SODA: Million-scale **Dia**logue Distillation with **So**cial Commonsense Contextualization

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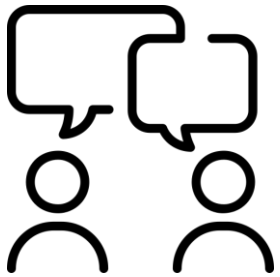
Motivation

- Conversations that occur in everyday spoken situations are often not recorded as data. Research is rightly restricted due to privacy and legal concerns.

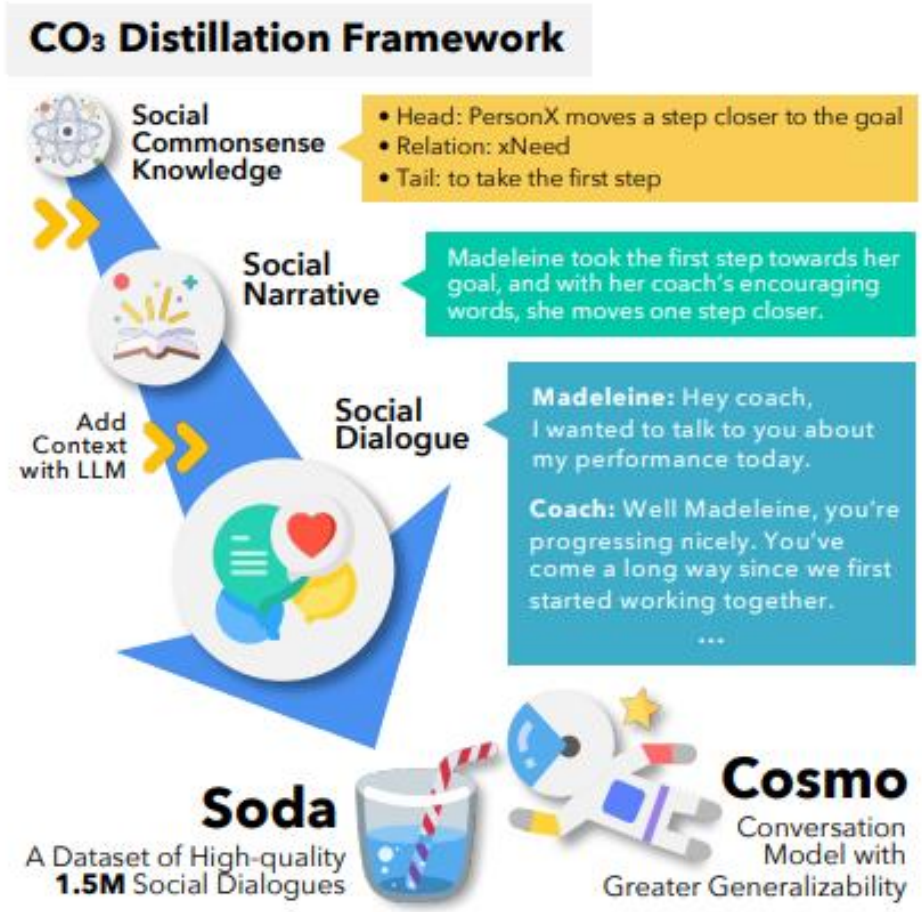


- As a result, the progress made in machine dialogues, including generation, evaluation, and understanding, has been severely hindered by the reliance on these small datasets

*hinder : 방해하다

So… what to do?

