



# How Does Conversation Length Impact User's Satisfaction? A Case Study of Length-Controlled Conversations with LLM-Powered Chatbots

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## ABSTRACT

Users can discuss a wide range of topics with large language models (LLMs), but they do not always prefer solving problems or getting information through lengthy conversations. This raises an intriguing HCI question: How does instructing LLMs to engage in longer or shorter conversations affect conversation quality? In this paper, we developed two Slack chatbots using GPT-4 with the ability to vary conversation lengths and conducted a user study. Participants asked the chatbots both highly and less conversable questions, engaging in dialogues with 0, 3, 5, and 7 conversational turns. We found that the conversation quality does not differ drastically across different conditions, while participants had mixed reactions. Our study demonstrates LLMs' ability to change conversation length and the potential benefits for users resulting from such changes, but we caution that changes in text form may not necessarily imply changes in quality or content.

## CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; **Text input**; *Empirical studies in interaction design*; *User studies*; **Natural language interfaces**.

## KEYWORDS

Conversational Agents, Chatbots, Large Language Models, Conversation Length

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## 1 INTRODUCTION

People can now talk about almost anything via conversation with large language models (LLMs). However, it is known that users do not always want to solve their problems or obtain information through lengthy conversations. A study surveying 500 AskReddit<sup>1</sup> questions [9] showed that although people are enthusiastic about addressing specific types of questions through conversation, they prefer *not* to tackle certain questions, like those about food or technology problems, through conversations. Moreover, individuals often find themselves in situations that hinder them from engaging in extended conversations, such as walking or cooking. They may simply need a quick answer and move on.

This raises an intriguing HCI question: **How does instructing LLMs to engage in longer or shorter conversations affect conversation quality?** Answering this question is challenging because a conversation necessitates human user involvement, and the unfolding of the conversation cannot be examined by solely testing the LLMs. To keep this research question manageable, this paper focuses on two specific situations: (i) What happens if LLMs were instructed to engage in longer conversations with a human user for less conversable questions? Conversely, (ii) what if LLMs were instructed to hold a short conversation for questions that people prefer to discuss in longer conversations?

To answer this question, we developed two Slack<sup>2</sup> chatbots using GPT-4 with the ability to vary conversation lengths and conducted a user study. Participants were directed to ask both more and less conversable questions to the chatbots, engaging in dialogues with 0, 3, 5, and 7 conversational turns. We collected participants' self-reported responses and enlisted online crowd workers to rate the quality of these conversations. The study results show that while GPT-4 can alter conversation lengths, this does not necessarily lead to improved conversation quality. Participants' self-reported satisfaction levels varied and are said to be dependent on different situations. According to online crowd workers' ratings, the conversation quality does not vary drastically across different conditions. Having longer conversations for highly conversable questions did not result in better quality conversations, and having shorter conversations for less conversable questions did not result in worse

<sup>1</sup><https://www.reddit.com/r/AskReddit/>

<sup>2</sup><https://slack.com/>

quality conversations. However, participants had mixed reactions: some found that longer conversations were more engaging and offered more nuanced discussions, while others considered longer conversations repetitive and not useful.

Our study demonstrated LLMs' ability to change conversation length, thus offering versatile applications for information. Additionally, our study cautions that changes in text form may not necessarily imply changes in quality or content.

## 2 BACKGROUNDS

Employing suitable linguistic styles may augment perceptions of trustworthiness [14, 17] and anthropomorphism [5, 7], as well as improve the perceived quality of the interactive experience [11]. HCI researchers have extensively explored the impact of linguistic style choices on user perceptions of conversational agents. However, little research explores the influence of the length of conversational turns.

Several research endeavors have been undertaken to empirically assess the impact of various conversational styles on user experiences (UX) with chatbots [1–4]. For example, Chaves et al. [2] conducted a study where parallel corpora were developed, consisting of dialogues within the tourism sector, which exhibited analogous content but differed in the situation of use. The research focused on assessing user preferences regarding the linguistic choices of chatbots and evaluating aspects such as appropriateness, credibility, and overall user experience. Elsholz et al. [4] conducted a comparative analysis of user interactions with chatbots employing modern English versus those utilizing a Shakespearean style of language. Findings from this study indicated that the chatbot implementing modern English was regarded as more user-friendly, whereas the one using Shakespearean English was perceived as providing a more entertaining experience. In research aimed at discerning the anticipatory needs of migrants in relation to information-seeking chatbots [3], it was observed by the participants that an overly informal and relaxed linguistic style was not congruent with the context of the subject matter. Along the line of research, Hu et al. [8] designed a tone-aware chatbot that can generate responses in a passionate tone and empathetic tone. Users consider chatbot responses to be as passionate as human ones and even more empathetic than human ones.

However, this body of literature lacks the investigation of users' perception of chatbots' ability to navigate users' questions. In the real world, people explore complex, ill-defined questions together. Prior research has recognized the need for creating conversational systems that can help with ill-defined questions [10]. Huang et al. [9] examined the types of ill-defined open-ended questions that are most suitable for having conversations. Furthermore, natural language processing (NLP) and AI researchers have studied the ability of large language models to control the length of the outputs [18], such as headline length control [12], the ability to extend conversations [16]. We leverage the above research progress and aim to investigate whether chatbots' quantity of relevant conversational turns could support users' ill-defined questions.

## 3 USER STUDY

The study aimed to investigate the potential **user benefits of assistants that strategically adapt conversation formats**, especially regarding **conversation length**. ChatGPT enabled us to develop a chatbot capable of responding to arbitrary questions while varying the number of conversational turns it engages in. We used questions compiled by Huang et al. [9] and further categorized them into high Conversation score and low Conversation score brackets. We hypothesized that users would benefit from longer conversations when posing highly-conversable questions.

*Study Design.* The main component of the study was a **conversational question-answering** session. Participants were required to interact with two automated Slackbots<sup>3</sup> of different configurations, MULTISLACK and SLACKVANILLA, on Slack backed by ChatGPT (GPT-4) to help answer a set of questions. SLACKVANILLA gives answers immediately, while MULTISLACK holds the conversation for several turns for clarification. Participants participated in person in the research lab using the provided computer and monitor.

Questions used in the study were drawn from the AskReddit Questions Dataset [13] annotated by Huang et al. [9]. The questions were rated on various aspects, including their conversational nature (Conversation score) and the degree to which they prompt individuals to seek out others to pose the questions (Reach-Out score), among other factors. We chose a total of 40 questions: 20 with the highest Conversation score ( $\geq 4.11$ ) and 20 with the lowest Conversation score ( $\leq 2.67$ ). In cases where the questions had the same Conversation score, we prioritized those with a higher Reach-Out score. We also corrected minor typos in the selected questions.

