents to converse in feminine way because the service economy is more associated with femininity (Cameron, 2000). In this scenario, the consistency-attraction hypothesis would not hold.

Hence, I pose the following sets of competing hypotheses, following the theoretical framework and dependent variables of Study 1. The entire conceptual diagram for Study 2 is displayed in Figure 5.

Hypotheses

Perceived interaction experience quality—ease and positive evaluation of interaction. H1a: A consistent match between the conversation style with the sex

representation of the agent (i.e. female agent with feminine conversation style/male agent with masculine conversation style) will be associated with a more positive perceived interaction experience quality as opposed to a complementary match between the conversation style with the sex representation of the agent (i.e. female agent with masculine conversation style/male agent with feminine conversation style).

H1b: A feminine conversation style will be associated with a more positive perceived interaction experience quality regardless of the sex representation of the agent.

Social judgment of agent—competence and trustworthiness. H2a: A consistent match between the conversation style with the sex representation of the agent (i.e. female agent with feminine conversation style/male agent with masculine conversation style) will be associated with a more positive social judgment as opposed to a complementary match between the conversation style with the sex representation of the agent (i.e. female agent with masculine conversation style/male agent with feminine conversation style).

H2b: A feminine conversation style will be associated with a more positive social judgment regardless of the sex representation of the agent.

Social presence. H3a: A consistent match between the conversation style with the sex representation of the agent (i.e. female agent with feminine conversation style/male agent with masculine conversation style) will be associated with greater social presence of the agent as opposed to a complementary match between the conversation style with the sex representation of the agent (i.e. female agent with masculine conversation style/male agent with feminine conversation style).

H3b: A feminine conversation style will be associated with a greater social presence of the agent regardless of the sex representation of the agent.

Outcome-based evaluation—quality of recommendation and intention to use. H4a: A consistent match between the conversation style with the sex representation of the agent (i.e. female agent with feminine conversation style/male agent with masculine conversation style) will be associated with a stronger intention to use the agent as opposed to a complementary match between the conversation style with the sex representation of the agent (i.e. female agent with masculine conversation style/male agent with feminine conversation style).

H4b: A feminine conversation style will be associated with a stronger intention to use the agent regardless of the sex representation of the agent.

H5a: A consistent match between the conversation style with the sex representation of the agent (i.e. female agent with feminine conversation style/male agent with masculine conversation style) will be associated with a more positive evaluation of the agent's recommendations as opposed to a complementary match between the conversation style with the sex representation of the agent (i.e. female agent with masculine conversation style/male agent with feminine conversation style).

H5b: A feminine conversation style will be associated with a more positive evaluation of the agent's recommendations regardless of the sex representation of the agent.

Mediation mechanisms of heuristic evaluations. H6a: The user's perceived interaction experience quality mediates the effect of the conversation style of the agent on the user's intention to use the agent.

H6b: The user's social judgment of the agent mediates the effect of the conversation style of the agent on the user's intention to use the agent.

H6c: The user's perceived social presence of the virtual mediates the effect of the conversation style of the agent on the user's intention to use the agent.

H7a: The user's perceived interaction experience quality mediates the effect of the conversation style of the agent on the user's evaluation of the agent's recommendation.

H7b: The user's social judgment of the agent mediates the effect of the conversation style of the agent on the user's evaluation of the agent's recommendation.

H7c: The user's perceived social presence of the virtual mediates the effect of the conversation style of the agent on the user's evaluation of the agent's recommendation.

The entire conceptual diagram for Study 2 is displayed in Figure 5.

Design and Procedure

The experimental set-up for Study 2 was exactly the same as that of Study 1, except for the manipulation of conversation scripts. In Study 2, instead of using the same conversation script for all conditions, a masculine and a feminine version of the script were used.

Following the results from Study 1, where generally no similarity-attraction effects were found, the factor of user sex was dropped in Study 2 so as to streamline the study design and the interpretation of results. Thus, Study 2 adopted a 2 (sex representation of virtual finance agent) × 2 (masculinity or femininity of conversation style) randomized between-subject experimental design. Participants were recruited from the staff and students of Nanyang Technological University in Singapore. Three participants were dropped as they failed the attention check (participants were asked the question: "was your virtual assistant male or female?" and participants who selected the incorrect gender option or the option "I don't remember" were dropped from the analysis); one participant was dropped due to straight-lining. The final

sample constitutes 216 participants (108 males, 108 females). The participants had an age range from 19 to 46 years, with a mean of 23.07 (*SD* = 2.91).

Stimuli

The masculine script was designed to display more agentic traits, such as greater dominance and reference to independence and individuality. The feminine script was designed to display more communal traits, such as being helpful and caring. Additionally, the feminine script used more emotive words and emojis, and also contained more exclamation marks as compared to the masculine script. Excerpts of the masculine and feminine scripts are displayed in Table 3.

The scripts were pre-tested (*n* = 24) to ensure that they were indeed perceived to be different with regards to their level of masculinity and femininity, yet comparable with regards to other controlled traits. The masculinity scale comprised the items "acts as a leader", "aggressive", "ambitious", "assertive", "dominant", and "masculine" (*M* = 5.18, *SD* = 1.31, Cronbach's *alpha* = .78). The femininity scale comprised the items "affectionate", "compassionate", "feminine", "gentle", "sensitive to others' needs", and "warm" (*M* = 6.10, *SD* = 1.48, Cronbach's *alpha* = .79). The masculinity and femininity scale were adapted from Bem's sex-role inventory (Bem, 1974). Participants were asked to rate the agents on the above adjectives on a 10-point scale, where 1 represents "not at all" and 10 represents "very much". Results showed that indeed, the masculine script is rated to be more masculine as compared to the feminine script ($M_{\text{masculine script}}$= 5.75, *SD* = 0.986; $M_{\text{feminine script}}$ = 4.61, *SD* = 1.37; *p* = .029) and the feminine script is rated to be more feminine as compared to the masculine script ($M_{\text{masculine script}}$ = 5.17, *SD* = 1.27; $M_{\text{feminine script}}$ = 7.01, *SD* = 1.06; *p* = .001). The two scripts were also found to be comparable on the controlled traits of "good-mannered" ($M_{\text{masculine script}}$= 7.33, *SD* = 1.826; $M_{\text{feminine script}}$ = 8.17, *SD* = 1.27; *p*

= .21), "competent" ($M_{\text{masculine script}}$= 6.33, *SD* = 1.231; $M_{\text{feminine script}}$ = 7.17, *SD* = 1.27; *p* = .12), "knowledgeable" ($M_{\text{masculine script}}$= 7.25, *SD* = 1.42; $M_{\text{feminine script}}$ = 7.17, *SD* = 1.64; *p* = .90), "professional" ($M_{\text{masculine script}}$= 7.58, *SD* = 1.83; $M_{\text{feminine script}}$ = 7.5, *SD* = 2.15; *p* = .92), and "reliable" ($M_{\text{masculine script}}$= 6.83, *SD* = 1.56; $M_{\text{feminine script}}$ = 6.92, *SD* = 1.44; *p* = .89). However, the feminine script was rated to be more "sincere" as compared to the masculine script ($M_{\text{masculine script}}$= 5.08, *SD* = 2.23; $M_{\text{feminine script}}$ = 7.42, *SD* = 1.78; *p* = .01). The results should thus be interpreted with this in mind.

