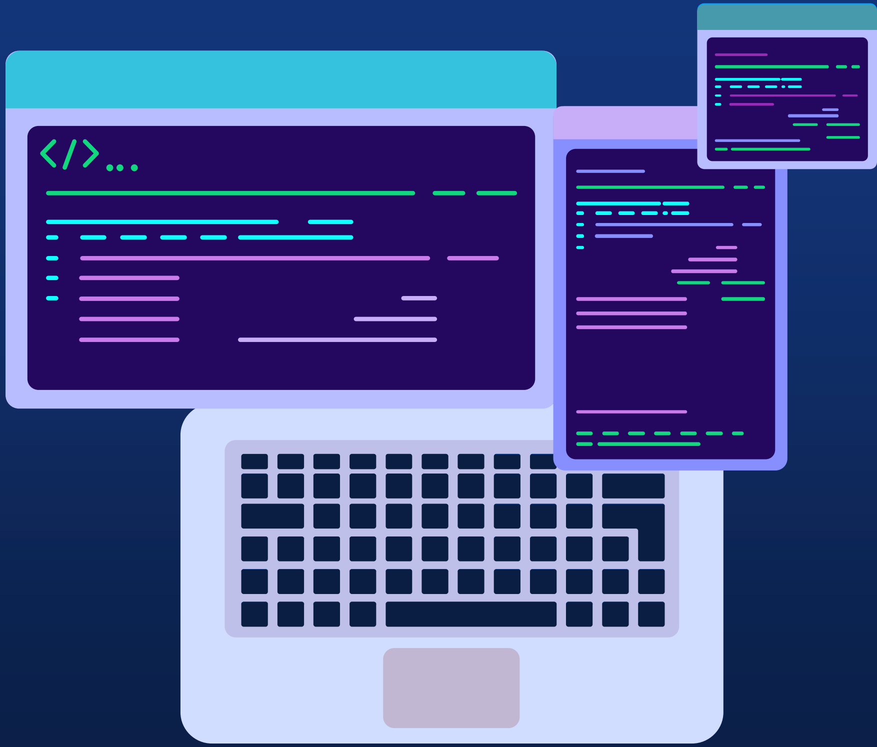
REVIEW-3



Analysing methods of Neural Text Generation to refine conversations

Team Members

Mihir Antwal

19BCE1641

Sam Methuselah

19BCE1698

Natural Language Generation task spectrum

Machine Translation

Sentence Compression

Abstract Summarization

Story Generation

ChitChat Dialogue

Less open-ended	More open-ended
Moslty world-level decisions	Requires high-level decisions
Neural LMs more successful	**Neural LMs less successful**

Natural Language Generation task spectrum

Machine Translation — Sentence Compression — Abstract Summarization — Story Generation — ChitChat Dialogue

Less open-ended	More open-ended
Moslty world-level decisions	Requires high-level decisions
Neural LMs more successful	**Neural LMs less successful**
Control is less important	**Control is more important**

Natural Language Generation task spectrum

Machine Translation — Sentence Compression — Abstract Summarization — Story Generation — ChitChat Dialogue

Less open-ended	More open-ended
Moslty world-level decisions	Requires high-level decisions
Neural LMs more successful	**Neural LMs less successful**
Control is less important	**Control is more important**
Eval is difficult	**Eval is fiendish**

Questions

By controlling multiple attributes of generated text and human-evaluating multiple aspects of conversational quality, we aim to answer the following:

1. **How effectively can we control the different attributes?**
2. **How do the controllable attributes affect conversational quality aspects?**
3. **Can we use control to make a better chatbot overall?**

PersonaChat task

Persona:

- I love to drink fancy tea.
- I have a big library at home.
- I'm a museum tour guide.
- I'm partly deaf.

Persona:

- I have two dogs.
- I like to work on vintage cars.
- My favorite music is country.
- I own two vintage Mustangs.

Hello, how are you doing?

Great thanks, just listening to my favorite Johnny Cash album!

Nice! I'm not much of a music fan myself, but I do love to read.

Me too! I just read a book about the history of the auto industry.

PersonaChat task

- The PersonaChat task was the focus of the NeurIPS 2018 ConvAI2 Competition.
  - Most successful teams built neural sequence generation systems. (Dinan et al 2019)
  - The winning team, Lost in Conversation, used a finetuned version of GPT.
- Our baseline model is a standard LSTM-based seq2seq architecture with attention.
  - It is pretrained on 2.5 million Twitter message/response pairs, then finetuned on PersonaChat.

