How Human Can a Robo-Advisor Be? Examining Intensified Anthropomorphism of a Robo-Advisory System

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Abstract

Innovations in financial services have led to the rise of Robo-Advisor ("RA") platforms.

This paper does a literature survey of existing RA studies, and explores the reasons why RAs have not been widely adopted despite their benefits. There may be due to the need for human interaction, especially within the investment advisory context. Resistance also tends to be stronger amongst certain demographic groups. Unique demographic, attitudinal, and behavioral drivers result in a lack of trust in the technology. RA systems may also have limitations in designs and functions, which impede user adoption. Recent trends have seen the exploration of anthropomorphism in RAs to bridge the human-digital gap.

The paper uses the results of a reference study ("Reference Study") which anthropomorphized an AI using a VR setting, and relates it to the different adoption paradigms in the current literature. It then challenges some prevailing assumptions in the current academic discourse, which posit that adoption behaviors are intrinsically constrained by users' own demographic characteristics or predispositions. It suggests that further research undertakes differentiated inquiry methodologies for unique demographic groups. This study aims to inspire more diverse and sophisticated approaches of applying AI to RAs, thereby enabling a broader dissemination of financial services.

Keywords: Robo-Advisory, Digital Assets, Artificial Intelligence, Web3, Disruption, Financial Inclusion

1. Introduction

The background of this research is the rise of innovative fintech platforms known as Robo-Advisor "RA" systems which seek to automate the traditional investment advisory process. These platforms aim to replace the typical human-to-human interactions in the wealth management process [26][55][57].

Behavioral biases and cognitive limitations may lead to suboptimal investment decisions. RAs, using AI, offer a potential solution to eliminate these limitations and enhance investment returns. They are also less susceptible to conflicts of interests, and may act as better fiduciaries than human advisors. By lowering investment cost and barriers, they serve as catalysts of financial inclusion [50][55].

However, RAs themselves face different challenges. One main obstacle is the prevailing consumer inclination towards human advisors, due to the higher levels of trust present in a human-to-human relationship as compared to a human-to-digital relationship [17][25][47][51][54]. The level of trust is

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influenced by demographic characteristics and other subjective norms [7]. Literature indicates that for certain groups of users, particularly those who are lower-income and older users, the trust barrier is the most significant one in adopting RA systems.

Existing studies approach this issue from a variety of dimensions, examining the users, systems, and other adoption variables. A more recent theme has explored the use of anthropomorphism in RA systems. The use of VR may be perceived as an intensified anthropomorphic tool to bridge the trust chasm between a digital platform and a human user. This may be especially relevant for particular demographic groups, which have unique resistance drivers.

2. Literature Review

The current literature on RA platforms can be systematically divided into 3 different themes [57]. The first can be termed as "RA Competition", which compares RA with traditional financial advisory [57]. The second is from the perspective of the RA User [57]. Such research examines the characteristics and motivations of the adopters of RAs (and non-adopters), from mainly socio-economic perspectives. And the third is from the perspective of the RA System Provider [57]. This body of research tends to focus on the Information Systems design and architecture of the RA, rather than on user characteristics.

A. RA Compared to Traditional Financial Advisory

Such literature typically discusses the key benefits of RA vis-à-vis human advisors. A well-known limitation of traditional finance is that investors are assumed to exhibit rational and optimal investing behavior under the Efficient Market Hypothesis paradigm [22]. However, in reality, individual investors often exhibit flawed decision-making patterns owing to behavioral biases and cognitive limitations. These biases encompass representativeness, loss aversion, disposition effect, familiarity bias, anchoring, self-attribution or overconfidence bias [3][8]. In fact, even human advisors and analysts/experts themselves suffer from flawed investment decisions which impede their ability to address investors' needs [3]. Consequentially, within certain contexts, individual investors systematically underperform institutional investors by a few percentage points [4].

As with many other AI which operate on algorithms, RAs are a potential solution that can eliminate the limitations in human decision-making processes. Empirical studies suggest that RA systems can significantly reduce this behavioral gap, estimated at approximately 2.9% annually [58]. In addition to algorithmic efficacy, RAs also enable clients to be appropriately vested in the financial markets, in accordance with time-tested mainstream concepts of optimal asset allocation [27]. As such, they are able to facilitate the meaningful participation of all groups in financial markets, and mitigates the risks of economic isolation [50].