Analytic Approach

The measures used in Study 2 were the same as those used in Study 1, and the analytical method is also similar to that used in Study 1, i.e. a series of 2 (agent sex representation) × 2 (conversation style) ANCOVA tests and mediation analyses were conducted. Similar to Study 1, the perceived physical attractiveness of the agent was controlled for in all analyses as a covariate.

In addition, participants' gendered traits were assessed using the same masculinity and femininity scales that were used to assess the virtual agents' scripts. The ANCOVA and mediation analyses also controlled for the participants' gendered traits to avoid any confounding effects that could be caused by a similarity-attraction in terms of masculine or feminine traits.

CHAPTER 9: STUDY 2 RESULTS AND DISCUSSION

Results—ANCOVA Tests of Manipulated Factors on Dependent Variables (H1 – H5)

For the first dependent variable, perceived interaction experience quality, the results show that there was no interaction effect between the conversation style and the sex presentation of the agent. However, there was a significant main effect of the female conversation style, F (1, 209) = 6.89, $p < .01$, $\eta^2 = .032$. This means that a feminine conversation style is associated with a more positive perceived interaction experience quality regardless of the sex representation of the agent (H1b supported), whereas the consistency-attraction hypothesis (H1a) was not supported. Additionally, the covariate of perceived physical attractiveness of the agent had a significant effect on the perceived interaction experience quality, F (1, 209) = 57.80, $p < .001$, $\eta^2 = .217$.

For the second dependent variable, social judgment of the agent, the results show that there was no interaction effect between the conversation style and the sex representation of the agent. There was also no significant main effect of the conversation style. There was, however, a significant covariate effect of perceived physical attractiveness of the agent, F (1, 209) = 78.62, $p < .001$, $\eta^2 = .273$. Thus, the sex representation of the agent and the conversation style did not influence how users judge the competence and trustworthiness of the agent (H2 not supported).

For the third dependent variable, social presence of the agent, the results show that there was no interaction effect between the conversation style and the sex presentation of the agent. However, there was a significant main effect of the female conversation style, F (1, 209) = 3.96, $p < .05$, $\eta^2 = .018$. This means that the consistency-attraction hypothesis (H3a) was not supported; results show that a

feminine conversation style is associated with stronger perceived social presence regardless of the sex representation of the agent (H3b supported). Additionally, the covariate of perceived physical attractiveness of the agent had a significant effect on the perceived social presence, F (1, 209) = 53.02, $p < .001$, $\eta^2 = .202$.

For the fourth dependent variable, the user's intention to use the agent, the results show that there was no interaction effect between the conversation style and the sex presentation of the agent. However, there was a marginally significant main effect of the female conversation style, F (1, 209) = 3.60, $p = .056$, $\eta^2 = .017$. This means that the consistency-attraction hypothesis (H4a) was not supported, but a feminine conversation style is marginally associated with stronger intention to use the agent regardless of the sex representation of the agent (H4b supported). Additionally, the covariate of perceived physical attractiveness of the agent had a significant effect on the user's intention to use the agent, F (1, 209) = 28.86, $p < .001$, $\eta^2 = .121$.

For the final dependent variable, the user's evaluation of the agent's recommendations, the results show that there was no interaction effect between the conversation style and the sex presentation of the agent. There was also no significant main effect of the conversation style. There was, however, a significant covariate effect of perceived physical attractiveness of the agent, F (1, 209) = 14.33, $p < .001$, $\eta^2 = .064$. Thus, the sex representation of the agent and the conversation style did not influence how users evaluate the quality of the agent's recommendations (H5 not supported).

All results from the above ANCOVA tests are displayed in Table 4.

Results—PROCESS Models Testing Mediational Processes (H6 – 7)

I posited that the user's perceived interaction experience quality (H6a), the user's social judgment of the agent (H6b), and the perceived social presence of the

agent (H6c) will mediate the effect of the conversation style of the virtual agent on the user's intention to use the agent. Results of the ANCOVA tests above have demonstrated that there is no interaction between the conversation style and the sex representation of the agent. In such cases where there are no interactions, I used PROCESS Model 4 to test for simple mediation, as advised by Hayes (2013).

Results show that the user's perceived interaction experience quality does mediate a positive effect of the feminine conversation style on the user's intention to use the agent ($b_{indirect\ effect}$ = 0.37, Boot *SE* = .15, 95% *CI* = [0.09, 0.69]. H6a was supported (Figure 6).

Following results for H2, since the conversation style of the agent had no effect on the user's social judgment of the agent, I did not examine mediation effects through the user's social judgment of the agent. H6b was not supported.

For H6c, the social presence of the agent does mediate a positive effect of the feminine conversation style on the user's intention to use the agent ($b_{indirect\ effect}$ = 0.26, Boot *SE* = .13, 95% *CI* = [0.01, 0.53]. H6c was supported (Figure 7).

Similarly, I posited that the user's perceived interaction experience quality (H7a), the user's social judgment of the agent (H7b), and the perceived social presence of the agent (H7c) will mediate the effect of the conversation style of the virtual agent on the user's evaluation of the quality of the agent's recommendations.

Results show that the user's perceived interaction experience quality does mediate a positive effect of the feminine conversation style on the user's evaluation of the quality of the agent's recommendations ($b_{indirect\ effect}$ = 0.26, Boot *SE* = .11, 95% *CI* = [0.07, 0.50]. H7a was supported (Figure 6).

Following results for H2, since the conversation style of the agent had no effect on the user's social judgment of the agent, I did not examine mediation effects through the user's social judgment of the agent. H7b was not supported.