Attributes we can control

Low-level controllable attributes

Low-level controllable attributes	Goal
Repetition (n-gram overlap)	Goal: Reduce repetition (within and across utterances)
Specificity (normalized inverse document frequency)	Goal: Reduce genericness of responses (e.g. oh that's cool)
Response-relatedness (cosine similarities of sentence embeddings)	Goal: Respond more on-topic; don't ignore user
Question-asking (‘?’ used in utterance)	Goal: Find the optimal rate of question-asking

Quality Aspects

Low-level controllable attributes

- Repetition (n-gram overlap)
- Specificity (normalized inverse document frequency)
- Response-relatedness (cosine similarities of sentence embeddings)
- Question-asking ('?' used in utterance)

Human judgement of conversational aspects

- Avoiding Repetition — Does the bot repeat itself?
- Interestingness — Did you find the bot interesting to talk to?
- Making sense — Does the bot say things that don't make sense?
- Fluency — Does the bot use English naturally?
- Listening — Does the bot pay attention to what you say?
- Inquisitiveness — Does the bot ask a good amount of questions?

Quality Aspects

Low-level controllable attributes

- Repetition (n-gram overlap)
- Specificity (normalized inverse document frequency)
- Response-relatedness (cosine similarities of sentence embeddings)
- Question-asking (‘?’ used in utterance)

Human judgement of conversational aspects

- Avoiding Repetition
- Interestingness
- Making sense
- Fluency
- Listening
- Inquisitiveness

Human judgement of overall quality

- Humanness — Is it a person or bot?
- Engagingness — Is it enjoyable to talk to?

Control methods

We evaluate and compare two existing general-purpose control methods, using them to control all four controllable attributes.

- **Conditional Training (CT):** Train the model to generate response y, conditioned on the input x, and the desired output attribute z. (Kikuchi et al 2016, Peng et al 2018, Fan et al 2018)
- **Weighted Decoding (WD):** During decoding, increase/decrease the probability of generating words w in proportion to features f(w). (Ghazvininejad et al 2017, Baheti et al 2018)

Q1: How effectively can we control attributes?

Attributes: repetition, specificity, question-asking, response-relatedness

Conditional Training (CT):

- Requires sufficient training examples for the attribute (repetition).
- Ineffective at learning complex relationships between input and output (response-relatedness)
- Effective for: ✓ specificity, ✓ question-asking

Weighted Decoding (WD):

- Requires attribute to be defined at the word-level (question-asking)
- Effective for: ✓ repetition, ✓ response-relatedness, ✓ specificity

Controlling specificity (WD and CT)

Input: *Yes, I'm studying law at the moment*
Baseline Response: *That sounds like a lot of fun!*

Wt	NIDF	Weighted Decoding Response
-5.0	0.6%	*Oh.......................................*
0.0	17.1%	*That sounds like a lot of fun!*
3.0	18.3%	*That sounds like a lot of fun. How long have you been studying?*
7.0	38.5%	*I majored in practising my spiritual full time philosophy test*
10.0	71.9%	*Oh wow! Merna jean isa paino yi hao hui bu acara sya gila* [. . .]

More generic

More specific

Input: *Yes, I'm studying law at the moment*
Baseline Response: *That sounds like a lot of fun!*

WD: Large range, but degenerate output at the extremes

Wt	NIDF	Weighted Decoding Response
-5.0	0.6%	*Oh.................................*
0.0	17.1%	*That sounds like a lot of fun!*
3.0	18.3%	*That sounds like a lot of fun. How long have you been studying?*
7.0	38.5%	*I majored in practising my spiritual full time philosophy test*
10.0	71.9%	*Oh wow! Merna jean isa paino yi hao hui bu acara sya gila* [. . .]

More generic
More specific

CT: Smaller range, but generally well-formed output

z	NIDF	Conditional Training Response
0	16.8%	*Sounds like you are a great person!*
2	18.3%	*So you are a law student?*
4	18.4%	*That sounds like a lot of fun*
6	22.8%	*That sounds like a rewarding job!*
8	24.4%	*That sounds like a rewarding career!*

More generic
More specific

Controlling response-relatedness (WD)

Input: *Do you go get coffee often*
Baseline Response: *I do, when I am not playing the piano.*

Wt	Sim	Weighted Decoding Response
-10.0	-0.05	*I am a musician.*
0.0	-0.02	*I do, when I am not playing the piano.*
5.0	0.40	*I do, usually at starbucks.*
8.0	0.59	*Not usually, especially when you drink latte.*
11.0	0.72	*Not often, usually with drinks, espresso, latte, tea, etc.*

Less related

More related

Output is degenerate when weight is too high

Q2: How does control affect human eval?