RAs may also be better fiduciaries than traditional advisors, by not being subject to conflicts of interests. This is because they generally employ passive portfolio allocation strategies using system algorithms [51]. They typically use ETFs, which do not offer commissions or incentives to advisors, and also tend to have a more transparent fee structure [37]. Studies show that the incentive structure of the agent (the advisor, broker, and other types of financial intermediary) exercises significant influence over their actions towards the principal [16]. This has resulted in poorer portfolio performance [16], by about 2% per annum, implying that human advisors are both a "costly" and suboptimal option [12].

The exponential expansion of smartphones, digital devices, and internet accessibility has accelerated the use of digital media as a preferred channel. The digital delivery of RAs, instead of traditional human

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interfaces, brings a high degree of accessibility and convenience to clients [25]. These attributes make it appealing to broad market segments, and not limited to the retail segments [55].

Another benefit of RAs is the ability to charge lower financial advisory fees and impose lower entry barriers, due to their economies of scale in onboarding, operations, and client-facing processes, which reduces the cost per client [25]. As such, RAs are generally regarded as promoting financial inclusion [50][55]. However, the literature is divided as to whether RAs can truly promote financial literacy, as there is a risk that RAs may "take over" the investment process and increase the passiveness of the user, especially for those who have lower income and little investment experience [1][56]. On the other hand, it is also argued that RAs generally operate on conventional financial concepts, and are therefore comprehensible to ordinary investors [27]. Accordingly, it is crucial for the RA platform to provide education for the user [27]. Studies also show that when implemented in certain ways, for example by giving the user partial autonomy, an RA can improve the financial literacy of even lower income investors [10]. Users started to get more involved in their own investment journeys and improved their returns [10].

The other aspect of this literature examines the key limitations of RAs. Apparently, the majority of investors globally still prefer human advisors to RAs [25]. One reason could be the existence of "algorithm aversion", whereby people are not trustful of investment decisions made by AI algorithms [45]. This falls under a general concept of "Negative Attitudes towards Robots" ("NARS"), whereby humans tend to exhibit negative attitudes towards robotic technologies arising from anxiety [46].

Accordingly, the majority of literature concludes that the lack of trust between a human client and an RA is the main obstacle for adoption [17][47][51][54]. Generally, establishing online trust is more challenging compared to face-to-face interactions, largely due to the heightened "perceived risk" of virtual settings, whereby there is physical separation of the consumer from the vendor, both in space and time [38]. But this issue is even more crucial in a financial management relationship. Such a relationship has a higher relational impact, as opposed to typical online transactional relationship like a one-off purchase of an insurance product, or any general online commercial activity [6]. These financial management human relationships can be so important that they command a "trust premium" of about 7%, with other outcomes like expected performance being secondary considerations [39].

B. The RA User

From the RA User perspective, it may be useful to distinguish between the user own intrinsic qualities, for example their demographic and attitudinal characteristics, and their behavior (i.e., their tendencies to adopt RA) [57].

Some of the literature examines the relationship between these two aspects, i.e., do the demographics and predispositions of a user actually relate to their behavior? There is substantial research which finds that early adopters of RA are typically a younger demographic, have a higher level of financial literacy and exhibited a greater propensity to trust such agents vis-à-vis human advisors [7][23][61]. Older demographics are more resistant to RA adoption [24][40][61]. Younger users' higher adoption rate is attributed to their digital native status, and their trust of social media, which has been found to be a salient mechanism for engendering trust in RAs [47][55]. Interestingly, geographical and cultural differences seem to have diminished importance compared to age differences, when it comes to RA adoption. The "Young Retail Investor" ("YRI") in Malaysia and Sweden have similar trust constructs when it comes to RA adoption [47]. As for gender, the literature is not conclusive as to whether this demographic variable is a significant differentiator of adoption tendencies [24][60].