For H7c, the social presence of the agent does mediate a positive effect of the feminine conversation style on the user's evaluation of the quality of the agent's recommendations ($b_{indirect\ effect}$ = 0.17, Boot *SE* = .09, 95% *CI* = [0.06, 0.34]. H7c was supported (Figure 7).

Discussion

Study 2 was conducted to explicitly test the assumption from Study 1 that users associate a fintech virtual agent with feminine-communal traits. Study 2 also extends the research in Study 1 to test another social rule in the context of fintech human-agent interaction: the consistency-attraction rule. Also, following the trend of chatbots being designed with more personality (Bennett, 2018), Study 2 seeks to increase the external validity of this research by investigating chatbots with a feminine or masculine conversation style as a manifestation of personality.

Overall, results indicate that regardless the sex representation of the agent, users tend to prefer a feminine-communal conversation style. This indicates that indeed, users associate a fintech virtual agent with feminine-communal traits. In fact, when the feminine conversation style was introduced into the stimuli, the mere sex representation of the agent no longer had a significant effect on the dependent variables. This shows that the user's experience and evaluations of the agent is not shaped by the sex representation of the agent per se, but by the gendered traits that is conveyed by the agent, either through the conversation style (as in Study 2), or through the sex representation of the agent if no other social cues are available (as was the case in Study 1).

The absence of interaction effects between the sex representation of the agent and the conversation style of the agent also indicates that there is no consistency-attraction rule at play in this fintech human-agent interaction context, at least in terms of consistency between sex representation and conversation style. There are two possible reasons for this. The first is that with increasing representation of women in society, people no longer subscribe to gender stereotypes as strongly as before, and thus do not have a strong expectation for gendered characters to follow masculine or feminine conversation styles. Indeed, recent research has shown that people have greater acceptance of agentic behaviors from women. Research comparing gender stereotypes in 1983 to those in 2014 has shown that while not statistically significant, there is a trend of reduced gender differences on agentic traits (Haines, Deaux, & Lofaro, 2016). Other research has also found that women leaders who displayed assertive speech were as likeable and influential as men who displayed assertive speech (Bongiorno, Bain, & David, 2013). Thus, changing societal norms may be a reason why the consistency-attraction rule did not manifest in this study.

The other possible reason is that people do not hold virtual agents to such strict standards of gendered speaking norms. Indeed, recent HCI studies have shown that users engage in gendered communicative behaviors to a lesser degree when conversing with a virtual agent as opposed to when chatting with an actual person (e.g., Mou et al., 2019). This suggests that users may not have such high expectations for virtual agents to abide by gendered communicative norms, and thus there is no strong consistency-attraction rule in terms of gendered communicative norms in a human-agent interaction context.

Further discussion on the implications and limitations of both Study 1 and Study 2 as a whole will be elaborated in the next section.

CHAPTER 10: GENERAL DISCUSSION AND CONCLUSION

Overall Theoretical Implications

In the nascent field of human-agent interaction in fintech, and at this time where societal norms regarding sex and gender are changing, it is unclear what types of social rules apply. Thus, a main objective of this research is to conduct critical tests on the social rules that apply. In Study 1, results suggested that users perceive that a female representation is more suitable for a virtual fintech agent, and that there isn't a strong similarity-attraction effect in terms of the sex categories between the agent and the user. In Study 2, I extended the research to test another social rule: the consistency-attraction rule. Overall, results indicate that users prefer a fintech virtual agent to be designed with feminine-communal traits: in Study 1, people preferred a female representation of the virtual agent, while Study 2 showed that people preferred a feminine conversation style for the virtual agent. This preference for feminine-communal traits indicates that people primarily associate a fintech chatbot as taking on a communal, other-oriented service role, as opposed to an assertive and influential advice-giver. Hence, while human-agent interactions are not exactly equivalent to human to human interactions (Edwards et al., 2017; Mou et al., 2019), people do apply social scripts and schemata in their interactions with a virtual fintech agent, as evinced by the findings that social cues such as a female representation of the agent and a feminine-communal conversation style inform an individual's evaluations and intention to use the virtual agent. In sum, this research further confirms the CASA framework, and sheds additional clarity on the specific social rules that apply to a fintech human-agent interaction.

Practical Design Implications

An interesting point to note is that the covariate of perceived physical attractiveness was consistently a significant predictor of user evaluation dependent variables and the user's intention to use the virtual agent. This means that it is important for designers to consider the aesthetic appeal of their virtual agents. Since the perceived physical attractiveness of an agent is subjective and may be unique to different cultural, generational, and social groups, chatbot designers can benefit from putting in more thought about the designs of their virtual agent to be physically attractive to their target users.

The results suggest that users have better user experience when using a female virtual fintech agent, especially when the conversation style lacks social cues; but if the conversation style has obvious feminine cues, the sex representation of the agent does not have an effect on user experience. Practically, this means that if the virtual agent has a basic and neutral conversation script, then the virtual agent should be designed as a female character. However, taking into consideration that the widespread use of female characters as virtual service agents may propagate negative stereotypes (Clark, 2018; Hempel, 2015), it might be more socially responsible for designers to incorporate feminine-communal characteristics in the conversation scripts of the virtual agent instead of the outward representation of the agent. A feminine and communal conversation style would sufficiently ensure that the customer is satisfied with the experience with the virtual agent, and ideally, these service agents can be represented by a diversity of genders and ethnicity so as not to replicate existing biases and prejudices in society (Hannon, 2018).

Limitations

Despite the theoretical and practical contributions of the two studies in this project, there are several limitations to note. First, the experiments were conducted in a university computer laboratory and the experimental stimuli were developed specifically for the study. While designers and developers were hired to make the experimental stimuli as professional-looking as possible, and the financial recommendations were adapted from existing financial products offered by large banks, there would still be artificiality in such a controlled experimental setting. While controlled experiments ensure internal validity, this may affect the external generalizability of the results. Furthermore, the participants of these studies were recruited from a university and consists mainly of students, who may not have sufficient experience with financial advisors or be at the life stage where they have to think about financial products such as home mortgage loans or life insurance policies. Older adults who have greater involvement with such financial decisions may have different and stronger opinions about their preferred virtual financial advisor. Future studies with a more general population should be conducted to improve the generalizability of the results.

Second, this research used self-reports of user evaluations and intention to buy as a proxy to assess the likelihood of people's actual adoption if the virtual agent were to be released commercially. However, self-reports of intention may not accurately predict actual behavior as intentions may change over time (Sun & Morwitz, 2010). Future experimental designs can use products that are available commercially and incorporate a longitudinal design to measure participants' actual adoption behavior.

