Evaluating multi-agent conversational interfaces in the early stages of the design process

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In this paper we describe a mixed-approach technique to understand user's perceptions of concepts in the early stage of the design process. We designed an evaluation study to understand desirability of a multi-agent cognitive investment advisor, a Chabot. The study was threefold. First participants watched the video, then chose reaction card adjectives to report their perceptions, and lastly gave their opinions guided by questions about the multi-party dialogue. From this experiment, we gather positive and negative reactions from users that helped to shape the user experience of cognitive investment advisors.

Keywords: Design for finance, Desirability, Design Research, Evaluation Studies

1. Introduction

Cognitive Computing is the use of computational learning systems to augment cognitive capabilities in solving real world problems. According to Kelly and Hamm (2013:8):

> *Tomorrow's cognitive systems will be fundamentally different from the machines that preceded them. While traditional computers must be programmed by humans to perform specific tasks, cognitive systems will learn from their interactions with data and humans and be able to, in a sense, program themselves to perform new tasks. Traditional computers are designed to calculate rapidly; cognitive systems will be designed to draw inferences from data and pursue the objectives they were given. […]. In the cognitive era, computers will adapt to people. They'll interact with us in ways that are natural to us.*

Kelly and Hamm (2013) also emphasize that Cognitive systems will help us to be smarter offering effectiveness processing large amount of information, dealing with complexity; expertise to help see the overall picture to make better decisions; objectivity avoiding bias; imagination helping us explore a broad range of choices to generate ideas; sense using sensors and analytics software to grasp also physical information. Not only is Cognitive computing a fundamentally new computing paradigm for tackling real world problems, exploiting enormous amounts of data using massively parallel machines, but

also it engenders a new form of interaction between humans and computers. Cognitive systems bring human-like reasoning to the problems of Big Data, and also permit us to expand into the white space of domains that require human-like cognition but that either exceed human capacity or are impossible for a live human presence (Nahamoo, 2014). Noor (2015) explains that computer essentially process a series of conditional equations and suggest answers. Therefore, it has consequences for user decision-making, since probability can be taken in consideration when making choices. Cognitive systems are able to infer information usually based on parameters that use data captured by sensors or/and user input and interaction. According to Lintern (2011) the robustness of a cognitive system is due to the manner in which the human participants in the system integrate their activities. For instance, those systems may learn more user behavior patterns and provide more assertive inferences. In this context, humans collaborate with machines to create knowledge, and issues of trust and collaboration are topics that are being considered to design those new kinds of systems (Baillieul et al., 2012). In this context, the present paper shows an early evaluation experiment of a Cognitive system called Cognia that aimed to enhance user experience.

2. Background

Traditional user interfaces have menus, simple text, icons, and links which define an intrinsic planned navigation flow created by designers. Information architecture is "*a creation of systemic, structural, and orderly principles to make something work — the thoughtful making of either artifact, or idea, or policy that informs because it is clear.*" (Wurman, 1997). However, structured and orderly principles often in practice vary according context and are not always linear or predictable. Organizing information on graphical user interfaces, required designers to plan ahead which way users would take to provide the best user experience. Several schemes and structures are available to organize information (Rosenfeld and Morville, 1998). Sequence diagrams, hierarchies and networks were the basic structures for designing all kinds of interactive experiences, from games to websites. Nowadays, a network structure is a common structure, although it has been argued by many researchers as not being the best way to organize information:

> *Although the goal of this organization is to exploit the Web's power of linkage and association to the fullest, web like structures can just as easily propagate confusion. Ironically, associative organizational schemes are often the most impractical structure for Web sites because they are so hard for the user to understand and predict. Webs work best for small sites dominated by lists of links and for sites aimed at highly educated or experienced users looking for*

> *further education or enrichment and not for a basic understanding of a topic. (Lynch, 2008).*

With the increase amount of information nowadays, dense structures are part of our everyday life. Methods, such as *card sorting* (Nawaz, 2012) help to organize and evaluate the information architecture of an interface. When designing websites or apps, Scenarios and Storyboards (Carroll, 2000; Llitjós, 2013) based on *journey maps* (Stickdorn &Schneider, 2011) and *blueprints* (Polaine et al., 2013) assist in predicting the user experience.