An alternative methodology generalizes the user profile, and shifts the focus towards the motivations behind adoption by a representative user. Broadly speaking, technology adoption motivation can be categorized into utilitarian (outcome-motivated), and hedonic (intrinsically-motivated) [19]. Utilitarian models include the Technology Acceptance Models ("TAM") to explain behavior [7][18]. TAM is a mainly cognitive based model originating from the Theory of Reasoned Action, and explains that new technology adoption rests on the user's "perceived usefulness "PU" and perceived ease of use "PEOU" [18]. These models are then adapted in various ways. For example, the TAM can be accompanied by demographic and attitudinal drivers [7][24]. Some studies incorporate trust factors into the TAM model in various ways [21]. Other frameworks use variations and extensions of TAM models, such as the Unified Theory of Acceptance and Use of Technology (UTAUT) model [13][59].

However, as a primarily cognition-based model, TAM may become increasingly limiting in terms of explaining human-computer interaction. This is increasingly evident given the advent of new technological interfaces designed to actively engage the experiential dimension of the user. Hence, another important branch of the literature examines the hedonic aspect of RA adoption. This focuses on the "positive affective emotion" (for example feeling of "joy") associated with RA system use [30]. Other positive emotions such as "satisfaction" are also attributed to the continuance of technology usage post-acceptance [15]. These emotions are also depicted as a "Flow Experience". This is a psychological state in which a person becomes completely engaged and immersed. This optimally pleasant experience serves as an intrinsic motivator for human-computer interaction [15].

Enveloping both cognitive and emotional aspects is the other theme of trust, which is extensively explored in RA literature [57]. Studies in "online trust" typically focus on the determinants of trust, and the development of trust, especially "initial trust" for the adoption phase [38][42][43]. Such studies attempt to understand the human trust constructs (competence, benevolence, integrity, and predictability) and try to transpose them into an online environment [42][43]. For example, integrity and predictability can be manufactured by transparency of information [5]. Additionally, trust can be transferred (for example from a vendor to a vendor-back RA [14]. It can also be spread through social means [5], which is increasingly via social media [47].

Although not specifically on an RA system, studies have found that a VR interface is specifically able to develop these trust constructs in users [49]. The metaphor of a "real" environment and the metaphor of a "real" salesperson became catalysts in achieving high levels of trust. This is because it was able to reduce the complexities inherent in the human–computer interaction [49]. Hence the use of VR may be a very powerful tool in generating "initial trust" in users.

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Within RAs, other factors create the foundation for trust development. An important element is Institution-based trust, which refer to consumers' belief that the regulatory regime is in place to ensure their welfare [1][51]. In line with technology diffusion paradigms, sufficient (though not excessive) regulations create institutional trust in RA systems [1][41]. Other studies find that informational convenience and availability are important trust contributors [44][47]. Trust in the RA vendor is important, which is in turn affected by reputation, information and service quality [14].

C. The RA System

The third body of RA literature looks at adoption from the RA system design perspective, rather than the RA user. The literature generally agrees that many existing RA platforms have limitations in client profiling and functionalities. As with most digital platforms, the design of the information gathering system may result in a flawed client data [35]. Profiling tends to be over-simplified. and over-standardized. This gives RA platforms only a limited perspective on the client's financial needs and risk profile, leading to

flawed profiling and inadequate recommendations [1][25][35][36]. Furthermore, the solutions provided by RAs are often over-simplified and generic, and they would benefit from expanding their scope of products and services (for example budgeting, retirement, tax, insurance, and financial education) to better address client needs [51].

The RA systems approach literature tends to employ the science of Information Systems "IS" design and architecture [34]. This IS approach uses mostly laboratory experiments of RA systems to determine how system design affects user engagement, and explores ways of "best-practices system architecture" to overcome user inertia and produce better investment outcomes [33][34]. Generally, the system design such as the User Interface "UI" is explored, together with the assurance of data security provided by the system [21]. Much of research also concludes that transparency is the most crucial aspect of an RA system design [34][52]. Indeed, the insufficiency and opacity of information in many current RA systems creates user aversion and resistance [56].

Other RA system design considerations involve solving the "performance-control dilemma", whereby a user may lose comfort when he loses too much control [53]. Apparently, the granting of more user control may mitigate this issue. This was corroborated by research showing successful engagement of users when a semi-automated system is used [10]. Additionally, it is found that more frequent interaction is helpful. Digital nudges are apparently useful tools for overcoming user passiveness and decision inertia [34]. Moreover, the process of constant user interactions would actually cement the trusting relationship, beyond the initial trust phase [10]. Nevertheless, some of the literature acknowledges that even with an optimal system design, it is still a challenge for specific types of vulnerable users to cross the threshold to an RA platform [33].

