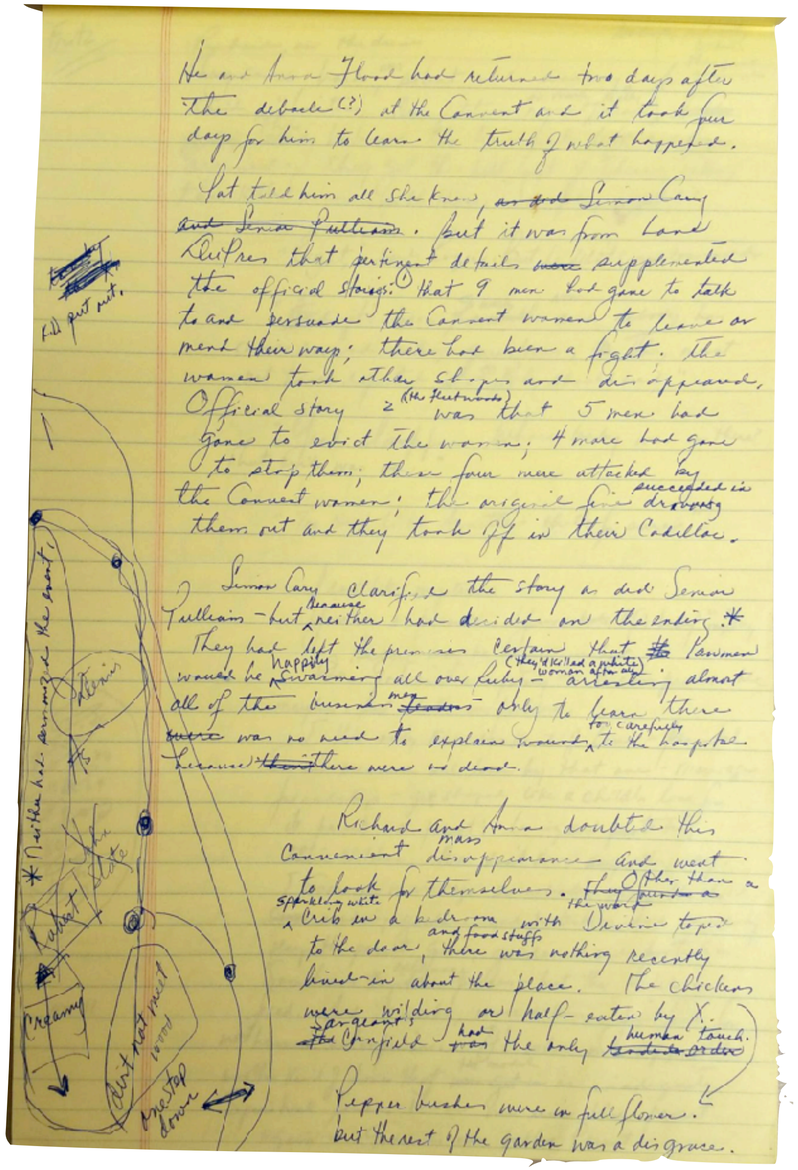
AI and the Writer
How Language Models Support Creative Writers

Thesis Defense

Katy Ilonka Gero

Advisor: Prof. Lydia Chilton
Committee: Kathy McKeown, Brian Smith, Eytan Adar, Kyle Booten
Date: November 11th, 2022


The Omnivore's Dilemma
MICHAEL POLLAN
WORLD CHANGING
USER'S GUIDE FOR THE 21ST CENTURY
EDITED BY ALEX STEFFEN
ABRAMS
SISTER OUTSIDER
Fractals, Chaos, Power Laws
Becoming Nicole
A Year Without a Name
Cyrus Dunham
GÖDEL, ESCHER, BACH:
DOUGLAS R. HOFSTADTER
Eternal Golden Braid
CARSON The SEA Around Us
OXFORD
SONG
CLIMATE LYRICISM
THE NEW JIM CROW
MICHELLE ALEXANDER
Out of Gas
cradle
Oliver Sacks Hallucinations
THE SILENT WOMAN
BEING WRONG
KATHRYN SCHULZ
David Foster Wallace
CONSIDER THE LOBSTER
RELATIVITY
Albert Einstein
ZADIE SMITH
CHANGING MY MIND
The Skeleton Key of Mathematics
THE PRINCE
Self-Reliance and Other Essays
Meander, Spiral, Explode
Jane Alison
REEF
A Collection of Essays
JAMES BALDWIN
THE FIRE NEXT TIME
Difficult Conversations
The FIRST ENGLISH DICTIONARY 1604
EMILY WITT
FUTURE SEX
CATHY O'NEIL
WEAPONS OF MATH DESTRUCTION
THE STRUCTURE OF SCIENTIFIC REVOLUTIONS
MALCOLM X
AS TOLD TO ALEX HALEY
MAYA ANGELOU
Wasting Time on the Internet
Kenneth Goldsmith
Raymond Queneau
Exercises in Style
Around the World
Calarco
A FIELD GUIDE TO GRAD SCHOOL
GREENE
STOP GUESSING
WEDGED
ERIK FOGG & NATHANIEL GREENE
objective becoming
OXFORD
CAUSATION, EXPLANATION,
OXFORD
may you kiss
A Fortune for Your Disaster
HANIF ABDURRAQIB
Shiro Eriksson
NATURE POEM
TOMMY PICO
JUNK
TOMMY PICO
MAGICAL NEGRO
MORGAN PARKER
CASE & MANGUS
21 19
WE BEGIN IN GLADNESS
CRAIG MORGAN TEICHER
Mary Oliver
A Poetry Handbook
LETTERS TO A YOUNG POET
STRUNK AND WHITE
THE ELEMENTS OF STYLE
Sound and Sense
The Wadsworth Anthology of
poetry
A POETS GUIDE TO POETRY
SOUNDS
KANDINSKY
YALE
THE DREAM SONGS
John Berryman
PABLO NERUDA
100 LOVE SONNETS
PETER SÍS
THE CONFERENCE OF THE BIRDS
LAYLI LONG SOLDIER
WHEREAS
LOUISE GLÜCK
THE SEVEN AGES
FAITHFUL AND VIRTUOUS NIGHT
LOUISE GLÜCK
SELECTED POEMS
GWENDOLYN BROOKS
DIỄN CẦM DẦU
CORNELIUS EADY
FRANK BIDART
METAPHYSICAL DOG
Stag's Leap
Sharon Olds
THE GOLD CELL
SHARON OLDS
Odes
Sharon Olds
CAROLYN FORCHÉ
ZENZONTILE
MARCELO HERNANDEZ CASTILLO
SEA CHANGE
JORIE GRAHAM
POEMS
WHAT HAVE LIVING DO
Marie Howe
POST & RAIL
Erica Funkhouser
KAY RYAN
ERRATIC FACTS
THE NIAGARA RIVER
SAY UNCLE
TONIGHT NO POETRY WILL SERVE
ADRIENNE RICH
DIVING INTO THE WRECK
ADRIENNE RICH
THE DREAM OF A COMMON LANGUAGE
ADRIENNE RICH
THE BLACK UNICORN
AUDRE LORDE
LEMONS IN THE CHICKEN WIRE
Jean Valentine
BREAK THE GLASS
ReRiles · Human + A.I. Poetry
PARISH
ARTICULATIONS
COUNTERPATH
Our Sudden Museum
Robert Fanning
JAMES GENDRON
SEXUAL BOAT (SEX BOATS)
OCTOPUS BOOKS
DANCING IN ODESSA
ILYA KAMINSKY
DEAF REPUBLIC
Ilya Kaminsky
ANNE CARSON
AUTOBIOGRAPHY OF RED
CLAY
TO MAKE ROOM FOR THE SEA
the black maria
Kingdom Animalia
Aracelis Girmay
TEETH
Aracelis Girmay
OCULUS
Anna Moschovakis
THEY AND WE WILL GET INTO TROUBLE FOR THIS
BALLOON POP OUTLAW BLACK
PATRICIA LOCKWOOD
MOTHERLAND FATHERLAND SWITZERLAND
CHEN CHEN
SOFT SCIENCE
FRANKY CHOI
EMILY SKAJA
BRUTE
GÓMEZ
FRACTURES
TRACY K. SMITH
WADE IN THE WATER
GRAYWOLF PRESS
SPLIT
CATHY LINH CHE
TERRANCE HAYES
AMERICAN SONNETS FOR MY PAST AND FUTURE ASSASSIN
PRELUDE TO BRUISE
CLAUDIA RANKINE
CITIZEN
MEIA GEDDES
love letters to the world
Katherine Larson
RADIAL SYMMETRY
NIGHT SKY WITH EXIT WOUNDS
OCEAN VUONG
FIELD THEORIES
SAMIYA BASHIR
ROSS GAY
AGAINST WHICH
Rachel McKibbens
blud
KAVEH AKBAR
CALLING A WOLF A WOLF
LIMÓN
THE CARRYING
the wind then turn from it
ADAM SAVAGE
Every Tool
Life Is What
CRASH
THE SECRET TO SUPERHUMAN STRENGTH
Are You My Mother?
Fun Home
ALISON
THE PELICAN SHAKESPEARE
THE FLICK
ANNIE
TOM STOPPARD
ROSENCRANTZ & GUILDENST
Ficciones
Everything That Rises Must Converge
HER BODY AND OTH
N.K. JEMISIN
HOW LONG
BLACK FUTU
TED CHIANG
EXH
YOUR HOUSE WILL PAY
WEIGHT
ANTOINE DE SAINT-EXUPÉRY
HALF OF A YELLOW
HIMAMANDA NGOZ
THE SOLITAIRE MYSTERY
INFINITE JES



Individuality

When writers discussed a support actor, the details of the actor were important. Not all people were the same, and the individual characteristics of a person (or computer program) impacted not only who they turned to for support, but what they did with the support provided.

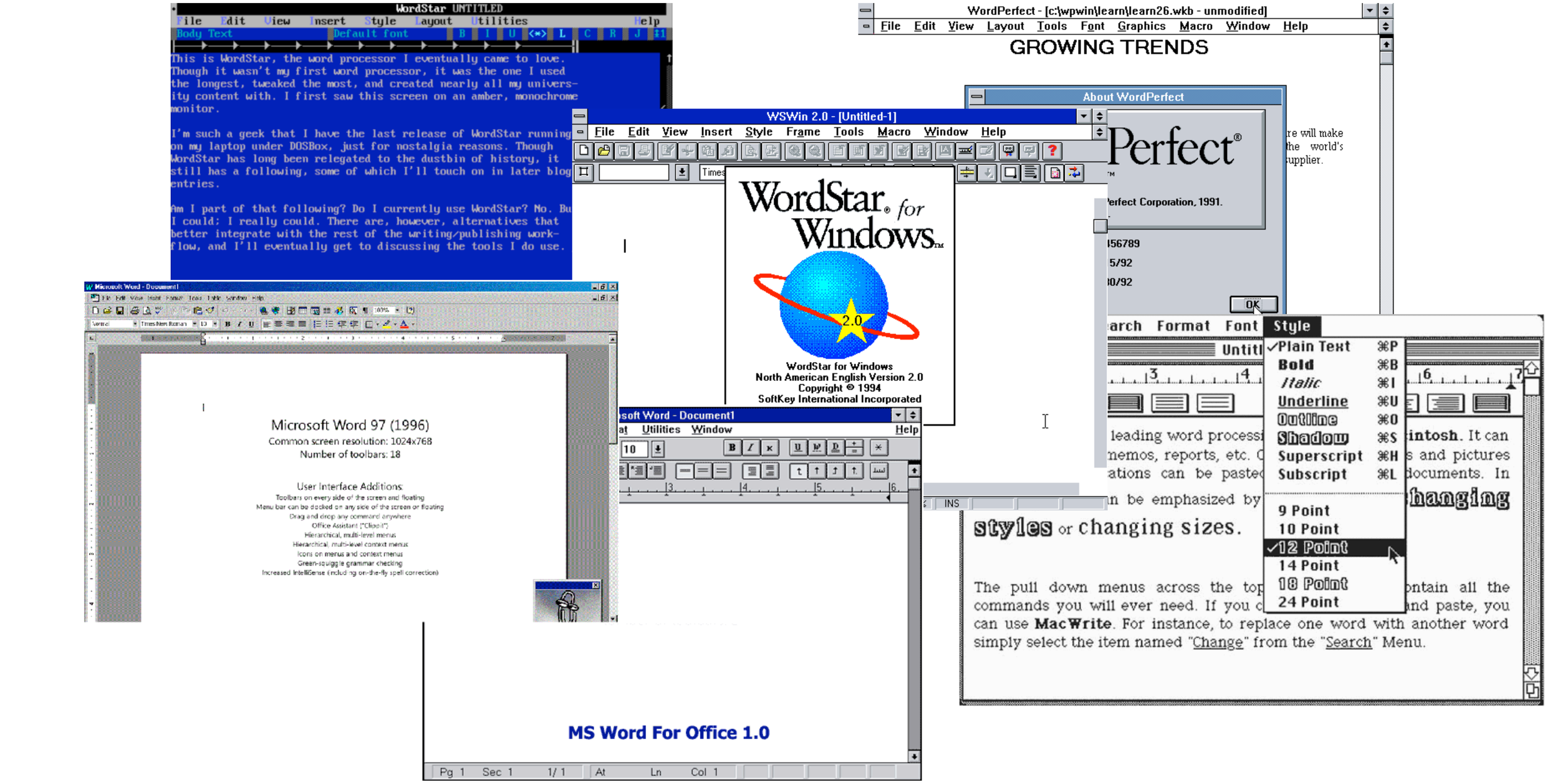
W2 describes how he considers the expertise of the person when considering their feedback. He talked about how a scientist may be relied upon to point out a factual error, but may not be trusted to critique the quality of an opening paragraph. S19 even described situations where negative feedback may indicate he's on the right track, saying "I can kind of place their feedback into preference categories… there's certain aspects where I know if a certain person doesn't like that, then it's exactly what I want to achieve in that part of the story." W9, on imagining a computer reading her work, said, "I would also need to know the reading background. Is this a high school, college, PhD student? What is their level of experience of the topic at hand, so on and so forth? Are they a skeptic or optimist? There's a lot of things to consider."

