



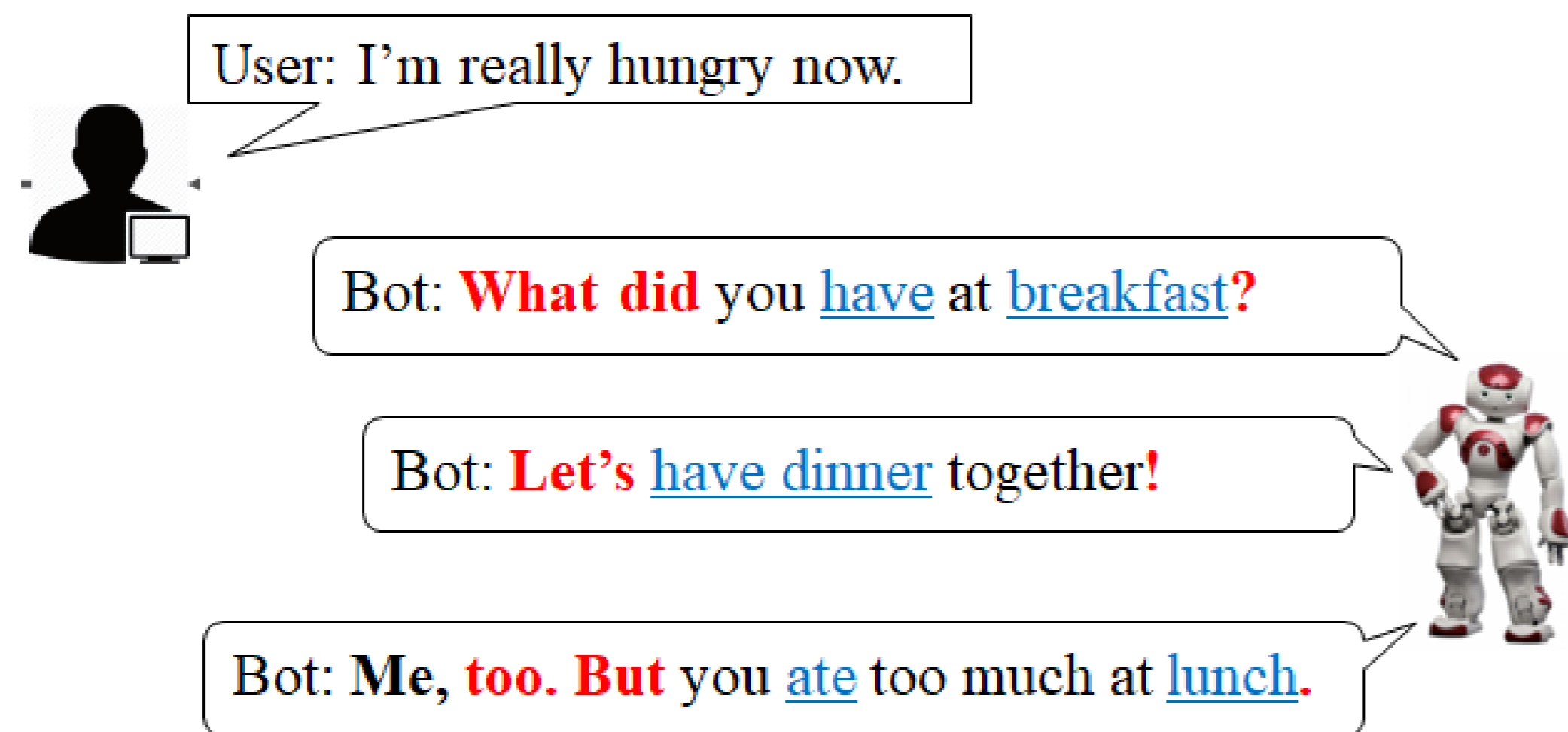
Generating Informative Responses with Controlled Sentence Function



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Introduction



● Function-related words ● Topic words ● Ordinary words

Figure 1: Responses with three sentence functions.