Reduce n-gram repetition to human level

Low-level controllable attributes

- Repetition (n-gram overlap)
- Specificity (normalized inverse document frequency)
- Response-relatedness (cosine similarities of sentence embeddings)
- Question-asking ('?' used in utterance)

→

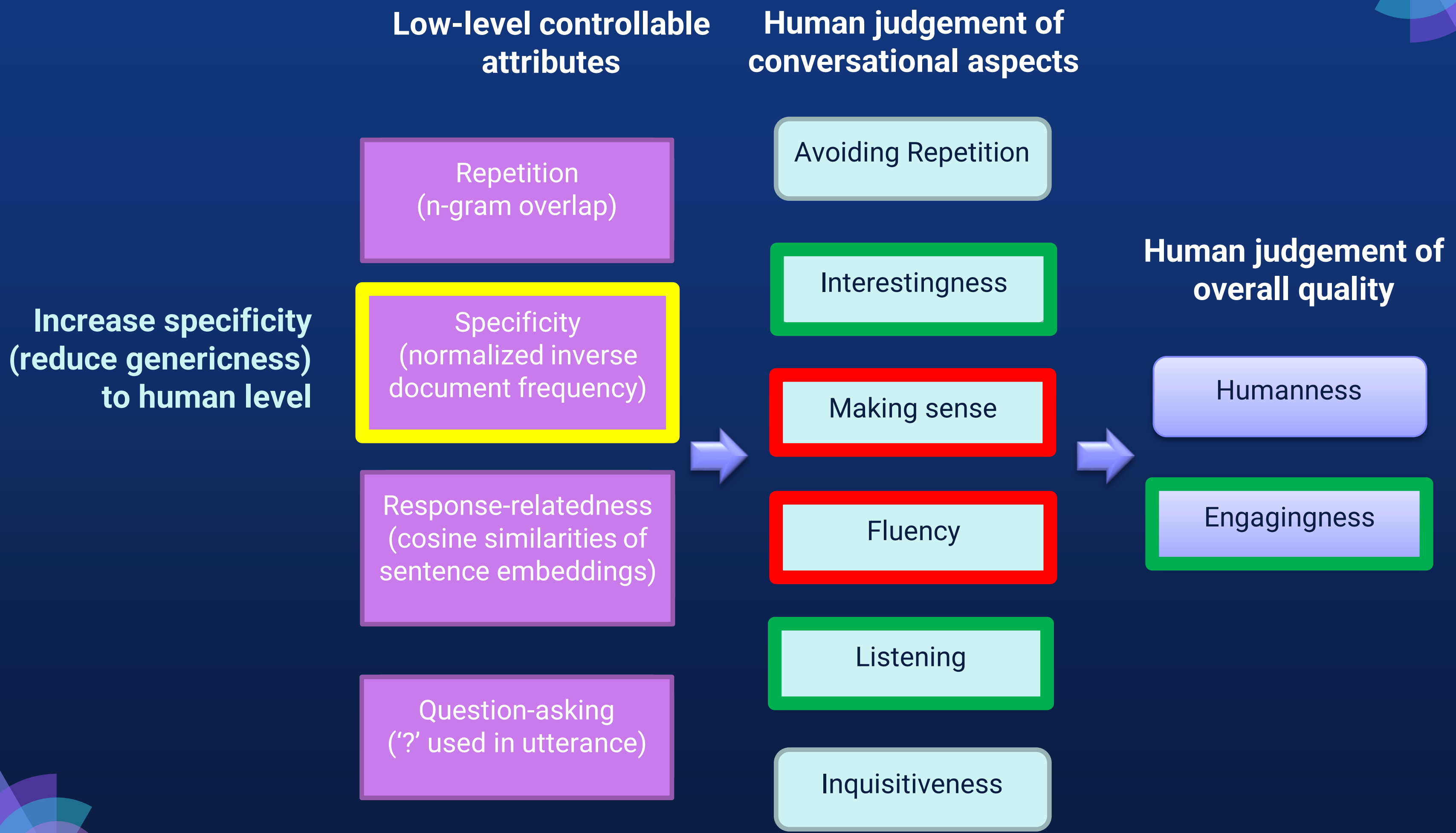
Human judgement of conversational aspects