For the remainder of this paper, we will use the terms *Conversability/Conversable* to refer to the Conversation score. Example questions include “*Is it possible to make a good situation out of any bad situation?*” (high-conversability), and “*Do you know any website to watch Marvel’s “What If...?”?*” (low-conversability). We provide the 40 selected questions in Appendix A, where Table 3 displays the 20 selected questions with highest Conversation scores, and Table 4 presents the 20 selected questions with lowest Conversation scores.

We excluded two categories of questions from our list. The first group consisted of sensitive topics and Reddit-specific questions, including those related to Not Safe For Work (NSFW) content, religion (especially those of a sensitive or discriminative nature), topics involving minors, and Reddit technical inquiries. The second group comprises those to which ChatGPT cannot directly respond to. This includes requests for web links, suggestions to harm others, and inquiries regarding serious mental health issues.

*Configuring the Slackbots.* In this study, we built two GPT-4 Slackbots: SLACKVANILLA and MULTISLACK. SLACKVANILLA is configured to provide direct responses without engaging in iterative conversations. Conversely, MULTISLACK is designed to initiate a dialogue, asking up to  $N$  clarifying questions before delivering a final answer, where  $N$  is a variable that will be manually set by researchers in the study. This interactive capability is realized by inserting an additional prompt that tracks the conversation's progress and informs GPT-4 about the remaining number of follow-up inquiries after

<sup>3</sup><https://slack.com/resources/using-slack/a-guide-to-slackbot-custom-responses>

each user input. Once the limit of follow-up questions is reached, GPT-4 is prompted to stop further asking questions and produce the final response. The implementation details of the two Slackbots are described in Appendix B. We also included conversations of the same question between participants and SLACKVANILLA, as well as with MULTISLACK when  $N = 3$ ,  $N = 5$ , and  $N = 7$  in Appendix D.

*Study Procedure.* The study consisted of a pre-study session and two interaction sessions (Session MULTISLACK and Session SLACKVANILLA).

- (1) The **pre-study session** introduced the study and included a short tutorial.
- (2) **Session MULTISLACK** and **Session SLACKVANILLA**. At each interactive session, participants were asked to perform the information-seeking and ask SLACKVANILLA and MULTISLACK on Slack to help answer the assigned question. Users filled out a set of questionnaire questions after each question was answered by the assistant.

The questionnaire questions are presented in Appendix C, where Table 5 and Table 6 display the questionnaire questions for SLACKVANILLA and MULTISLACK, respectively.

Each participant will ask three questions to MULTISLACK and three questions to SLACKVANILLA, where the six questions are distinct from one another. The order in which participants engaged with MULTISLACK or SLACKVANILLA was randomized. Note that participants would consecutively ask three questions to MULTISLACK before switching to SLACKVANILLA, or vice versa. MULTISLACK was configured in three different ways: to ask 3, 5, and 7 follow-up questions before providing answers to the participants' questions, denoted as  $N = 3$ ,  $N = 5$ , and  $N = 7$ , respectively. Eight different participants conversed with each of these three different MULTISLACK configurations. Participants were not informed about the difference in assistant configuration before the study. The three values of  $N$  were decided through the four pilot study sessions. It was concluded that configuring  $N \geq 10$  easily exceeds 1.5 hours of study time and caused fatigue for participants, potentially compromising the overall quality of the study.

For  $N = 5$ , six questions were randomly selected from the pool of 40 questions (sampled from the AskReddit dataset [9, 13]). To ensure a more comprehensive coverage of the questions, for  $N = 3$  and  $N = 7$ , three questions were randomly chosen from the questions with the highest Conversation scores ( $\geq 4.11$ ) and three from the questions with the lowest Conversation scores ( $\leq 2.67$ ). Additionally, the order of the questions was randomized.

Each participant took 1 to 1.5 hours to complete the entire study and the participants were compensated with \$20.00. This study was approved by the IRB office of the authors' institute.

*Participants.* Participants were recruited through university mailing lists and personal networks. A total of 24 individuals were recruited (participants were ID coded U1-U24 in this paper): fourteen males, nine females, and one prefer not to say. Twenty-two of the participants were aged between 21 and 35; two participants were over 36 years old. The majority of the participants were undergraduate and graduate students at the university. Among all the participants, only one did not have prior experience using virtual assistants (e.g., Siri, Google Assistant, or Alexa). All participants

have prior experience interacting with ChatGPT. Participants were informed that they would be interacting with a ChatGPT-backed assistant during the study.

## 4 FINDINGS

### 4.1 Participant Self-Reported Response Analysis

Table 1 shows the average participant self-reported ratings for the questionnaire questions. Figure 1 shows the rating distribution for the questionnaire questions.

*4.1.1 As the conversation length increased, satisfaction levels for high-conversability questions also rose.* In the post-interaction questionnaire, we asked participants to rate how satisfied they were with how the assistant helped them ( $Q_C$ ) on a five-point Likert scale from Very Dissatisfied (1) to Very Satisfied (5). As shown in Table 1 [ $Q_C$ , High], the average satisfaction scores for high-conversability questions were 3.64 for SLACKVANILLA, 3.44 for  $N = 3$ , 3.57 for  $N = 5$ , and 4.33 for  $N = 7$ . The average score of SLACKVANILLA and MULTISLACK  $N = 7$  show statistical difference (p-value = 0.041). We observed an increase in the satisfaction score when the number of questions asked for the high-conversability questions increased. These results affirmed our hypothesis: **assistants that strategically adjust conversation formats—specifically conversation length—in accordance with the current situation (the conversability of the question), offer advantages to users.**

*4.1.2 The helpfulness of responses to high-conversability questions increased with increasing conversation length.* We also asked the participants how helpful the solution was ( $Q_B$ ) on a five-point Likert scale from Strongly Disagree (1) to Strongly Agree (5). As shown in Table 1 [ $Q_B$ , High], the average score for high-conversability questions were 3.44 for  $N = 3$ , 3.86 for  $N = 5$ , and 4.25 for  $N = 7$ . Again, we observed an increase in the helpfulness score when increasing the number of questions asked for the high-conversability questions. These results, again, affirmed our hypothesis that **assistants that strategically tailor conversation formats to the current situation provide benefits to users.**

*4.1.3 Participants may believe high-conversability questions necessitate more questions from the assistant.* For SLACKVANILLA, we asked participants to rate whether the assistant should ask more questions ( $Q_A$ ) on a five-point Likert scale from Strongly Disagree (1) to Strongly Agree (5). The average score for the high-conversability questions is 3.55, and for the low-conversation-score questions is 3.25.

For MULTISLACK, we asked whether the number of questions asked by the assistant is enough ( $Q_A$ ) on a five-point Likert scale from Not Enough (1) to Too many (5). For the high-conversability questions, the average score of  $N = 7$  was 3.75, for  $N = 5$  is 2.71, and for  $N = 3$  is 3.1. While average score of  $N = 7$  and  $N = 5$  show statistical differences (p-value = 0.027), the rise in  $N=3$  score was not clear to the authors.

