Designing the user experience of a multi-bot conversational system

Heloisa Candello  
IBM Research  
São Paulo Brazil  
hcandello@br.ibm.com

Claudio Pinhanez  
IBM Research  
São Paulo, Brazil  
csantosp@br.ibm.com

Abstract
In this paper we describe the design process of a multi-bot conversational system to assist people to make more informed decisions about finance. Several user activities were held to understand the experience of investment decisions, the opportunities to design financial cognitive advisors, and the user perceptions of such systems. We discuss the main design implications of our studies in the context of a prototype called CognIA and highlight several challenges of designing multiparty conversational systems.

Author Keywords
Conversational interfaces; dialogue systems; multiparty dialogue, user experience.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; See http://acm.org/about/class/1998 for the full list of ACM classifiers. This section is required.

Introduction
Multi-person conversations are an integral part of everyday life interactions, in meetings, family dinners, chats in bars, and in almost every collaborative or competitive environment including hospitals, offices, etc. The ability of human beings to organize, manage, and (mostly) make productive such complex interactive structures are nothing less than remarkable. The advent of social media platforms and messaging systems such as WhatsApp in the first 15 years of the 21st century expanded our ability as a society to also have asynchronous conversations in text form, from family and friends chat groups to national conversing in a highly distributed form in social media [Jenkins et al. 2013].

In this context, many technological advances in the early 2010s in natural language processing (spearheaded by the IBM Watson’s victory in Jeopardy) spurred the availability in the early 2010s of text-based chatbots in websites and apps (notably in China [Olson 2016]) and spoken speech interfaces such as Siri and Cortana. However, the absolute majority of those chatbot deployments were in contexts of dyadic dialog, that is, a conversation between a single chatbot with a single user.
Human-computer interaction, in practice, has also been mostly about dyadic interaction since the dawn of computer systems in 1950s. Notice that the two dominant interaction paradigms, command-line and point-and-click, are both not well suited for either multi-user interaction (one application with more than one user engaged in the same activity); nor multi-app interaction (one user interacting seamlessly with more than one application); and even less for generic multiparty applications (many users and many bots simultaneously). Notably exceptions are surface interaction and multi-user games, but the mainstream of human-computer interaction remains one-to-one.

In this sense, conversational interfaces powered by chatbots are an important breakthrough from the past of computer interaction because they naturally enable multiparty applications. By exploiting the many social protocols human had developed for multi-person conversations since the advent of language, conversation-based interfaces may finally break from the dyadic paradigm in computer interaction.

In this paper, we consider a scenario of wealth management where advice is provided by multiple chatbots. We highlight several design activities undertaken with potential users with limited financial knowledge to understand their rational when making investment decisions. We then explore opportunities to use this knowledge in the context of a multiparty dialogue system. We then present CognIA (Cognitive Investment Adviser) which is a chat system aiming to help people to take more informed decisions about investments which uses multiple chatbot advisers.

3. Design activities
In our research we are interested in the often blurred connections between human and machines which result in better decision-making. Through a series of user studies in Brazil we have explored the nuances of human-machine interaction to better inform the design process of the chatbot advisers in CognIA. The aim of the user studies was twofold: understanding the everyday practices which prevent people to make better investment decisions; and how a system could be to help people to make more conscious investment decisions. CognIA is for people who have limited knowledge of finance (and often not willingly to spend time learning it) but nevertheless would like to make good investments. We focused on people younger than 40 years old, well-educated, and with medium-high income. We recruited participants with those characteristics for four qualitative user studies, numbered 1 to 4 in the text, detailed below.

(1) Understanding financial decisions - A set of semi-structured interviews were undertaken to understand everyday practices, motivation stoppers and interaction channels to make investments. Our findings suggest that people rely on conversations with family and friends and also on external resources (news and websites). Participants also have reservations to trust bank managers to make investment decisions.

