# *Inducing Positive Perspectives*
with Text Reframing

Caleb Ziems,* Minzhi Li,* Anthony Zhang, Diyi Yang
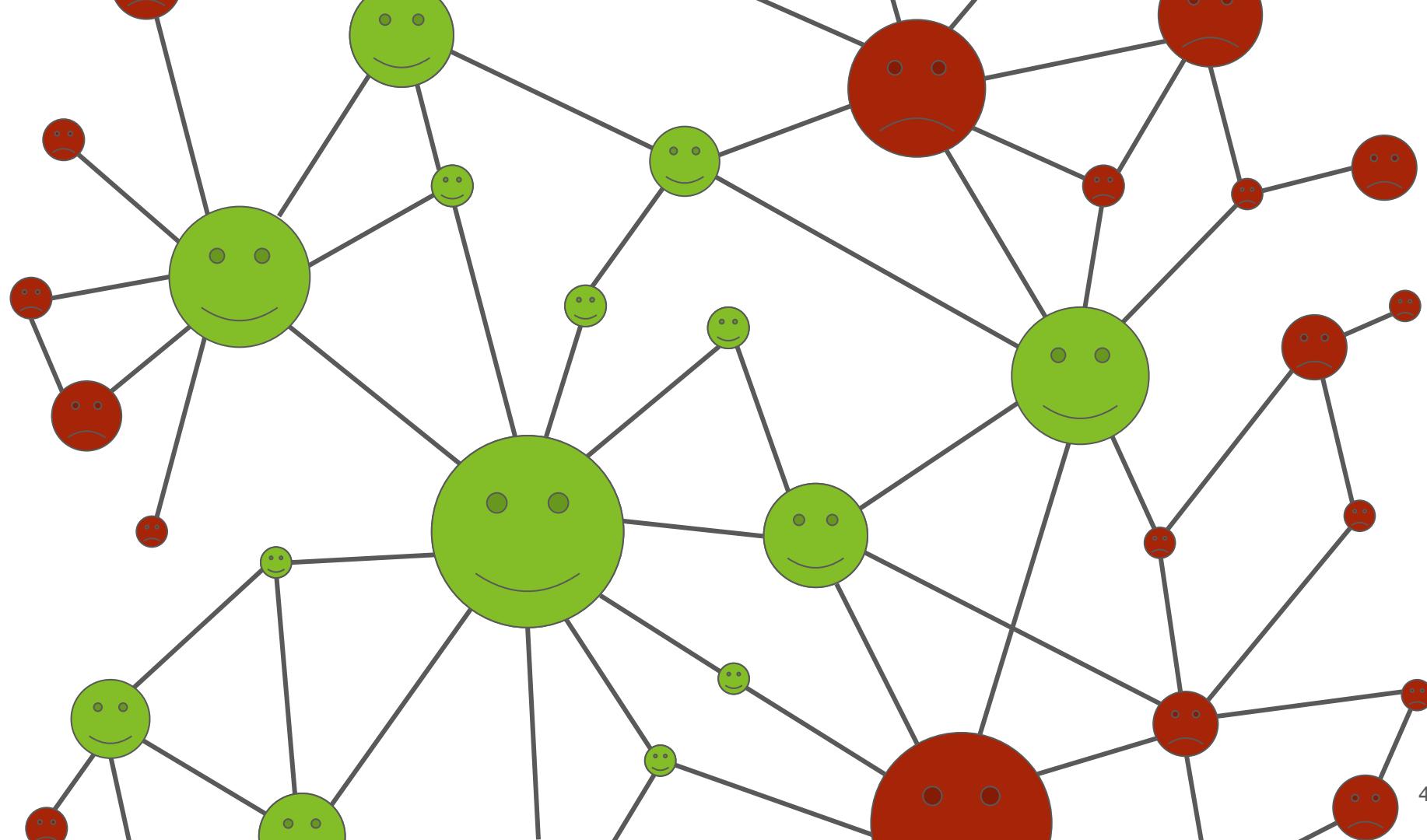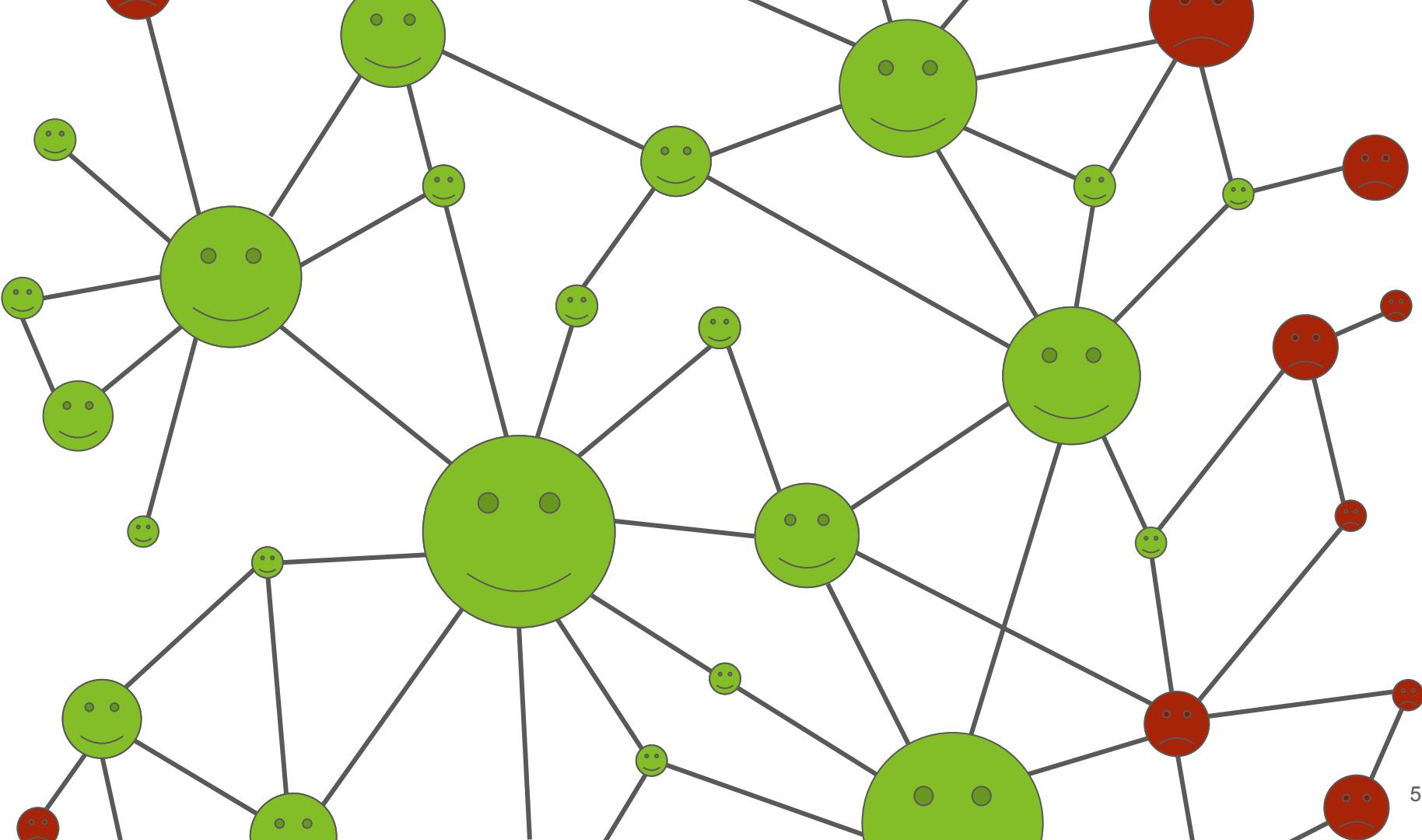
ACL 2022