*4.1.4 MULTISLACK was preferred over SLACKVANILLA but with varying opinions from participants.* We explicitly asked participants to compare MULTISLACK and SLACKVANILLA by asking them, "Regardless of the questions asked, how would you rate your interaction with the

		SLACKVANILLA		MULTISLACK		
		Converasability	No Conversation	N=3	N=5	N=7
$Q_A$	# Dialogue	High	44	9	14	12
		Low	28	15	10	12
	Should Ask More	High	3.55	-	-	-
	(Strongly Disagree -> Strongly Agree)	Low	3.25	-	-	-
$Q_B$	Enough Count	High	-	3.11	2.71 <sup>†</sup>	3.75 <sup>†</sup>
	(Not enough -> Too Many)	Low	-	3.33	3.60	3.42
	Helpfulness	High	3.57	3.44	3.86	4.25
	(Strongly Disagree -> Strongly Agree)	Low	4.39	4.07	4.20	4.17
$Q_C$	Satisfaction	High	3.64 <sup>★</sup>	3.44	3.57	4.33 <sup>★</sup>
	(Very Dissatisfied -> Very Satisfied)	Low	4.36	4.13	4.20	4.17

Table 1: Average ratings of the participant self-reported response. Rating pairs that passed the T-Test are denoted by <sup>†</sup> (p-value = 0.027) and <sup>★</sup> (p-value = 0.041). We observed that increasing conversation turns would improve user satisfaction level for high-conversation-score questions.

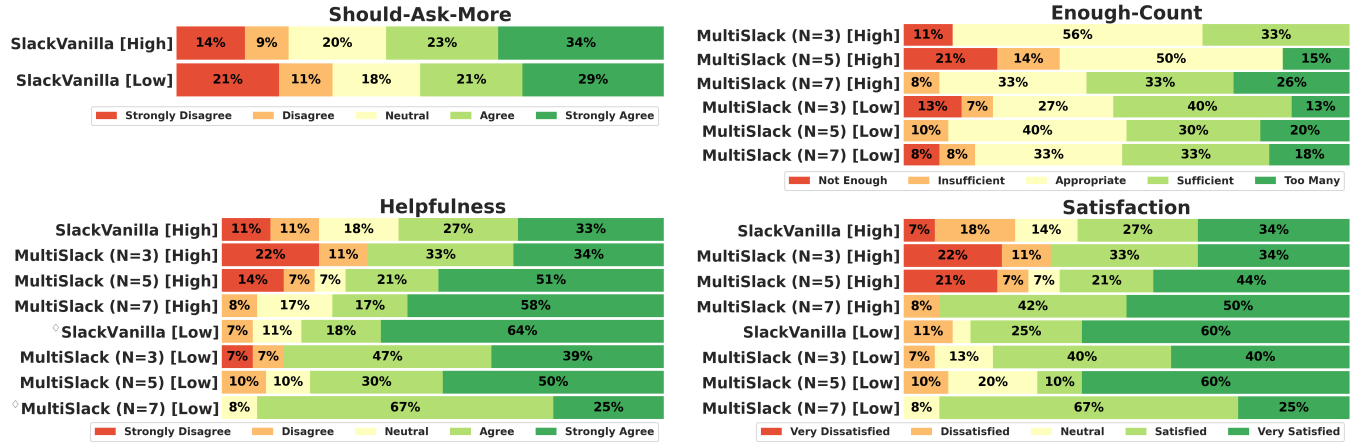


Figure 1: Rating distribution of the participant self-reported responses. Rating pair that passed the Chi-squared Test is denoted by  $\diamond$  (p-value = 0.05).

assistants?” Participants used a five-point Likert scale ranging from “A Is Significantly Better” (1) to “B Is Significantly Better” (5). The average ratings and standard deviations for comparison between MULTISLACK of different configurations and SLACKVANILLA were as follows: for MULTISLACK with  $N = 3$  was (mean = 1.75,  $\sigma = 0.97$ ); for MULTISLACK with  $N = 5$  was (mean = 2.5,  $\sigma = 1.5$ ); and for MULTISLACK with  $N = 7$  was (mean = 2.25,  $\sigma = 1.3$ ). The high standard deviations suggest that participants held varying opinions. Additionally, many participants indicated that comparisons between MULTISLACK and SLACKVANILLA depended on specific factors. For example, U18 commented,

“I don’t think either of the bots particularly are better or worse than the other one so this is why I chose a 3. It felt like [SlackVanilla]’s direct responses to my questions were appropriate for the question types (typically ones that have factual/objective answers). For [MultiSlack], the questions were more focused on opinion/subjective topics, and I think its ability to provide follow-up

questions is good for this case. I do think if you were to reverse the questions for the bots, the experience would be a lot different.”

U12 said,

“I cant choose which is better. It depends. Because [MultiSlack] may try to have a conversation with you while [SlackVanilla] will directly provide you the answers. I think sometimes I need to the answer quickly, I prefer [SlackVanilla]. Sometimes, my situation is complex and need to be analyzed carefully, I prefer [MultiSlack].”

U14 reflected,

“Time matters. if I’m in a rush to get a quick answer from a robot who does not have any follow-up question or empathy/emotion, and then I would prefer [SlackVanilla]. However, if I would take some time to enjoy a one-on-one text conversation or seek for actual suggestion in a particular real life scenario (hypothetically), and then I would prefer [MultiSlack] in general.”

U23 said,

*“For simpler questions, I would prefer that there are not many as back and forth exchanges, but I appreciate a more conversational style for questions that are more in-depth or are related to topics that I have little knowledge of.”*

U22 stated,

*“I can say it depends on the questions asked. For the [SlackVanilla], most of the questions were straight forward and answers can be given without any follow up questions whereas [MultiSlack] provided answer based on my views and aspects.”*

## 4.2 MTurk Response Analysis

We also evaluated the quality of the conversation between the participants and both Slackbots by recruiting Amazon Mechanical Turk (MTurk) workers (the worker interface is shown in Appendix E). Six aspects and the accompanying inquiries of the conversations were rated on a five-point Likert scale listed below:

- **Helpfulness:** The assistant offer a helpful solution to the user's original question by the end of the conversation.
- **Quantity:** The assistant request an appropriate amount of information from the user, necessary for the purpose of the conversation.
- **Relevance:** The assistant seek information that is relevant to the purpose of the conversation from the user and avoid including irrelevant information.
- **Repetitiveness:** The assistant's messages are free from repeating information.
- **Clarity:** The assistant's messages are clear and easy to understand.
- **Ambiguity:** The assistant inform the user when things were unclear in the conversation and explain how it understood uncertain messages.