(2) Design concept perceptions - This study had the intent to gather users’ impressions of three different design concepts we designed. In the first concept users explored a tag cloud containing investment names with links to financial websites. In the second concept, an intelligent assistant based on the user’s profile provided best investment choices with levels of confidence. The
third concept was an interactive knowledge map which users could interact with topics and listen to audio samples of a human financial advisor. Overall, people with low financial knowledge preferred the intelligent assistant concept while people with some financial knowledge preferred exploring web sources. Most of our participants found narrow and not appealing the third option, they argue the need for more than one advisor perspective. (Figures 1 and 2).

(3) Wizard of OZ - This experiment was designed to explore the implementation of the intelligent assistant concept as a conversational investment adviser. We used the Wizard of Oz technique in which a human simulates the system’s behavior through a computer interface. Participants believed they were interacting with a functional system. Results provided insights and recommendations for designing our prototypes of chat-based cognitive investment advisers. It also provided the first corpus for the CognIA system. (Figure 3).

(4) Video-card perception – We designed an evaluation study to understand the desirability of a prototype of our multi-bot chat advising system, CognIA. The study had three steps. First, the participants watched a video demo, then chose reaction card adjectives to report their perceptions, and lastly they gave their opinions guided by questions about the multiparty dialogue. From this experiment the most positive rated words were: Easy to use, Sophisticated, Friendly, Straightforward, Helpful, and Connected. The most negative rated words were: Insecure, Scary, and Intimidating. (Figure 4 e 5)

Those design activities enabled our multidisciplinary team to effectively develop the CognIA system.

4. CognIA – Cognitive Investment Adviser

CognIA is a multi-bot dialogue system which helps people to make better investment decisions (Figure 6). Three bots participate in the same dialogue with humans. Cognia is the bot which moderates the conversation; SavingsGuru is a bot which answers questions about savings accounts; and CDBGuru is a bot which answers questions related to CDB investments (a kind of certificated of deposit). A multi-bot platform, called Sabia, is used to define the entities, relationships, and behaviors needed for the creation of coordinated chatbots which react and pro-actively act using natural language. Hence, the Cognia agent is able to invite one or more chatbots in the chat group while interacting with the user based on the user’s needs. Cognia is also able to redirect the topics based on the user’s utterances and to enforce that the chatbots only send allowed messages.

The CognIA design process has been informed by the design activities described in the last section. The questions embodied in the system and their intents were initially gathered from the results of the Wizard of Oz study. The answers were composed based on financial websites and financial experts posts. Nevertheless, we are still continuously improving the quality and scope of our corpus. A concept video was produced to guide the design and deployment of CognIA.
The graphical interface design paradigm was created based on the familiarity of our participants with conversational apps such as WhatsApp and Skype. The visual identity was designed to reach the audience of our project. A mood board, a semantic panel with graphical elements (colors, typefaces, shapes) with perceptual aspects gathered from the user studies, were created to guide the visual design. Graphical elements were added to the chat interface to create the sense of a multiparty dialogue, such as: icons of the agents, location of icons on the screen, distinct colors for each agent. Visual comparison and calculation of the investment returns were considered essential features and were added to the system.

At the time of this paper, a new version of the CognIA system was being finalized to get deployed in a finance-related website where it would be exposed to interact with thousands of users seeking for investment advice.

5. Turn-taking in multi-bot conversations
There are many differences between dyadic and multiparty conversations but chiefly among them is turn-taking, that is, how a participant determines when it is appropriate to make an utterance and how that is accomplished. In dyadic conversations, the issue is most often trivially solved, except for the issue of how long a participant can speak before it is the other participant’s turn. We developed two platforms which handle the turn-taking issue differently. In the Sabia platform, we map speech intent directly to a specific chatbot, that is, the natural language analysis of an utterance automatically selects the chatbots that should respond to it. In other words, we hardcode the next speaker to the semantics of the utterance. In the second platform, called Medusa, turn-taking is distributed through computer-generated filters based on the turn-taking protocols described in a manually-created orchestration file. We are currently experimenting with both platforms.