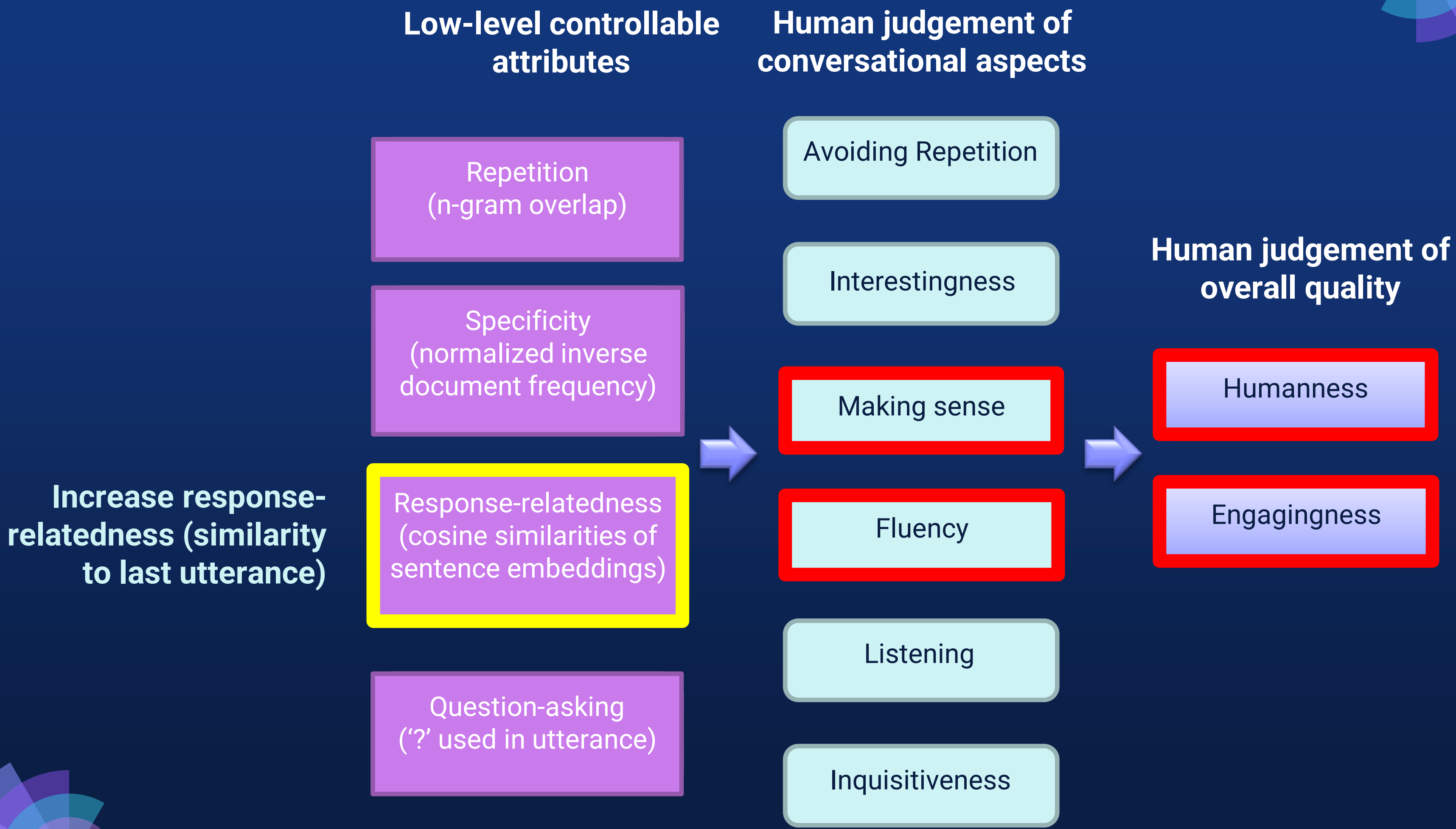
- Avoiding Repetition
- Interestingness
- Making sense
- Fluency
- Listening
- Inquisitiveness