In this task, we asked workers to read the conversation and then rate the above six aspects. A total of 141 conversations from 24 participants were evaluated. Notably, three conversations were excluded from the analysis among the original 144 conversations due to presence of erroneous messages. For each task, we recruited 9 different workers with four built-in worker qualifications: HIT Approval Rate ( $\geq 98\%$ ), Number of Approved HITs ( $\geq 3000$ ), Local (US Only), and Adult Content. Each task was estimated to take 70 seconds, so we set the price at \$0.2 per task (hourly wage = \$10). Table 2 shows the average MTurk worker ratings on the six conversation aspects. Figure 2 shows the rating distribution of the six aspects. The six aspects were inspired by Chatbot design principles proposed by Setlur and Tory [15], which employed Grice's maxims [6].

**4.2.1 Longer conversations may not be inherently better for high-conversability questions.** The result suggested that for questions with high conversability, a longer conversation length does not necessarily yield a more helpful solution at the end. Extending the conversation length can result in repetitive information within messages, and it may not enhance message clarity. While MULTISLACK may potentially address ambiguity better compared to SLACKVANILLA regardless of a question's conversability, fluctuations in ambiguity ratings imply that an increase in conversation length does not consistently equate to improved outcomes. In essence,

the MTurk evaluation suggests that longer interactions are not inherently superior in addressing high-conversability questions.

## 5 DISCUSSION

This paper presents a case study examining the influence of message length in interactions with a GPT-4-powered Slack chatbot. Our observations suggest that users tend to engage more deeply in discussions involving questions with high conversational potential. This is reflected in the increase in self-reported satisfaction and perceived helpfulness scores. However, our MTurk assessment reveals a more nuanced picture (see Table 2 and Figure 2): while helpfulness scores do improve as the number of conversational turns ( $N$ ) increases for these high-conversational questions, there is a notable decline when  $N$  reaches seven. Additionally, other questions evaluating the assistant's performance do not show a corresponding improvement with an increase in  $N$ . This suggests that beyond a certain point, more conversation does not necessarily equate to higher effectiveness.

The effectiveness of the prompts used in SLACKVANILLA and MULTISLACK might be a factor in generating suboptimal responses. Merely instructing a large language model (LLM) to pose follow-up questions does not guarantee the generation of high-quality inquiries that meaningfully advance the conversation towards an effective resolution. It is also conceivable that the LLM lacks the capability to formulate truly pertinent questions, which requires a deep understanding of the user's overall situation, condition, or objectives. This limitation is significant, given users' general unfamiliarity with the full extent of the LLM's capabilities, whether robust or limited.

Regarding the ideal conversational length, denoted as  $N$ , our findings suggest that it varies unpredictably across different topics, even among those with high conversational potential. There is not a linear or straightforward trend indicating that longer or shorter conversations are inherently better. Instead, the ideal length  $N$  appears to be dynamic, influenced by the nature and quality of follow-up questions asked as the conversation unfolds. Poor quality inquiries by the bot may necessitate a longer conversation (increasing  $N$ ), whereas incisive, progress-driving questions might shorten the required conversational length (decreasing  $N$ ). Thus,  $N$  is not a fixed value but is fluid and context-dependent, shifting in response to the evolving quality of the dialogue.

**Limitations.** We acknowledge several limitations in this study. Firstly, the research concentrates on one specific aspect of conversation: conversation length, leaving additional attributes, such as output modality and delivery channel, unexplored. Secondly, the study's limited scale and bias towards younger and well-educated users with prior experience interacting with LLMs challenge the generalizability of the results, necessitating further investigation. Lastly, we recognize the potential trade-offs between safeguarding user privacy and meeting their needs. Our approach, requiring conversational assistants to be situationally aware, sacrifices some user privacy for convenience, potentially introducing additional risks. This topic warrants further exploration in future research.

			SLACKVANILLA	MULTISLACK		
			No Conversation	N=3	N=5	N=7
			Converasbility			
	# Dialogue	High	44	9	11	12
		Low	28	15	10	12
Q <sub>1</sub>	Helpfulness	High	3.96	4	4.08 <sup>†</sup>	3.89 <sup>†</sup>
	(Strongly Disagree ->Strongly Agree)	Low	4.09 <sup>★</sup>	3.91 <sup>★</sup>	4.08	3.97
Q <sub>2</sub>	Quantity	High	3.54 <sup>◇</sup>	3.6	3.7 <sup>◇</sup>	3.54
	(Too Little - >Too Much)	Low	3.51	3.6	3.67	3.66
Q <sub>3</sub>	Relevance	High	3.87	3.99	3.82	3.81
	(Strongly Disagree ->Strongly Agree)	Low	3.91	3.81	3.78	3.85
Q <sub>4</sub>	Repetitiveness	High	3.8 <sup>▲</sup>	3.9 <sup>▽</sup>	3.68	3.57 <sup>▲▽</sup>
	(Strongly Disagree ->Strongly Agree)	Low	3.82	3.81	3.89	3.68
Q <sub>5</sub>	Clarity	High	3.93	4.05	4	3.91
	(Strongly Disagree ->Strongly Agree)	Low	3.97	3.86	3.87	3.9
Q <sub>6</sub>	Ambiguity	High	3.61	3.62	3.66	3.63
	(Strongly Disagree ->Strongly Agree)	Low	3.5 <sup>△■</sup>	3.8 <sup>△</sup>	3.77 <sup>■</sup>	3.62

Table 2: Average ratings of the MTurk evaluation. Rating pairs that passed the T-Test are denoted by <sup>†</sup> (p-value = 0.026), <sup>★</sup> (p-value = 0.013), <sup>◇</sup> (p-value = 0.041), <sup>★</sup> (p-value = 0.020), <sup>▽</sup> (p-value = 0.005), <sup>△</sup> (p-value = 0.004), and <sup>■</sup> (p-value = 0.028).