However, in a conversational interface, the conversation flow is not linear; it might take different courses according to circumstances that influence dialogue. One of the most interesting features of human conversation is this ability to explore sidetracks and easily go back to the main conversation objective. For instance, while people are making a decision, such as in planning a trip, people can ask clarifying questions, explore a similar case, get delighted by photos and comments, consult a friend, and then go back to make the trip decisions. It is almost impossible to predict in what sequence a user will interact to a machine and how this machine could provide satisfactory user experience. Traditional design methods might help to envision a graphical user interface applications and detect topics that will embody the conversational system but have clear limitations in supporting the design of the conversation flow of a conversational system.

A Wizard of OZ technique, where a human (wizard) simulates the intelligent system tasks such as natural language understanding without user awareness, was perceived as one of the main approaches to evaluate cognitive dialogue systems. Forbes-Riley and Litman (2011) applied the Wizard of Oz technique. The system was a spoken language tutoring system in which the wizard performed speech recognition, natural language understanding, and uncertainty annotation, for each student to answer. 81 students participated in the study. The authors also claim it was the first study to show that dynamic responding to student uncertainty can significantly improve learning during computer tutoring. Rieser et al 2014 applied the Wizard of Oz tool to improve information presentation in natural language generation dialogues; humans simulated the intelligent system that provided recommendations of restaurants to other humans. Their aim was to present enough information to users while keeping the utterances short and understandable. Authors identified the adaptive natural language generation, as well the information presentation, affects perceived or objective task success of the system. Design methods quoted above help to guide designers to create better experiences with interactive systems. Some of them assist in shaping the dialogue flow, like the Wizard of Oz, although a little has be seeing of how to evaluate concept perception of multi-agent systems and its desirability.

A method that focus to gather desirability of products is the *Product Reaction Cards* (Benedek et al. 2002). It consists in a method for measuring intangible aspects and emotional responses from designs and products. This technique forms the basis of a *Desirability Toolkit*, used by usability engineers to evaluate desirability in their projects with another method called *Faces Questionnaire* that is not be explored in this user study. A set of 118 physical cards with different product-reaction words targeted a 60% positive and 40% negative/neutral balance, like enthusiastic, friendly and annoying. (see Figure 1)The set is displayed to the participants in a random order and the moderator asks them to select a deck of 5 words that best describes and matches their personal reactions about the product they just tested. Afterwards, the participants can be asked to justify the reason of their selections, getting thus, more evaluation about the product. Obtain user feedback is one of the benefits provided by the technique according to Benedek et al.(2002). According to authors of this method, participants enjoy the toolkit exercises and it is quick and easy to analyze the results and administrate it. Additionally, team members can have a big picture of how users feel of the product. The method was designed to specific contexts, "*it is not designed for making broad statements about all potential users of the product, they are biased toward information that we can use to judge the quality of the user experience for the participants who are in our usability evaluations and suggest design changes*". (Benedek et al, 2002). Considering it, we used this method to have sense of how people perceive multi-agent systems in financial contexts after seeing a video demo showing the system concept.

Figure 1: Product Reaction cards adjectives

The complete set of 118 Product Reaction Cards				
Accessible	Creative	Fast	Meaningful	Slow
Advanced	Customizable	Flexible	Motivating	Sophisticated
Annoying	Cutting edge	Fragile	Not Secure	Stable
Appealing	Dated	Fresh	Not Valuable	Sterile
Approachable	Desirable	Friendly	Novel	Stimulating
Attractive	Difficult	Frustrating	Old	Straight Forward
Boring	Disconnected	Fun	Optimistic	Stressful
Business-like	Disruptive	Gets in the way	Ordinary	Time-consuming
Busy	Distracting	Hard to Use	Organized	Time-Saving
Calm	Dull	Helpful	Overbearing	Too Technical
Clean	Easy to use	High quality	Overwhelming	Trustworthy
Clear	Effective	Impersonal	Patronizing	Unapproachable
Collaborative	Efficient	Impressive	Personal	Unattractive
Comfortable	Effortless	Incomprehensible	Poor quality	Uncontrollable
Compatible	Empowering	Inconsistent	Powerful	Unconventional
Compelling	Energetic	Ineffective	Predictable	Understandable
Complex	Engaging	Innovative	Professional	Undesirable
Comprehensive	Entertaining	Inspiring	Relevant	Unpredictable
Confident	Enthusiastic	Integrated	Reliable	Unrefined
Confusing	Essential	Intimidating	Responsive	Usable
Connected	Exceptional	Intuitive	Rigid	Useful
Consistent	Exciting	Inviting	Satisfying	Valuable
Controllable	Expected	Irrelevant	Secure	
Convenient	Familiar	Low Maintenance	Simplistic	

3. Cognia

Cognia system is a Cognitive Investment Advisor, it is a system based dialogue that helps people to make better investment decisions (see Figure 2). It is a multi-agent system; several agents participate in the same dialogue with humans. Cognia system was trained to answer questions about two types of investments: Savings accounts and CDBs. Each investment is an intelligent agent in the system, and Cognia is the agent that moderates the conversation and helps users to decide more suitable investment for them.