Finally, social norms and expectations are always in flux and may change with developments in social trends and advancements in chatbot technologies (e.g.,

Bennett, 2018; Hannon, 2018). Natural language processing capabilities are also evolving quickly, and users may grow to have different expectations of the conversation styles that chatbots use. As such, the results from this research are not meant to be conclusive about a general law of how users evaluate virtual agents; the human-agent interaction research field has to continue studying such technologies as they evolve to better understand the social rules that apply.

Conclusion

This master's thesis consists of two studies that empirically demonstrate that users prefer feminine characteristics for a fintech virtual agent. However, this study does not make any value judgment on whether designing a virtual agent to embody feminine characteristics is right or wrong. As previously discussed, technology designers have a social responsibility to design virtual agents that do not propagate existing biases and negative stereotypes. The empirical findings from this study can inform the design process to achieve a fair representation of different demographic groups in virtual agents while ensuring customer satisfaction.

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TABLES AND FIGURES

Table 1. Correlations among the dependent variables (Study 1).

	Social presence of agent	Ease of interaction	Positive evaluation of interaction	Competence of agent	Trustworthiness of agent	Intention to use agent	Quality of recommendation
Social presence of agent	-	.56*	.61*	.46*	.59*	.56*	.55*
Ease of interaction	-	-	.74*	.49*	.55*	.47*	.50*
Positive evaluation of interaction	-	-	-	.60*	.63*	.57*	.67*
Competence of agent	-	-	-	-	.79*	.64*	.69*
Trustworthiness of agent	-	-	-	-	-	.58*	.67*
Intention to use agent	-	-	-	-	-	-	.69*

*$p < .01$.

Table 2. *Unadjusted means and unadjusted standard deviations of dependent variables, and ANCOVA results (Study 1).*

	*M*s and *SD*s				*F* values and effect sizes			
	Male user		Female user		Main effects		Interaction effects	Covariate effect
	Male agent	Female agent	Male agent	Female agent	Agent (A) gender	User (U) gender	A × U	Good-looking
Perceived interaction experience quality	7.17 (1.56)	6.67 (1.76)	7.07 (1.47)	7.92 (1.23)	0.04 $\eta^2 = .000$	4.80* $\eta^2 = .039$	5.98* $\eta^2 = .048$	3.74 $\eta^2 = .030$
Social judgment of agent	6.35 (1.55)	6.86 (1.63)	6.37 (1.26)	7.44 (1.18)	5.96* $\eta^2 = .048$	1.74 $\eta^2 = .014$	1.09 $\eta^2 = .009$	10.25*** $\eta^2 = .079$
Social presence of agent	5.43 (1.96)	5.58 (1.96)	5.99 (1.37)	6.48 (1.59)	0.25 $\eta^2 = .002$	6.07* $\eta^2 = .049$	0.24 $\eta^2 = .002$	5.87* $\eta^2 = .047$
Intention to use agent	4.60 (2.44)	6.31 (2.40)	5.94 (2.30)	6.87 (1.95)	7.90** $\eta^2 = .062$	5.69* $\eta^2 = .046$	1.00 $\eta^2 = .008$	2.62 $\eta^2 = .022$
Quality of recommend-ation	6.13 (1.74)	6.57 (1.55)	6.47 (1.40)	7.22 (1.42)	2.26 $\eta^2 = .019$	3.74 $\eta^2 = .030$	0.25 $\eta^2 = .002$	9.25** $\eta^2 = .072$

Note. Standard deviations are in parentheses. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3. *Excerpts of the feminine and masculine scripts used in Study 2.*

Feminine Script	Masculine Script
- Hi there! 👋 Thank you for using RBT Bank. My name is Michelle and I am your helpful and supportive personal finance assistant. 😊 I hope you're doing good today and I hope I would be able to meet all your personal finance-related needs! - May I show you what I can do? I would like to help you with several tasks today. First, shall I help you choose a bank savings account? - Wonderful! 😊 - A bank savings account allows you to earn while you save! Our interest rates are one of the most competitive and we have a credit rating of AA. So don't worry, you can surely trust your savings with us!😉 - ABC Bank has several kinds of banking accounts to suit different people with different needs. I know it can get confusing with so many options to choose from, that's why I'm here to help! 😊 - May I conduct a short interview with you to find out more about your needs and goals?	- **Hello. Thank you for using RBT Bank. I'm Michael, your capable and brilliant personal finance assistant. I'm sure I'll be able to take care of your personal finance-related needs. Let's get down to business.** - **Today, I want to show you what I can do. I will help you with several tasks. First, I will help you choose a bank savings account.** - **Then let's get to it.** - **A bank savings account allows you to earn while you save. Our interest rates are one of the most competitive and we have a credit rating of AA. We will ensure that your savings are safe with us.** - **ABC Bank has several kinds of banking accounts to suit different people with different needs. My job here is to find the perfect option for you.** - **But first, I will conduct a short interview with you to find out more about your needs and goals.**

Table 4. *Unadjusted means and unadjusted standard deviations of dependent variables, and ANCOVA results (Study 2).*

	*M*s and *SD*s				*F* values and effect sizes					
	Masculine conversation style		Feminine conversation style		Main effects		Interaction effects	Covariate effects		
	Male agent	Female agent	Male agent	Female agent	Agent sex representation (A)	Conversation style (C)	A × C	Perceived physical attractiveness of agent	User's masculinity	User's femininity
Perceived interaction experience quality	6.09 (1.17)	5.95 (1.36)	6.33 (1.24)	6.51 (1.00)	0.02 $\eta^2 = .000$	6.89** $\eta^2 = .032$	0.04 $\eta^2 = .000$	57.80*** $\eta^2 = .217$	2.94 $\eta^2 = .014$	0.28 $\eta^2 = .001$
Social judgment of agent	6.64 (1.49)	6.19 (1.67)	6.66 (1.51)	6.71 (1.41)	1.11 $\eta^2 = .005$	1.61 $\eta^2 = .008$	0.20 $\eta^2 = .001$	78.62*** $\eta^2 = .273$	0.12 $\eta^2 = .001$	0.85 $\eta^2 = .004$
Social presence of agent	6.14 (2.09)	5.51 (2.13)	6.39 (1.60)	6.21 (1.60)	3.20 $\eta^2 = .015$	3.96* $\eta^2 = .018$	0.05 $\eta^2 = .000$	53.02*** $\eta^2 = .202$	1.01 $\eta^2 = .005$	1.79 $\eta^2 = .009$
Intention to use agent	5.48 (2.27)	5.03 (2.33)	5.67 (2.20)	5.98 (1.81)	0.06 $\eta^2 = .000$	3.60† $\eta^2 = .017$	0.47 $\eta^2 = .002$	28.86*** $\eta^2 = .121$	0.12 $\eta^2 = .001$	0.07 $\eta^2 = .000$
Quality of recommend-ation	6.38 (1.63)	6.26 (1.65)	6.49 (1.83)	6.70 (1.54)	0.04 $\eta^2 = .000$	1.30 $\eta^2 = .006$	0.14 $\eta^2 = .001$	14.33*** $\eta^2 = .064$	0.19 $\eta^2 = .001$	1.06 $\eta^2 = .005$