Contribution

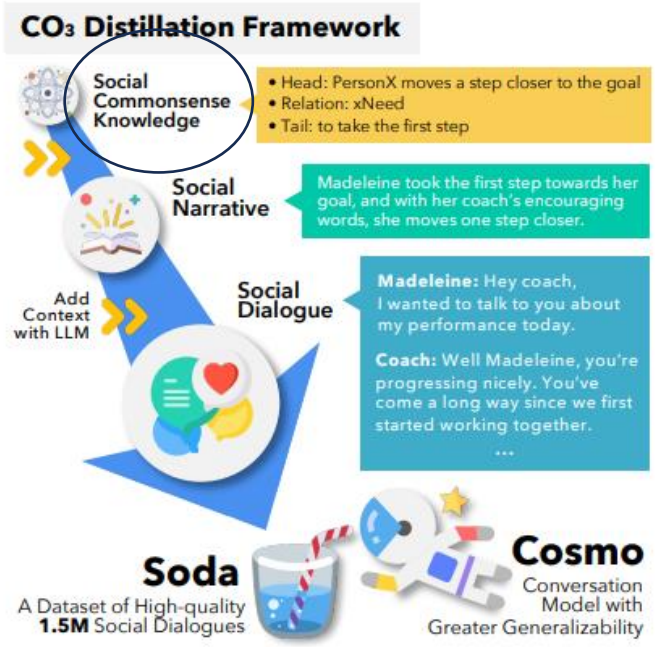


- https://github.com/skywalker023/sodaverse

- 1. CO3 Distillation Framework: SODA 데이터셋을 만들어낸 방법, 지식을 LLM을 이용해서 대화 형태로 만들어 냈다.
- 2. SODA Dataset: 기존의 부족했던 담화 데이터셋을 대용량으로 만들어냈다.
- 3. Cosmo Model : 위의 SODA 데이터셋을 이용해서 학습시킨 모델로, 기존의 SOTA 모델을 능가하는 성능을 보였다.

CO_3

- A **Co**ntextualization Framework for **Co**nversation Distillation using **Co**mmonsense
- **Co**mmonsense Knowledge Graph : Atomic10x(West et al., 2022)



X starts running	**xEffect** *so, X*	gets in shape	X sings a song	**HinderedBy** *but not if*	X can't remember the lyrics
X and Y engage in an argument	**xWant** *so, X wants*	to avoid Y	X is not well liked	**xReact** *so, X feels*	lonely
X learns to type fast	**xNeed** *X needed*	to have taken typing lessons	X takes care of a monkey	**xAttr** *X is seen as*	kind
X steals his grandfather's sword	**xEffect** *so, X*	is punished by his grandfather	X butts in	**HinderedBy** *but not if*	X is too shy to speak up
X takes up new employment	**xIntent** *because X wants*	to be self sufficient	X waits for the storm to break	**xEffect** *so, X*	is safe from the storm

Figure 2: Example **automatically generated** ATOMIC triples from our ATOMIC^{10x} commonsense knowledge graph. Each example includes a generated **event**, **relation** (with natural language interpretation), and generated **inference**.

CO_3

- Commonsense Knowledge -> Sentence-form Commonsense

Symbolic Social Commonsense Knowledge:
- Head: PersonX moves a step closer to the goal
- Relation: xNeed
- Tail: to take the first step

Sentence-form Commonsense: Madeleine took the first step. Madeleine moves a step closer to the goal.

Relation	Template for sentence form
xReact	[Head]. Now PersonX feels [Tail].
xIntent	[Head] because PersonX wants [Tail].
xAttr	PersonX is [Tail]. [Head].
xEffect	[Head]. Now PersonX [Tail].
xWant	[Head]. Now PersonX wants [Tail].
xNeed	PersonX [Tail in past tense]. [Head].

Table 8: Templates for converting symbolic commonsense knowledge to sentence form.

CO_3

- Sentence-form Commonsense -> Narrative

Sentence-form Commonsense: Madeleine took the first step. Madeleine moves a step closer to the goal.

Narrative:
Madeleine took the first step towards her goal, and with her coach's encouraging words, she moves one step closer.
Speakers: Madeleine, Coach

"[sentence-form commonsense] Rewrite this story with more specific details in two or three sentences:".

CO_3

- Narrative -> Conversation

Narrative:
Madeleine took the first step towards her goal, and with her coach's encouraging words, she moves one step closer.
Speakers: Madeleine, Coach

Conversation:
Madeleine: Hey coach, I wanted to talk to you about my performance today. I was really pushing myself and I think I did pretty well. But I'm still not quite where I want to be.
Coach: Well Madeleine, you're progressing nicely. You've come a long way since we first started working together. But if you want to reach your full potential, there's still some work to be done.
Madeleine: I know that. And I'm willing to put in the work. It's just that sometimes I feel like I'm not making as much progress as I should be. Maybe I'm not training hard enough? Or maybe my technique is off?
Coach: It could be a number of things, Madeleine. But don't worry, we'll figure it out together. Let's just keep working hard and see how things go.
Madeleine: Alright, coach. Thanks for the talk.
Coach: No problem. See you at practice tomorrow.