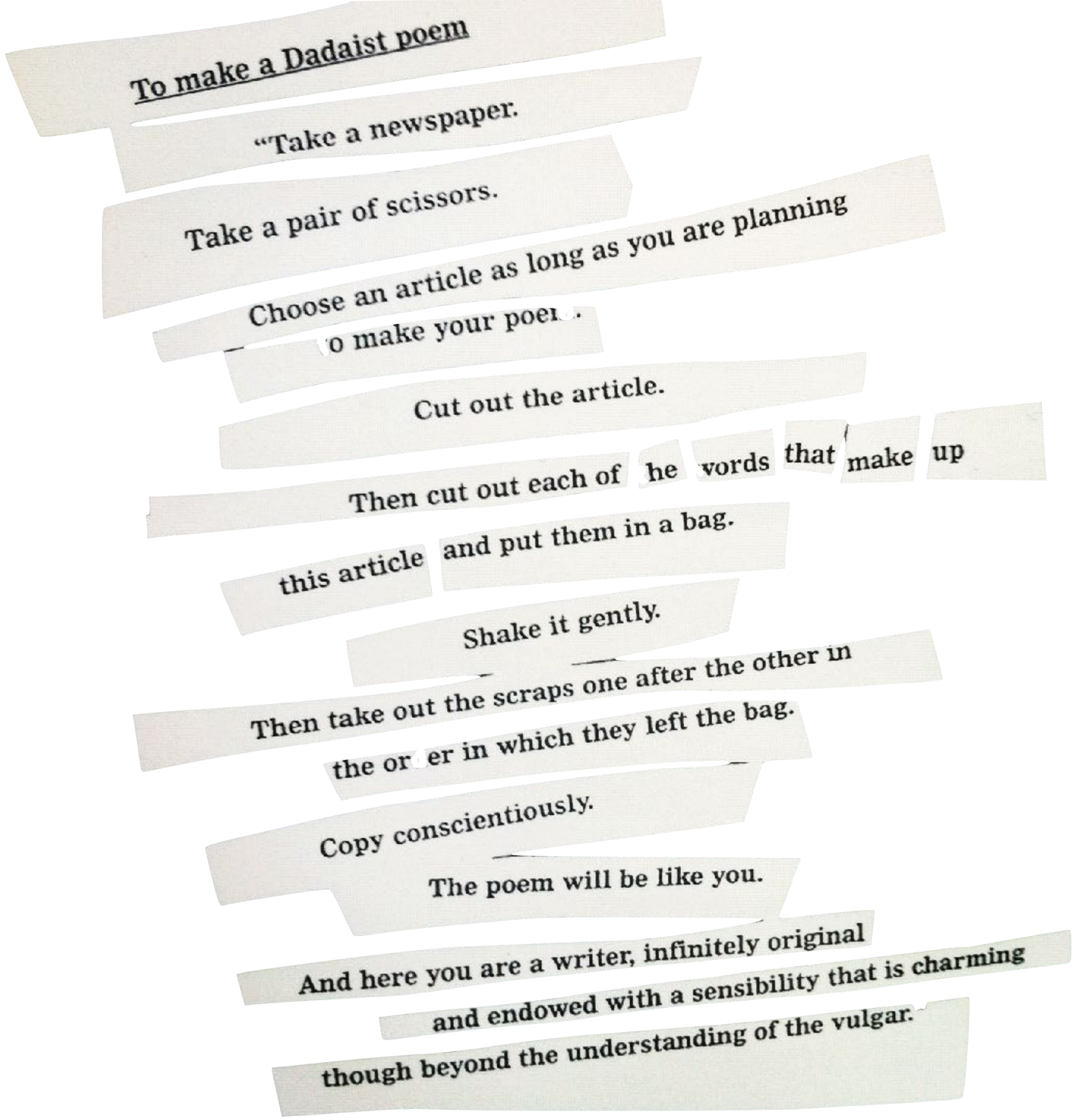
W7 explained that during her MFA program, she came to learn the kinds of feedback different people would give, saying that when "you're offering [your writing] to a specific person, you kind of know the things that they're into, you know that one person is always going to tell you to like make it weirder or that one person is going to tell you to like add a bird." Similarly, W8 discussed how the life experience or writing interests of a peer would dictate who she would send it to, saying "Since my brother is also Indian, if I want to know how something reads to another Indian person, I will show him. But then if I'm writing a story about girlhood, I'll send it to my friend Jen, who also writes about girlhood."

When discussing a computer support actor, several writers talked about the impossibility of a "universal" reader. W10 worried that computers would represent only a dominant perspective, saying, "The 'universal' perspective has been the perspective of cis straight white men and any other perspective is just not considered universal." Others noted that, based on their understanding of how such a computer program might work, it would reflect generalizations of its training data, and lose the individuality that people provide. W6 described the uniqueness of humans in this way: "Let's just say there's a 1%, that is unpredictable, a response they'll have that does not fit the pattern … I'm interested in that 1%, too. I like the inherent unpredictability of a person."

SudoWrite users were able to articulate the unique characteristics of SudoWrite. S20 describes their sense of SudoWrite:

> A peer is someone who is grounded in a very specific point of view, and culture and identity and preference, you know, their own reading habits and a peer can be a very valuable partner … when I turn to SudoWrite, I know that I'm getting feedback and interactions with my work that is not personal at all, but is very targeted in a date in the, in the sense of like data targeting. … The amount of information on hand that SudoWrite is pulling from is this vast trove. And that's something that a human could never, even if they're well read, could really never achieve.


WordStar UNTITLED
File Edit View Insert Style Layout Utilities Help
This is WordStar, the word processor I eventually came to love. Though it wasn't my first word processor, it was the one I used the longest, tweaked the most, and created nearly all my university content with. I first saw this screen on an amber, monochrome monitor.
I'm such a geek that I have the last release of WordStar running on my laptop under DOSBox, just for nostalgia reasons. Though WordStar has long been relegated to the dustbin of history, it still has a following, some of which I'll touch on in later blog entries.
Am I part of that following? Do I currently use WordStar? No. But I could; I really could. There are, however, alternatives that better integrate with the rest of the writing/publishing workflow, and I'll eventually get to discussing the tools I do use.
WordPerfect - [c:\wpwin\learn\learn26.wkb - unmodified]
File Edit View Layout Tools Font Graphics Macro Window Help
GROWING TRENDS
About WordPerfect
Perfect®
erfect Corporation, 1991.
OK
re will make the world's supplier.
WSWin 2.0 - [Untitled-1]
File Edit View Insert Style Frame Tools Macro Window Help
WordStar® for Windows™
2.0
WordStar for Windows
North American English Version 2.0
Copyright © 1994
SoftKey International Incorporated
Microsoft Word - Document1
Microsoft Word 97 (1996)
Common screen resolution: 1024x768
Number of toolbars: 18
User Interface Additions:
Toolbars on every side of the screen and floating
Menu bar can be docked on any side of the screen or floating
Drag and drop any command anywhere
Office Assistant ("Clippit")
Hierarchical, multi-level menus
Hierarchical, multi-level context menus
Icons on menus and context menus
Green-squiggle grammar checking
Increased IntelliSense (including on-the-fly spell correction)
soft Word - Document1
at Utilities Window Help
MS Word For Office 1.0
Pg 1 Sec 1 1/1 At Ln Col 1
arch Format Font
Untitl
Style
✓Plain Text ⌘P
Bold ⌘B
Italic ⌘I
Underline ⌘U
Outline ⌘O
Shadow ⌘S
Superscript ⌘H
Subscript ⌘L
9 Point
10 Point
✓12 Point
14 Point
18 Point
24 Point
leading word processi
nemos, reports, etc.
ations can be paste
n be emphasized by
styles or changing sizes.
The pull down menus across the top
commands you will ever need. If you c
can use MacWrite. For instance, to replace one word with another word
simply select the item named "Change" from the "Search" Menu.
intosh. It can
s and pictures
documents. In
hanging
ontain all the
nd paste, you


To make a Dadaist poem

"Take a newspaper.

Take a pair of scissors.

Choose an article as long as you are planning
o make your poe

Cut out the article.

Then cut out each of he vords that make up
this article and put them in a bag.

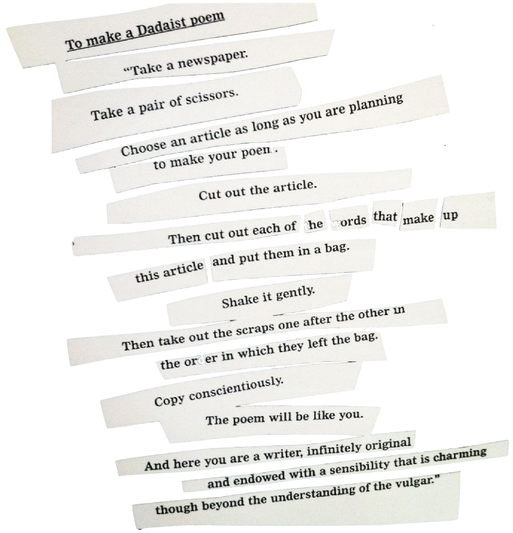
Shake it gently.

Then take out the scraps one after the other in
the or er in which they left the bag.

Copy conscientiously.

The poem will be like you.

And here you are a writer, infinitely original
and endowed with a sensibility that is charming
though beyond the understanding of the vulgar.



To make a Dadaist poem

"Take a newspaper.

Take a pair of scissors.

Choose an article as long as you are planning

to make your poem.

Cut out the article.

Then cut out each of the words that make up

this article and put them in a bag.

Shake it gently.

Then take out the scraps one after the other in

the order in which they left the bag.

Copy conscientiously.

creative & constrained

novel, surprising, engaging

coherent, sensible, within genre bounds

generative

programs that can generate text

Research Question:

How can **generative** systems support writers in **constrained**, **creative** tasks?

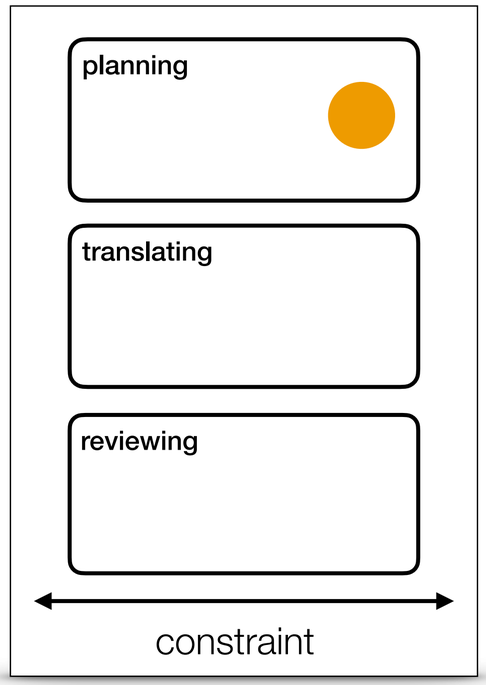
This thesis demonstrates that
generative writing systems can support writers in constrained, creative tasks
by providing **inspiration**, **translation**, and **perspective**;

furthermore, this thesis finds that
social dynamics modulate writers' response to such systems
across writer desires, perception of support, and values.

Contribution 1

Design Space

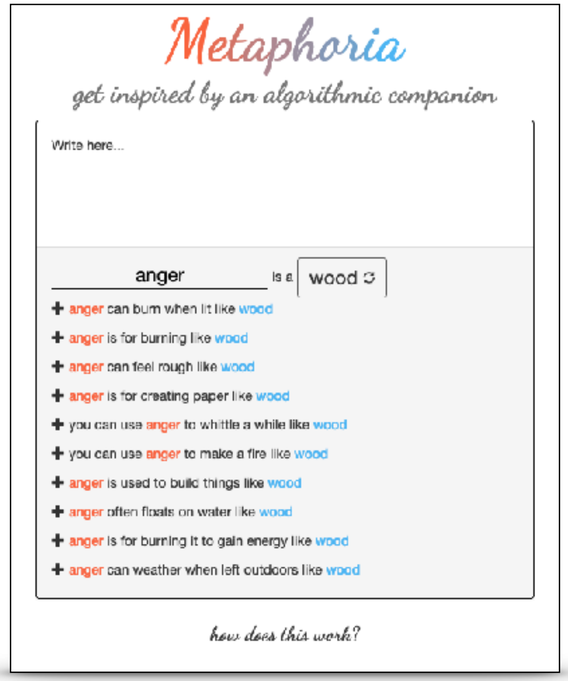
Defining the landscape of writing support tools.



