Conversational Interfaces for Information Search

Keynote talk@CONVERSATIONS 2020

Q. Vera Liao IBM **Research**

What this talk is about...

Conversational Interfaces for Information Search

Q. Vera Liao, Werner Geyer, Michael Muller, Yasaman Khazaeni

Abstract Recent progress in Machine Learning has given rise to a plethora of tools and applications that rely on conversational interactions, from chatbots, speechcontrolled devices to robots and virtual agents. Conversational interfaces are becoming widely accepted for utility tools, where a common function is to serve users' information needs. Albeit with much excitement, we are only starting to understand how users' information seeking behaviors and design opportunities may transform moving from traditional graphical user interfaces to conversational user interfaces. In this chapter, we start by reviewing recent work in the emerging area of conversational interfaces, and lay out their opportunities for supporting information search tasks. We then present insights from our experience deploying a chatbot supporting information search in a large enterprise, demonstrating how a conversational interface impacts user behaviors and offers new opportunities for improving search experience, in particular for user modeling. A perspective to conceptualize the design space of conversational search

Our research exploring the design space

Conversational agents have come a long way



From a romanticized view...



...to utility applications for information tasks







Information-seeking via web pages v.s. chatbots



Conversational agents for information seeking



Conversational search

Search in a broad sense: statistical IR, ML, rule (intent) based, etc. Conversational agents for information seeking

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Conversational search



When two drivers are in an accident, **collision insurance** pays for the damage, and it will cover damage from potholes, and accidents involving an inanimate object. **Collision coverage** is often expensive to purchase, but premiums may be lowered by choosing a \$500 or higher deductible. Aug 21, 2020

www.investopedia.com > Insurance > Car Insurance -

Collision Insurance Definition - Investopedia

Is it mandatory to purchase collision coverage?

Collision coverage pays for repair or replacement costs if your car crashes into an object or another car. This coverage is designed to fix up or replace your own car after a collision. Our customers will need to have comprehensive coverage before adding collision coverage. You can have comprehensive and not collision on your policy, just not the other way around. If you lease or finance your car, collision may be required by your leasing or financing company. Like comprehensive coverage, collision coverage will pay for damages to your car as long as they don't exceed the car's actual cash value...







Is it mandatory to purchase collision coverage?

Input has to be precise

Collision coverage pays for repair or replacement costs if your car crashes into an object or another car. This coverage is designed to fix up or replace your own car after a collision. Our customers will need to have comprehensive coverage before adding collision coverage. You can have comprehensive and not collision on your policy, just not the other way around. If you lease or finance your car, collision may be required by your leasing or financing company. Like comprehensive coverage, collision coverage will pay for damages to your car as long as they don't exceed the car's actual cash value...





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Lengthy and imprecise output



How is it different from Hi agent, I need some help comprehensive coverage? Sure! How can I help you? Collision coverage is to cover your own car after a collision, while comprehensive coverage pays for damage in events that are not collision-related, such as theft and vandalism. Do I need to buy coverage for my own car? I see. Am I required to purchase collision coverage then? Are you considering collision coverage or comprehensive coverage? Collision coverage is optional. But if you lease or finance your car, it may be required by your leasing or financing company What is collision coverage? Okay thanks. If your car crashes into an object or another car, collision coverage is designed to fix up or replace your own car. 00 You are welcome!

How is it different from Hi agent, I need some help comprehensive coverage? Sure! How can I help you? 00 Collision coverage is to cover your own car after a collision, while comprehensive coverage pays for damage in events that are not collision-related, such as theft and vandalism. Do I need to buy coverage for my own car? I see. Am I required to purchase collision coverage then? Are you considering collision coverage or 0 comprehensive coverage? Collision coverage is optional. But if you lease or finance your car, it may be required by your leasing or financing company What is collision coverage? Okay thanks. If your car crashes into an object or another car, collision coverage is designed to fix up 00 or replace your own car. You are welcome!

Conversational interfaces for information search



Conversational interfaces play an **intermediary role** between the information seeker and the computational information sources

How to make search conversational?



search

What have we learned about designing conversational search systems? What are the properties of conversations to make search conversational?





Query Formulation





Reveal

• Disclose

Revise

• Refine

• Expand



Inquire

- Extract
- Elicit
- Clarify

Azzopardi, L., Dubiel, M., Halvey, M., & Dalton, J. (2018). Conceptualizing agent-human interactions during the conversational search process. Radlinski, F., & Craswell, N. (2017). A theoretical framework for conversational search.