"[narrative] The following is a long in-depth conversation happening in the scene between Madeleine and her coach with multiple turns.₩nMadeleine:"

* Narrative가 논문에서 말하는 문맥이다.

SODA: Example

Symbolic Social Commonsense Knowledge:
- Head: PersonX moves a step closer to the goal
- Relation: xNeed
- Tail: to take the first step

Sentence-form Commonsense: Madeleine took the first step. Madeleine moves a step closer to the goal.

Narrative:
Madeleine took the first step towards her goal, and with her coach's encouraging words, she moves one step closer.
Speakers: Madeleine, Coach

Conversation:
Madeleine: Hey coach, I wanted to talk to you about my performance today. I was really pushing myself and I think I did pretty well. But I'm still not quite where I want to be.
Coach: Well Madeleine, you're progressing nicely. You've come a long way since we first started working together. But if you want to reach your full potential, there's still some work to be done.
Madeleine: I know that. And I'm willing to put in the work. It's just that sometimes I feel like I'm not making as much progress as I should be. Maybe I'm not training hard enough? Or maybe my technique is off?
Coach: It could be a number of things, Madeleine. But don't worry, we'll figure it out together. Let's just keep working hard and see how things go.
Madeleine: Alright, coach. Thanks for the talk.
Coach: No problem. See you at practice tomorrow.

Table 1: A sample from SODA. More examples can be found in Appendix B.

Symbolic Social Commonsense Knowledge:
- Head: PersonX takes on a lot of work
- Relation: xReact
- Tail: pressured

Sentence-form Commonsense: Yamir takes on a lot of work. Now Yamir feels pressured.

Narrative:
Yamir is a high school student who often takes on too much work. She frequently signs up for more extracurricular activities than she can handle and regularly agrees to do favors for her friends, even when she's already overwhelmed with other commitments. As a result, Yamir is constantly stressed out and feels like she can never catch up.
Speakers: Yamir, Lily

Conversation:
Yamir: I can't believe I agreed to do this. I'm already so behind on everything else.
Lily: What's wrong? You seem really stressed out.
Yamir: I am. I feel like I can never catch up. Every time I turn around, there's something else that needs to be done. And it's all because I keep taking on too much.
Lily: Why do you keep doing that?
Yamir: I don't know. I guess I just feel like if I don't, then I'm not really doing my part or contributing enough. But it's just too much sometimes and it makes me so stressed out.
Lily: Well, maybe you need to start saying no more often. Just because someone asks you to do something doesn't mean you have to say yes. You have a right to say no and set your own limits.
Yamir: Yeah, maybe you're right...I should start saying no more often. It's just so hard though when people are counting on me and asking for favors all the time. But maybe if I start setting some boundaries, it'll help reduce my stress levels in the long run. Thanks for talking with me about this, Lily - it really helped put things into perspective!"

Table 11: Another sample from SODA.

SODA: filltering

- Post-processing the Conversations
- Basic Filtering
  - 정규표현식
  - 3명 이상이 담화에 참여
  - 4번보다 적게, 20번보다 많이 대화를 주고 받기
  - 사람이 아닌 주체가 대화에 참여
- Safety Filtering
  - Canary와 Rewire API 사용 (혐오성 발화를 분류하는 API)