Sentence Function: Indicating the conversational purpose of speakers

- **Interrogative:** Acquire further information from the user
- **Imperative:** Make requests, instructions or invitations to elicit further information
- **Declarative:** Make statements to state or explain something

Response Generation Task with Specified Sentence Function

- **Global Control:** Plan different types of words globally
- **Compatibility:** Controllable sentence function + informative content

Method

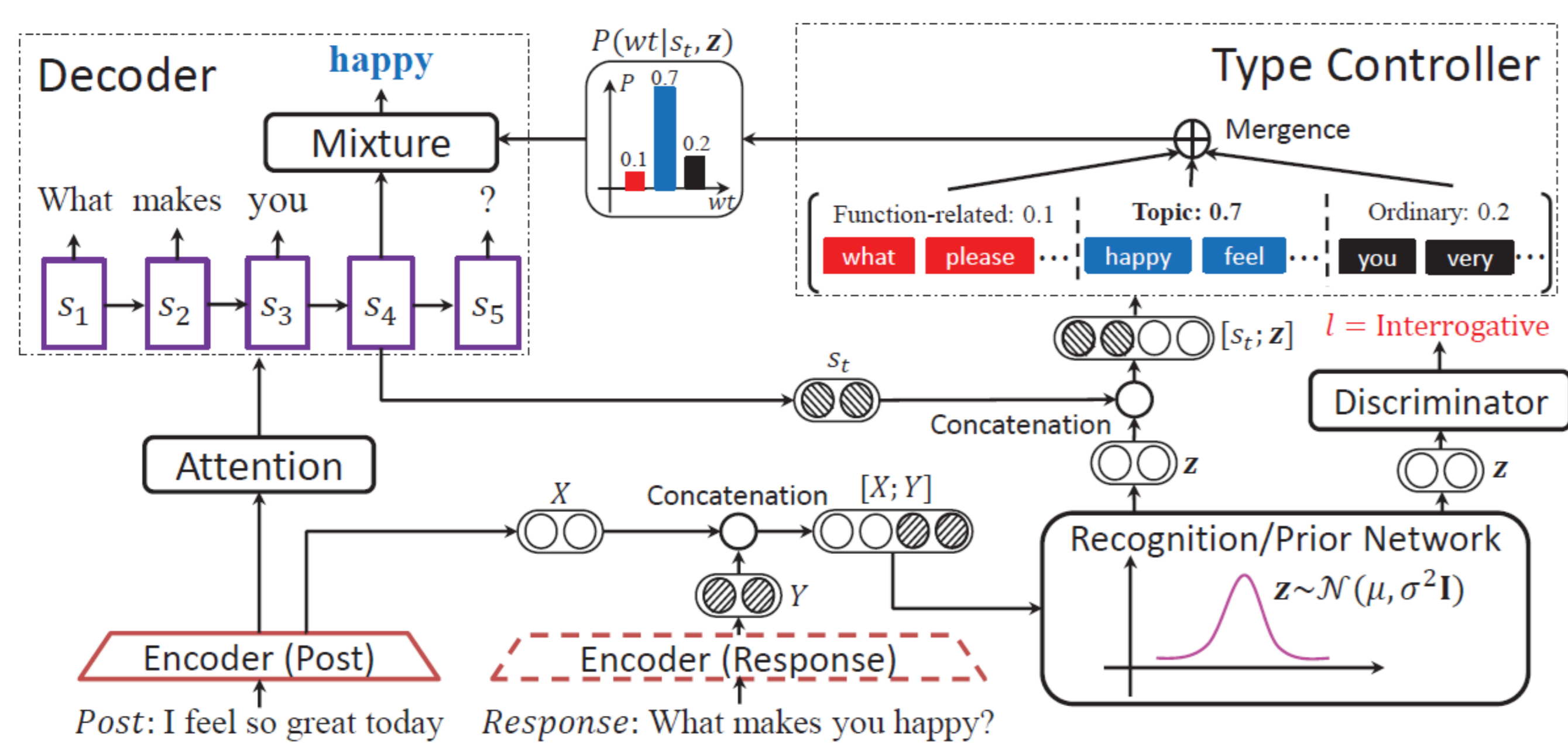


Figure 2: Model overview.

