Reasoning before Responding: Integrating Commonsense-based Causality Explanation for Empathetic Response Generation

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Introduction

- Empathy is a desirable capacity of humans to place themselves in another's position to show understanding of his/her **experience and feelings** and respond appropriately.
- Exploring the causality within the user's context and reasoning his/her desires can be helpful so that the system's intention is aligned with the user's desires, and the response is generated from the user's perspective (Figure 1).
- In real human communication, the responder's intention is not always confined to the user's desires, as shown in Figure 2. Therefore, it is necessary to incorporate both the user's perspective and the system's perspective for empathetic response.

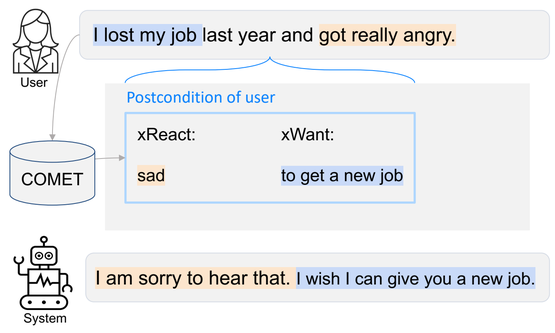

Fig 1: Gegerate response from user's perspective

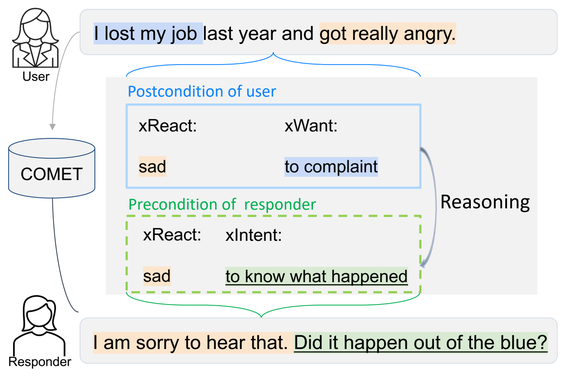

Fig 2: Response from the actual responder's perspective, based on reasoning reaction and intent to mimic humans.

Proposal: Causality Reasoning based on ChatGPT

- We propose a commonsense-based causality explanation approach for diverse empathetic response generation that considers both the **user's perspective (user's desires and reactions)** and the **system's perspective (system's intentions and reactions).**
- We integrate the commonsense-based causality explanation with both ChatGPT and a T5-based model.

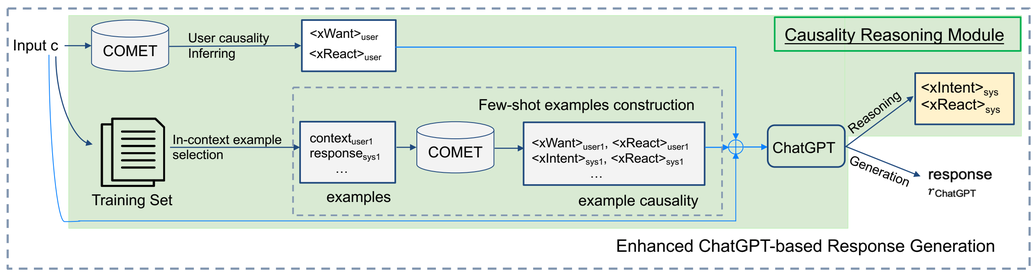

Fig 3: Proposed causality reasoning module and enhanced ChatGPT-based empathetic response generation.