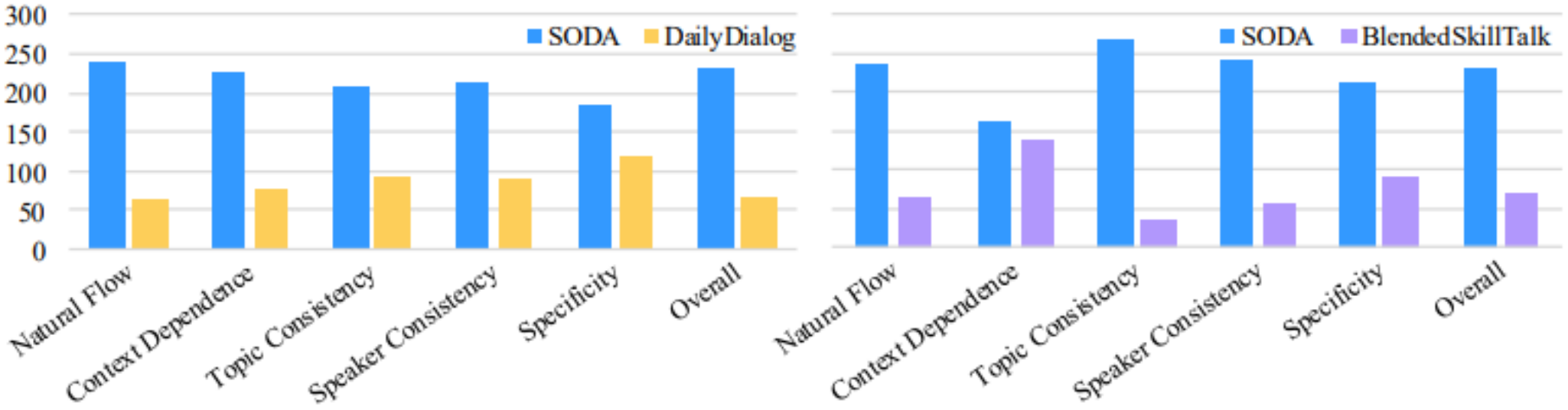
SODA: filltering

- Post-processing the Conversations
- Commonsense Filtering
  - 대화 주제에 맞지 않은 데이터 삭제
  - GPT 3.5를 사용함

Relation	Template for building validation questions
xReact	Does PersonX feel [Tail] after [Head]?
xIntent	Does PersonX intend [Tail] when [Head]?
xAttr	Can PersonX be considered [Tail] when [Head]?
xEffect	[Head]. As a result, PersonX [Tail]. Is this true?
xWant	Does PersonX want [Tail] after [Head]?
xNeed	[Tail in past tense]. Is this true when [Head]?

Table 9: Templates for converting symbolic commonsense knowledge to questions for validation.

SODA



- Better Than Human Conversation

SODA

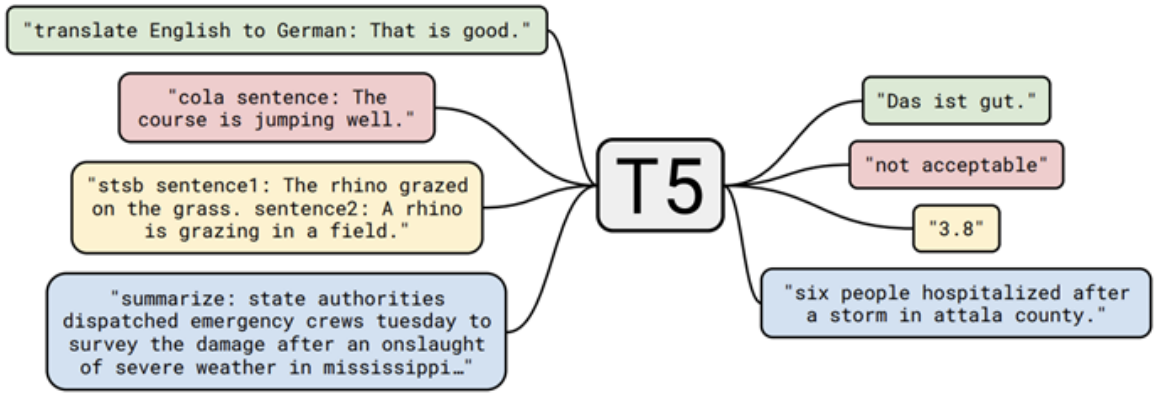
	#Dialog	Avg. #Turns	Avg. Utt. Length	Lexical Diversity
DailyDialog	13K	7.9	14.6	63.0
PersonaChat	11K	14.8	14.2	43.6
WizardOfWikipedia	22K	9.1	16.4	60.3
EmpatheticDialogue	25K	4.3	13.7	64.2
BlendedSkillTalk	7K	11.2	13.6	64.2
ProsocialDialog	58K	5.7	20.0	60.2
SODA	1.5M	7.6	16.1	68.0

- 가격 대비 엄청나게 많은 데이터 셋을 만들어 냄. (API 한번 호출에 0.002달러)

* Lexical Diversity : 어휘 다양성

COSMO

- A Socially Situated Conversation Model
- Training T5 (Raffle etal. 2020)



p(r | n, i, c)

the contextual narrative : n
the perspective/speaker instruction : i
the dialogue context : c