NUS National University of Singapore

Georgia Tech | College of Computing
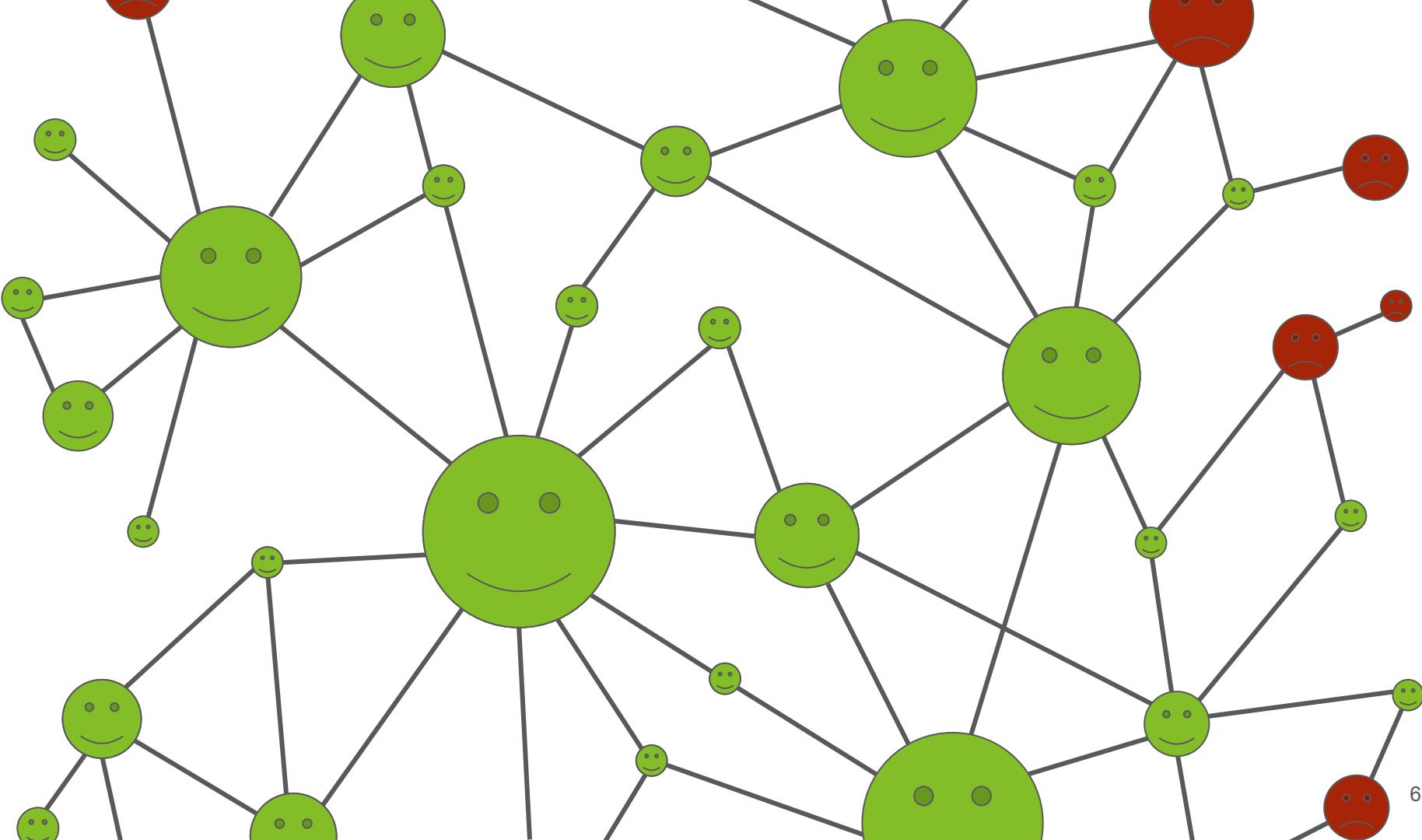
Benefits of **Positivity**

- **Individuals**
  - *Emotional well-being*
  - *Psychological well-being*

Benefits of **Positivity**

- Individuals
    - Emotional well-being
    - Psychological well-being
- **Dyads**
    - *Motivational Support*
    - *Negotiation*
    - *Persuasion*

Benefits of **Positivity**

- Individuals
  - Emotional well-being
  - Psychological well-being
- Dyads
  - Motivational Support
  - Negotiation
  - Persuasion
- **Teams**
  - *Reduce conflict*
  - *Increase collaboration*

Benefits of **Positivity**

- Individuals
  - Emotional well-being
  - Psychological well-being
- Dyads
  - Motivational Support
  - Negotiation
  - Persuasion
- Teams
  - Reduce conflict
  - Increase collaboration
- **Corporations**
  - *Branding*
  - *Customer relations*

10

Benefits of **Positivity**

- Individuals
  - Emotional well-being
  - Psychological well-being
- Dyads
  - Motivational Support
  - Negotiation
  - Persuasion
- Teams
  - Reduce conflict
  - Increase collaboration
- Corporations
  - Branding
  - Customer relations

Caution: Avoid "fake" positivity

Inducing Positive Perspectives with Text Reframing

Motivation: machines can help people achieve these **positive benefits**

Inducing Positive Perspectives with Text Reframing

Motivation: machines can help people achieve these **positive benefits**

restructure thought

Inducing Positive Perspectives with Text Reframing

Motivation: machines can help people achieve these **positive benefits**

restructure thought

(a)   **remove:** de-emphasize *exaggerated* forms of negativity

Inducing Positive Perspectives with Text Reframing

Motivation: machines can help people achieve these **positive benefits**

restructure thought

(a) **remove:** de-emphasize *exaggerated* forms of negativity
(b) **reweight:** place more emphasis on positive elements with *new perspectives*

Inducing Positive Perspectives with Text Reframing

Motivation: machines can help people achieve these **positive benefits**

restructure thought

(a) **remove:** de-emphasize *exaggerated* forms of negativity
(b) **reweight:** place more emphasis on positive elements with *new perspectives*
(c) **rephrase:** maintain fluency and genuineness without contradicting the original idea

Inducing Positive Perspectives with Text Reframing

Motivation: machines can help people achieve these **positive benefits**

restructure thought

(a) **remove:** de-emphasize *exaggerated* forms of negativity

(b) **reweight:** place more emphasis on positive elements with *new perspectives*

(c) **rephrase:** maintain fluency and genuineness without contradicting the original idea

→ *"positive reframing"*

I absolutely love making decisions.