Contribution 2

Metaphoria

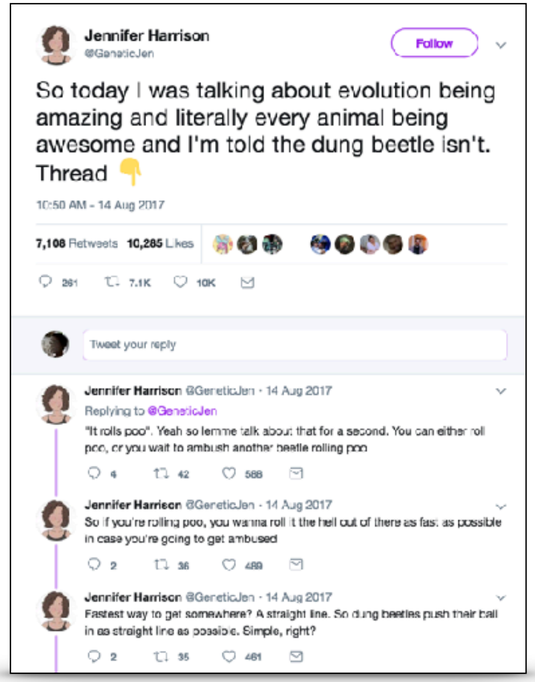
Supporting writing extended metaphors.



Contribution 3

Sparks

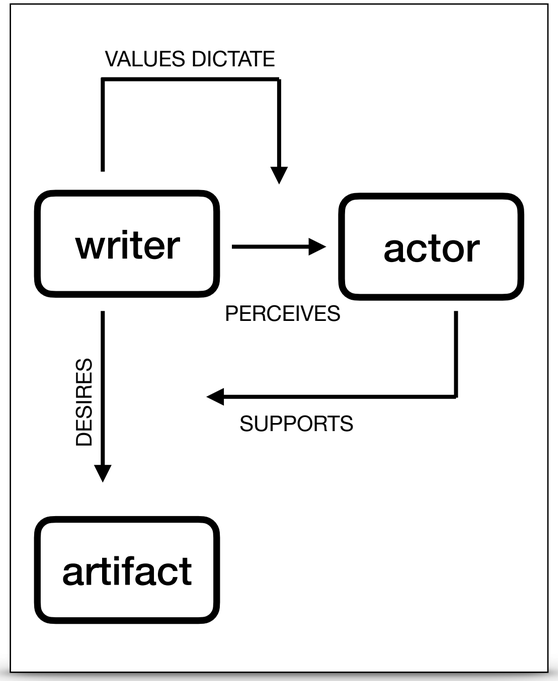
Supporting writing scientific explanations.



Contribution 4

Social Dynamics

When and why writers turn to computers.



Contribution 1

Design Space

Defining the landscape
of writing support tools.

Contribution 2

Metaphoria

Supporting writing
extended metaphors.

Contribution 3

Sparks

Supporting writing
scientific explanations.

Contribution 4

Social Dynamics

When and why writers
turn to computers.

Background

Psychology,
NLP, and HCI.

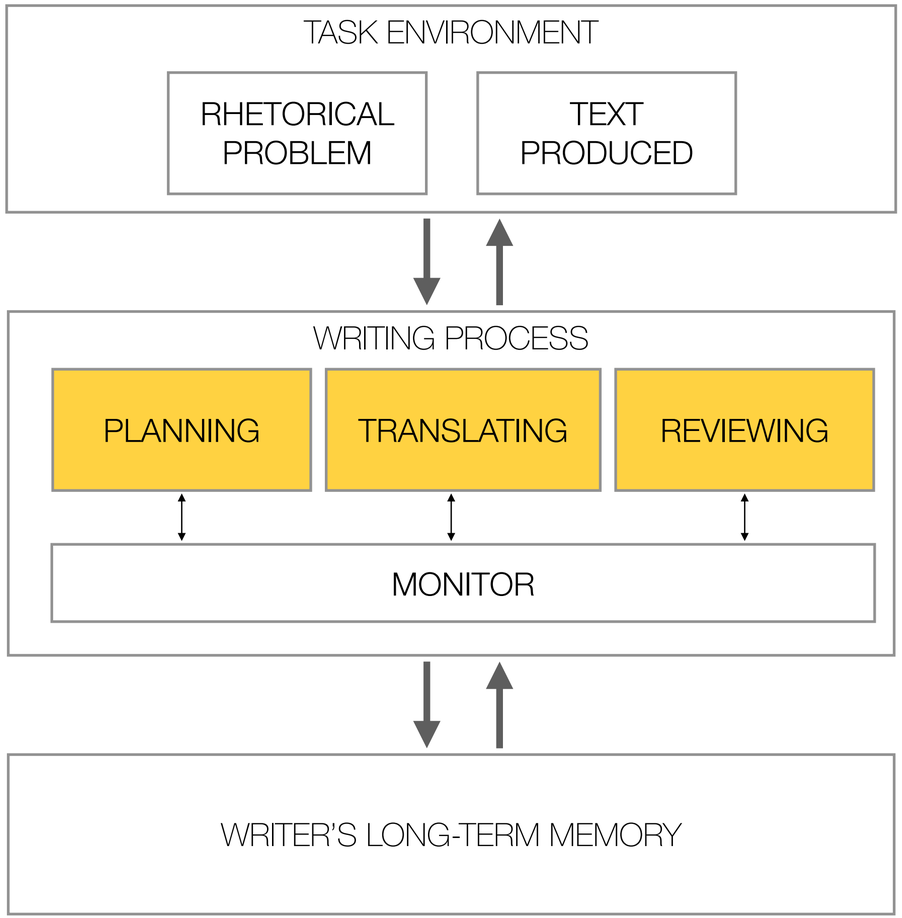
Introduction

Leveraging technology
for new ways to write.

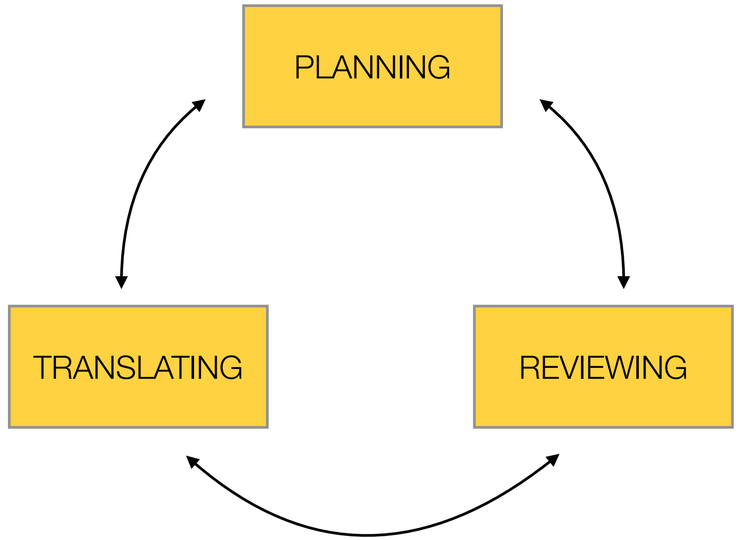
Conclusion

Future work and
acknowledgements.

Cognitive Process Model of Writing



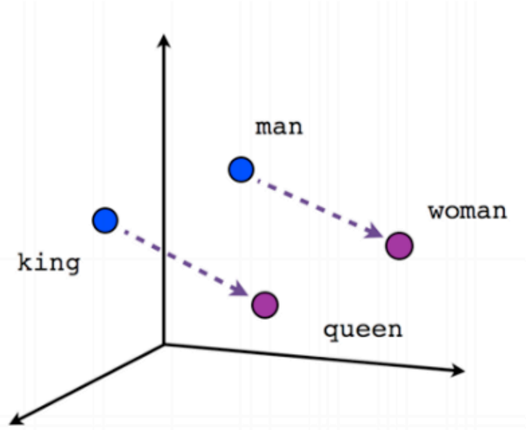
Flower & Hayes, 1981

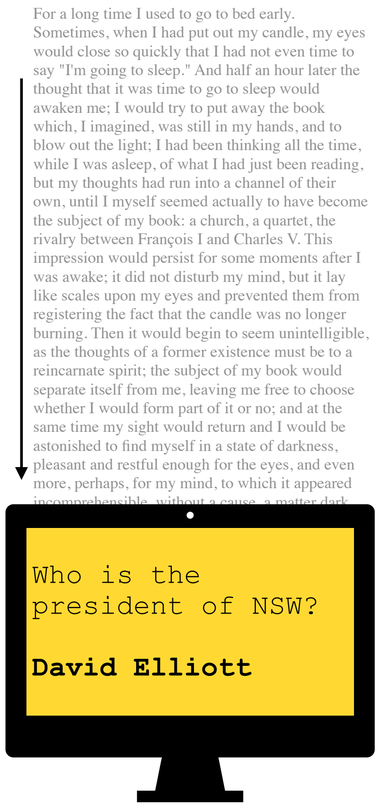


Key takeaways:
This model move beyond thinking of writing as a monolith.
I'm studying planning (idea generation, goal setting).

Natural Language Generation

This impression would persist for some moments after I was awake; it did not disturb my mind, but it lay like scales upon my eyes and prevented them from registering the fact that the candle was no longer _____





Next word prediction
for language modeling

Word embeddings
for nuanced word relations

Large language models
for improved coherence at scale

Key takeaway:
Large language models have potential, but aren't a panacea.

Prior Work on Writing Support Tools

SPELL AND GRAMMAR CHECKING

For a long time I use to go to bed earley.

Constrained, but not creative, support

[Damerau, 1964], [Peterson, 1980], [Leacock et al, 2010], [Ge et al, 2018]

EXAMPLES & CROWDSOURCING

Hello Dr. [name],

I'm [name] with [Entrepreneurship Organization], a [University] organization where students use design to create local and social impact. My coach, [name], has put my team in contact with you.

Non-generative constrained, creative support

[Hui et al, 2018], [Maiden et al, 2018], [Bernstein et al, 2010], [Huang et al, 2020]

STORY CONTINUATION TASK

Once there was an adorable black kitty named Opal . She was very fluffy and soft, and everybody loved her. Unfortunately one day while she was coming home from her grandmother's house, she got lost in a dark forest. And she was trying to make her way through the trees.

Generative constrained, creative support

[Roemmele, 2018], [Clark et al, 2018], [Calderwood et al, 2018]

Key takeaway:
This thesis focused on an unsolved problem in writing support.

Introduction
Leveraging technology for new ways to write.

Background
Psychology, NLP, and HCI.

Contribution 1
Design Space
Defining the landscape of writing support tools.

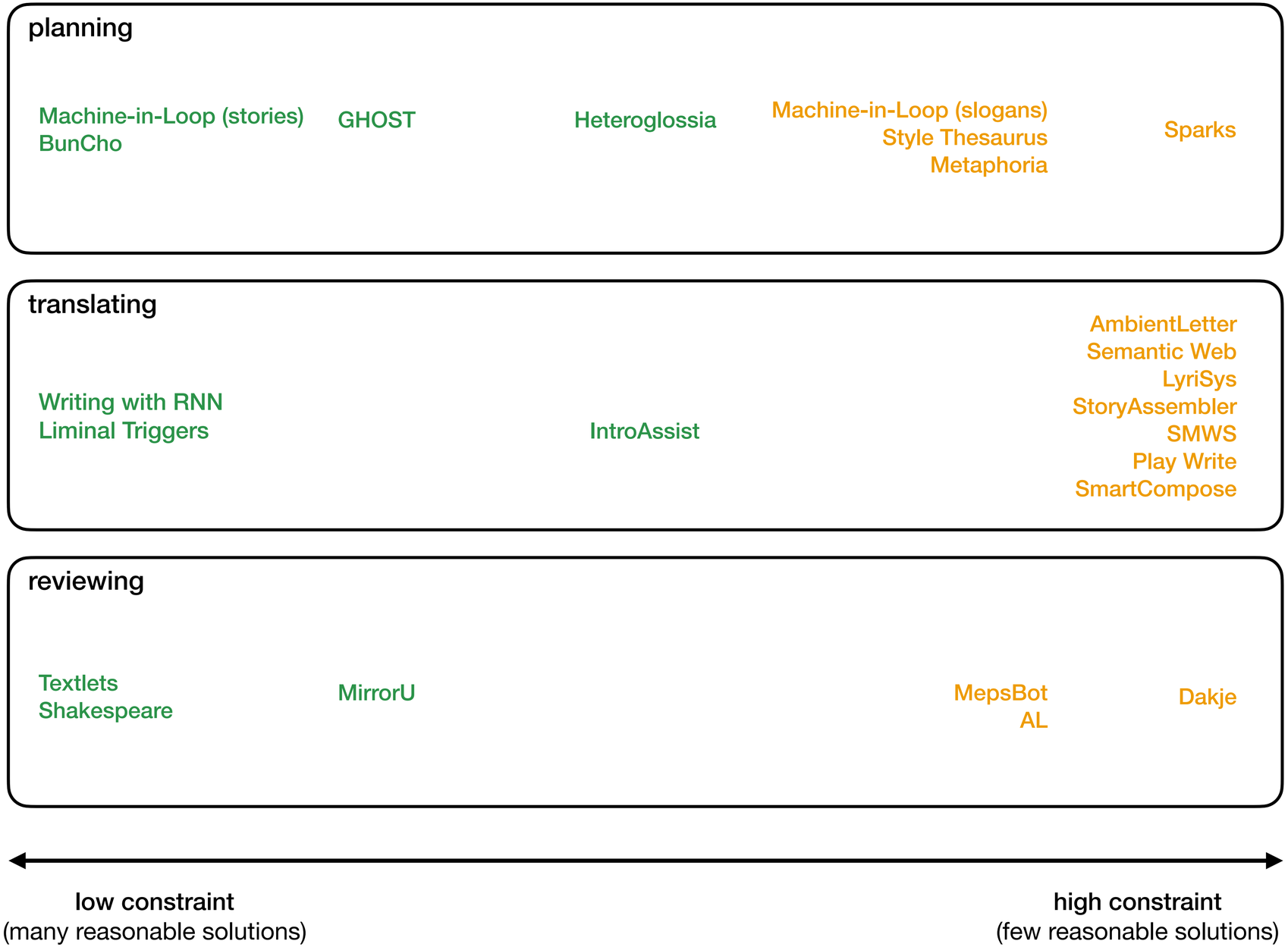
Contribution 2
Metaphoria
Supporting writing extended metaphors.