The model is trained to generate
a target response : r

COSMO

- Evaluation

Dialogue Context: **A**: I really need to start eating healthier. **B**: I have to start eating better too. **A**: What kind of food do you usually eat? **B**: I try my best to eat only fruits, vegetables, and chicken. **A**: Is that really all that you eat? **B**: That's basically it. **A**: How do you stick to only those foods?
Ground-truth response: Actually, fruits and veggies are really good for you.
DialoGPT: I eat a lot of fruit and veggies. I stick to a lot of things. I don't eat a lot of junk food.
BlenderBot: I eat a lot of fruit and veggies. I try to stay away from processed foods.
GODEL: I go to the gym and eat healthy food.
COSMO: I just try to make sure that I'm getting enough variety in my diet so that I don't get sick of eating the same thing all the time.

Table 14: The original ground-truth response and sample responses from DialoGPT, BlenderBot, GODEL, and COSMO to a context in DailyDialog.

Model	Natural	Consistent	Specific	Overall
BlenderBot-3B	23%	26%	39%	28%
COSMO-3B	**77%**	**74%**	**61%**	**72%**
GODEL_L	13%	14%	15%	14%
COSMO-3B	**87%**	**86%**	**85%**	**86%**
Koala-7B	30%	34%	30%	29%
COSMO-3B	**70%**	**66%**	**70%**	**71%**
Vicuna-7B	42%	42%	44%	42%
COSMO-3B	**58%**	**58%**	**56%**	**58%**
Ground Truth	43%	45%	46%	45%
COSMO-3B	**57%**	**55%**	**54%**	**55%**

Table 5: Results of head-to-head human evaluation between model responses on an unseen dataset: DailyDialog (Li et al., 2017) (§5.1). The differences are all statistically significant with $|z| > 12.45$ and $p < 0.05$, except for the *Specific* in the bottom row.

Ground-truth response가 사람이 작성한 반응이다.

사람과 비교했을 때도 성능이 더 높다는 점이 놀랍다.

다른 모델들도 대화형 모델이다.
COSMO가 모델 사이즈가 더 작음에도 더 좋은 성능을 보인다. (그만큼 데이터셋이 좋다는 얘기라고 생각함)

COSMO

- Evaluation

Model	Natural	Consistent	Specific	Overall
BlendedSkillTalk				
BlenderBot-3B	32%	35%	40%	36%
COSMO-3B	**68%**	**65%**	**60%**	**64%**
SODA				
BlenderBot-3B	21%	17%	25%	17%
COSMO-3B	**79%**	**83%**	**75%**	**83%**

Table 6: Human evaluation results for head-to-head comparison of model responses under one-sided out-of-domain setting with COSMO and BlenderBot (Roller et al., 2021) (§5.2). BlendedSkillTalk (Smith et al., 2020) is an unseen dataset for COSMO, and SODA is an unseen dataset for BlenderBot. The differences are all statistically significant with $|z| > 4.24$ and $p < 0.05$.

BlenderBot이 학습한 데이터에서도 COSMO가 더 높은 성능을 보이며 잘 일반화된 성능을 보이고 있다.

당연하게도 SODA 데이터셋에서 COSMO가 더 높은 성능을 보인다.

COSMO

- Evaluation

Model	Natural	Consistent	Specific	Overall
GPT-3.5	**50%**	46%	31%	47%
COSMO-11B	**50%**	**54%**	**69%**	**53%**
ChatGPT	39%	49%	**70%**	**50%**
COSMO-11B	**61%**	**51%**	30%	**50%**

Table 7: Head-to-head human evaluation between models on response generation for SODA (§5.3). The differences in the *Specific* from the top row, and the differences in the *Natural* and *Specific* from the bottom row are statistically significant with $|z| > 7.6$ and $p < 0.05$.

175B 파라미터를 가진 teacher 모델과의 비교이다.

이들보다 엄청나게 뛰어난 성능을 보여주고 있진 않지만, 모델 사이즈가 1/10도 안되는 것을 생각하면 COSMO를 사용하는 것을 고려해볼 수 있을 것이다.

Conclusion

- 데이터 부족 문제 완화하는데 기여 (양질의 데이터)
- CO_3 framework를 통해 향후에 더 많은 데이터를 만들어낼 수 있음.
- 현존하는 데이터셋에서 ground-truth보다도 좋은 COSMO 모델을 만들어 냄.