I find myself having a lot of those to make.

style transfer

⊥ contradiction

I absolutely hate making decisions.

I find myself having a lot of those to make.

Style Transfer

I absolutely hate making decisions.
I find myself having a lot of those to make.

style transfer

I absolutely love making decisions.
I find myself having a lot of those to make.

⊥ contradiction

Style Transfer

style transfer

I absolutely love making decisions.

I find myself having a lot of those to make.

⊥ *contradiction*

I absolutely hate making decisions.

I find myself having a lot of those to make.

Positive Reframe
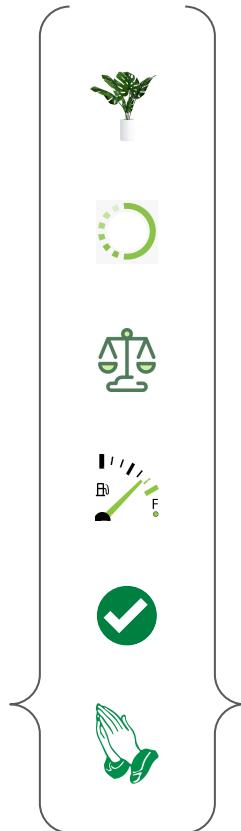
positive reframe

Although I have a lot of decisions to make,

it'll become easier once I start to get used to it.

Style Transfer

*I absolutely love making decisions.*
I find myself having a lot of those to make.

style transfer

⊥ *contradiction*

I absolutely hate making decisions.
I find myself having a lot of those to make.

implicature +>

Positive Reframe

positive reframe

Although I have a lot of decisions to make,

it'll become easier once I start to get used to it.

Positive Reframe

Strategies

Growth Mindset

Impermanence

Neutralizing

Optimism

Self-Affirmation

Thankfulness

Positive Reframe

Ugh, it is SUCH a hot day 🥵

⬇
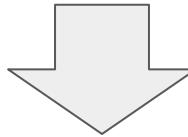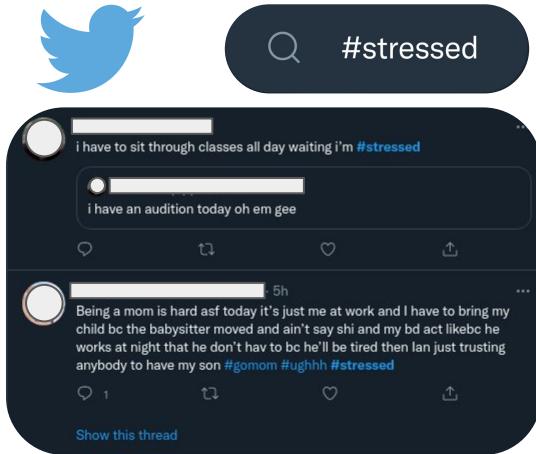
Reframe:
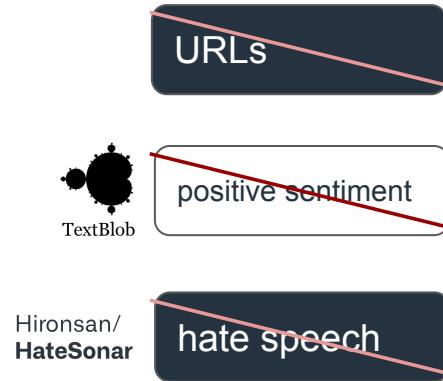
This hot weather makes it the perfect day for ice cream 🍦

1. Building the Positive Psychology Corpus

1: Use *distant supervision* to identify negative posts

1. Building the Positive Psychology Corpus

🐦 #stressed

i have to sit through classes all day waiting i'm #stressed

i have an audition today oh em gee

· 5h
Being a mom is hard asf today it's just me at work and I have to bring my child bc the babysitter moved and ain't say shi and my bd act likebc he works at night that he don't hav to bc he'll be tired then Ian just trusting anybody to have my son #gomom #ughhh #stressed

Show this thread

URLs

TextBlob — positive sentiment

Hironsan/
HateSonar — hate speech

1: Use *distant supervision* to identify negative posts

2: Apply Content Filters

1. Building the Positive Psychology Corpus

TEXT *positivity*   1 2 3 4 5

REFRAME: *free text*

REFRAME *strategy*

REFRAME *positivity*   1 2 3 4 5

#stressed

i have to sit through classes all day waiting i'm #stressed

i have an audition today oh em gee

· 5h

Being a mom is hard asf today it's just me at work and I have to bring my child bc the babysitter moved and ain't say shi and my bd act likebc he works at night that he don't hav to bc he'll be tired then Ian just trusting anybody to have my son #gomom #ughhh #stressed