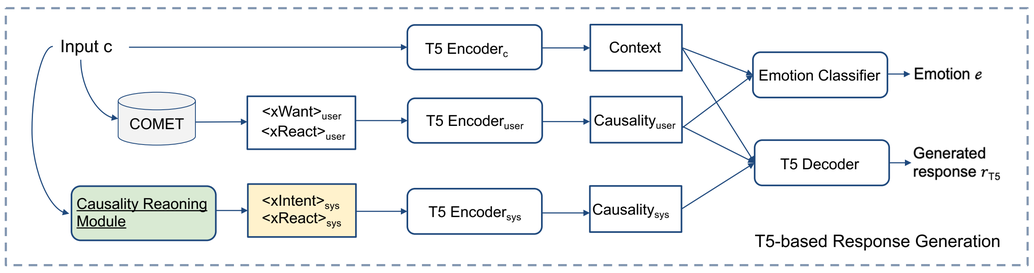

Fig 4: Integrating the causality reasoning module into a T5-based encoder-decoder for empathetic response generation.

Experiments

- ***Dataset***

  EmpatheticDialogue corpus: 25k empathetic conversations.

- ***Number of few-shots***

	EMOACC	IP	EX	ER
k=2	0.24	0.08	**0.57**	**1.10**
k=3	0.25	0.09	0.48	1.05
k=4	**0.27**	0.09	0.40	1.04
k=5	0.25	**0.10**	0.33	1.00
k=6	0.25	0.08	0.32	1.01

EMOACC = Emotion | IP = Interpretation
EX= Exploration | ER= Emotion reaction
We set $k = 2$ for the experiments.

- ***Results on ChatGPT-based Response Generation***

Results of automatic evaluations for single-turn.

	Method	Empathy				Coherence		
		EMOACC	ER	IP	EX	PBERT	RBERT	FBERT
k=2	ChatGPT	0.060	0.923	0.073	0.341	0.877	0.872	0.875
	ChatGPT+Causality$_{user,sys}$	**0.280**	**1.116**	**0.104**	**0.768**	**0.886**	**0.878**	**0.882**

Results of automatic evaluations for multi-turn.

	Method	Empathy				Coherence		
		EMOACC	ER	IP	EX	PBERT	RBERT	FBERT
k=2	ChatGPT	0.083	0.917	**0.065**	0.318	0.891	0.902	0.894
	ChatGPT+Causality$_{user,sys}$	**0.199**	**1.094**	0.058	**0.397**	**0.899**	**0.907**	**0.901**

Results of human A/B test evaluations.
Emp., Coh., Inf. refer to Empathy, Coherence, and Informativeness

Comparisons	Aspects	Win	Loss	Tie
ChatGPT+Causality$_{user,sys}$ vs. ChatGPT (k=2)	Emp.	**50.7**	36.0	13.3
	Coh.	**42.7**	42.0	15.3
	Inf.	**51.3**	37.3	11.3

➢ Compared with ChatGPT, ChatGPT with causality explanation can generate response with appropriate emotion and contents.

- ***Results on T5-based Response Generation***

	Methods	PPL ↓	BLEU-2	BLEU-3	BLEU-4	D1	D2	PBERT	RBERT	FBERT
Baselines	MOEL	37.63	8.63	4.25	2.43	0.38	1.74	86.19	85.67	85.91
	MIME	36.84	8.37	4.31	2.51	0.28	0.95	86.27	85.59	85.92
	EmpDG	38.08	7.74	4.09	2.49	0.46	1.90	86.09	85.49	85.78
	CEM	36.36	6.35	3.55	2.26	0.54	2.38	86.61	85.39	85.98
	LEMPEx	30.42	2.1	0.8	0.35	1.02	**10.81**	83.60	83.09	83.34
Ours	T5	46.13	3.59	1.94	1.15	0.49	2.82	86.69	84.07	85.35
	T5+Causality$_{user}$	15.26	4.84	1.97	0.89	**1.08**	10.75	90.16	89.48	89.80
	T5+Causality$_{user,sys}$	**13.07**	**10.53**	**6.34**	**4.06**	0.75	5.52	**92.24**	**90.76**	**91.48**

Comparisons	Aspects	Win	Loss	Tie
T5+Causality$_{user,sys}$ vs. CEM	Emp.	**42.0**	40.0	18.0
	Coh.	**38.7**	33.3	28.0
	Inf.	38.3	**44.3**	17.3
T5+Causality$_{user,sys}$ vs. LEMPEx	Emp.	**53.0**	35.0	12.0
	Coh.	**39.0**	33.3	27.7
	Inf.	**50.0**	38.0	12.0

➢ Our proposed method surpasses baselines in most of the metrics in automatic evaluation and human A/B test.