Figure 2: Cognia – Cognitive Investment Advisor

Our project team is multidisciplinary, is composed by computer scientists, designers and engineers. With the aim to guide the team through the design process of Cognia we used a video demo as tool. Therefore, our team would have an example of how the envisioned concept should work and develop the functions illustrated in the video. The video case scenario was inspired by previous design activities to understand investment decisions with real users. It was made by the designers in the team. The video length is about three minutes and shows how the multi-part cognitive dialogue helps a user to make an investment decision. (see Figure 2). Follow a description of the video demo: The first part of the video consists in a short introduction with an initial phrase "*Cognia has detected that you have considerable money in your bank account*" to introduce the participant in the case scenario. Next, a user receives a push notification from the system with a message "*Your account in Banco Blue has R$ 16.000 that is not receiving any interest. Would you like to invest some of this money?*". This message acts like a trigger for opening the application. After that, Cognia, the moderator agent, displays three

options with different values. The person selects one of those options and Cognia replies: "*There may be a penalty for early withdrawal for your investment. How long do you plan to leave the money in this investment?*" and shows three options of investment horizon. User chooses one and Cognia invites two more expert agents to participate in the dialogue, one is SavingsGuru and the other is CDBGuru. CDBGuru gives a simulation of values selected by the user and after SavingsGuru does the same. The user asks definition questions, such as: "*What is CDB?*" and CDBGuru answers. Cognia tells the user which investment is more profitable. CDBGuru and SavingsGuru show parts of Web crawled articles with links that can be useful for the user. An interactive visualization comparing values is also shown for the user in the video. Cognia asks for a decision and the user chooses CDB option in the dialogue. Cognia redirect the user to the Bank Blue page, where he can complete the transaction.

Figure 2: Video demo.

4. User study

The objective of this user evaluation was to examine the user perceptions of a multi-agent dialogue, illustrated in a video demo, and identify users' preferences with regard to cognitive investment advisors. Our main research questions to guide this study are:

- What are the user's reactions to Multi-agent conversation?
- What are the user's reactions to Interface and Information design?

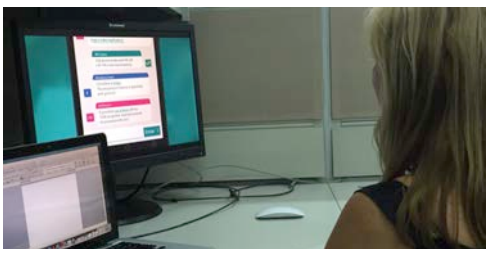
In order to answer those questions, the Product Reaction Cards (Benedek et al. 2002) technique was included in the experiment as a way to extract user's perceptions from a Video demonstration of Cognia. The adjectives were written in Portuguese and English in each card, to avoid misconceptions of words. The video demo language was Portuguese.

The option of having a video instead of a real application was to evaluate the first impressions people would have of multi-agent concept. The aim was not fully understanding usability issues and functionalities, it was to gather impressions of those and of visual design issues. (Figure 3, 4, 5).

In the first part of the study, participants were asked to watch the video and make any comments they judge necessary. The instructor asked them first to select 10 adjectives of 118 Product Reaction Cards adjectives written in individual paper cards and asked them to use the think aloud technique (Love 2005:64; Preece 2007). Afterwards, participants were asked to choose 5 adjectives of 10 adjectives previously chosen, and give reasons for choosing those to the instructor. Participants were also requested to add any words they did not find in the stack of 118 cards, and explain why. Following the reaction cards activity, participants were asked to watch again a specific fraction of the video in which Cognia invites other agents to participate in the conversation. Then, the instructor questioned the participant: Who are the participants of this conversation? And What is your impression of this concept? Participants shared their thoughts of multi-party dialogues with the instructor.