1

Show this thread

URLs

TextBlob   positive sentiment

Hironsan/
HateSonar   hate speech

1: Use *distant supervision* to identify negative posts

2: Apply Content Filters

3: Data Annotation
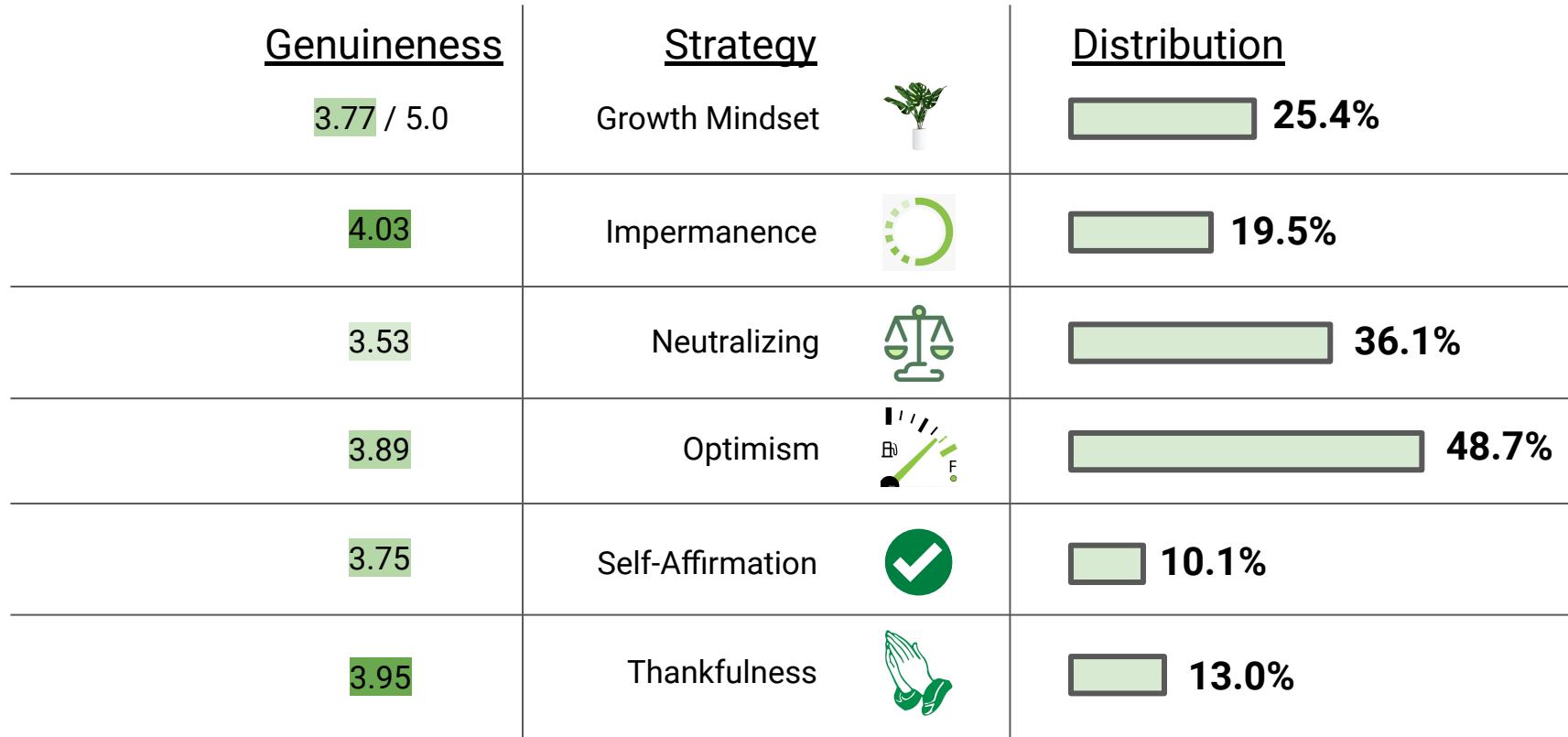
1. Building the Positive Psychology Corpus

	Strategy	
	Growth Mindset	
	Impermanence	
	Neutralizing	
	Optimism	
	Self-Affirmation	
	Thankfulness	
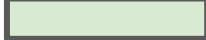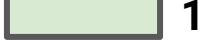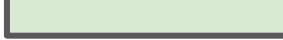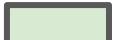
1. Building the Positive Psychology Corpus

Strategy		Distribution
Growth Mindset		25.4%
Impermanence		19.5%
Neutralizing		36.1%
Optimism		48.7%
Self-Affirmation		10.1%
Thankfulness		13.0%

1. Building the Positive Psychology Corpus

Genuineness	Strategy		Distribution
3.77 / 5.0	Growth Mindset		25.4%
4.03	Impermanence		19.5%
3.53	Neutralizing		36.1%
3.89	Optimism		48.7%
3.75	Self-Affirmation		10.1%
3.95	Thankfulness		13.0%
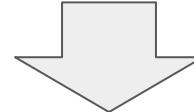
1. Building the Positive Psychology Corpus

Agreement	Genuineness	Strategy		Distribution
ICC = 0.59	3.77 / 5.0	Growth Mindset		25.4%
0.60	4.03	Impermanence		19.5%
0.32	3.53	Neutralizing		36.1%
0.44	3.89	Optimism		48.7%
0.42	3.75	Self-Affirmation		10.1%
0.42	3.95	Thankfulness		13.0%

2. Automatic Positive Reframing

2. Automatic Positive Reframing

Ugh, it is SUCH a hot day 🥵
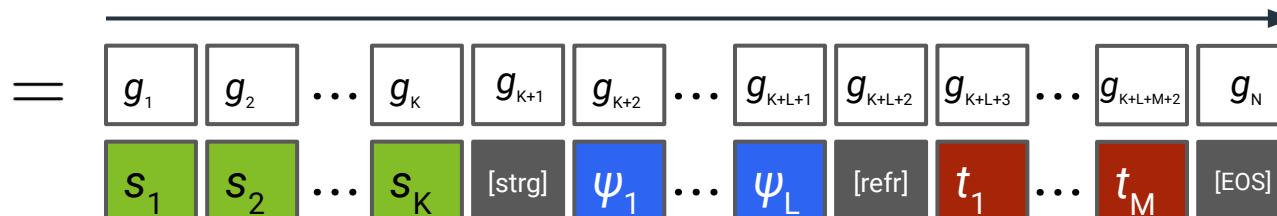
Reframe:

This hot weather makes it the perfect day for ice cream 🍦

2. Automatic Positive Reframing
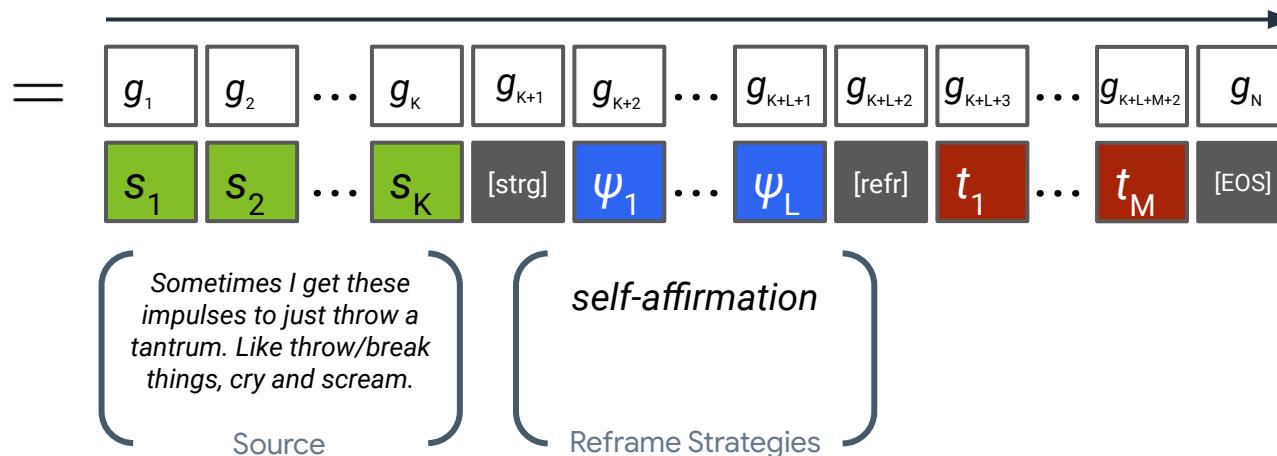
Objective: $\dfrac{1}{N}\sum_{i=0}^{N}\log p(g_i|g_{0:i-1})$