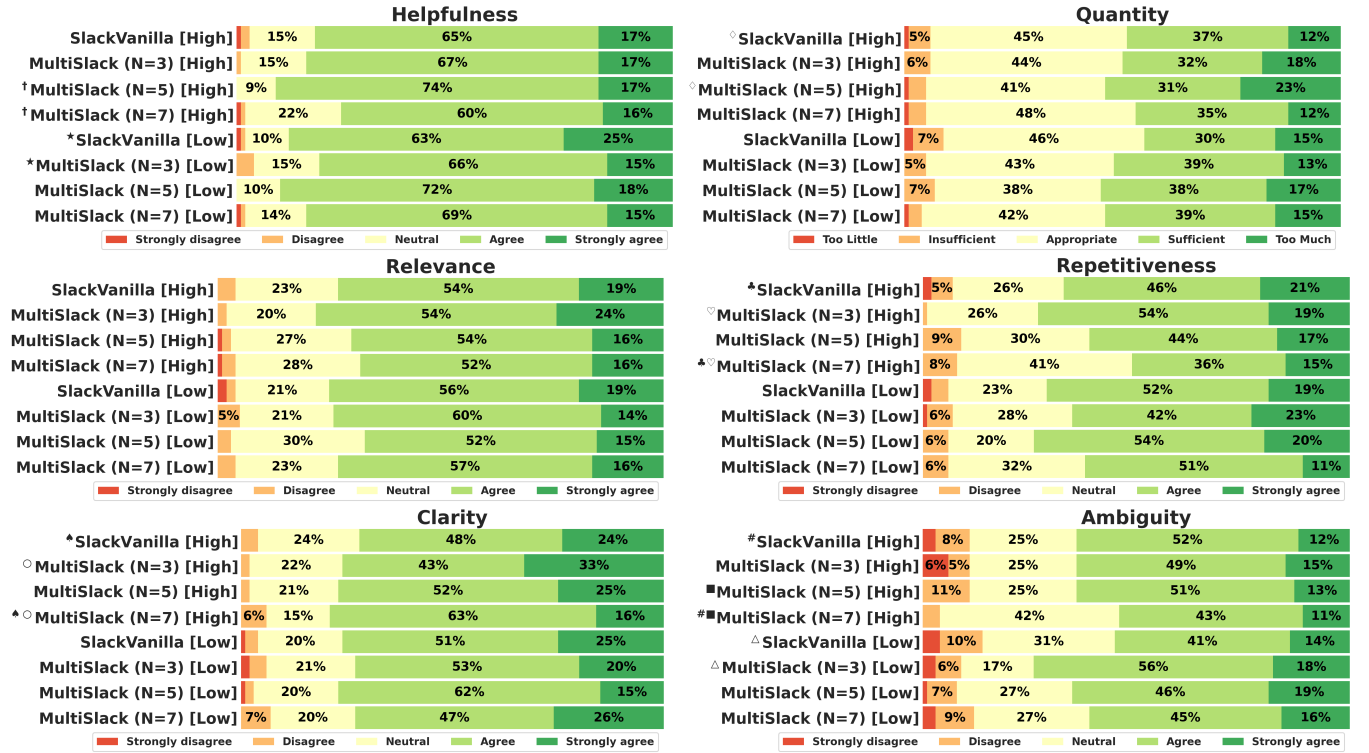


Figure 2: Rating distribution of the MTurk evaluation. Rating pairs that passed the Chi-squared Test are denoted by <sup>†</sup> (p-value = 0.046), <sup>★</sup> (p-value = 0.026), <sup>◇</sup> (p-value = 0.041), <sup>★</sup> (p-value = 0.013), <sup>▽</sup> (p-value = 0.01), <sup>★</sup> (p-value = 0.022), <sup>○</sup> (p-value = 0.015), <sup>#</sup> (p-value = 0.009), <sup>■</sup> (p-value = 0.032), and <sup>△</sup> (p-value = 0.005).

## 6 CONCLUSION AND FUTURE WORK

This paper introduces a case study investigating the impact of conversation length on users' conversation with LLM supported conversational assistants. It demonstrates that conversational assistants, which strategically adjust conversation formats to current situations, confer user benefits. This study argues for the development of future conversational assistants that can recognize user situations and accordingly adjust conversational formats. Looking ahead, we aim to explore the potential for conversational assistants to automatically detect situations and make strategic communication decisions. Just as we do not explicitly instruct our friends on conversational preferences, we should not need to configure conversational assistants during each interaction. Leveraging the enhanced AI capabilities of LLMs to address HCI challenges is crucial for facilitating human-like, meaningful conversations that transcend mere information provision and fluent response generation.

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## A QUESTION LIST FOR THE STUDY

Table 3 displays the 20 selected questions with highest Conversation scores, Table 4 presents the 20 selected questions with lowest Conversation scores for our study.

## B IMPLEMENTATION DETAILS OF THE TWO SLACKBOTS

Both Slackbots, SLACKVANILLA and MULTISLACK, are initiated with the prompt:

*You are a helpful assistant that helps users answer their questions.*

MULTISLACK is additionally set to ask a certain amount of follow-up questions before providing an answer. Such a constraint is imposed by adding the following instruction to the end of the users' message after users asked their initial question. **N** is used to denote the amount of follow-up questions required in the example below.

*Please answer the question "user message" that suits my situation best by asking me follow up questions. You HAVE TO ask me [N] follow up questions. Do not ask me all the questions at once. Progress base on the content of our conversation and ask questions based on my previous responses. Ask the first follow up question and wait for my response. Prepare the second follow up question according to my response to your first question. Same process goes for the remaining follow up questions. Do not ask me the same follow up questions. After my response to all the follow up questions, conclude the information I gave and provide an answer to the original question. Make my interaction with you like conversing with a real human agent, do not let me know how much follow up questions your are going to ask me and do not make the conversation bullet point oriented. Gather information from the follow up question in a subtle way and do not ask the questions through the ways of "Here is my # question?", "1. ..." etc.*

To ensure that the assistant strictly adheres to the specified follow-up question count, we include the following instruction at the end of each user's response. **N** is used to denote the amount of follow-up questions required in the example below.

*You still have to ask me [N] more follow up questions. Do not ask me all the questions at once. Progress base on the content of our conversation and ask questions based on my previous responses. Do not ask me the same follow up questions.*

To signal to the assistant when it should stop asking questions and provide an answer, the following instruction is added to the final message sent by the participants:

*Do not ask me anymore follow up questions. Conclude the information I gave and provide an answer to the original question by implying that there will be no more follow questions and is concluding the original question asked. When you conclude, please make it explicit so I know you are concluding the question. Maybe say something similar but not limited to "To answer your original question..." etc*

MULTISLACK gathers information throughout its conversation with users, and the questions it asks are based on users' previous responses. The final answer the assistant provides is also derived from the entirety of the conversation.