Contribution 3
Sparks
Supporting writing scientific explanations.

Contribution 4
Social Dynamics
When and why writers turn to computers.

Conclusion
Future work and acknowledgements.


planning
fantasy
plot ideation
memoir
plot ideation
translating
describe
new character
describe
technical topic
reviewing
feedback on
story opening
feedback on
plot ending
low constraint
(many reasonable solutions)
high constraint
(few reasonable solutions)


planning
Machine-in-Loop (stories)
BunCho
GHOST
Heteroglossia
Machine-in-Loop (slogans)
Style Thesaurus
Metaphoria
Sparks
translating
Writing with RNN
Liminal Triggers
IntroAssist
AmbientLetter
Semantic Web
LyriSys
StoryAssembler
SMWS
Play Write
SmartCompose
reviewing
Textlets
Shakespeare
MirrorU
MepsBot
AL
Dakje
low constraint
(many reasonable solutions)
high constraint
(few reasonable solutions)

Introduction
Leveraging technology for new ways to write.

Background
Psychology, NLP, and HCI.

Contribution 1
Design Space
Defining the landscape of writing support tools.

Contribution 2
Metaphoria
Supporting writing extended metaphors.

Contribution 3
Sparks
Supporting writing scientific explanations.

Contribution 4
Social Dynamics
When and why writers turn to computers.

Conclusion
Future work and acknowledgements.

Writing Metaphors is Constrained & Creative

We formulate metaphor creation as the following problem:

What are the metaphorical connections between two nouns?

How is **anger** like wood? → Burns when lit.

How is **peace** like a window? → Lets in the sunshine.

How is **gratitude** like a stream? → Flows over you.

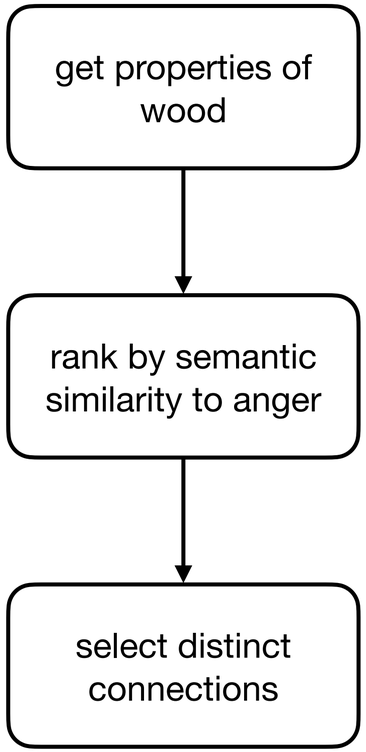
Writing Metaphors is Constrained & Creative

Based on a literature review, our design goals are:

- generate suggestions that are **coherent to context**
- generate suggestions that result in **divergent outcomes**

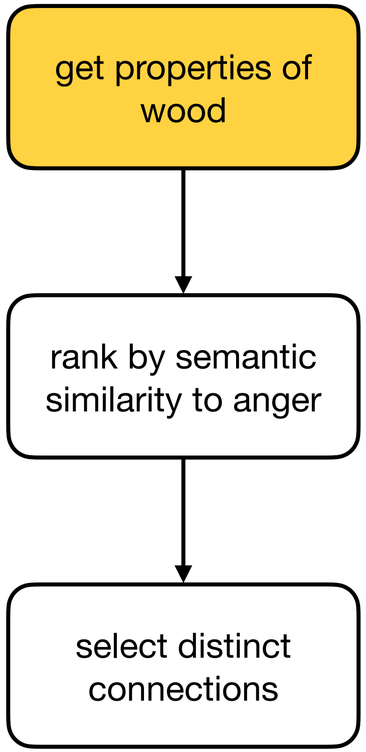
Algorithm for Metaphor Creation

Example: How is **anger** like wood?



Algorithm for Metaphor Creation

Example: How is **anger** like wood?

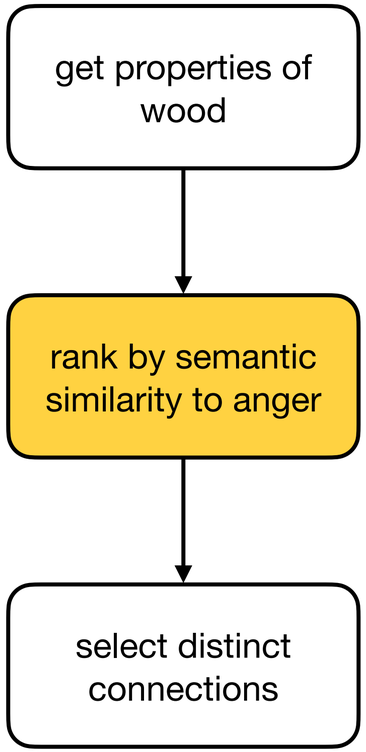


Properties of wood from ConceptNet, querying *HasA*, *UsedFor*, & *CapableOf* relations.

- fencing in a yard
- building a boat
- burning when lit
- burn in a fireplace
- being composted
- feeling rough
- making a fire
- floats on water
- …

Algorithm for Metaphor Creation

Example: How is **anger** like wood?



Rank properties of wood by semantic similarity to anger using word embedding distance (Word Mover's Distance).

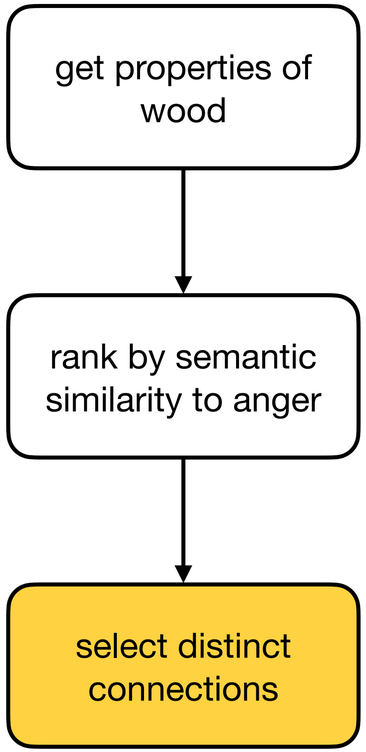
1. burning when lit
2. making a fire
3. feeling rough
4. burn in a fireplace
5. build things

   …

29. being composted
30. fencing in a yard
31. building a boat

Algorithm for Metaphor Creation

Example: How is **anger** like wood?

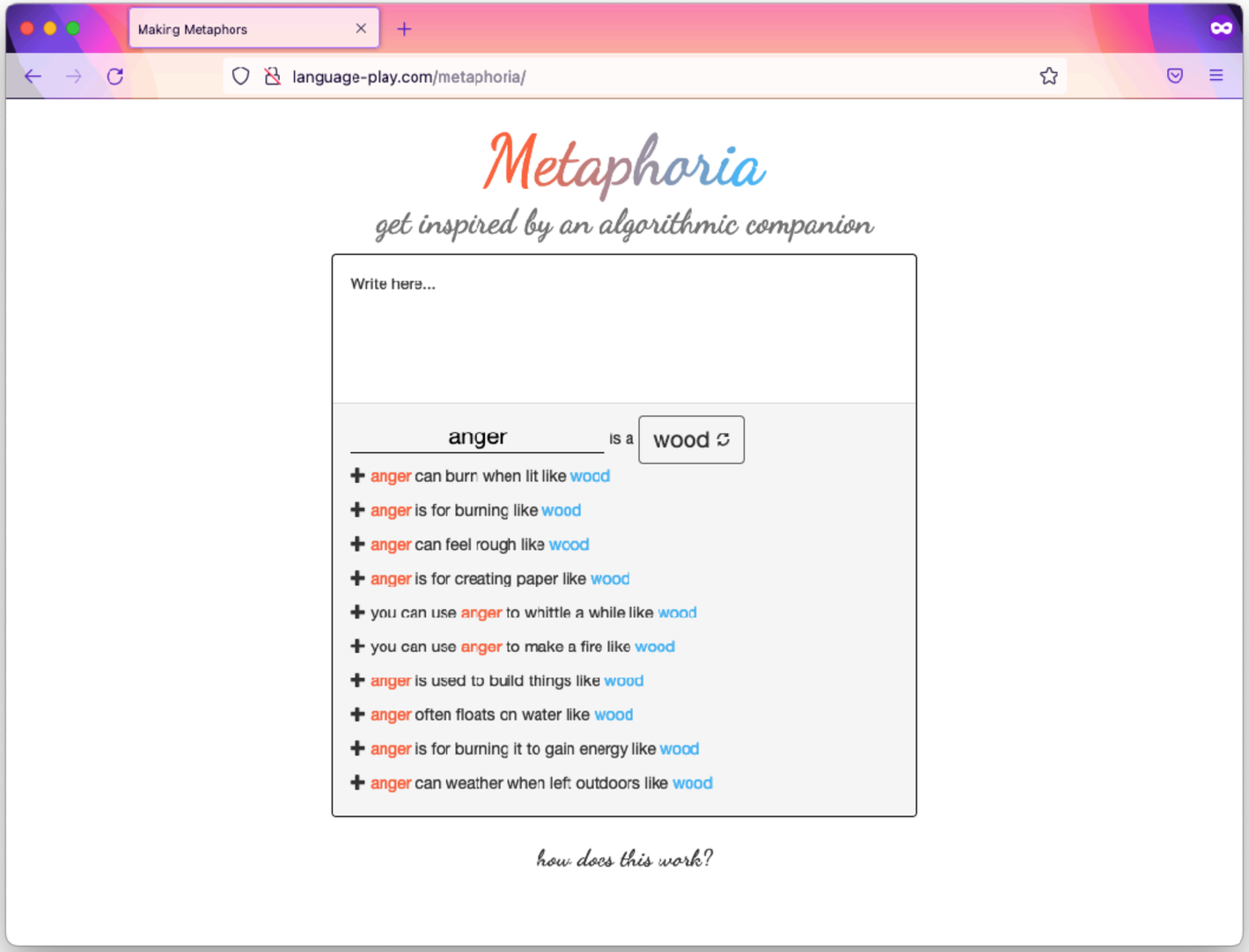


Select distinct, highly ranked properties using semantic similarity threshold between all properties.

1. burning when lit
2. ~~making a fire~~
3. ~~burn in a fireplace~~
4. build things
5. feeling rough

   …

29. ~~being composted~~
30. ~~fencing in a yard~~
31. ~~building a boat~~


Making Metaphors
language-play.com/metaphoria/
Metaphoria
get inspired by an algorithmic companion
Write here...
anger
is a
wood
anger can burn when lit like wood
anger is for burning like wood
anger can feel rough like wood
anger is for creating paper like wood
you can use anger to whittle a while like wood
you can use anger to make a fire like wood
anger is used to build things like wood
anger often floats on water like wood
anger is for burning it to gain energy like wood
anger can weather when left outdoors like wood
how does this work?

Evaluation

Study 1: Measure the quality of the generated metaphors

Study 2: Controlled experiment on use of generated metaphors

Study 3: Case study with professional writers

Study 1: Are the suggestions high quality?

We had expert writers annotate 144 metaphorical connections across our own algorithm and two competing algorithms.