$$\boldsymbol{g} = \{s, \boldsymbol{\psi}_t, t\}$$

$= \quad \boxed{g_1} \; \boxed{g_2} \cdots \boxed{g_K} \quad \boxed{g_{K+1}} \; \boxed{g_{K+2}} \cdots \boxed{g_{K+L+1}} \; \boxed{g_{K+L+2}} \; \boxed{g_{K+L+3}} \cdots \boxed{g_{K+L+M+2}} \; \boxed{g_N}$

$\boxed{s_1}\;\boxed{s_2}\cdots\boxed{s_K}\;\boxed{\text{[strg]}}\;\boxed{\psi_1}\cdots\boxed{\psi_L}\;\boxed{\text{[refr]}}\;\boxed{t_1}\cdots\boxed{t_M}\;\boxed{\text{[EOS]}}$

Sometimes I get these impulses to just throw a tantrum. Like throw/break things, cry and scream.

Source

2. Automatic Positive Reframing

Objective: $\dfrac{1}{N}\sum_{i=0}^{N}\log p(g_i|g_{0:i-1})$

$$\boldsymbol{g} = \{s, \boldsymbol{\psi}_t, t\}$$

$$= \boxed{g_1}\ \boxed{g_2}\ \cdots\ \boxed{g_K}\ \boxed{g_{K+1}}\ \boxed{g_{K+2}}\ \cdots\ \boxed{g_{K+L+1}}\ \boxed{g_{K+L+2}}\ \boxed{g_{K+L+3}}\ \cdots\ \boxed{g_{K+L+M+2}}\ \boxed{g_N}$$

s_1 s_2 $\cdots$ s_K [strg] ψ_1 $\cdots$ ψ_L [refr] t_1 $\cdots$ t_M [EOS]

Sometimes I get these impulses to just throw a tantrum. Like throw/break things, cry and scream.

Source

self-affirmation

Reframe Strategies

2. Automatic Positive Reframing

Objective: $\dfrac{1}{N}\displaystyle\sum_{i=0}^{N}\log p(g_i|g_{0:i-1})$

$$\boldsymbol{g} = \{s, \boldsymbol{\psi}_t, t\}$$

$= $

| g_1 | g_2 | $\cdots$ | g_K | g_{K+1} | g_{K+2} | $\cdots$ | g_{K+L+1} | g_{K+L+2} | g_{K+L+3} | $\cdots$ | $g_{K+L+M+2}$ | g_N |
| s_1 | s_2 | $\cdots$ | s_K | [strg] | ψ_1 | $\cdots$ | ψ_L | [refr] | t_1 | $\cdots$ | t_M | [EOS] |

Sometimes I get these impulses to just throw a tantrum. Like throw/break things, cry and scream.

self-affirmation

It's normal for to feel overwhelmed sometimes but I know I am strong to handle and go through it.

Source   Reframe Strategies   Target

2. Positive Reframing

$p(t|s)$ <u>Unconstrained:</u>   Human evaluation

■ **Meaning**

2. Positive Reframing

$p(t|s)$ <u>Unconstrained:</u> Human evaluation

■ **Meaning**

■ **Positivity**

2. Positive Reframing
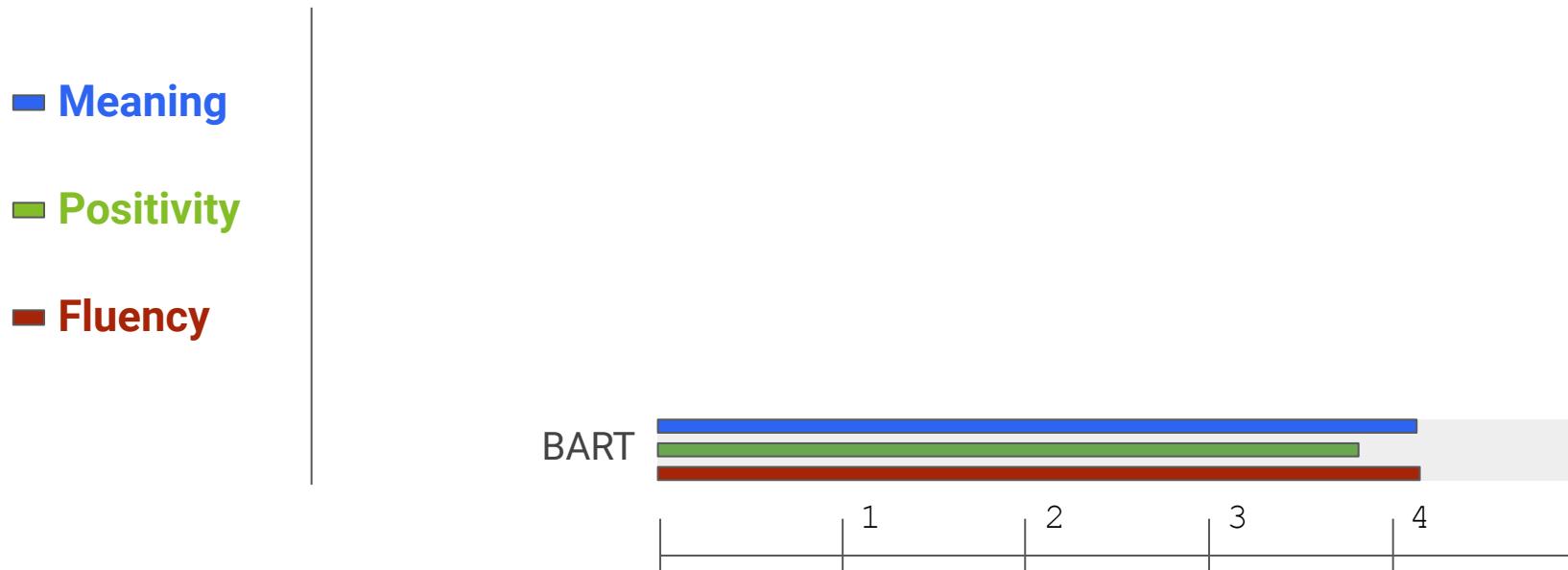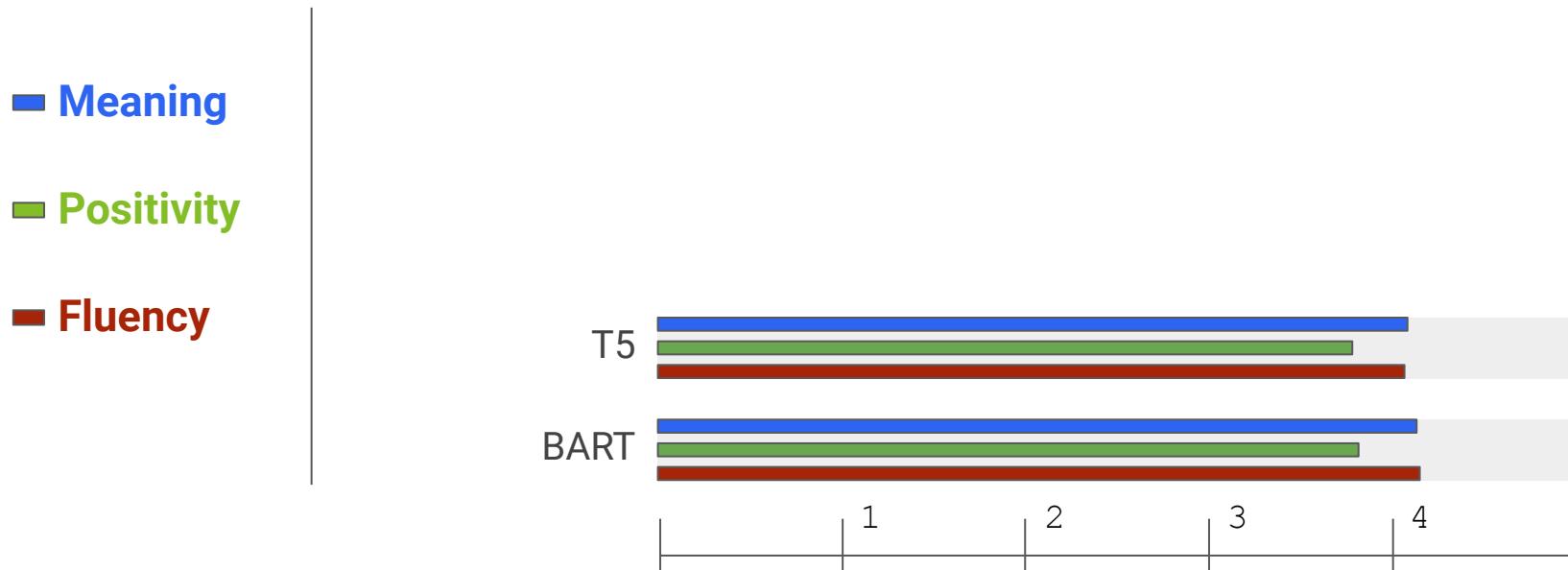
$p(t|s)$ <u>Unconstrained:</u>   Human evaluation