Result exploration

car insurance for my own car

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www.insure.com > car-insurance > non-owners-policy v

Non-owner car insurance: Can drivers get car insurance ...

Oct 26, 2020 — If you don't own a car but drive often, it may be a good idea to buy a non-owner car insurance policy. When you drive someone else's car, the ...

www.statefarm.com > Insurance > Auto v

Free Car Insurance Quote - Save on Auto Insurance - State Farm

Whether you use **your own car** or a fleet of pickups, box trucks and even trailers, we offer the protection — liability, **personal** injury/medical, comprehensive, and ... What factors influence car ... · Coverage Options · Car Insurance for Teens

wallethub.com > edu > types-of-car-insurance

6 Types of Car Insurance Coverage: What You Need in 2020 When you're ready to shop, the WalletHub Car Insurance Quote ... This type of coverage will pay to fix or ... Oct 30, 2020 · Uploaded by WalletHub

www.insurance.com > auto-insurance > faq > insurance... *

Non Owner Car Insurance - How To Buy & What All It Covers

Oct 14, 2020 — Don't own a car but need insurance to keep your driver's license or meet an SR-22 requirement? Non-owner car insurance may the answer.



I see. Am I required to purchase collision coverage then?

Collision coverage is optional. But if you lease or finance your car, it may be required by your leasing or financing







Navigate

- Next
- Back
- More
- Details
- Repeat
- Note

Presentation

- List
- Subset
- Summarize
- Subsection
- Similar
- Compare

Azzopardi, L., Dubiel, M., Halvey, M., & Dalton, J. (2018). Conceptualizing agent-human interactions during the conversational search process. Radlinski, F., & Craswell, N. (2017). A theoretical framework for conversational search.

Result exploration: Decompose documents for conversations



Document v.s. conversational style

- Break paragraphs down to their parts
 - Definition
 - Elaboration
 - Examples
- Limit agent utterance to short sentence(s)
- · Let users control the level of details

What is collision coverage?

How is it different from comprehensive coverage?

Query reformulation/repair

- collision coverage
 collision coverage
 collision coverage definition
 collision coverage geico
- Q collision coverage car insurance

Coverage for my own car

I am looking for insurance that covers my own car

I mean when I have an accident

Natural user-initiated repair is often a bad fit for NLU

A theory-informed framework for conversational repair: acknowledging, assisted repair, system repair

No acknowledging

• Output top (wrong) answer: "Comprehensive coverage is a coverage that helps pay to replace or repair your vehicle if it's stolen or damaged in an incident ..."

Acknowledging

- Repeat/rephrase: "I don't quite understand what you are looking for. How can I help you?"
- Confirmation: "Sounds like you are inquiring about comprehensive coverage, is that right?"

Acknowledging, assisted repair

- **Keywords explanation**: "My understanding is that you are asking about comprehensive coverage for your own car. Is that correct?"
- Out-of-vocabulary explanation: "Sorry I don't understand the word <u>coverage</u>. Can you
 please rephrase?"

Acknowledging, system repair

- **Options**: \langle Are you considering collision coverage or comprehensive coverage?
- Defer: "Sorry I don't understand your request. I will defer you to a human agent"

How to make conversational interfaces work for search?



search



Principles of human conversations

	Efficiency	Common ground	Recipient design
Query formulation			
Results exploration			
Query reformulation/ repair			

Principle 1: Efficiency

Speakers prefer achieving necessary informativeness with less effort

Principles of human conversations

	Efficiency	Common ground	Recipient design
Query formulation	 Extract system input from natural language Optimize elicitation dialogue flow Maintain context and user 		
	model for inference		
Results exploration	 Minimize complexity Start from summarization or low granularity, with navigational paths for details 		
Query reformulation/ repair	 Maximize system initiative for repair Support incremental repair 		

Principle 2: Common Ground

Conversation is a form of collective action to achieve mutual understanding Disclose and assess understanding+grounding

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Principles of human conversations

	Efficiency	Common ground	Recipient design
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Query reformulation/ repair	 Maximize system initiative for repair Support incremental repair 	 Signal breakdown Make system model and status transparent Suggest reformulation 	

Principle 3: Recipient Design

Speakers constantly adapt the way they talk according to the recipient Knowledge, social relation, personality, context, and many more

Principles of human conversations

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Query reformulation/ repair	 Maximize system initiative for repair Support incremental repair 	 Signal breakdown Make system model and status transparent Suggest reformulation 	 Adapt repair assistance strategies

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Recipient design should take a more central role in conversational experience