- ***Sample of In-context Reasoning***

Test input		user: I'm so excited because I'm finally going to visit my parents next month! I didn't see them for 3 years.
Predictions		user wants: to spend time with family; to have fun with them; to see them again. *User causality referring* user reacts to: excited; happy; nostalgic; anxious; joyful.
Few-shot1	context1	user1: Someone is visiting me soon and I can't wait! *In-context reasoning process* sys1: Who is it? user1: My mom, she is amazing.
	example	user1 wants: to have a good time; to talk to their mom; to have fun with Mom. user1 reacts to: excited; happy; satisfied; good; loved.
	causality	sys1's intent: to be with her; to be loved; to be nice; happy. sys1 reacts to: happy; excited; proud; good; loving.
	response1	sys1: I bet she is! I am so glad you get to see her. Mom's are awesome!
Few-shot2	context2	user2: My family is coming to visit! sys2: Awesome. When are they coming and for how long? user2: They are coming next year from Africa!
	example	user2 wants: to have a good time; to go to the airport; to have fun with the family. user2 reacts to: happy; excited; happy; excited; loved.
	causality	sys2's intent: to see the sights; to be with family; to be with them; to have fun. sys2 reacts to: happy; excited; satisfied; tired; relieved.
	response2	sys2: That's a long trip. I hope they have a good time.
Reasoning		sys's intent: to be supportive; to be happy for them; to ask about the visit. *Reasoned results* sys reacts to: happy; excited; curious; supportive; interested. response: That's great news! I'm so happy for you. What are you planning to do when you visit them?

- ***Automatically Comparison between ChatGPT and T5***

Model	Empathy				Diversity		BLEU		
	EMOACC	IP	EX	ER	D1	D2	BLEU-2	BLEU-3	BLEU-4
T5+Causality$_{user,sys}$	0.125	**0.271**	0.498	0.751	0.75	5.52	**10.53**	**6.34**	**4.06**
ChatGPT+Causality$_{user,sys}$	**0.235**	0.046	**0.668**	**1.109**	**2.91**	**16.44**	3.95	2.17	1.32

- ***case studies between T5-based and ChatGPT-based models with corresponding baselines***

	Context	user: I'm so sad because I've read an article about a newborn girl who died because her parents didn't believe in medication and doctors.
Baselines	MOEL	sys: I am so sorry to hear that. I hope you are able to find her.
	MIME	sys: That is sad. I am sorry to hear that.
	EmpDG	sys: I am sorry to hear that. I hope you find out of it.
	CEM	sys: Oh no, I am so sorry to hear that.
	LEMPEx	sys: I'm sorry to hear that. I'm so sorry to hear that.
	ChatGPT	sys: That's heartbreaking. It's important to trust medical professionals and seek help when needed.
Ours	Causality$_{user}$	user wants: to tell their friends; to cry; to find out what happened. user reacts to: sad; sorrowful; depressed; upset.
	Causality$_{sys}$	sys's intent: to comfort user; to show empathy; to be supportive. sys reacts to: sad; upset; empathetic; sympathetic; concerned.
	T5+Causality$_{user,sys}$	sys: I know what you mean, I would have been so mad!
	ChatGPT+Causality$_{user,sys}$	sys: That's really heartbreaking. I'm here for you if you need to talk or just need someone to listen.

Conclusions

- ❖ A commonsense-based causality explanation approach that reasons not only the user's desires/reaction but also the system's proper intention/reaction.
- ❖ Integration of T5 with ChatGPT's reasoning capability realizes more empathetic responses that result in better evaluations.
- ❖ Ours are more accurate and empathetic than the responses by ChatGPT while not so diverse.