→

Human judgement of overall quality

- Humanness
- Engagingness

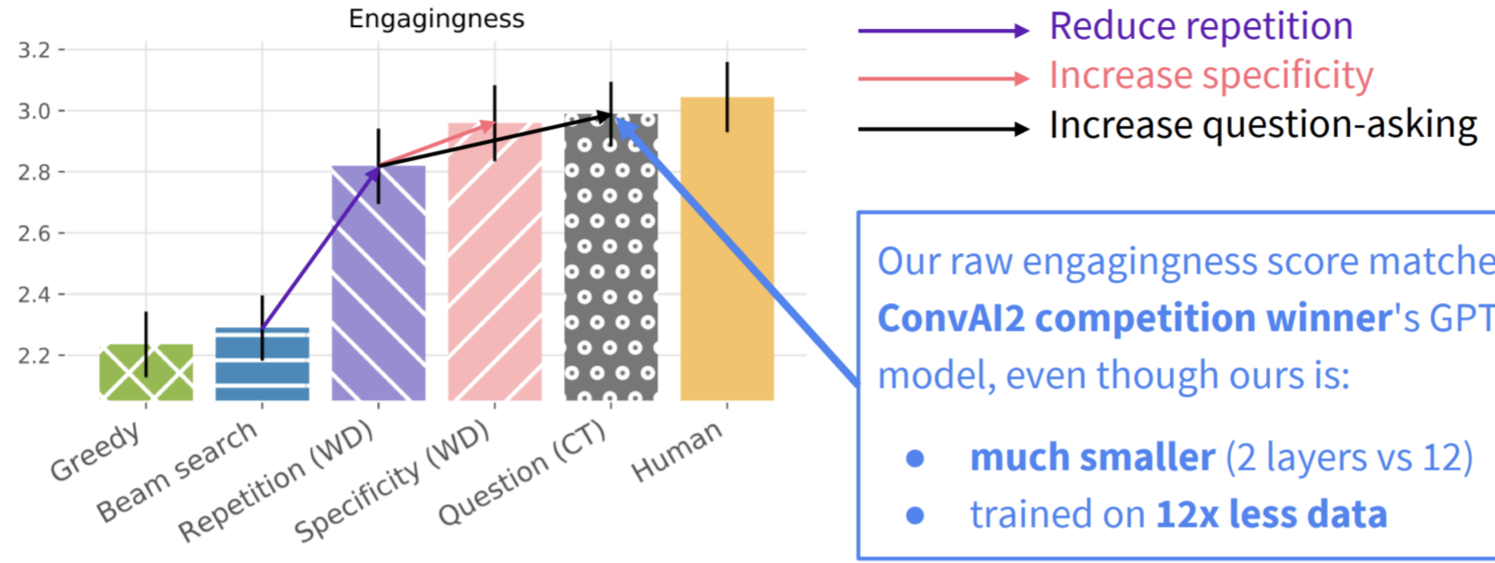

Low-level controllable attributes
Human judgement of conversational aspects
Human judgement of overall quality
Increase specificity (reduce genericness) to human level
Repetition (n-gram overlap)
Specificity (normalized inverse document frequency)
Response-relatedness (cosine similarities of sentence embeddings)
Question-asking (‘?’ used in utterance)
Avoiding Repetition
Interestingness
Making sense
Fluency
Listening
Inquisitiveness
Humanness
Engagingness



Low-level controllable attributes
Human judgement of conversational aspects
Human judgement of overall quality
Repetition (n-gram overlap)
Specificity (normalized inverse document frequency)
Response-relatedness (cosine similarities of sentence embeddings)
Question-asking ('?' used in utterance)
Avoiding Repetition
Interestingness
Making sense
Fluency
Listening
Inquisitiveness
Humanness
Engagingness
Increase response-relatedness (similarity to last utterance)

Q3: Can we make a better chatbot overall?