■ **Meaning**

■ **Positivity**

■ **Fluency**

2. Positive Reframing

$p(t|s)$ **Unconstrained:**   Human evaluation

- **Meaning**

- **Positivity**

- **Fluency**

BART

1   2   3   4

2. Positive Reframing

$p(t|s)$ <u>**Unconstrained:**</u>   Human evaluation

- 🟦 **Meaning**

- 🟩 **Positivity**

- 🟥 **Fluency**

2. Positive Reframing

$p(t|s)$ <u>Unconstrained:</u>   Human evaluation

Legend: **Meaning** (blue), **Positivity** (green), **Fluency** (red)

Chart — seq2seq LSTM, T5, BART with x-axis values 1, 2, 3, 4

2. Positive Reframing
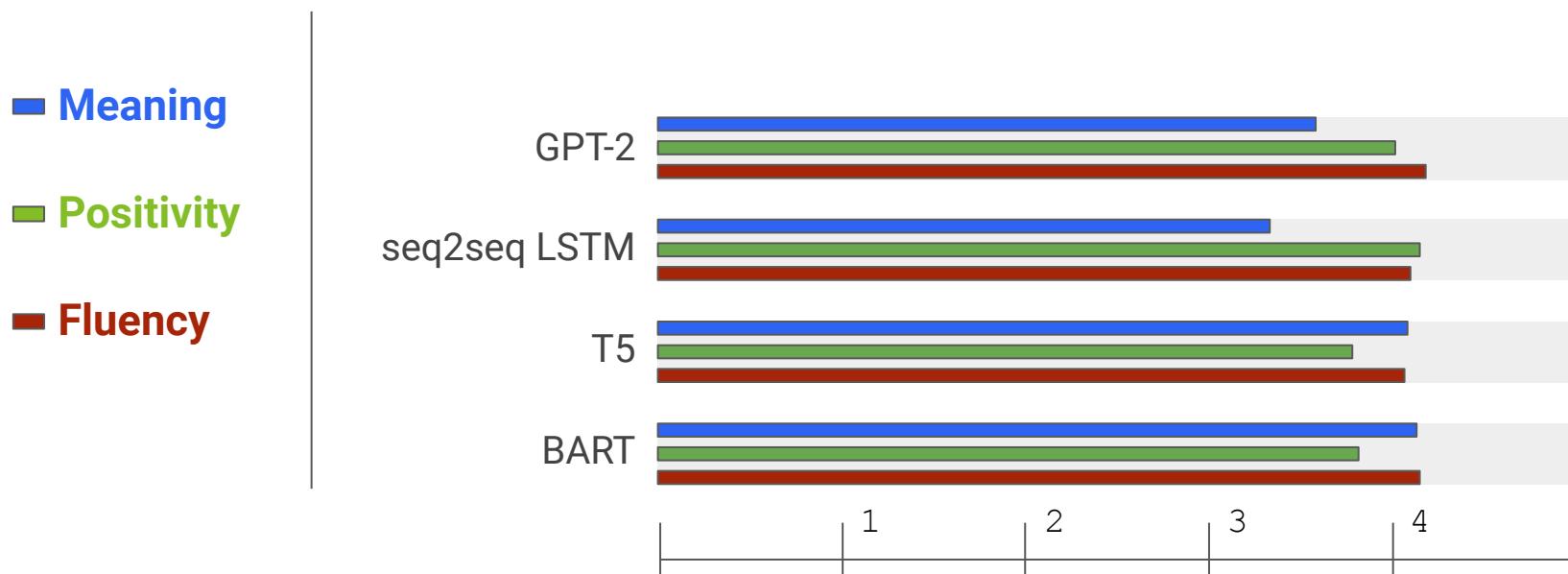
$p(t|s)$ <u>Unconstrained:</u>   Human evaluation

- **Meaning**
- **Positivity**
- **Fluency**
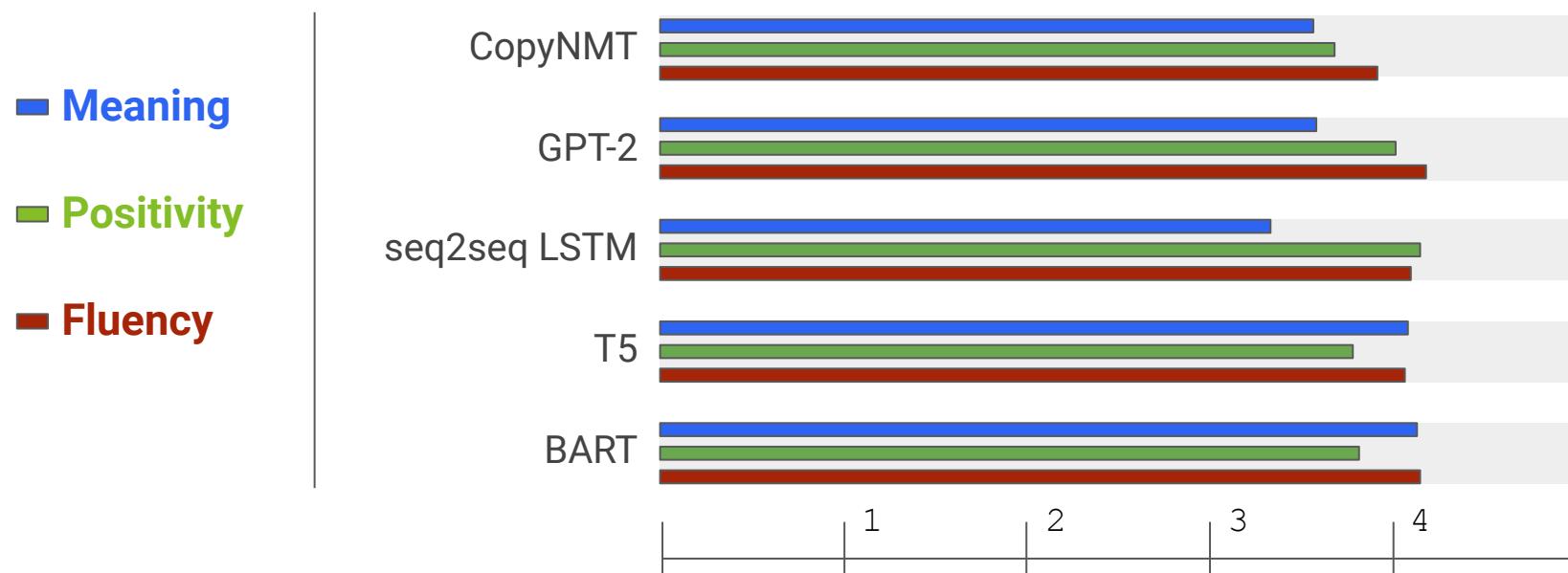
2. Positive Reframing

$p(t|s)$ <u>Unconstrained:</u>   Human evaluation

- 🟦 **Meaning**
- 🟩 **Positivity**
- 🟥 **Fluency**

2. Positive Reframing

$p(t|s)$ **Unconstrained:**   Human evaluation

■ **Meaning**

■ **Positivity**

■ **Fluency**

Model	Meaning	Positivity	Fluency
BART (Unconstrained)	4.13	3.81	4.15

2. Positive Reframing

$p(t|s, \boldsymbol{\psi}_t)$ Controlled:

Performance boost
from targeting gold strategies

🟦 **Meaning**

🟩 **Positivity**

🟥 **Fluency**

Model	**Meaning**	**Positivity**	**Fluency**
BART (Unconstrained)	4.13	3.81	4.15
BART (Controlled)	**4.23**	**4.07**	**4.27**

2. Positive Reframing

Few Shot:

Loss in *meaning* preservation,
despite increase in positivity

- **Meaning**
- **Positivity**
- **Fluency**
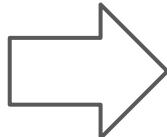
Model	**Meaning**	**Positivity**	**Fluency**
BART (Unconstrained)	4.13	3.81	4.15
BART (Controlled)	**4.23**	**4.07**	**4.27**
GPT-3 (5-shot)	3.73	4.17	4.27

2. Positive Reframing: Example Reframes 😁

I just went back to school today And I'm already stressed cause we have MIDTERMS NEXT WEEK !!! AND THIS WEEKEND -- JAM PACKED :-(