Task Overview

Post \times Function \rightarrow Response

Model: Conditional Variational Autoencoder (CVAE) Framework

- **Encoder-Decoder with Attention:** Common framework to model the mapping from the post to the response
- **Recognition / Prior Network:** Construct the posterior / prior distribution of latent variable based on the representations of posts and responses
- **Discriminator:** Supervise the latent variable to encode function-related information in responses with supervised signals
- **Type Controller:** Estimate a distribution over the word types (i.e., topic words, function-related words and ordinary words) at each decoding position
- **Decoder:** Generate responses in a mixture form combined with the type distribution and the word distribution

Experiments

Dataset

Training	#Post	1,963,382			
	#Response	Interrogative 618,340	Declarative 672,346	Imperative 672,696	
Validation	#Post	24,034			
	#Response	Interrogative 7,045	Declarative 9,685	Imperative 7,304	
Test	#Post	6,000			

Table 1: Corpus statistics.

Automatic Evaluation

Automatic Metrics:

- **Perplexity:** Grammaticality
- **Distinct-1/Distinct-2:** Diversity
- **Accuracy:** How accurately the sentence function can be controlled

Model	PPL	Dist-1	Dist-2	ACC
c-seq2seq	57.14	949/.007	5177/.041	0.973
MA	46.08	745/.005	2952/.027	0.481
KgCVAE	56.81	1531/.009	10683/.070	0.985
Our Model	55.85	1833/.008	15586/.075	0.992

Table 2: Automatic evaluation with perplexity (PPL), distinct-1 (Dist-1), distinct-2 (Dist-2), and accuracy (ACC). The integers in the Dist-* cells denote the total number of distinct n-grams.

Manual Evaluation

Manual Metrics: Grammaticality, appropriateness, informativeness

Model	Interrogative			Declarative			Imperative		
	Gram.	Appr.	Info.	Gram.	Appr.	Info.	Gram.	Appr.	Info.
Ours vs. c-seq2seq	0.534	0.536	0.896*	0.630*	0.573*	0.764*	0.685*	0.504	0.893*
Ours vs. MA	0.802*	0.602*	0.675*	0.751*	0.592*	0.617*	0.929*	0.568*	0.577*
Ours vs. KgCVAE	0.510	0.626*	0.770*	0.546*	0.515*	0.744*	0.780*	0.521*	0.837*

Table 3: Manual evaluation results for different functions. The scores indicate the percentages that our model wins the baselines after removing tie pairs. The scores of our model marked with * are significantly better than the competitors (p-value < 0.05).

Words and Patterns in Function Control

Function	Frequent Words	Frequent Patterns	Response Examples
Interrogative	?,be,particle,mean, what	Does x mean y ?	Do you mean I'm handsome?
		Is x y ?	Are you praising me?
		Where does x y ?	Where do you work?
Imperative	!,will,can,come, please	Do y , then.	Take care of yourself, then.
		Let x give y to z .	Let me give your house to you.
Declarative	be,also/too,think,but,no	x also y , but z .	I also think so, but I will find a person. Ha-ha.
		x , too, and a has b .	Me, too, and my fans have been shocked by me.

Table 4: Frequent function-related words and frequent patterns containing at least 3 function-related words. The letters denote the variables which replace ordinary and topic words in the generated responses.

Case Study

Post:	What would you do if I suddenly broke up with you someday?
Target Function:	Interrogative
KgCVAE:	Did you miss me?
Our Model:	Do you mean that it's my fault?
Target Function:	Imperative
KgCVAE:	I will tell you!
Our Model:	Rest assured that I would give your gift to you.
Target Function:	Declarative
KgCVAE:	I think I'm a good man, too.
Our Model:	I would think that I was stupid and I would be blamed by my mother.

Table 5: Generated responses of all the models for different sentence functions.

Post:	What would you do if I suddenly broke up with you someday?
Interrogative Response #1	Do you mean that it's my fault?
Interrogative Response #2	Can you speak normally?
Interrogative Response #3	What do you think I should do? Shall I break up with you?

Table 6: Different patterns of interrogative responses generated by our model.