5. User experience design
In this paper we briefly described a set of design methods which assisted us to understand better user’s needs, contexts and restrictions that would affect our project. We hope other designers can apply our selection of methods in their conversational projects. Those methods were chosen to understand investment decisions and were suitable for generating insights and recommendations to design chatbots. Evaluating concepts embodied in low-tech prototypes help defining directions for the project team to work on. Listening to users in interviews and asking them about past experiences gave us valuable insights of information flow. The Wizard of Oz technique highlighted conversation flow stoppers and provided an initial corpus for the project team work on. Video card activities were fast to set up and gave a glance of perceptions and user adoption issues. Designers of conversational agents should look carefully at the space of the conversation, moment-by-moment, because it is where interaction happens and decisions of dialogue management are crucial. Those conversation system characteristics are even more important when more than one chatbot dialogue with users.

6. Final Considerations
In today’s point-and-click interfaces it is very hard to two or more people to explore together the options in an investment website and even harder in a smartphone app. In most cases mouse control is appropriated by one of the users, creating a natural
dominance which is not inductive to collective decision-making. This can be addressed in our proposed system, a multiparty chat where investment chatbots and humans can talk to each other in the same dialogue. In the next version it will be possible to bring to the conversation their spouses, family, or other people they trust such as a human investment advisor. Similarly, multiparty chats naturally allow competitive behavior and its effective management. In the investment scenario, the users could bring banks with competitive products to a single conversation, allowing easier comparison and even auction-like competition between the bots. Challenges to design multi-bot systems are to understand and implement humans’ protocols, to manage and monitor turn-taking in a dialogue [Traum 2011], to track of threads and topic changes, and to design the support of multiple roles (for example bank managers, family) [Dignum 2004].

Our interest in this workshop is threefold: (i) to explore with the other workshop participants our findings, user methods, and design activities to understand better the user experience in multiparty conversations; (ii) to discuss challenges that multi-bot systems can pose to the HCI field and some of its key assumptions; and (iii) to discuss and shape our follow-up user evaluations of CognIA.

6. References

Example of a user interaction

<table>
<thead>
<tr>
<th>Turn</th>
<th>Utterance</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>I have $30,000 USD, where should I invest it?</td>
</tr>
<tr>
<td>Mediator Chatbot</td>
<td>Well, for how long could you keep the money invested?</td>
</tr>
<tr>
<td>User</td>
<td>Say, for 2 years.</td>
</tr>
<tr>
<td>Mediator Chatbot</td>
<td>All right, then, considering the amount and the time period, why don't you simulate this investment in a savings account?</td>
</tr>
<tr>
<td>User</td>
<td>Sure! I would love to.</td>
</tr>
<tr>
<td>Mediator Chatbot</td>
<td>Ok, I will invite the savings account to this group.</td>
</tr>
<tr>
<td>Savings Account Chatbot</td>
<td>&lt;&lt; Savings account chatbot joins the group &gt;&gt;</td>
</tr>
<tr>
<td>Mediator Chatbot</td>
<td>Hi Savings Account expert, could you please simulate the return of investment of $30,000 in 2 years?</td>
</tr>
<tr>
<td>Savings Account Chatbot</td>
<td>Sure, just a minute...</td>
</tr>
<tr>
<td>Savings Account Chatbot</td>
<td>Well, at the end, one would have $32,500 USD.</td>
</tr>
<tr>
<td>Mediator Chatbot</td>
<td>Thank you. Well, it seems a good idea given the economy right now.</td>
</tr>
<tr>
<td>User</td>
<td>Thank you all.</td>
</tr>
<tr>
<td>Savings Account Chatbot</td>
<td>You’re welcome.</td>
</tr>
<tr>
<td>Mediator Chatbot</td>
<td>No problem. Let me know if I can help you with something else.</td>
</tr>
</tbody>
</table>