Well, just think by the end of next week we'll be all done with the midterms!
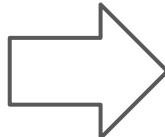
I just went back to school today and I'm already stressed because we have midterms next week and this weekend – JAM PACKED

2. Positive Reframing: Example Reframes 😁

Could someone just give me like $1000? It would change my life, stressing about rent, bills and food money is just the worst.

➡️
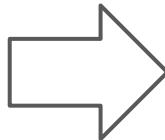
Time to focus on making a budget, so I don't have to stress about rent, bills, and food money.

I need to learn how to manage my money better so that I don't have to stress about rent, bills and food money.

51

2. Positive Reframing: Example Reframes 😄

So glad that tomorrow is Friday. This has seriously been the longest week of my life! tired

➡️
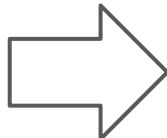
I'm glad the weekend is coming up, so I can rest.

This week has been long, but I'm looking forward to the weekend.

2. Positive Reframing: Example Reframes 😁

Sometimes I get these impulses to just throw a tantrum. Like throw/break things, cry and scream.

→

✅ *It's normal for to feel overwhelmed sometimes but I know I am strong to handle and go through it.*

Sometimes I get these impulses to just throw a tantrum. Like throw/break things, cry and scream. But I'm strong, and I know I can handle it.

Conclusion

1. *Introduced:* <u>New NLG Task</u>

Conclusion

1. *Introduced:* <u>New NLG Task</u>

2. *Built:* PoSITIVE PSYCHOLOGY FRAMES

Conclusion

1. *Introduced:* <u>New NLG Task</u>

2. *Built:* POSITIVE PSYCHOLOGY FRAMES

3. *Tested:* Baseline Style Transfer Models for <u>Automatic Positive Reframing</u>

Conclusion

1. *Introduced:* <u>New NLG Task</u> (Far from Solved!)