Note. Standard deviations are in parentheses. * $p < .05$. ** $p < .01$. *** $p < .001$.
† marginally significant ($p = .056$)

Figure 1. *Conceptual model of Study 1.*

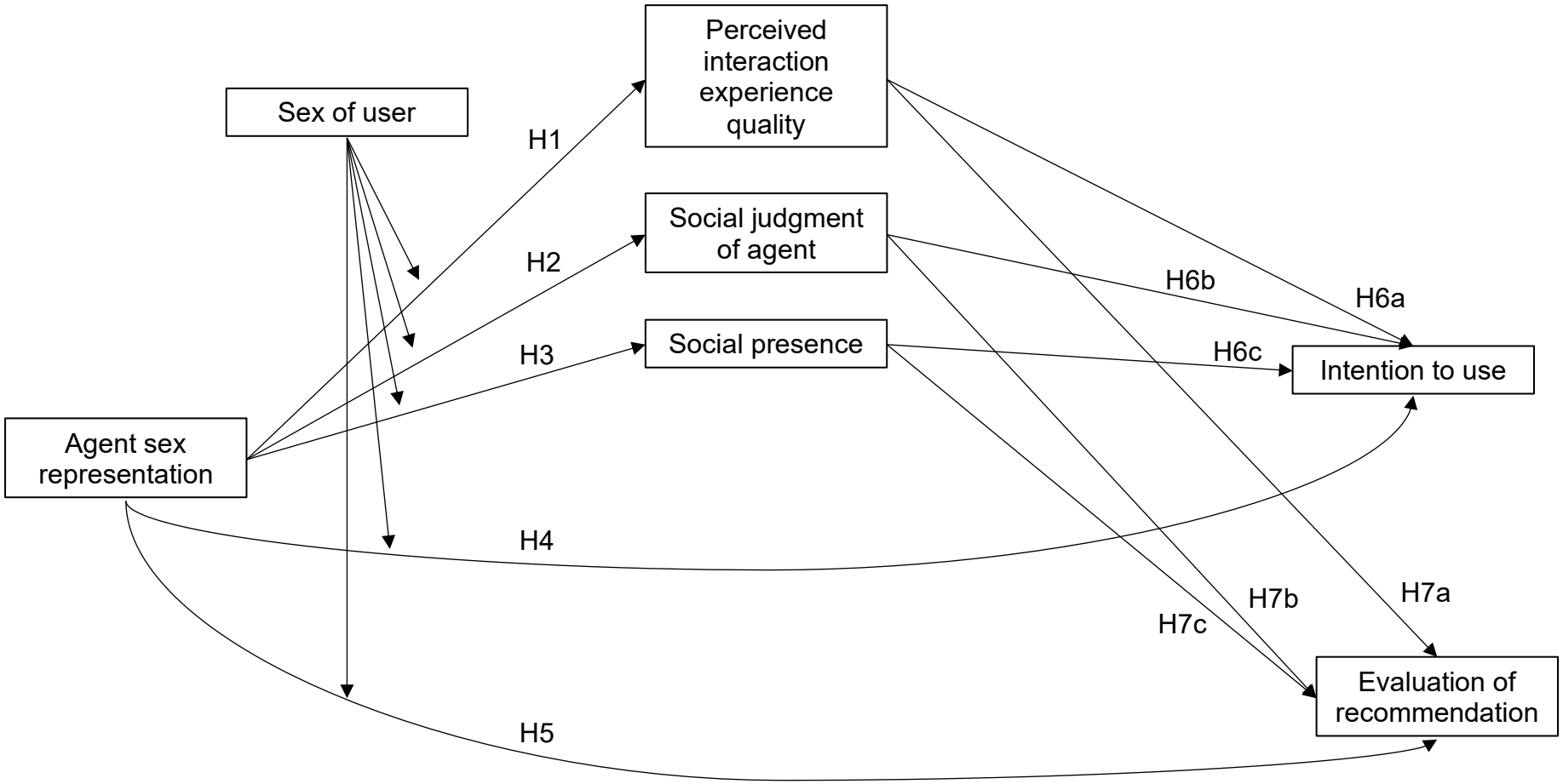


Figure 2. *Interaction effect between user gender and agent gender on the perceived interaction experience quality.*

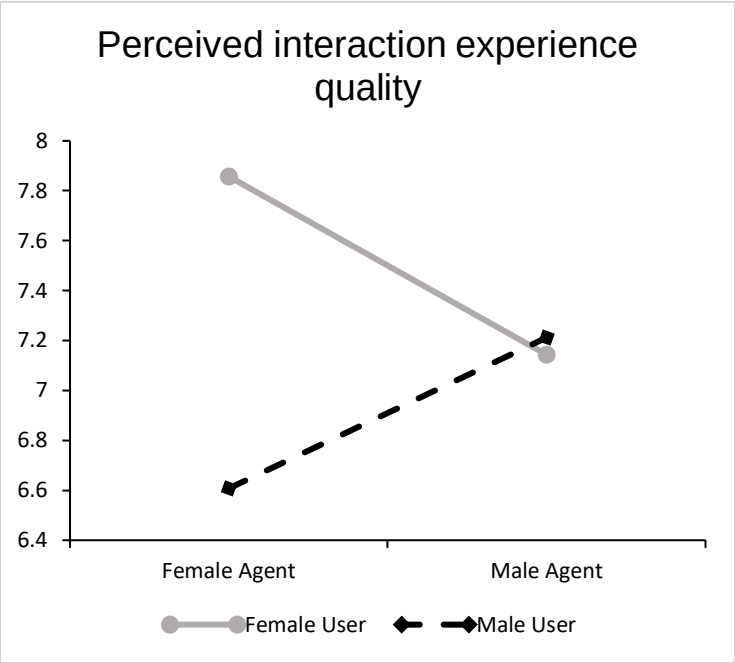


Figure 3. *Moderated mediation via perceived interaction experience quality (PROCESS, Model 7; Study 1).*