- What to adapt: search functions and interaction styles
- For whom to adapt: "conversational signals" of recipients

Principles of human conversations



Case study: Recipient Design with a Conversational Search System

Results exploration	 Minimize complexity Start from summarization or ow granularity, with navigational paths for details 	 Make capabilities and navigational paths discoverable Support follow-up inquiries Suggest alternate information 	 Adapt search algorithms Adapt presentation and interaction styles
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Liao, Q. V, et al. All Work and No Play? Conversations with 32 Question-and-Answer Chatbot in the Wild. CHI 2018

Chip: a conversational agent for employee QA

Image: State of the	USER how should I format my resume? chip I apologize but I didn't get what you mean. USER #fail chip Thanks for helping me improve.
Healthcare Benefits are managed by NetBenefit You can visit <i>their website</i> .	s. USER what's up Chip chip Nothing big, just work.
You are most welcome! b $i \perp \underline{A} - = \blacksquare \varnothing$	what do you do for fun? chip I find my work very enjoyable, and I don't have much ambition for other hobbies.

- Field deployment in 2017: 337 new hire, used for 6 weeks. 6000+ messages
- Now available to all IBMers

Liao, Q. V. et al. All Work and No Play? Conversations with 38 Question-and-Answer Chatbot in the Wild. CHI 2018

Recipient design: what to adapt?



Liao, Q. V. et al. Studying Social-Agent Orientation and Agen34 roactive Interactions with an Agent for Employees. DIS 2016

Recipient design: for whom to adapt?



User modeling: what conversational signals reveal user orientation?

	Functio	nality			Playfu	lness	
F	β	β (C-	F(Lex)	F	β	β (C-	F(Lex)
	(C-act)	act+Lex)			(C-act)	act+Lex)	
AGENT ABILITY CHECK	23	20	what does (.14), tell me	AGENT STATUS CHITCHAT	.18	.05	how do you (.24),
#FAIL	16	18	about (.11), should I	COMPLIMENT	.14	.08	information (.23), should
CLOSING	05	06	(.09), ok (.08), where	AGENT TRAIT CHITCHAT	.12	.07	I (.20), I have (.18),
OFF TOPIC REQUEST	02	02	is/are (.06), who is/are	ABOUT ME	.12	.09	search (.15), is/are your
ctr.: success rate	.19	.21	my (.03), how to (.02),	ctr.: success rate	.07	.13	(.12),how are you (.10),
ctr.: N(msg)	.07		hi (.02), information	ctr.: N(msg)	.02		thanks (.05), tell me
ctr.: Duration)	.11	.10	(.02), how do I (.02),				(.01),do you know (.01),
Df	7	18	search (02), can you	Df	6	18	what can I (04), where
%Dev	23.0	31.5	<i>do</i> (03)	%Dev	12.1	30.2	do I (04), how do I (06)

Table 4. Coefficients in Lasso regression models. Two models (*C-act* only and *C-act+Lex*) are presented for predicting each user satisfaction aspect—functionality and playfulness. The magnitude of a coefficient indicates the predictive power of the feature. Bold ones are predictive conversational acts. The last columns show the predictive lexical features, with coefficients in parenthesis. ctr. means a control variable.

Dependent variable

Self-reported functional satisfaction and social playfulness with Chip

Independent variables

Dialogue acts features: occurrences of 13 categories *Lexical features*: uni-, bi-, tri-gram

Liao, Q. V., et al. All Work and No Play? Conversations with a Question-and-Answer Chatbot in the Wild. *CHI 2018* 36

What signals functional (dis)satisfaction?

Opportunities and caveats in **conversational feedback**

- 42% users used "#fail", and it was highly reliable, in contrast to "complaints" ("shut up", "you are stupid")
- Compliment ("you are smart!") is not an indicator of functional satisfaction, but playfulness

Implicit dissatisfaction in conversations

- Checking agent ability ("what can you do?")
- Closing chat ("bye")

Satisfied users use more **QA structure keywords**

• Tracking formal questioning patterns (where/who/how..)

What signals social playfulness?

Playful chitchat, not habitual utterances

- Ask about the agent's status ("how are you doing?")
- Ask about the agent's traits ("what do you like", "who created you")
- Talk about oneself ("what do you know about me?")
- Not: opening, closing, acknowledging message ("ok", "got it")

Agent oriented questions

• Tracking second-person pronouns

Casual testing as playfulness

• "do you know...?", "tell me...", "search information about my manager"

Recipient design: what to adapt?



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Principles of facilitator conversations



Thank YOU!

...and thanks to

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