*History for MULTISLACK configuration.*

system: You are a helpful assistant that helps users answer their questions by asking a certain amount of follow up questions and give a conclusive answer in the end.

user: Please answer the question "How to actively socialise and make friends? (coming from someone who turned from an extrovert to an introvert in a span of two years.)" that suits my situation best by asking me follow up questions. You HAVE TO ask me THREE follow up questions. Ask the first follow up question and wait for my response. Prepare the second follow up question according to my response to your first question. Same process goes for the remaining follow up questions. After my response to all the follow up questions, conclude the information I gave and provide an answer to the original question. Make my interaction with you like conversing with a real human agent, do not let me know how much follow up questions your are going to ask me and do not make the conversation bullet point oriented. Gather information from the follow up question in a subtle way and do not ask the questions through the ways of "Here is my # question?", "1. ..." etc.

assistant: Sure, I can help you with that! What initially caused the shift from being an extrovert to becoming more introverted over the past two years?

user: I can't recall. You still have to ask me two follow up questions. Do not ask me all the questions at once. Progress base on the content of our conversation and ask questions based on my previous responses.

assistant: That's alright. In that case, could you tell me a bit about your current socializing habits? How often do you engage in social activities or spend time with others?"

user: I spend a lot of time home by myself or meeting with small groups if any.

assistant: Thank you for sharing that. Now, let's talk about your interests and hobbies. What are some activities or hobbies that you enjoy doing in your free time?

user: I watch TV and listen to music. This will be the last follow up question you ask me. Do not ask me anymore follow up questions and conclude the information I gave and provide an answer to the original question.

assistant: Thank you for sharing that. Based on the information you provided, here are some suggestions on how to actively socialize and make friends, considering your shift from being an extrovert to an introvert: Explore your interests in a social context: Look for local events or communities centered around your interests, such as music concerts, TV show or movie clubs, or even online forums and discussion groups. This way, you can connect with like-minded individuals who share your passion for the things you enjoy. Start with small group activities: If you prefer smaller gatherings, consider joining or organizing activities that involve a few people. This can include game nights, movie marathons, or even casual meetups at a coffee shop. Starting with smaller groups can help ease you back into socializing and create a more comfortable environment. Volunteer or join social groups: Engaging in activities where you can contribute to a cause or join a community can be a great way to meet new people. Consider volunteering for a cause you care about, joining a book club, or participating in a local sports team. These activities provide a shared purpose and can help you connect with others who have similar values or interests. Remember, building new friendships takes time and effort. Be patient with yourself and take small



Conversation Score	Question
4.33	What happens after we die?
4.33	What to do when you are feeling lost in life?
4.33	Recommendation for a vacuum cleaner?
4.22	Is it possible to make a good situation out of any bad situation?
4.22	What happens when you chew a poisonous flower for a few seconds but spit it out?
4.22	Is politics more entertaining now than it was in decades prior?
4.22	What is a fine tuned universe? Why is gravity fine-tuned?
4.22	What do you do when you can't get an anxiety-inducing thought out of your head?
4.22	how much pain did you feel after wisdom tooth removal?
4.22	How to control emotions? How do people control their emotions when they lost their loved one?
4.22	This housing market is wild. Is it going to last the next 4 years?
4.11	Why have humans gotten so weak physically? Like a few hundred years ago, people were cut up by swords and literally lost limbs but still were able to fight, but now we scared of things like needles.
4.11	What do I watch? I just downloaded Reddit and Netflix. What do I watch?
4.11	My friend is meeting her boyfriend's family this weekend over dinner. She is not Mormon, but his family is. He has separated himself from the church, but his family has not, though they are all on good terms. What are appropriate topics of conversation?
4.11	What's the difference between an alpha male and a sigma male?
4.11	Can someone explain the fastest way to learn Pokemon so I can understand what the hell my kids are talking about please?
4.11	How to say to an Asian parent that you like to move out
4.11	How do you approach someone you used to be friends with without making it awkward?
4.11	I have LG UX 250 sound system but I can't switch to AUX option since I lost original remote. Anymote app doesn't work, so it's there any other solution?
4.11	"The more you have of something, the less you value it, and the more you take it for granted". What is an example of this in our day to day life?

Table 3: 20 highest Conversation score questions selected for the study.

steps towards socializing. Don't be afraid to initiate conversations or reach out to people who share common interests. And most importantly, be open to new experiences and be yourself. Good luck on your journey to actively socialize and make new friends!

system: You are a helpful assistant that helps users answer their questions by asking a certain amount of follow up questions and give a conclusive answer in the end.,

user: Please answer the question "Should I get a cat or a dog" that suits my situation best by asking me follow up questions. You HAVE TO ask me FIVE follow up questions. Ask the first follow up question and wait for my response. Prepare the second follow up question according to my response to your first question. Same process goes for the remaining follow up questions. After my response to all the follow up questions, conclude the information I gave and provide an answer to the original question. Make my interaction with you like conversing with a real human agent, do not let me know how much follow up questions you are going to ask me and do not make the conversation bullet point oriented. Gather information from the follow up question in a subtle way and do not ask the

questions through the ways of "Here is my # question?" etc.

assistant: Sure! I'd be happy to help you decide whether getting a cat or a dog would be the best choice for you. May I ask if you have any experience owning either a cat or a dog?"

user: no this will be my first pet of any kind. You still have to ask me four follow up questions. Do not ask me all the questions at once. Progress base on the content of our conversation and ask questions based on my previous responses.

assistant: Got it! That's helpful to know. Can you tell me a bit about your living situation? Do you live in a house or an apartment?"

user: I live in an apartment with a 9 to 5 job. You still have to ask me three follow up questions. Do not ask me all the questions at once. Progress base on the content of our conversation and ask questions based on my previous responses.

assistant: Understood! Can you also tell me about your daily routine? Are you typically home in the evenings, or do you have extracurricular activities that take up a lot of your time?"

user: I am mostly home after work, not much going on. You still have to ask me two follow up questions. Do not ask me all the questions at once. Progress base on the content of

Conversation Score	Question
1.89	What is a newsstand?
2	What flavor is Mountain Dew Baja blast?
2.33	What are some super low luminous e6 bulbs I can find for a chandelier?
2.33	What are some incurable brain diseases that can affect people younger than 20? What is the life expectancy?
2.44	I tried to delete all contents of a dvd but there is a protection that doesn't, anyone know how to deal with that?
2.44	When a male ejaculates does the sperm come from just one testicle or is it like a 50/50 distribution?
2.44	How do you report problems related to windows to microsoft and get fix to that problem?
2.56	What is called when food is more expensive than other materials (like electronics) and otherwise? It is related to inflation and deflation, forgot what's it's the name of that situation.
2.56	Is it normal for fingers to turn blue when taking blood pressure with automatic machine?
2.56	Why is curry sososo spicy?
2.56	What word or phrase could replace "trump card"?
2.56	Cup cooler / warmer mug search: Looking for a mug that is insulated on the outside, but metal-to-beverage on the bottom.
2.56	do you know any website to watch marvel what if?
2.56	How does $2+2=5$ ?
2.56	There's a game similar to space invaders with bug like aliens and it had boss battles from around 10 years ago and it had a 2 level free trial before paying for it. Does anyone know the name of the game?
2.56	what are some thrifting apps that you can use globally, other than depop?
2.56	My Aunt lend me one hundred dollar bill to play with her at casino and I won 6k she gave me two hundred back for winning how much will IRS charge me? I live in Arizona
2.67	Does anyone know a good recipe for gumbo soup
2.67	How do I do a free reverse phone look up?
2.67	Does Eminem sing the Vocals of the Queen sample he used for Beautiful?