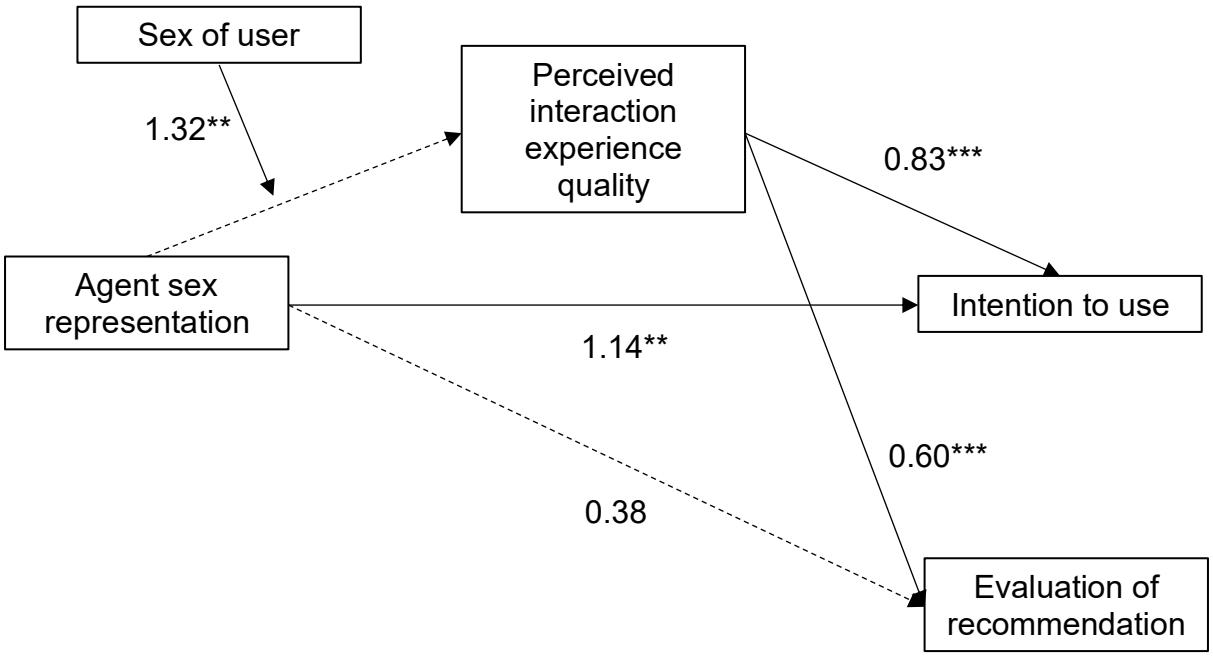


Figure 4. *Simple mediation via social judgment of agent (PROCESS, Model 4; Study 1).*