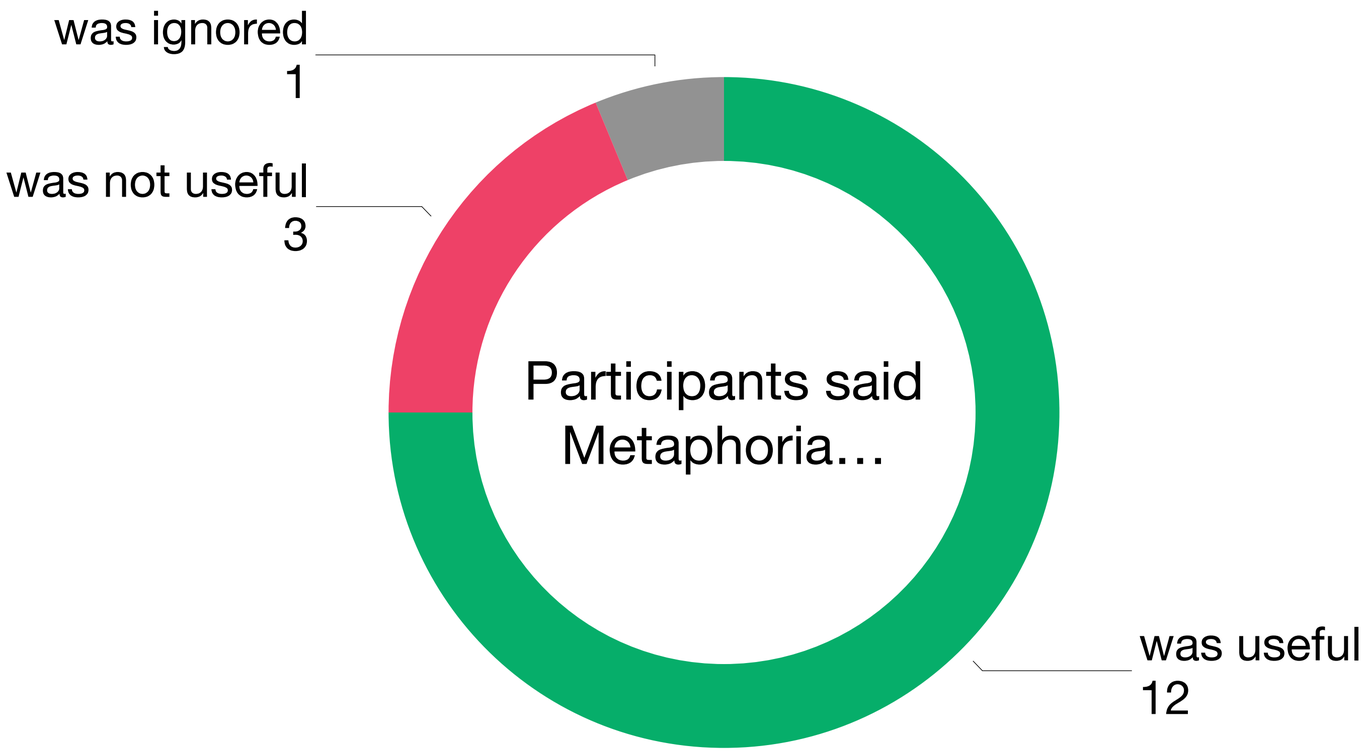
Algorithm	**Apt**	**Specific**	**Imageable**
Metaphoria	97%	**82%**	**100%**
Thesaurus Rex	**100%**	47%	**100%**
Intersecting Vectors	49%	43%	53%

Veale & Hao 2007 *Comprehending and generating apt metaphors: a web-driven, case-based approach to figurative language*.

Gagliano et al. 2016 *Intersecting Word Vectors to Take Figurative Language to New Heights*.

Study 2: Is Metaphoria coherent?

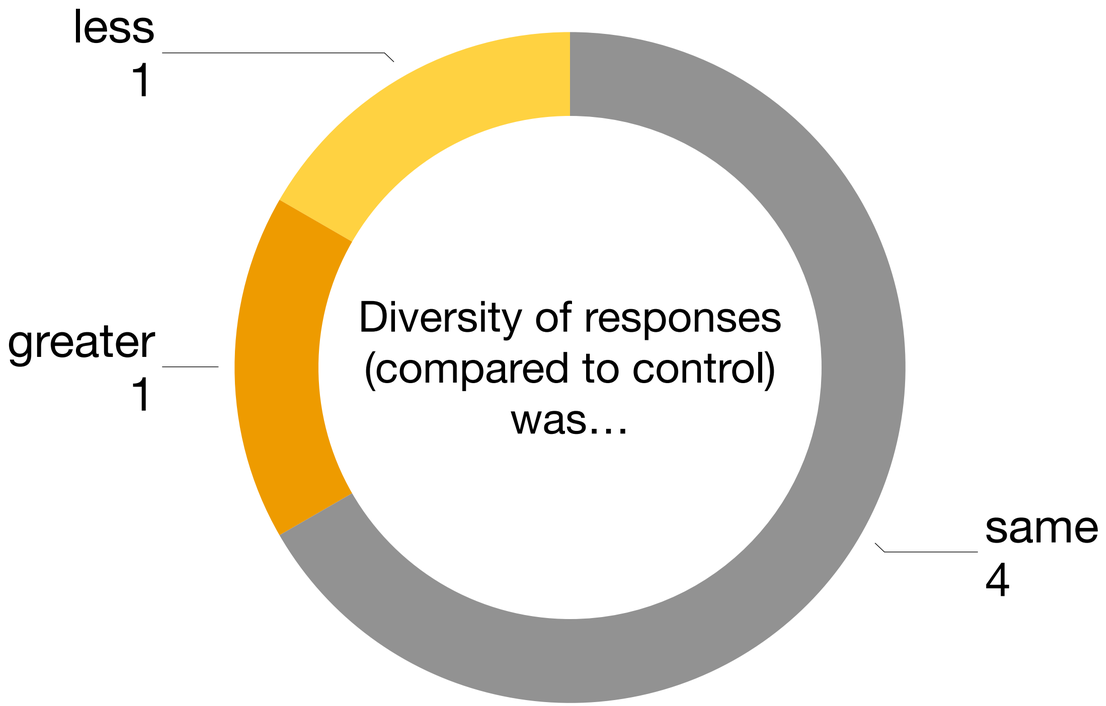
We have 16 undergraduates each write 3 metaphors with Metaphoria and 3 without.



16 participants

Study 2: Does Metaphoria preserve diversity?

We measures the diversity of responses with Metaphoria and without.



6 prompts

Study 3: How do poets use Metaphoria?

Translation	Planning	Translation & Planning
PO1's response	PO2's response	PO3's response
My island fills glasses like wine, i'ts vines wrap around my new mouth like grapes. This new America is used to building things, anew, strange comfort like the rest of an air-bed at dusk. How new is new?	Garden Work with my mother, her tulips flaming blue and yellow, laboring to bloom beneath her palms, the soft lawn grating against early spring. We are wasting time, lingering under the porch light before dark, flirting with enemy weeds before my father returns home, drunk and swaying like a storm. She is used for currency and jewelry and lighting the pathway. She is for making flowers rise up to collide with her hands.	Metaphor for restoring quiet Use a gun to paint a room Addiction can clog a sink drain like hair History can win a war The garden of wasted time Fear to extinguish a fire like sand ice is for finding the source of light swimming is like snow. it is for children You can use caution to build fear in a movie You can use witchcraft to listen to music like an ear Corruption can outrun you like a horse

Table 4.8: Part of responses from three professional poets working with Metaphoria. Words highlighted in pink were input into Metaphoria by the poets, while words and phrases highlighted in green were suggestions that poets used.

Introduction
Leveraging technology for new ways to write.

Background
Psychology, NLP, and HCI.

Contribution 1
Design Space
Defining the landscape of writing support tools.

Contribution 2
Metaphoria
Supporting writing extended metaphors.

Contribution 3
Sparks
Supporting writing scientific explanations.

Contribution 4
Social Dynamics
When and why writers turn to computers.

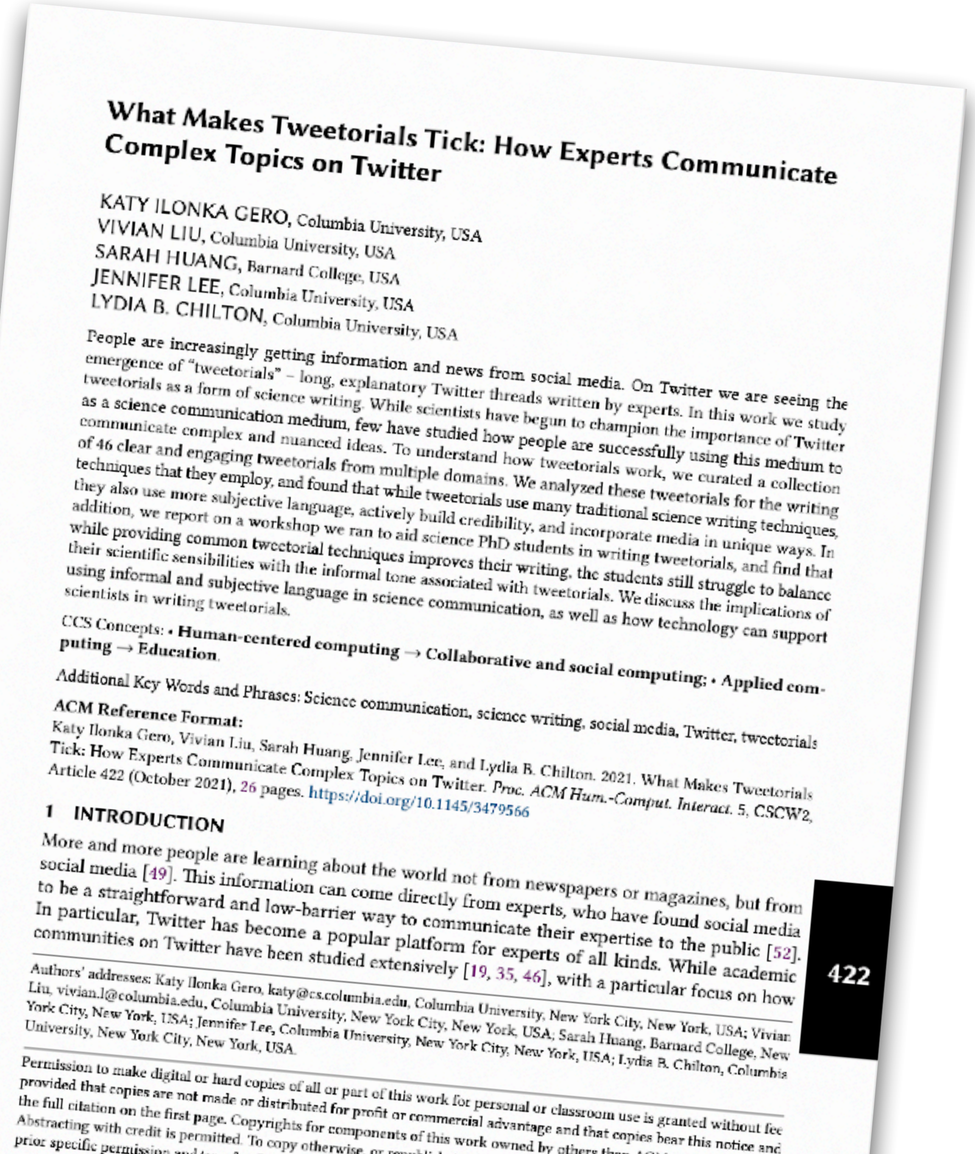
Conclusion
Future work and acknowledgements.

Science Writing is Constrained & Creative

The Hook
Short and sweet, the first tweet "hooks" the reader with a personal story and intriguing question.

Mechanism Narrative
This tweetorial starts with a mechanistic narrative, where the *dung beetle* is the main character.

Discovery Narrative
Then the reader follows a scientist on their journey of discovery…



What Makes Tweetorials Tick: How Experts Communicate Complex Topics on Twitter

KATY ILONKA GERO, Columbia University, USA
VIVIAN LIU, Columbia University, USA
SARAH HUANG, Barnard College, USA
JENNIFER LEE, Columbia University, USA
LYDIA B. CHILTON, Columbia University, USA

People are increasingly getting information and news from social media. On Twitter we are seeing the emergence of "tweetorials" – long, explanatory Twitter threads written by experts. In this work we study tweetorials as a form of science writing. While scientists have begun to champion the importance of Twitter as a science communication medium, few have studied how people are successfully using this medium to communicate complex and nuanced ideas. To understand how tweetorials work, we curated a collection of 46 clear and engaging tweetorials from multiple domains. We analyzed these tweetorials for the writing techniques that they employ, and found that while tweetorials use many traditional science writing techniques, they also use more subjective language, actively build credibility, and incorporate media in unique ways. In addition, we report on a workshop we ran to aid science PhD students in writing tweetorials, and find that while providing common tweetorial techniques improves their writing, the students still struggle to balance their scientific sensibilities with the informal tone associated with tweetorials. We discuss the implications of using informal and subjective language in science communication, as well as how technology can support scientists in writing tweetorials.

CCS Concepts: • **Human-centered computing** → **Collaborative and social computing**; • **Applied computing** → **Education**.