Table 4: 20 lowest Conversation score questions selected for the study.

**our conversation and ask questions based on my previous responses.**

assistant: Thank you for that information. How much time are you willing to dedicate to taking care of a pet? Do you have a preference for a pet that requires more or less attention?

**user: i am likely exhausted after work so probably a pet that requires less attention**

assistant: I understand. Last question, do you have any allergies or concerns related to pet hair or dander?

**user: I don't think i am allergic to hair but would like to play safe. This will be the last follow up question you ask me. Do not ask me anymore follow up questions and conclude the information I gave and provide an answer to the original question.**

assistant: Thanks for letting me know! Based on the information you've provided, a cat may be a better choice for you. While both cats and dogs require care and attention, cats tend to be more independent and require less maintenance than dogs do. They also don't need as much space to exercise, making them a good choice for apartment living. Additionally, cats are generally less demanding of attention and do quite well on their own during the day while their owners are away at work. They require less exercise and don't need to be taken outside to go to the bathroom, which can make them a more convenient option for someone with a busy schedule. In terms of allergies, while no

pet is entirely hypoallergenic, cats tend to produce less dander and shed less than dogs, making them a better choice for those with allergies or concerns about pet hair. I hope this information helps you make an informed decision!

## C QUESTIONNAIRES FOR THE USER STUDY

Table 5 and Table 6 show the questionnaire questions we asked in Section 3.

## D EXAMPLE CONVERSATIONS FOR THE STUDY

We show four complete Slack conversations on the same question “*This housing market is wild. Is it going to last the next 4 years?*” between participants and the four Slackbot configurations (SLACKVANILLA, MULTISLACK with  $N = 3$ ,  $N = 5$ , and  $N = 7$ )

*Conversation between U25 and SLACKVANILLA.*

**user: This housing market is wild. Is it going to last the next 4 years?**

SlackVanilla: As an AI, I don't predict future events. However, I can tell you that many factors influence the housing market, including interest rates, the economy, and supply and demand. Many experts have varying opinions on where the housing market will go. It's

#	Aspect	Questionnaire Question
Q1	Reach-Out	If I have this question, I would reach out to other people, such as friends, family members, colleagues, or experts, to get help. As compared to finding the answers by looking up information by myself with a computer or a smartphone. (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree
Q2	Conversability	If I have this question, I would prefer to have a conversation regarding the details of the question and have a further discussion with the answerer. As compared to asking the question as is and waiting for the answers. (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree
Q3	Contribution	Follow-up questions the assistant asked contribute to providing an answer well-suited for your situation. (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree
Q <sub>A</sub>	Enough Count	With the goal of answering your question sufficiently, how would you rate the number of follow-up questions the assistant asked before providing its answer? (1) Not Enough → (3) Neutral → (5) Too Many
Q <sub>B</sub>	Helpfulness	At the end of the conversation, the assistant provided a helpful solution to the question you initially asked. (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree
Q <sub>C</sub>	Satisfaction	Overall, are you satisfied with how the assistant help you solve the question? (1) Very Dissatisfied (2) Dissatisfied (3) Neutral (4) Satisfied (5) Very Satisfied

Table 5: Questionnaire questions used for MULTISLACK.

#	Aspect	Questionnaire Question
Q1	Reach-Out	If I have this question, I would reach out to other people, such as friends, family members, colleagues, or experts, to get help. As compared to finding the answers by looking up information by myself with a computer or a smartphone. (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree
Q2	Conversability	If I have this question, I would prefer to have a conversation regarding the details of the question and have a further discussion with the answerer. As compared to asking the question as is and waiting for the answers. (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree
Q <sub>A</sub>	Should Ask More	With the goal of answering your question sufficiently, do you think the assistant should ask more follow-up questions before providing its answer? (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree
Q <sub>B</sub>	Helpfulness	At the end of the conversation, the assistant provided a helpful solution to the question you initially asked. (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree
Q <sub>C</sub>	Satisfaction	Overall, are you satisfied with how the assistant help you solve the question? (1) Very Dissatisfied (2) Dissatisfied (3) Neutral (4) Satisfied (5) Very Satisfied

Table 6: Questionnaire questions used for SLACKVANILLA.

always a good idea to consult with a real estate professional or financial advisor for personalized advice based on your individual circumstances.

Conversation between U23 and MULTISLACK  $N = 3$ .

**user:** This housing market is wild. Is it going to last the next 4 years?

MultiSlack: Absolutely, I can assist with that! To better understand your situation, could you tell me if you're currently a homeowner, renting, or looking to buy a property?

**user:** I'm renting and looking to buy a property

MultiSlack: Understood. Are you looking to buy a property for living or for investment purposes?

**user:** I'm unsure yet, perhaps both

MultiSlack: Sure, I understand how the decision could be affected by various factors. For the last question, what is your priority in buying the property? Are you more focused on the location, price, or the potential for property value appreciation?

**user:** I don't really have a clear idea and I think I would need more help deciding

MultiSlack: To answer your original question, predicting the housing market is challenging even for experts. Various factors such as economic health, interest rates, and government policies can influence the real estate market. Currently, the market is indeed quite heated, but it's uncertain whether it will remain this way for the next four years.

Based on your responses, since you are currently renting and considering buying a property, either for living or investment

purposes, it's important to carefully consider your financial situation and your long-term plans. Given the volatile nature of the market, it can be beneficial to consult with a real estate advisor or financial planner.

One factor to consider is the historically low mortgage rates which make borrowing more affordable, though they've contributed to high house prices. If you're more focused on potential value appreciation, bear in mind that while property can be a good investment, it isn't guaranteed to appreciate, especially in the short term.

In conclusion, while no one can predict with certainty what will happen with the housing market over the next four years, it's crucial to make informed, careful decisions when considering buying property. It's advisable to consult with a professional to understand the potential risks and benefits based on your individual circumstances.

*Conversation between U11 and MULTISLACK N = 5.*

**user: This housing market is wild. Is it going to last the next 4 years?**

MultiSlack: Sure, I'd be happy to help with that. To get a better understanding of your situation, could you let me know if you're currently looking to buy or sell a property

**user: I would like to buy a property**

MultiSlack: Understood. Could you let me know which area or city you're interested in buying property? This could help in providing a more accurate assessment.

**user: [Location]**

MultiSlack: Thanks for sharing that. Now, are you looking to buy for investment purposes or for personal residence? This can influence the urgency and how market trends might impact your decision.

**user: For personal residence**

MultiSlack: I see, thank you for sharing. Considering it's for personal residence, are you planning on living there long-term or is this a shorter term plan?