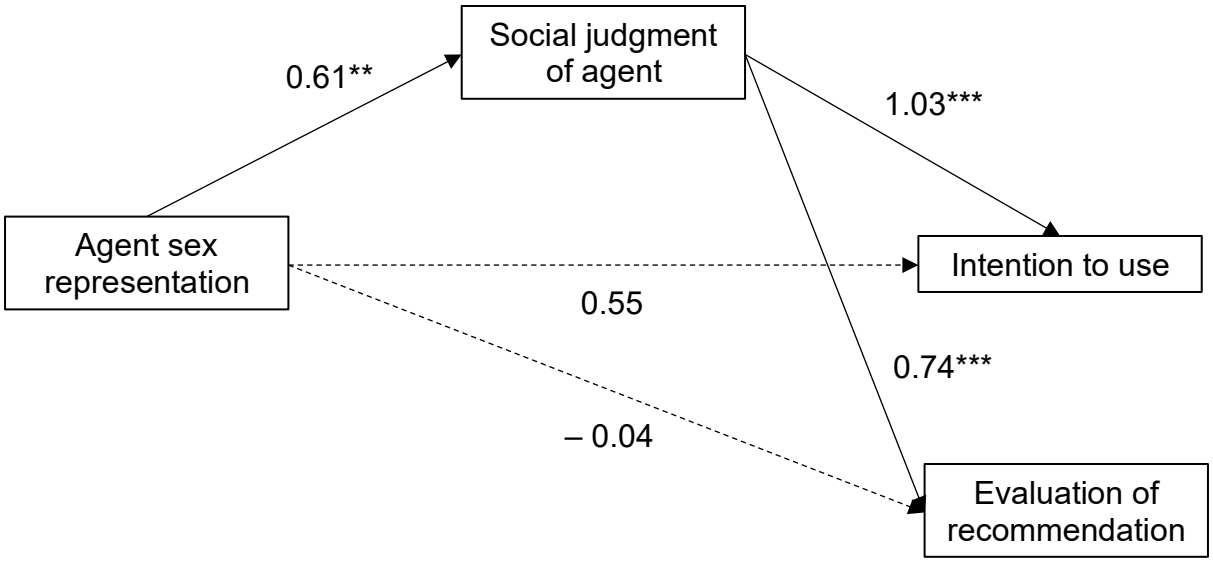


Figure 5. *Conceptual model of Study 2.*

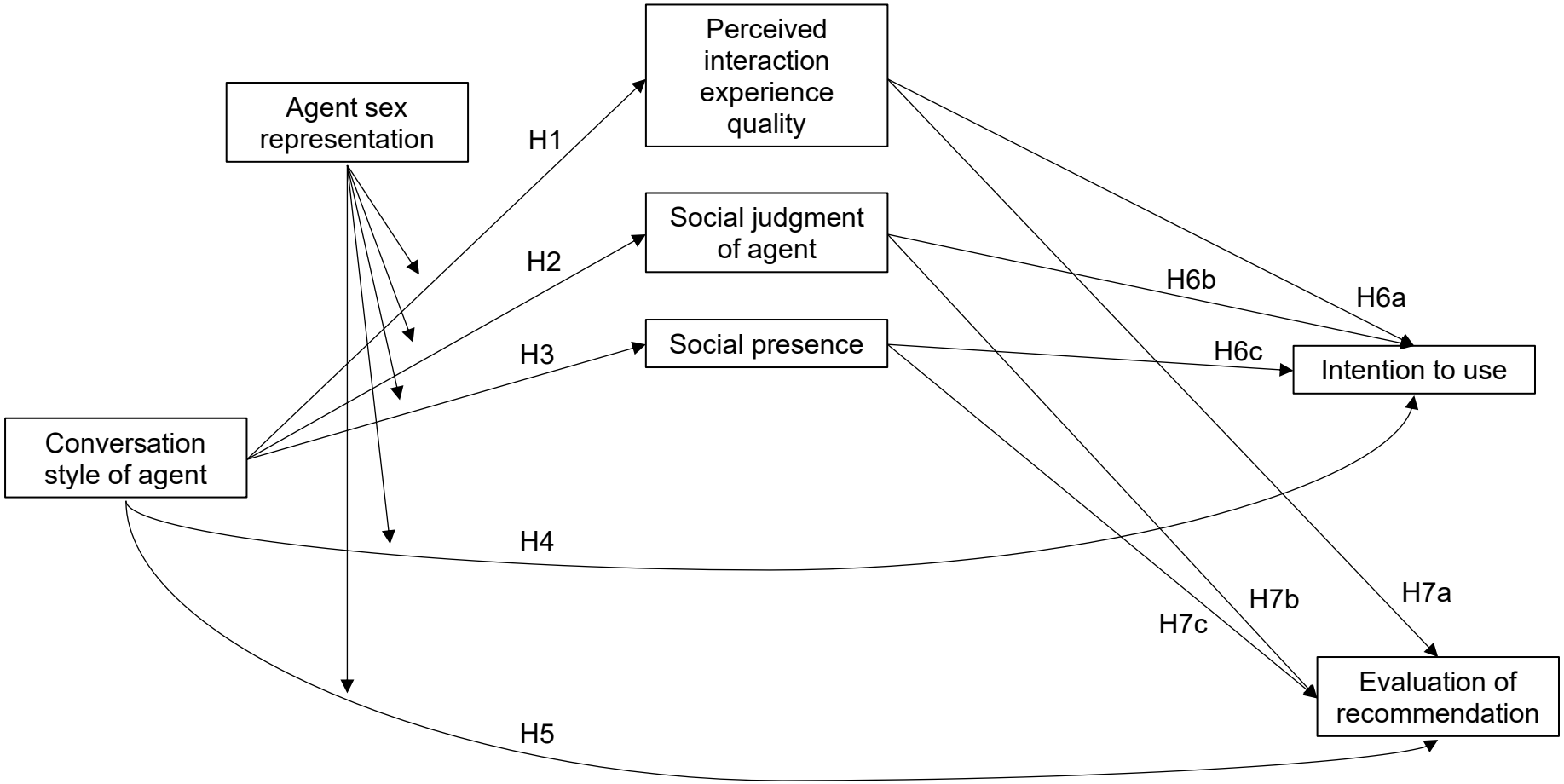


Figure 6. *Simple mediation via perceived interaction experience quality (PROCESS, Model 4; Study 2).*

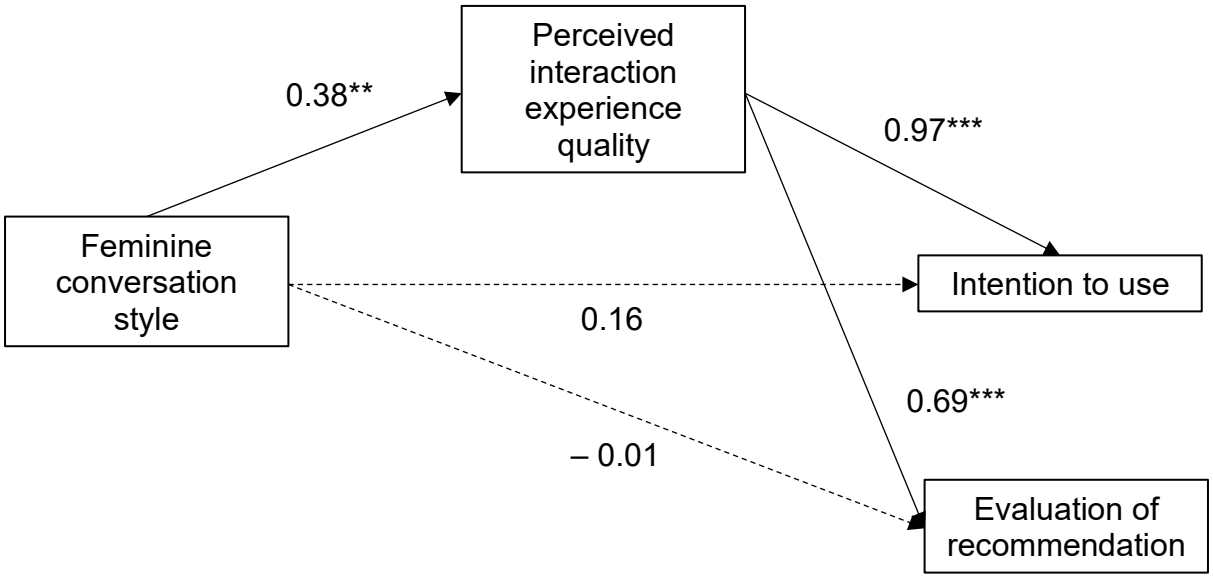
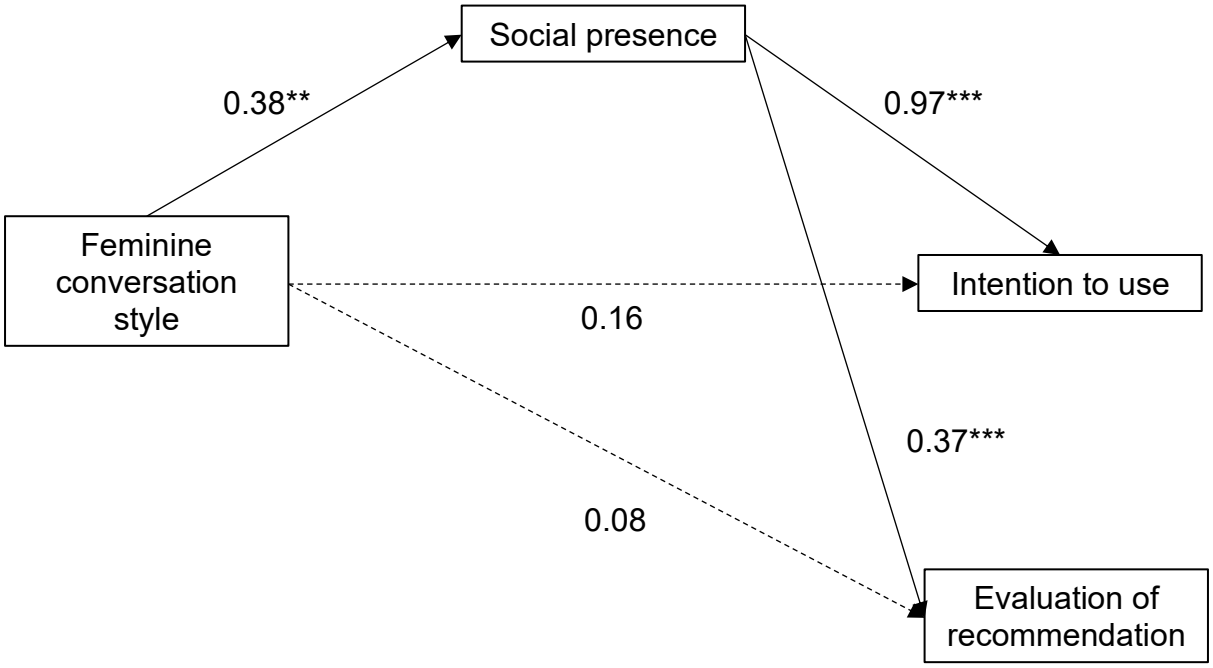
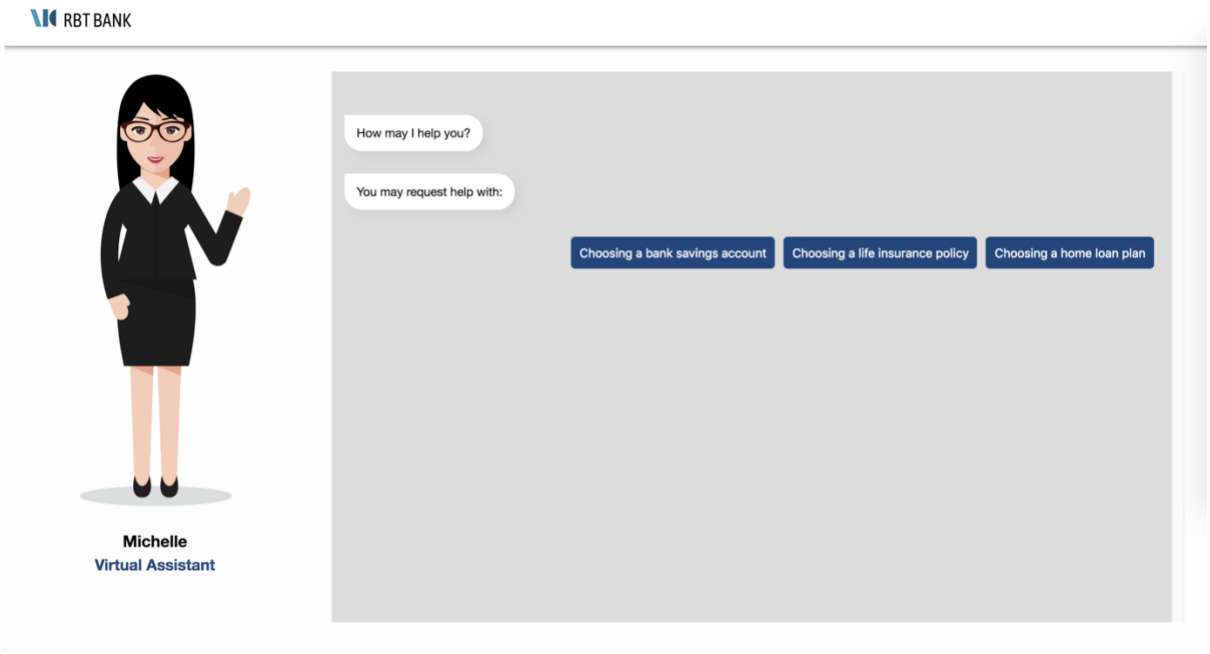