Another body of RA design studies attempts to bridge the human-machine divide by focusing on anthropomorphizing (humanization) of RA systems [28][57]. Research has found conclusively that anthropomorphism is a strong cause for usage intention, by fulfilling fundamental human desires for social interaction and control of surroundings [11]. However, it is particularly stronger for smart service robots, and hence very applicable to financial services [11][20]. Additionally, RA studies have identified issues like algorithm aversion [45], which can be overcome by humanizing the technology [11]. Hence, it is a relevant application to RA systems.

Studies have looked at different forms of anthropomorphism. One found that for simple tasks, the act of "naming" an RA is well received by investors [29]. Another showed that when a named Avatar uses "speech bubbles", it succeeds in creating higher usage intentions [2]. The most recent one found that the use of conversational bots resulted in higher engagement [28]. This was attributed to the higher levels of trust created by the "benevolence" effect [28]. Yet another research is conceptualizing the use of a voice-enabled RA to make the user feel "heard" and recognized as a human [48]. In line with the explosive growth in AI innovations, these studies reflect the increasing trend of anthropomorphizing interfaces in contemporary systems.

3. Brief Description of Reference Study

The Reference Study recruited 182 participants online for the experiment. One group was recruited from a demographic group which had a higher income (USD26,000 and higher) and a higher education (college degree and higher). The other group was recruited from another demographic group with a lower income and education profile. Both groups had approximately similar representation from both male and female genders. Both groups also had the majority of participants within the 26-49 age group (>60% of participants); followed by those within the 21-25 age group (>20% of participants), and with the least proportion of older participants above the age of 49 (<15% of participants). Two systems were used on the two distinct demographic groups, one of which used a typical RA system, and the other employed VR characters to guide and engage the users. The VR characters were semi-animated and engaged the users in an audio-visual manner, taking on characters like a Receptionist, a Professor, and a Customer Service Officer, allowing interactions between user and the system. Results showed that the VR system significantly affected feelings of trust and intentions to sign up, whilst not significant for cognitive variables such as "usefulness in meeting financial needs". Qualitative data supported the findings that emotive forces were influential in the positive reception.

Furthermore, the older groups responded the most significantly to VR, especially with respect to "trust" in the system after the use of VR. The Reference Study concluded that the use of VR is able to change the resistance of users, especially for lower-income, lower educated and older age groups.

4. Discussion

Studies on RA adoption have found that certain groups are more resistant, due to demographic characteristics like age, income and education, largely due to a trust barrier. The Reference Study provided an extension to this literature by examining this demographic group specifically. The results showed that the use of VR enables the lower-income and less financial literate to develop trust, via emotive and psychological drivers. It also significantly influenced their intention to sign up. This is an important first step towards improving their financial inclusion.

Current research on RA has identified that the lack of human interaction is a key impediment to RA adoption. Accordingly, the Reference Study sought to explore further applications of anthropomorphism, building on recent research in this area. Anthropomorphism has a few major dimensions, widely under broad categories of "form" ("likeness to a human") and "function" ("acting like a human") [20]. Previous studies had explored certain dimensions, for example "naming" [29], showing a named visual avatar [2], or providing chatbot interaction [28]. The Reference Study adopted a similar trajectory but *intensified* the anthropomorphic mechanism in both form and function. By using VR characters of finance professionals within a virtual bank setting, it sought to create a digital twin of a real-life human advisor. The VR Avatar had a comprehensive visual representation which was animated on demand (satisfying "form"), and was able to "advise" the user (satisfying "function"). The VR characters were also designed to generate "likeability" and "perceived intelligence". In previous studies, these had been found to be key mediators in enhancing anthropomorphism on usage intentions [11].

Furthermore, the Reference Study showed that the significant impact was related to the development of trust, in particular. As such, it validates earlier literature that VR is able to develop some of the main trust constructs [49]. Users had felt that the VR characters were devoted and helpful ("benevolence"), responsive and informative ("competence"), transparent ("integrity"), and consistent ("predictability") [49]. More importantly, it was able to have a significant effect on traditionally resistant groups such as the lower-income, lower-educated, and elderly groups. This suggests that this trust development may be particularly helpful within the context of "vulnerability" or lower financial and digital literacy [38].