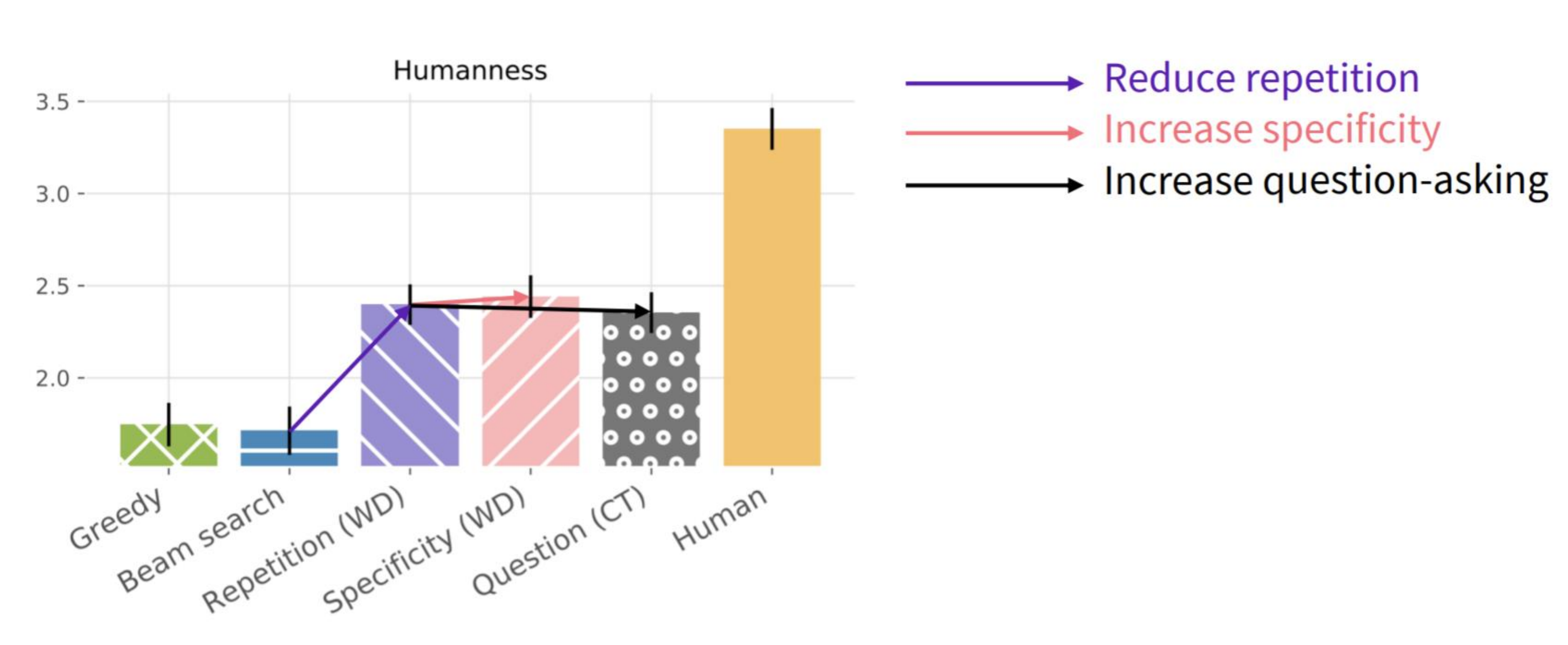
Yes! By controlling repetition, specificity and question-asking, we can achieve **near-human engagingness (i.e. enjoyability) ratings.**



Our raw engagingness score matches the **ConvAI2 competition winner**'s GPT-based model, even though ours is:

- **much smaller** (2 layers vs 12)
- trained on **12x less data**

However: On the **humanness** (i.e. Turing test) metric, the models are **nowhere near human-level!**



Engagingness vs Humanness

Finding: The bots are **(almost) as engaging as humans,** but they're **clearly non-human.**

Two conclusions:

1. **Engagingness ≠ Humanness.** While both are frequently used as standalone overall quality metrics, our results show the importance of measuring more than one.

2. On this task, **the human "engagingness" performance may be artificially low.**
   Turkers chatting for money are less engaging than people chatting for fun. This may be why the human-level engagingness scores are easy to match.

Conclusions

1. **Control is a good idea** for your neural sequence generation dialogue system.
2. Using simple control, **we matched performance of GPT-based contest winner.**
3. **Don't repeat yourself. Don't be boring. Ask more questions.**
4. **Multi-turn phenomena** (repetition, question-asking frequency) are important – so need **multi-turn eval** to detect them.
5. **Engagingness ≠ Humanness**, so think carefully about which to use.
6. **Paid Turkers** are **not engaging conversationalists**, or good judges of engaging conversation. Humans chatting for fun may be better.

Problem: Manually finding the best combination of control settings is **painful.**

Thank You