2. *Built:* POSITIVE PSYCHOLOGY FRAMES

3. *Tested:* Baseline Style Transfer Models for <u>Automatic Positive Reframing</u>

- *Future Work:* **enforce semantic equivalence** + **allow new perspectives**
  - Semantic Attention-Guided Decoding (Krause et al. 2020)
  - Pragmatic Reconstruction (Nie et al. 2020)
  - Persona Consistency (Kim et al. 2020)
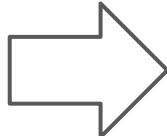
2. Positive Reframing: Example Reframes 😄

talacre beach really need to sort there checking in routeen caravans are never ready 30mins later and still sat in the car waiting ..

Talacre beach's check in process could do with some improvement to reduce the wait time for customers.
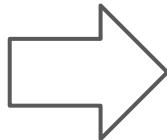
The caravans at Talacre beach need to sort out their check-in process, so the kids don't get stuck in the car.

2. Positive Reframing: Example Reframes 😁

The fact that my mom's been calling me every night to calm me down from school says so much. I've needed it these past few days

→

My mom has been calling me every night to calm me down from school. I've needed it these past few days. I'm thankful for her.

I'm really lucky to have such a caring mum who is willing to call me every night when I'm having a hard time.

2. Automatic Positive Reframing

NEGATIVE: "I am the only person I know who writes a healthy grocery list and plans meals when I am stressed:(CantSleep"

POSITIVE: "I'm so thankful that I am still able to eat healthy even when I'm stressed."

1

NEGATIVE: "I am SO stressed with all my exams and my lit review hanging over my head this week."

POSITIVE: "Only one more week until my exams and lit review are all done!"

2

NEGATIVE: "Ugh my mac is starting to slow up and I need to figure out how to defragment the hard drive..."

POSITIVE: "I need to defragment the hard drive to speed up my mac. Good thing I'm smart, and I know I can do this."

3

NEGATIVE: "This has been like the worst week ever im so done with everything. sick tired"

POSITIVE: "I made it to the end of the most challenging week ever!"

4

NEGATIVE: "I have a huge project due tomorrow morning. But where do I have to be, a stupid basketball game dumb"

POSITIVE: "I should plan ahead next time so that my basketball game does not conflict too closely with my projects."

5

2. Positive Reframing: Error Analysis

1. **insubstantial changes** (26%)

   (especially for *neutralizing* category) ⚖️

2. **contradictions to the premise** (9%)

3. **self-contradictions** (6%)

4. **hallucinations** (2%)

2. Positive Reframing

ROUGE: R-1 R-2 R-L
(meaning)

BERT Score: BScore
(meaning)

Positivity Delta: Δ TB
(sentiment)

Meaning Positivity Fluency
(on 5-point Likert scale)

		Model	Human Evaluation		
			Meaning	Positivity	Fluency
Few-shot		GPT-3			
		GPT-Neo			
Unconstrained	$p(t\|s)$	GPT			
		GPT-2 No-pretrain			
		GPT-2			
		Seq2Seq-LSTM			
		CopyNMT			
		T5			
		BART			
Predict	$p(t, \psi_t\|s)$	T5			
		BART			
Control	$p(t\|s, \psi_t)$	T5			
		BART			
		Human	*3.80*	*3.82*	*4.18*

2. Positive Reframing

Few-Shot:

- *High* Positivity and Fluency

- Less Meaning preservation

		Model	Human Evaluation		
			Meaning	Positivity	Fluency
Few-shot		GPT-3	**3.73**	**4.17**	**4.27**
		GPT-Neo	3.69	4.16	4.21
Unconstrained	$p(t\|s)$	GPT			
		GPT-2 No-pretrain			
		GPT-2			
		Seq2Seq-LSTM			
		CopyNMT			
		T5			
		BART			
Predict	$p(t, \psi_t\|s)$	T5			
		BART			
Control	$p(t\|s, \psi_t)$	T5			
		BART			
		Human	*3.80*	*3.82*	*4.18*

2. Positive Reframing

$p(t|s)$ <u>Unconstrained:</u>

Reasonable Positivity and Fluency while better preserving Meaning

		Model	Human Evaluation		
			Meaning	Positivity	Fluency
Few-shot		GPT-3	**3.73**	**4.17**	**4.27**
		GPT-Neo	3.69	4.16	4.21
Unconstrained	$p(t|s)$	GPT	3.55	3.91	4.08
		GPT-2 No-pretrain	3.11	3.66	3.96
		GPT-2	3.58	4.01	**4.18**
		Seq2Seq-LSTM	3.33	4.15	4.10
		CopyNMT	3.57	3.69	3.91
		T5	4.09	3.79	4.06
		BART	**4.13**	**3.81**	4.15
Predict	$p(t, \psi_t|s)$	T5			
		BART			
Control	$p(t|s, \psi_t)$	T5			
		BART			
		Human	*3.80*	*3.82*	*4.18*

2. Positive Reframing

$p(t, \psi_t|s)$ <u>Prediction:</u>

Performance remains stable

		Model	Human Evaluation		
			Meaning	Positivity	Fluency
Few-shot		GPT-3	**3.73**	**4.17**	**4.27**
		GPT-Neo	3.69	4.16	4.21
Unconstrained	$p(t|s)$	GPT	3.55	3.91	4.08
		GPT-2 No-pretrain	3.11	3.66	3.96
		GPT-2	3.58	4.01	**4.18**
		Seq2Seq-LSTM	3.33	4.15	4.10
		CopyNMT	3.57	3.69	3.91
		T5	4.09	3.79	4.06
		BART	**4.13**	**3.81**	4.15
Predict	$p(t, \psi_t|s)$	T5	**4.10**	3.64	**4.11**
		BART	4.09	**3.95**	**4.11**
Control	$p(t|s, \psi_t)$	T5			
		BART			
		Human	*3.80*	*3.82*	*4.18*

2. Positive Reframing

$p(t|s, \psi_t)$ <u>Controlled:</u>

Performance boost
from targeting gold strategies

		Model	Human Evaluation		
			Meaning	Positivity	Fluency
Few-shot		GPT-3	**3.73**	**4.17**	**4.27**
		GPT-Neo	3.69	4.16	4.21
Unconstrained	$p(t|s)$	GPT	3.55	3.91	4.08
		GPT-2 No-pretrain	3.11	3.66	3.96
		GPT-2	3.58	4.01	**4.18**
		Seq2Seq-LSTM	3.33	4.15	4.10
		CopyNMT	3.57	3.69	3.91
		T5	4.09	3.79	4.06
		BART	**4.13**	**3.81**	4.15
Predict	$p(t, \psi_t|s)$	T5	**4.10**	3.64	**4.11**
		BART	4.09	**3.95**	**4.11**
Control	$p(t|s, \psi_t)$	T5	4.11	3.89	4.07
		BART	**4.23**	**4.07**	**4.27**
		Human	*3.80*	*3.82*	*4.18*

67

2. Positive Reframing

$p(t|s, \psi_t)$ <u>Controlled:</u>

Performance boost
from targeting gold strategies