Additional Key Words and Phrases: Science communication, science writing, social media, Twitter, tweetorials

ACM Reference Format:
Katy Ilonka Gero, Vivian Liu, Sarah Huang, Jennifer Lee, and Lydia B. Chilton. 2021. What Makes Tweetorials Tick: How Experts Communicate Complex Topics on Twitter. *Proc. ACM Hum.-Comput. Interact.* 5, CSCW2, Article 422 (October 2021), 26 pages. https://doi.org/10.1145/3479566

1 INTRODUCTION

More and more people are learning about the world not from newspapers or magazines, but from social media [49]. This information can come directly from experts, who have found social media to be a straightforward and low-barrier way to communicate their expertise to the public [52]. In particular, Twitter has become a popular platform for experts of all kinds. While academic communities on Twitter have been studied extensively [19, 35, 46], with a particular focus on how

Authors' addresses: Katy Ilonka Gero, katy@cs.columbia.edu, Columbia University, New York City, New York, USA; Vivian Liu, vivian.l@columbia.edu, Columbia University, New York City, New York, USA; Sarah Huang, Barnard College, New York City, New York, USA; Jennifer Lee, Columbia University, New York City, New York, USA; Lydia B. Chilton, Columbia University, New York City, New York, USA.

Science Writing is Constrained & Creative

We formulate science writing support as a sentence continuation problem. For example:

Pseudo-random number generators ***are used by****…*

One application *of glacial retreat research* ***in the real world is****…*

Science Writing is Constrained & Creative

Similar to Metaphoria, our design goals are:

- generate sentences that are **coherent to context**
- generate sentences that are **diverse**

Algorithm for Sentence Completion

using GPT-2 as the underlying language model

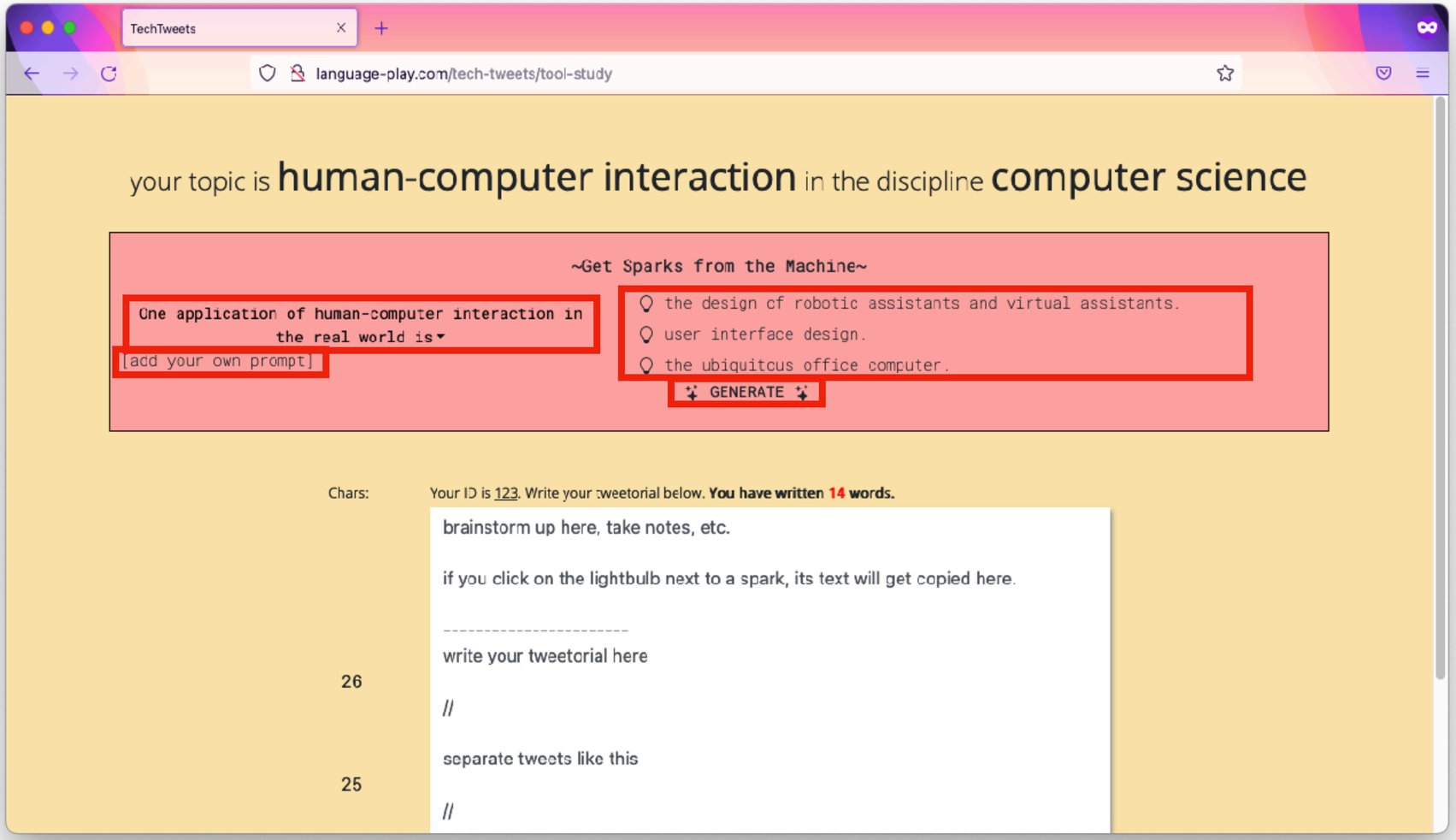
Baseline generation is too vague and repetitive. But sampling & high temperature won't work.

1. Make more specific words more likely
   modify the probability distribution with the normalized inverse word frequency

2. Increase diversity
   force first token of each new generation to be unique

3. Preserve accuracy with modified beam search
   search only from top 50 tokens

System Design for Sparks



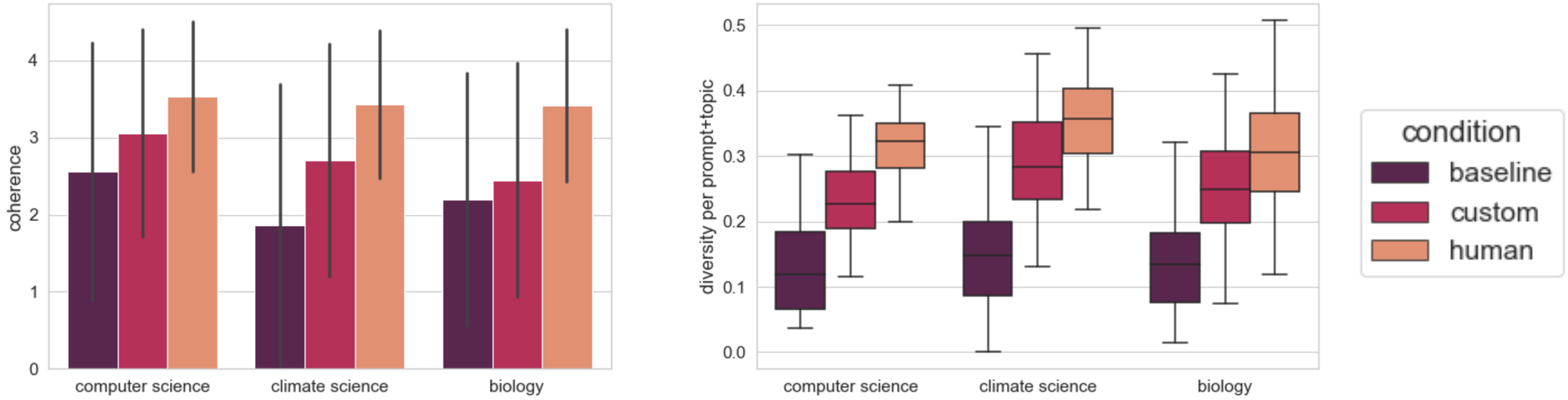
Evaluation

Study 1: Measure the quality of the sparks across topics

Study 2: Measure use of sparks by STEM graduate students

Study 1: How coherent and diverse are sparks?

- Three conditions: human-written gold standard, baseline decoding method, custom algorithm
- Coherence measured with human annotation; diversity measured with average word embedding distance

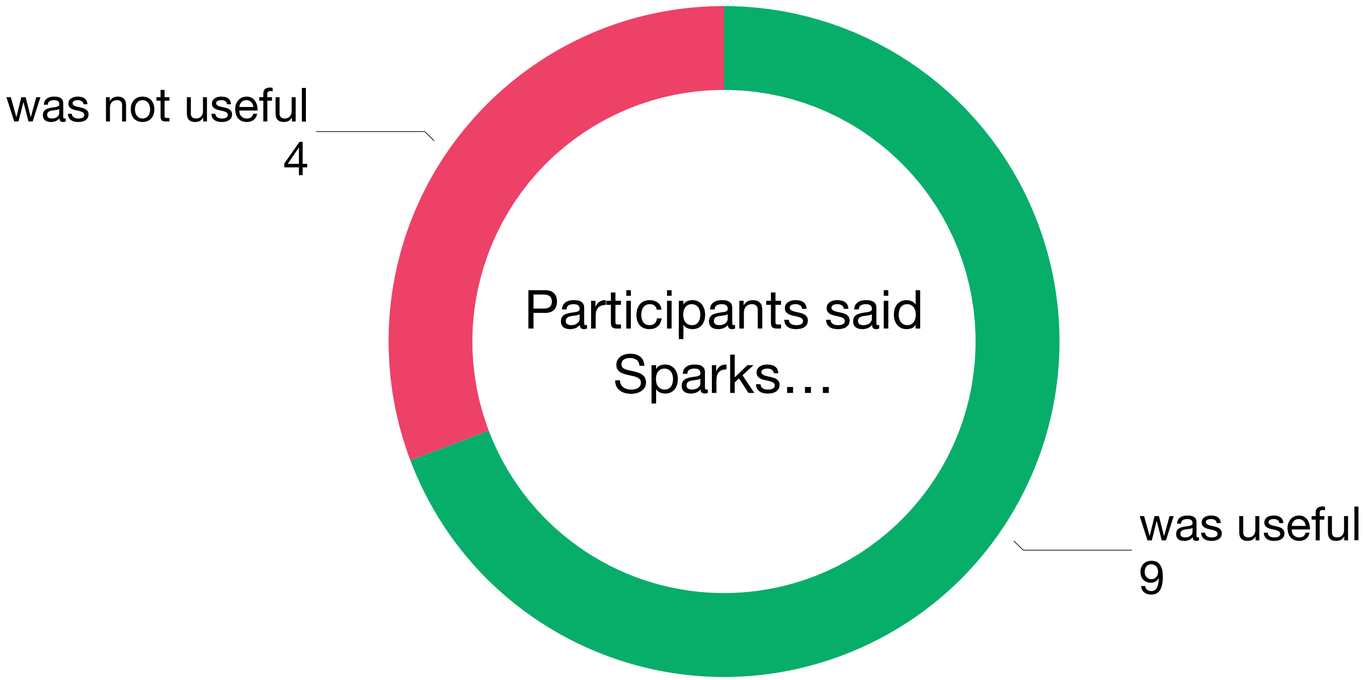


Study 2: How do writers make use of Sparks?

Table 3: Participant demographics. Low = once a year or so. Med = Once a month or so. High = once a week or so.

ID	Discipline	Science Writing (general / twitter)	Topic	Context Area
P1	Climate Science	Low / Low	rainfall variability	climate science
P2	Climate Science	Low / Never	predicting climate change	climate science
P3	Climate Science	Never / High	sea level change	geophysics
P4	Climate Science	Low / Low	glacier retreat over the holocene	paleoclimate
P5	Computer Science	Low / Never	computationally hard problems	computer science
P6	Computer Science	Never / Never	pseudorandomness	theoretical computer science
P7	Political Science	Med / Med	document embeddings	natural language processing
P8	Psychology	Never / Low	regulatory fit	psychology
P9	Psychology	Low / Low	motivated impression updating	social psychology
P10	Public Health	Low / Low	measurement of sexism	sociology
P11	Public Health	Never / Never	logistic regression	epidemiology
P12	Public Health	Low / Never	deprivation indices	public health
P13	Public Health	Med / Med	threat multiplier	environmental health

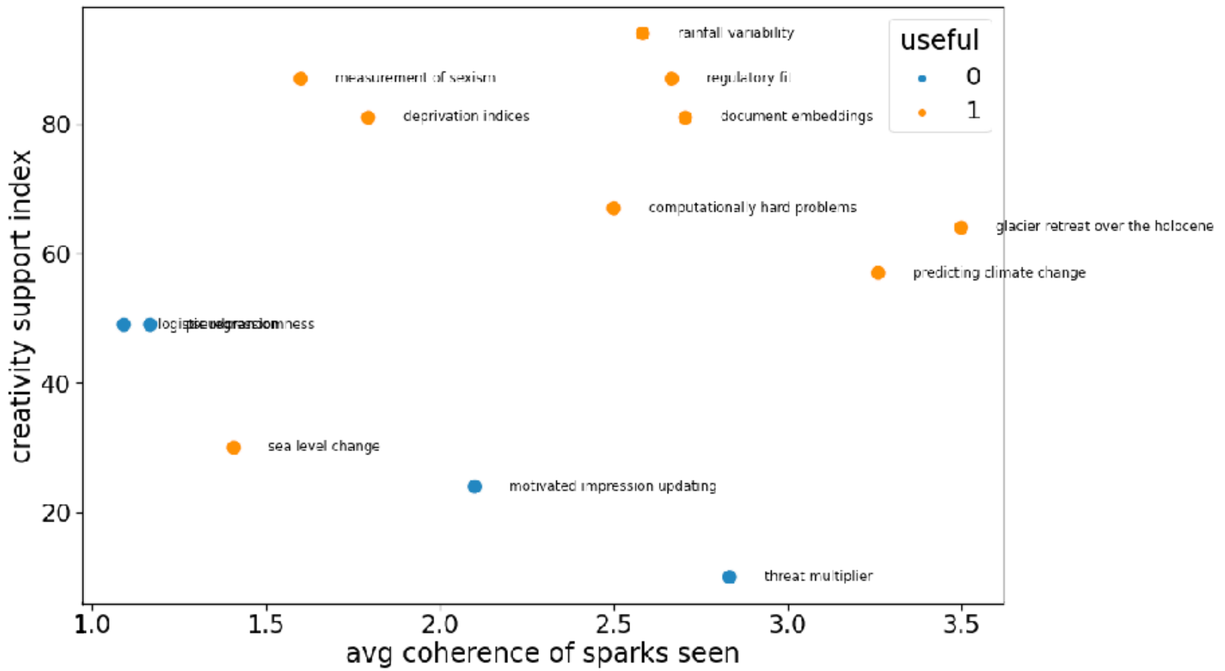
Study 2: Are sparks coherent in an actual writing task?