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Quantitative and qualitative results also illustrated that the emotional experience was largely positive, suggesting that this was due to the "Immersive", "Interactive", and "Imaginative" ("I3") aspects of VR experience [31][32]. In line with earlier literature on the hedonistic element of RA usage, apparently, the user's enhanced experience became an intrinsic motivator [30].

Another finding was that the use of VR was not effective in the cognitive engagement aspect (for example "usefulness in meeting financial objectives"), although it had a significant impact on users' intention to sign up. There could be a few implications from this finding. Firstly, it challenges some of the literature which has employed primarily cognitive or utilitarian models of RA Adoption, like the TAM models. Secondly, it may also imply that the anthropomorphism of RA systems may be more effective on the emotive, and psychological aspects of trust, rather than the cognitive aspects. The potential inference is that distinct demographic cohorts may display contrasting behavior, and necessitate separate adoption models. It thus prompts inquiry into the effectiveness of conducting research from a standardized user perspective. Further studies can be carried to explore this line of reasoning.

Current RA literature has also tended towards a static characterization of the relationship between user demographics, attributes, and behavior. For example, younger demographics tend to have certain attributes which lead them to behave in a certain way. However, the application of anthropomorphic techniques may challenge some of these assumptions, because it may radically change the relationship between user demographic and adoption. For example, elderly users generally have more negative attitudes towards technology use, but are more sensitive to the influence of anthropomorphism [11], which may change their attitudes and behavior significantly. In this case, anthropomorphism can actually drive a clear distinction between demographics and behavior, such that these variables are not presumed to operate in conjunction.

Indeed, the results of the Reference Study support this theory, whereby older age groups were overwhelmingly receptive to the use of VR. It is proposed that older groups may suffer from multiple and inter-related emotional or psychological resistance factors. They may have trust issues (NARS), but also competency issues (low digital literacy), causing Computer Anxiety [11]. Because the VR characters were able to actively "push" the information to users and simplify the user navigation process, it could have eliminated a few of these attitudinal obstacles. Future studies could undertake the in-depth investigation of specific resistance/adoption drivers within each demographic group, rather than ascribing behavior solely on the basis of demographics.

With regards to practical implications, the Reference Study suggests that RAs may need to employ clearly differentiated strategies if they are targeting different consumer segments. RAs may like to consider different types of system designs to cater to specific types of users. Dimensions to consider would be socio-economic variables, digital literacy, and competence levels. This is in accordance with previous literature, which contends that many current RA platforms are overly simplistic and generalized. The Reference Study also implies that certain user groups may require more financial literacy education than anticipated for their specific needs. This is in line with much of the current literature which finds that the issue of inadequate financial literacy is a pressing concern. Hence RA systems need to place priorities on providing more educational content, and delivering it effectively.

The current RA system design literature has developed many useful findings on how to improve system design and architecture. However, the approach taken can somewhat be characterized as incrementalist in nature. The Reference Study suggests that intense anthropomorphism may radically change user attitudes. It sets the stage for future studies to explore transformative models of financial advisory, especially in this era of abundant AI technologies. For example, future studies or commercial applications may explore the use of a real Metaverse setting whereby VR Avatars can provide real-time financial literacy education and actually interact actively with users.

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Alternatively, RA platforms can consider integrating generative AI chatbots (such as chatGPT) with the VR system, enabling users to receive comprehensive financial knowledge on demand. Other design ideas include the personalization of VR characters who mimic the user's own demographic characteristics and communication styles, to enhance engagement levels.

5. Conclusion

This paper reviews the extensive literature on RAs along the categories of Users, Systems, and Competition. It also reviews literature on trust, the use of VR, and anthropomorphism. It then describes a Reference Study which combined the various aforementioned themes. Using results obtained, it points towards new research directions for RA literature. It also suggests that progressive AI methodologies may increasingly replace the need for human interaction. It thus hopes to encourage further research into the use of VR and other innovative AI features in RAs. The scalability of AI applications facilitates the dissemination of financial services to a widened user demographic, potentially improving financial inclusion.

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