In the end of the session, participants answered a semi-structured interview with demographic questions and their previous experience with investments. A consent form was filled out by participants before the study. The experiment was conducted in a lab, and also remote via Video Conference. For the remote participants, the paper cards were substituted by a table with the adjectives. Remote participants were asked to highlight 10 words in red and the 5 words in bold. The length of the session was on average 15 – 25 min. All the sessions were audio and video recorded. The observation data was analyzed supported by the notes the researchers took during the tours. The use of a notepad was vital to gather information in case any problems might happen with the video recording. Participants were rewarded with a small gift.

Figure 3, 4, 5: Figure 3 participant watches the video; Figure 4 participant choosing cards e Figure 5 cards used in the study.



4.1. Participants

The target of Cognia is people do not have knowledge about investment but have money to invest. We are focusing on people younger than 40 years old, well-educated and with medium-high income. According to previous research (SPC 2014), the majority of Brazilians save money, in the savings account, instead of investing. And this percentage is 70% in the class A and B (higher income class). We were looking for participants with those characteristics. Ten Brazilian participants were recruited by a snow-ball sample. Linguistic, Design, Computer science, Anthropology, Computer science, Tourism and Engineering were the main background of our participants. Although, all them work for a technology company. Five participants were female and Five male. An average of 35 years old. All of them had previous experience with Savings account and four with other types of investments CDBs, LCI, LCA. It was the first time they saw a multi-party dialogue system aimed to advise about finance. Although, some of them used other apps for conversation like What's App. All the participants we recruited were familiar with chatrooms.

5. Data Analysis

The data was analyzed using descriptive statistical methods and qualitative methods. Basic statistical analysis was carried out to analyze the data from the questionnaires - demographic data, semantic scales and design preferences. Tables and cross tabulation were applied to compare the results among participants and the use of the system. The restricted number of participants in the study was not enough to ensure the validity of the statistical analysis. Besides, these results did not give us enough evidence of essential elements for designing mobile guide applications. Writing on design evidence, Lawson (2006: 64) highlights that "we normally measure and express quantities by counting using a numerical system. This leads us to believe that all numbers behave in the same way and this is quite untrue". The same author emphasizes what designers really need is to have a feel for the meaning behind the numbers rather than precise methods of calculating them. (p.71). In agreement with Lawson ideas, a qualitative approach was applied in most of the process. The data analysis was based on data transformation. Data transformation is a quantification of qualitative data. This involves creating qualitative codes and themes, and then counting the number of times they occur in the textual data. This enables researchers to compare quantitative results with qualitative data (Creswell, 2009: 218).

The transcriptions of the video observations, important notes taken during the fieldwork and suggestions given by participants while they were doing the experiment were considered. Research questions were kept in mind while the data was classified and codified.

Relevant issues were classified into sets of codes. The principal set of issues emerging from the data were: reactions of multi-agent concept and reactions to interface and information design (positive and negative adjectives). The transcriptions of the videos, observation analysis and coding were assisted by the qualitative software Nvivo.

6. Results

6.1. Multi-agent impressions

Overall participants found useful the separation of investments in agents. Some of them considered this approach useful for information design, since each agent has a different color that helps in organizing and distinguish information in the chatroom screen. Others did not notice the separation, likewise participant 1: “Funny, I found interesting this approach, but for me I was talking to Cognia all the time. It was what I felt. Even though we had characters (CDB and Savings) for me the interface is the app, the system.”.

Therefore, it is clear some confusion between the Cognia agent, the dialogue moderator, and the Cognia system, overall app happened among our participants. Some participants also emphasized the importance of information and not the way it was delivered. Participants also highlighted that having different agents for different investment helped them to compare which one was the most suitable for them. And it is also important that one of the investments are known by users. In the words of Participant 6: “I think to present a new thing, you need to compare, and the best thing to do this is comparing things people already know like the Savings account that works as a baseline, well-known”.

A better work has to be done to distinguish the differences between agents in the system, even though they liked the separation it was not possible to be certain they understood the system was multi-agent only seeing the video. It was also clear the option of multi-agent did not affect negatively participant’s perceptions.

6.2. Reaction Cards – Words Rank

Participants chosen 35 words from 118 reaction cards. Thirty-two words selected were positive and three negative. (see Figure 6). In this session, we describe the most rated words and discuss participant’s impressions. (see Figure 6).

Figure 6: Word cloud of words chosen ad explained by participants.