Study 2: How do writers make use of Sparks?

Use Case	Participant Quote
💡 inspiration	“My specialty is very specific and technical. And it's often hard to figure out how to spin things in ways that feel relevant to people who don't study this. Sea level rise is something that people would find relevant.”
✍️ translation	“Most of the time it [the system] was articulating the ideas that were already in my head in a way that's short and concise.”
🎭 perspective	“The research that I do around sexism is not concerned with people's attitudes, and instead concerned about things like incomes or legal rights or education levels. And so I wouldn't have even thought to talk about like sexism as it relates to people's attitudes.”

Study 2: What predicts usage & satisfaction?



Introduction
Leveraging technology for new ways to write.

Background
Psychology, NLP, and HCI.

Contribution 1
Design Space
Defining the landscape of writing support tools.

Contribution 2
Metaphoria
Supporting writing extended metaphors.

Contribution 3
Sparks
Supporting writing scientific explanations.

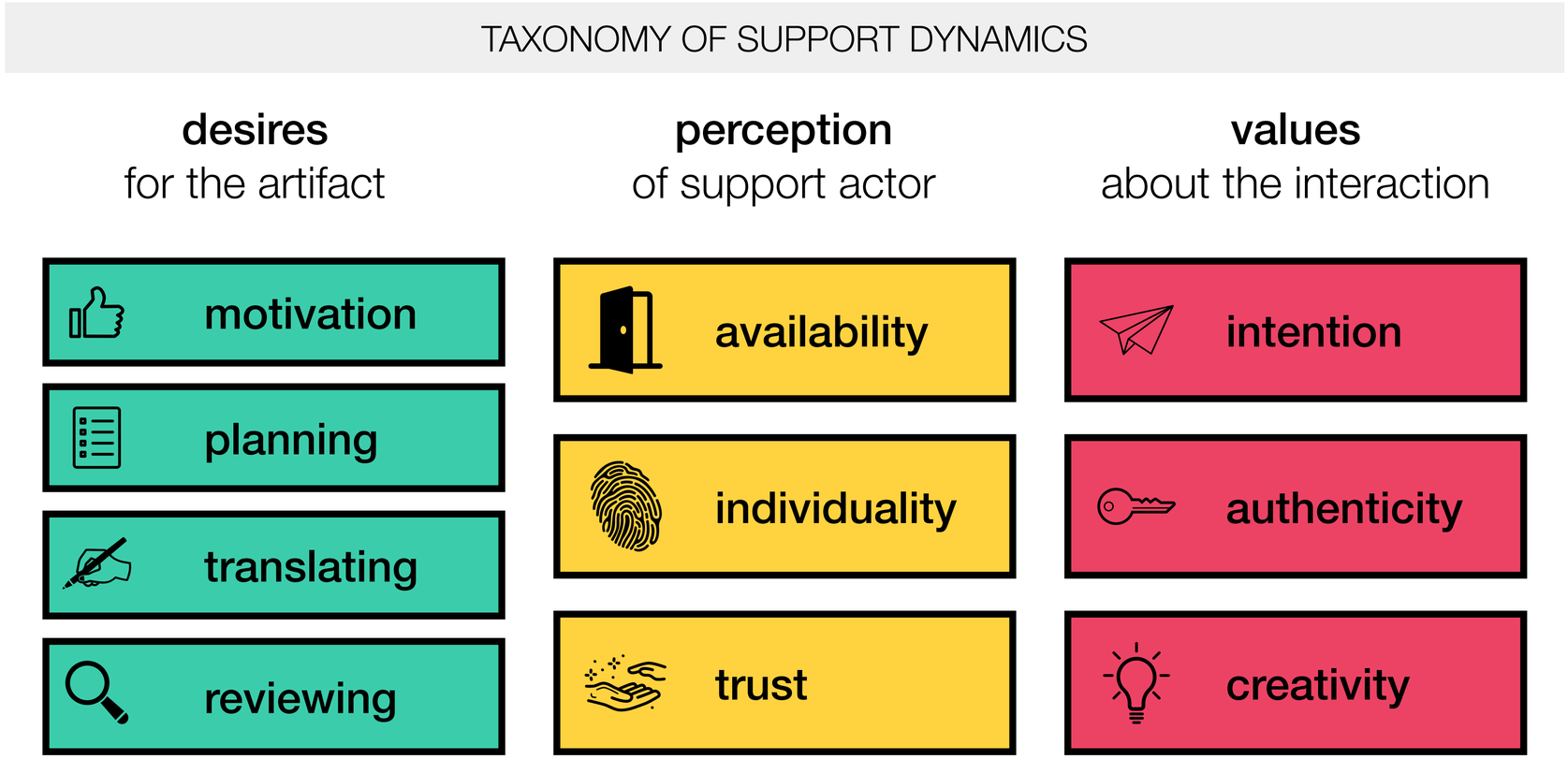
Contribution 4
Social Dynamics
When and why writers turn to computers.

Conclusion
Future work and acknowledgements.

Methodology

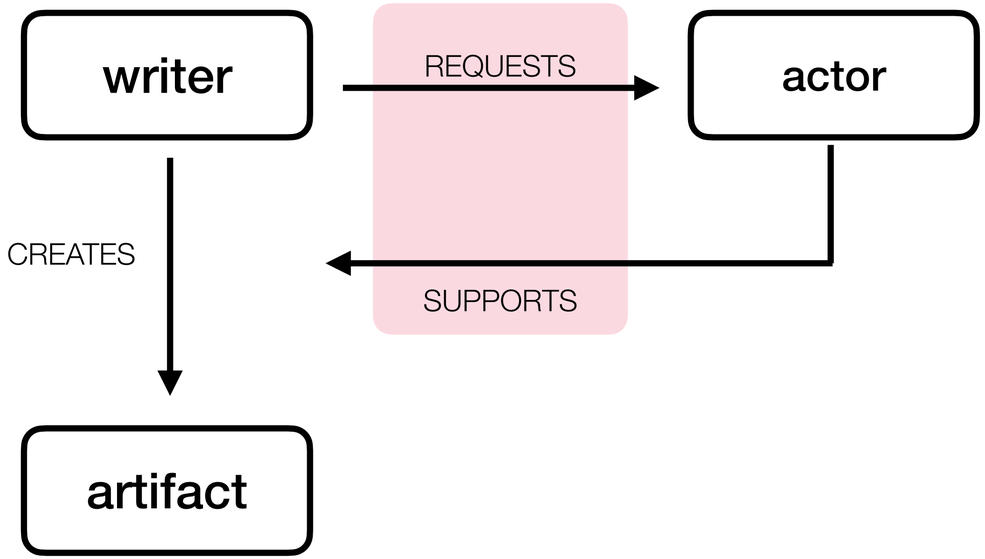
- Interviewed 20 creative writers, including 6 currently using an AI support tool
  - Purposeful sampling for maximum variation across writing genres and experiences
- Qualitative analysis of interview transcripts
  - Used a general inductive approach
  - Two researchers repeatedly read and discussed the transcripts
  - Resulted in annotated quotes and two-level taxonomy

Results: Taxonomy

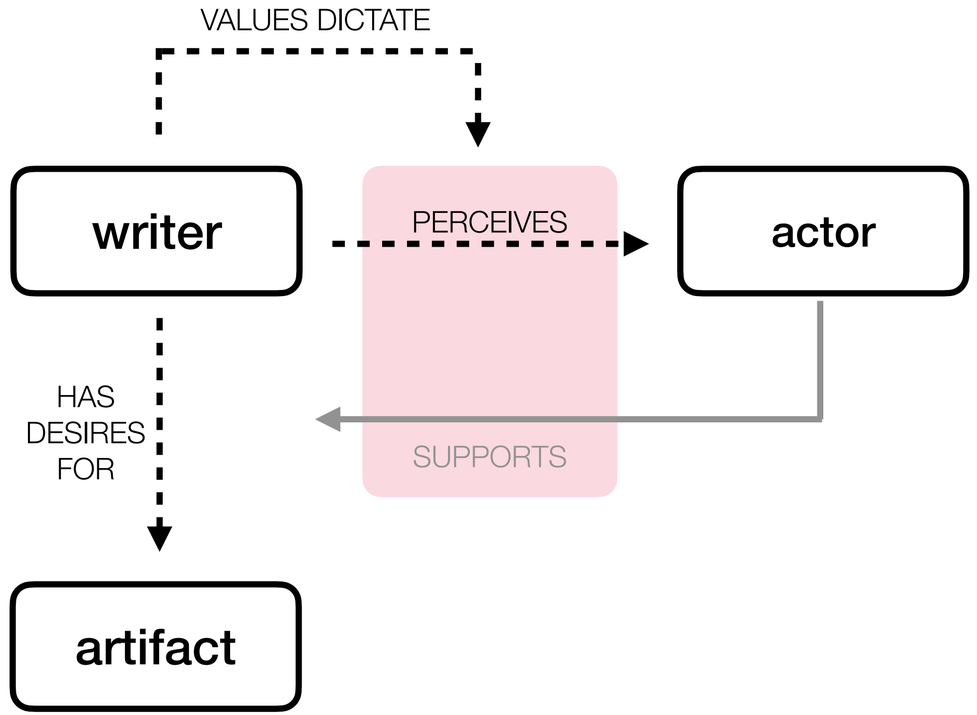


Results: External v. Internal Dynamics

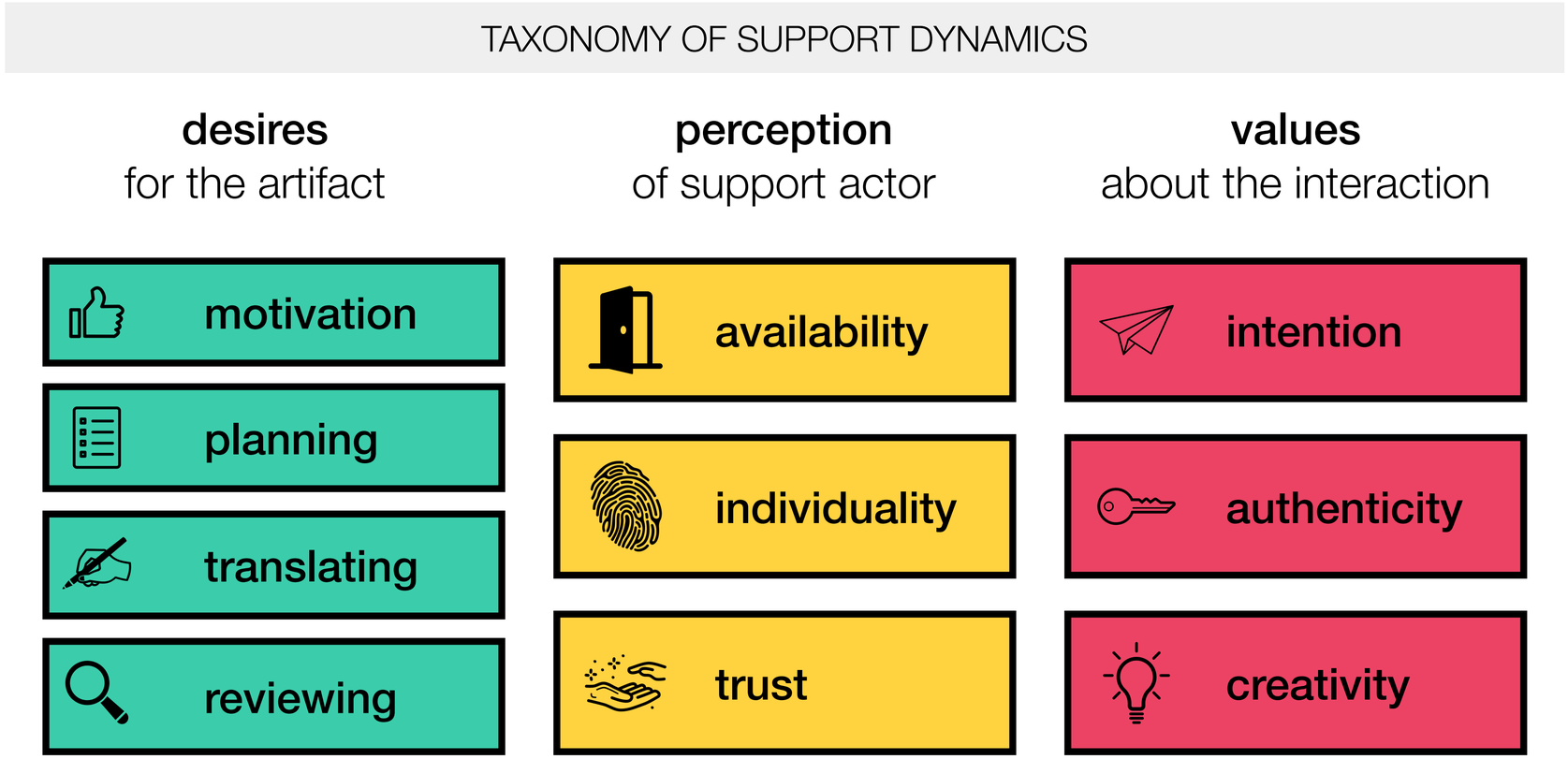
EXTERNAL DYNAMICS OF SUPPORT



INTERNAL DYNAMICS OF SUPPORT



Results: Taxonomy



Results: Writer Perception of Support Actor

perception
of support actor

availability

individuality

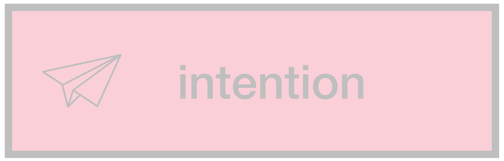
trust

- Levels and kind of expertise
  "Is this a high school, college, PhD student? What is their level of experience of the topic at hand? Are they a skeptic or optimist?"
- Personal experience
  "If I want to know how something reads to another Indian person, I will show [my brother]. But if I'm writing a story about girlhood, I'll send it to my female friend."
- The impossibility of a universal reader
  "The 'universal' perspective has been the perspective of cis straight white men and any other perspective is just not considered universal."