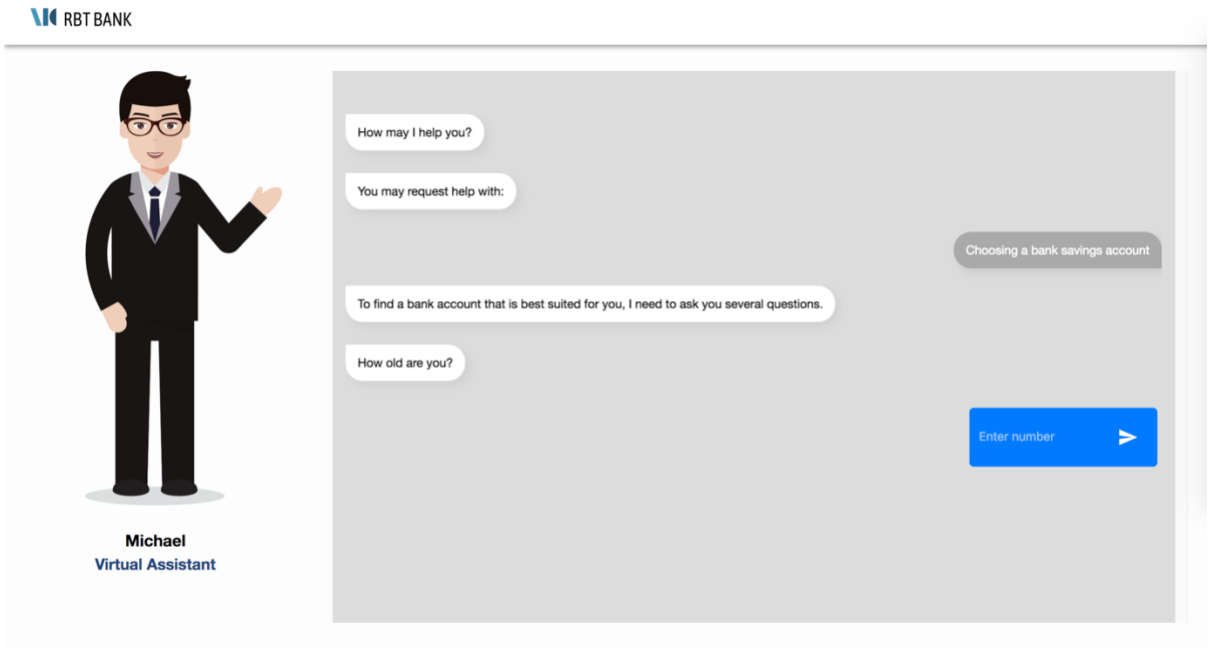
Figure 7. *Simple mediation via perceived interaction experience quality (PROCESS, Model 4; Study 2).*



APPENDIX A



Female virtual agent condition



Male virtual agent condition