6.3. Positive Impressions

Third two positive words were chosen by participants. Easy to use, Sophisticated, Friendly, Straightforward, Helpful and Connected were the most rated words participants chose and gave a rational of their choices.

Easy to use: Participants perceived the interface as easy to use, since some of them have use in their everyday life apps to exchange messages between people. According to P7 “When I saw that was so easy to use, I got suspicious – It’s not possible it is so easy, to get and invest my money”. Even though, they have tech experience, some found the dialogue approach interface easy for people they know that is not. “It is easy to direct the conversation to what you want to know; you make a question” (P5).

Sophisticated: Participants chose this word for two reasons. First, they found sophisticated to do transactions from a mobile phone and do not have to go to the bank, like a privilege. “When you see a dialogue like this, it motivates me to do an investment” (P3). Second, they appreciated the visualization of investment values on the interface and the interaction shown in the video. The possibility to exclude investments from the visualization and concentrate on the relevant information.

Friendly: Only one participant that chose – Easy to use – choose – Friendly – as well. The other participants that chose Friendly choose for similar reasons the ones that chose – Easy to use. Participants found well-explained the content. “for example, it gives the information that you will have 200 to 700 more if you invest in CDB, people open the chart and it shows why, so no secret you go there and see, that is why it is friendly, because it is easy to use and beyond that it is well done visually”. (P3).

Straightforward: Participants liked the flow of the dialogue. They found Cognia direct, “shows the option without so many steps, it gives you the information and you only have

to select" (P8). Another example of being straightforward was to direct people to the Bank page.

Helpful: The system notifies users they have money in the bank that should be invested. The notification showing this was considered helpful since participants mentioned not having enough time to check it in everyday situations. Found helpful and informative having this information in their personal devices "faster and more informative than accessing the bank website". (P4). Additionally, a participant considered the level of information given by the system as suitable "the system guides me in a very soft way, given me information, like a date based on information, not so much, not so little, I found this cool." (p6).

Connected: The function of having a link with some parts of the content was valuable for some of our participants. "He gave me an explanation and brought a link, brought a link as an example, brought a web article from Internet that is my main source of information for those issues". (P10).

A new word was added, that was not available in the 118 cards:

Credibility: Participants connected credibility to the way the system shows information without bias for a specific investment, showing the source. People can choose from Savings or CDB options examining information. The system not tell people what to do. "One thing is an app saying what you should do, it did not do this what you have to do. It gives you the choices from what is more interesting. You are the one who is taking the decision". (P5).

6.4. Negative Impressions

Three negative words were chosen by participants: Scary, Insecure and Intimidating.

Insecure/ Scary/ Intimidating: Participants chosen those three words for the same reason. The main concern of participants was the access of their bank financial information from an app. Questions such as: how is it work? Is it safe? Were common during their explanations. Participants, that mentioned this word, were not comfortable with a system sending notification to their phone home screen, information the amount they have in their account. (see Figure 7).

Figure 7: Notification and trigger.

7. Discussion and Conclusion

In this paper, we presented an evaluation experiment of a cognitive investment advisor in the early stages of the development. A video demo was used to illustrate our concept and the Reaction cards technique was applied to gather user's perceptions of our concept.

It was a good mix of approaches, using video and the reaction cards in this stage of the design process. Since several functionalities were not ready to be evaluated by interacting with the real system and user feedback would not be related to the concept, that in our case we were interested in.

Concept reactions could be summarized as Positive and Scary. Suitable level of information, connected and easy to use on one hand. On the other hand, not so safe and scary accessing personal bank accounts. Interface was considered familiar and easy to use, participants identified similar tools they use to chat with Cognia. The dialogue styles was recognized as useful letting people ask what they want, and in Cognia participants perceived the choices given to choose with questions, which in their opinion facilitates the interaction. The multi-party dialogue was not identified as we expected, people did not see the agents as individual agents. They identified the agents as a visual organization of information and not different entities in the same system. More work is necessary to distinguish this on the visual design. Although, participants considered the information as being the most important component of our system, and not the way it is presented (different agents or only one agent), it is important to have this distinction. In the future, we envision to have more agents, so they will represent different points of view to help in decision making.

Triggers and notifications will also be addressed in the redesign of the system, given privacy to user information. Following-up this study, an interactive prototype will be

evaluated to help us to gather more insights of people interacting with multi-party agents in financial contexts.

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