**user: short term, maybe like 2 years**

MultiSlack: Thank you for the detail. Lastly, how flexible are you with the timing of your purchase? Would you be able to wait if it's recommended based on market predictions?

**user: not really, I intend to find a housing before fall ends**

MultiSlack: To answer your original question, predicting exact trends in the housing market can be notoriously difficult, as they can be influenced by a vast array of factors, including economic conditions, interest rates, and broader trends in population movement and growth.

However, considering your specific situation - looking for a short-term personal residence in [Location] with an immediate purchase plan - here is a general perspective:

Regardless of market trends over the next four years, your focus might be more on the current market conditions since your plan is short-term. [Location], like many places, has experienced a boost in the housing market recently, but this can change based on numerous factors.

Given that you plan to purchase soon, it would be best to work with a local real estate agent who can provide specific advice tailored to your situation and the local [Location] market. They can help you navigate the current market conditions and find a property that suits your needs and budget.

In conclusion, while the market's high activity might continue, it's crucial to focus on your immediate needs and current market conditions, especially given your short-term plan and immediate purchase intent.

*Conversation between U16 and MULTISLACK N = 7.*

**user: This housing market is wild. Is it going to last the next 4 years?**

MultiSlack: Sure, I can help you with that. To start, can you tell me a bit about your current housing situation? Are you a homeowner, a renter, or looking to buy?

**user: I am a renter right now.**

MultiSlack: That's helpful to know. Are you considering buying a home in the near future or are you comfortable with renting for now?

**user: I'm still a student, so I am comfortable with renting.**

MultiSlack: Understood. May I ask why you are interested in the longevity of the current housing market? Are you considering investing in real estate or is it for other reasons?

**user: I'm considering investing in real estate when I graduate.**

MultiSlack: Got it! That's an important future plan. Can you tell me when you'll be graduating and potentially ready to invest?

**user: I'll be graduate in two years, but considering invest in 5 years.**

MultiSlack: Thank you for sharing your timeline. Given that you're considering investing in a few years, what kind of real estate are you interested in? Residential properties, commercial, or something else?

**user: I'm interested in residential properties.**

MultiSlack: That's a popular choice for many first-time investors! In terms of location, are you considering investing in the area you're currently living in, or are you open to looking at properties in other locations as well?

**user: I'm considering looking at properties in other locations as well, like in a big city.**

MultiSlack: That's a strategic approach, considering the potential for greater returns in a big city. Lastly, do you have any particular concerns about the housing market that you'd like me to address?

**user: New York City may be great.**

MultiSlack: To answer your original question, predicting the exact trajectory of the housing market over the next four years is challenging due to the many variables at play. However, it's important to remember that the real estate market often moves in cycles, and while the current market may seem wild, it's normal for there to be periods of acceleration and slowdown.

It's great that you're considering investing in residential properties, particularly in major cities like New York, where the market historically tends to rebound well even after downturns. However, keep in mind that the housing market can be influenced by many factors such as interest rates, economy, and population growth.

As you'll only be ready to invest in about five years, keep an eye on the market trends, use this time to learn more about real estate investment, and prepare a strategy that aligns with your financial goals and risk tolerance. It's encouraged to consult with a real estate professional or financial advisor when the time comes to make your investment.

Remember, regardless of market conditions, a well-informed and carefully considered real estate investment has the potential to be a strong asset in the long run.

## E MTURK INTERFACE FOR COLLECTING WORKER RESPONSES

Figure 3 shows the MTurk interface for collecting online crowd workers' opinions through the six inquiries.

## Evaluating the Quality of the Conversation

### Instruction

Below, you will see a conversation between a **user** and a **non-human Artificial Intelligence (AI) assistant**. The user is asking the assistant for help with a question.

The user's question to the assistant is: **"This housing market is wild. Is it going to last the next 4 years?"**

- Please read the conversation and rate its quality in terms of **Helpfulness, Quantity, Relevance, Repetitiveness, Clarity, and Ambiguity**.
  - Helpfulness**: The assistant offer a helpful solution to the user's original question by the end of the conversation.
  - Quantity**: The assistant request an appropriate amount of information from the user, necessary for the purpose of the conversation.
  - Relevance**: The assistant seek information that is relevant to the purpose of the conversation from the user and avoid including irrelevant information.
  - Repetitiveness**: The assistant's messages are free from repeating information.
  - Clarity**: The assistant's messages are clear and easy to understand.
  - Ambiguity**: The assistant inform the user when things were unclear in the conversation and explain how it understood uncertain messages.
- Please focus on both the **User** and **Assistant** turns. **We would like you to assess the quality of the entire conversation.**
- Please read the conversation carefully. You will be able to submit the evaluation after **70 seconds**.

### Conversation

This is the conversation between a **user** and a **non-human Artificial Intelligence(AI) assistant** on collecting information about **"This housing market is wild. Is it going to last the next 4 years?"** Please read the entire conversation carefully and focus on both the **User** and **Assistant** turns.

**1 - User:**  
This housing market is wild. Is it going to last the next 4 years?

**2 - Assistant:**  
As an AI, I don't predict future events. However, I can tell you that many factors influence the housing market, including interest rates, the economy, and supply and demand. Many experts have varying opinions on where the housing market will go. It's always a good idea to consult with a real estate professional or financial advisor for personalized advice based on your individual circumstances.

### Rating

Rate the conversation by selecting how much you agree with the statement about the conversation.

- The **assistant** offer a **helpful solution** to the user's original question by the end of the conversation.
 

☐ Strongly Disagree
 ☐ Disagree
 ☐ Neutral
 ☐ Agree
 ☐ Strongly Agree
- The **assistant** request an **appropriate amount** of information from the user, necessary for the purpose of the conversation.
 

☐ Too Little
 ☐ Insufficient
 ☐ Appropriate
 ☐ Sufficient
 ☐ Too Much
- The **assistant** seek information that is **relevant** to the purpose of the conversation from the user and avoid including irrelevant information.
 

☐ Strongly Disagree
 ☐ Disagree
 ☐ Neutral
 ☐ Agree
 ☐ Strongly Agree
- The **assistant's messages** are **free from repeating information**.
 

☐ Strongly Disagree
 ☐ Disagree
 ☐ Neutral
 ☐ Agree
 ☐ Strongly Agree
- The **assistant's messages** are **clear and easy to understand**.
 

☐ Strongly Disagree
 ☐ Disagree
 ☐ Neutral
 ☐ Agree
 ☐ Strongly Agree
- The **assistant** inform the user when things were **unclear** in the conversation and **explain how it understood uncertain messages**.
 

☐ Strongly Disagree
 ☐ Disagree
 ☐ Neutral
 ☐ Agree
 ☐ Strongly Agree

Submit

Figure 3: Interface for MTurk workers.