내 생각

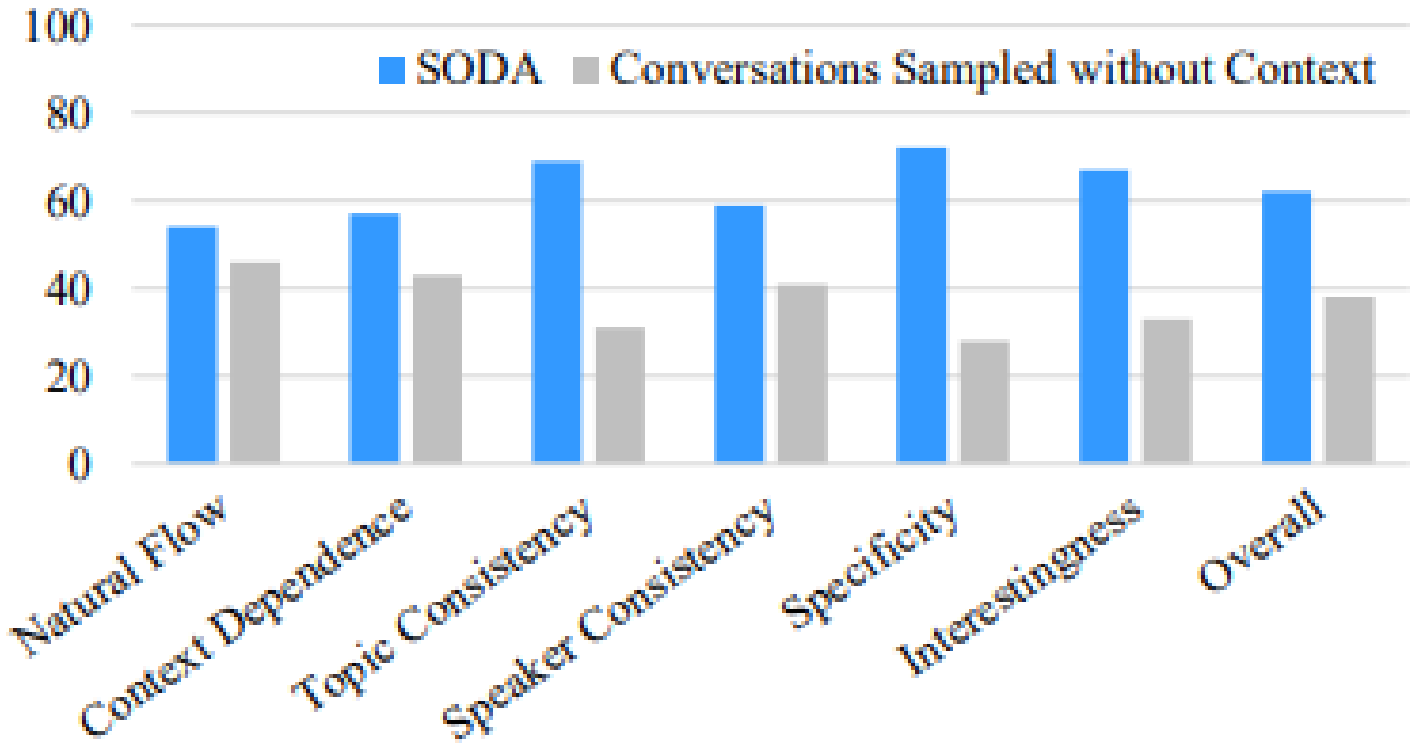
- 모델이 학습할 데이터를 다른 모델을 이용해서 만들어낸 것에 가치가 있는 논문이라고 생각함. (사람 개입 거의 없음)

- 또한 SODA가 사람과 비교했을 때도 더 좋은 데이터라면, 앞으로 LLM으로 데이터를 만들어내는 논문도 계속해서 나올 것임.

Open Questions

- 더 많은 데이터셋을 사용하면 어떻게 될까?
- 보완할 만함 점 혹은 확장시킬 만한 점이 있을까?

Appendix


100
80
60
40
20
0
SODA
Conversations Sampled without Context
Natural Flow
Context Dependence
Topic Consistency
Speaker Consistency
Specificity
Interestingness
Overall