Writers develop a mental model of support actors' individual characteristics, which modulates <u>who</u> they turn to for support.

Results: Writer Values

values
about the interaction

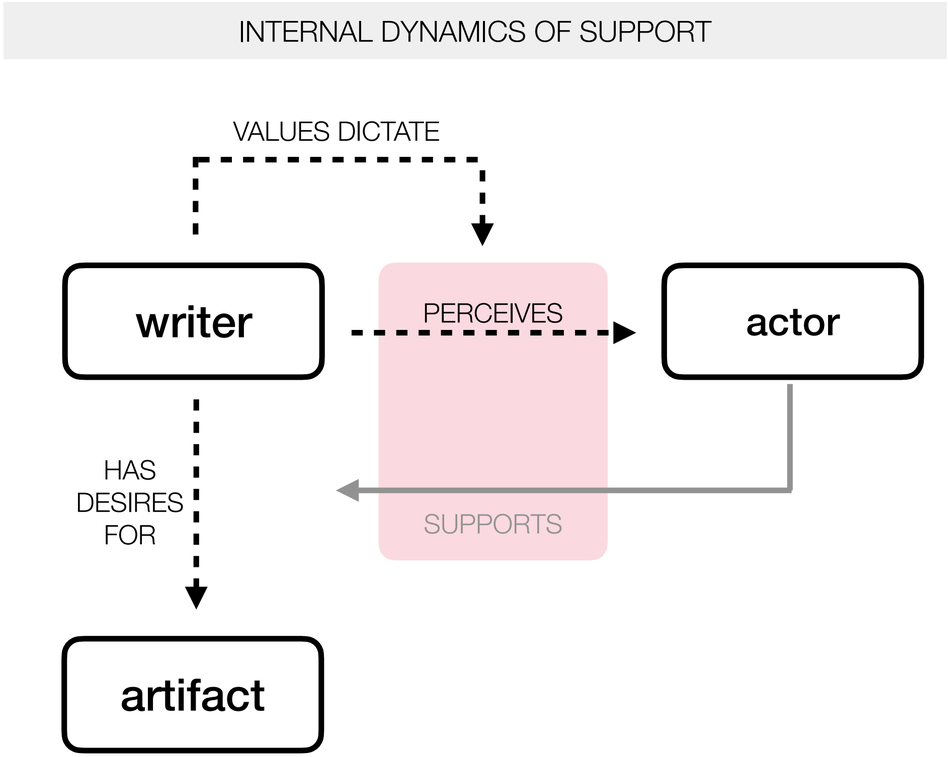


- The reader's sense of authenticity
  Not just about how the writer feels, but what they project to their audience.
- The impact of viewing suggestions
  "Once something is on the page, it's harder to imagine anything else."
- Differing opinions on where authenticity lies:
  Crafting the ending, versus the storyline, versus drafting.
- Humans are more personal; computers are more private:
  "When my brother influences me, it feels like there's more of me in it."

Writers' comfort with influence is modulated by where their sense of authenticity lies.

What made some participants find a system useful?

- How does the writer perceive the system?
  - Skeptical participants perceived the system to be incapable based on any bad suggestion.
  - Trusting participants found all suggestions useful.
- What values does the system support (or negate)?
  - Some participants value independence for idea generation.
  - Others value the execution of an idea over coming up with the idea themselves.



Introduction
Leveraging technology for new ways to write.

Background
Psychology, NLP, and HCI.

Contribution 1
Design Space
Defining the landscape of writing support tools.

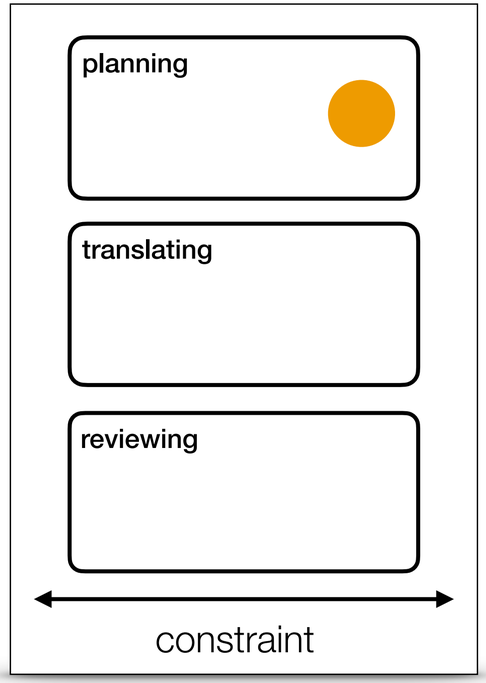
Contribution 2
Metaphoria
Supporting writing extended metaphors.

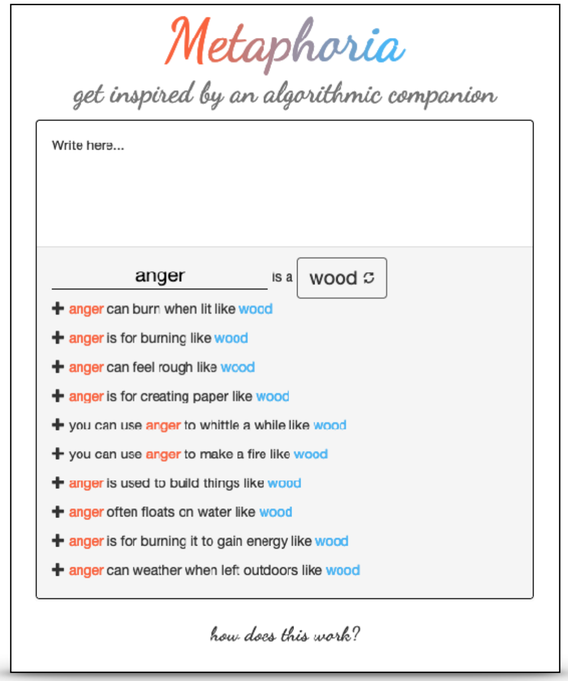
Contribution 3
Sparks
Supporting writing scientific explanations.

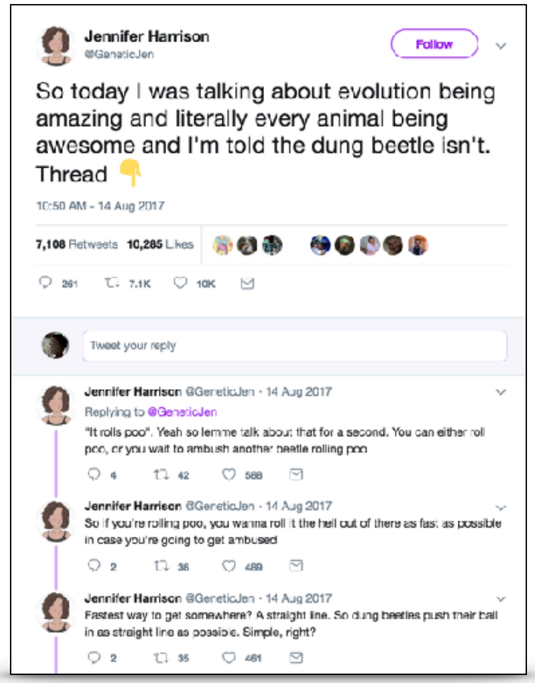
Contribution 4
Social Dynamics
When and why writers turn to computers.

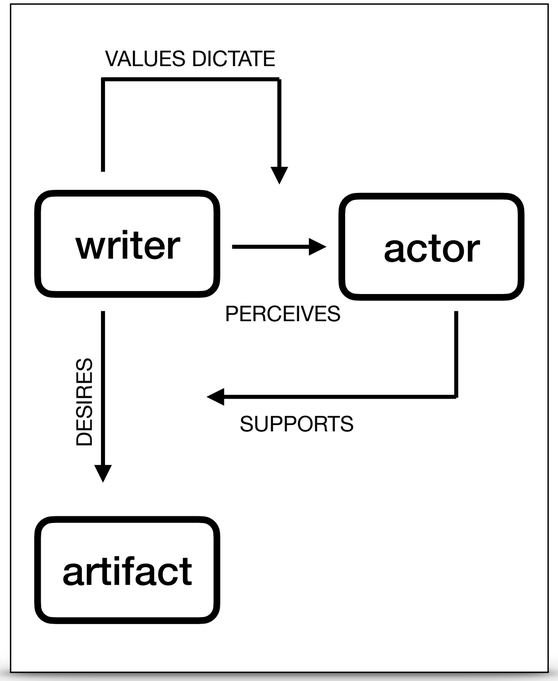
Conclusion
Future work and acknowledgements.

How can **generative** systems support writers in **constrained**, **creative** tasks?









Contribution 1
Design Space
Defining the landscape of writing support tools.

Contribution 2
Metaphoria
Supporting writing extended metaphors.

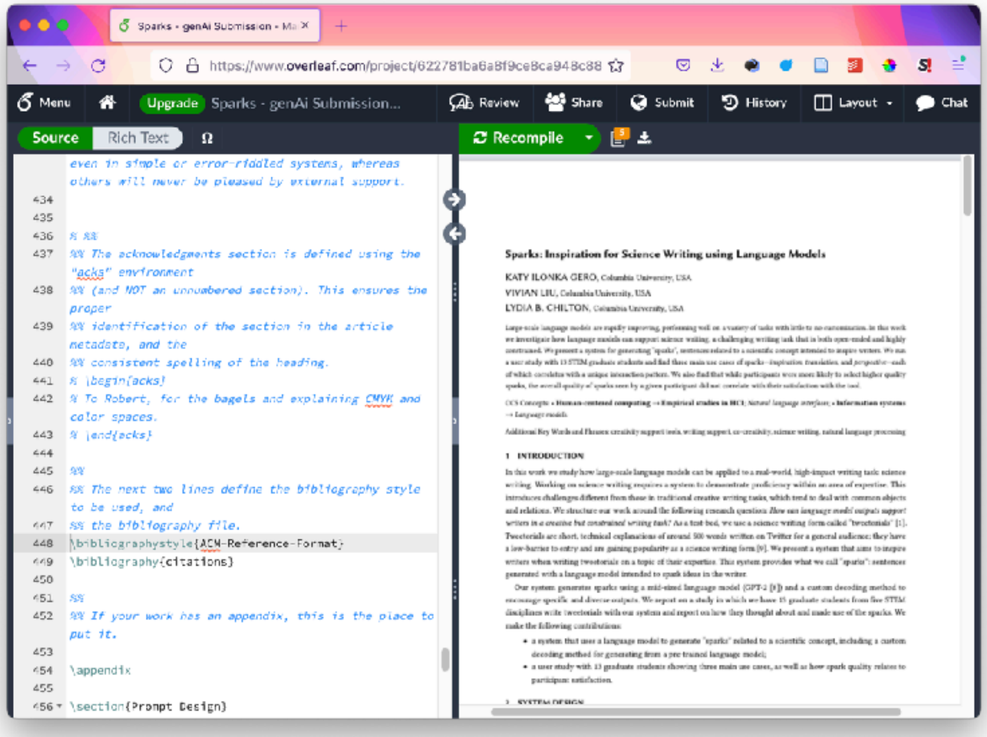
Contribution 3
Sparks
Supporting writing scientific explanations.

Contribution 4
Social Dynamics
When and why writers turn to computers.

New Domains for Writing Support

Academic paper writing

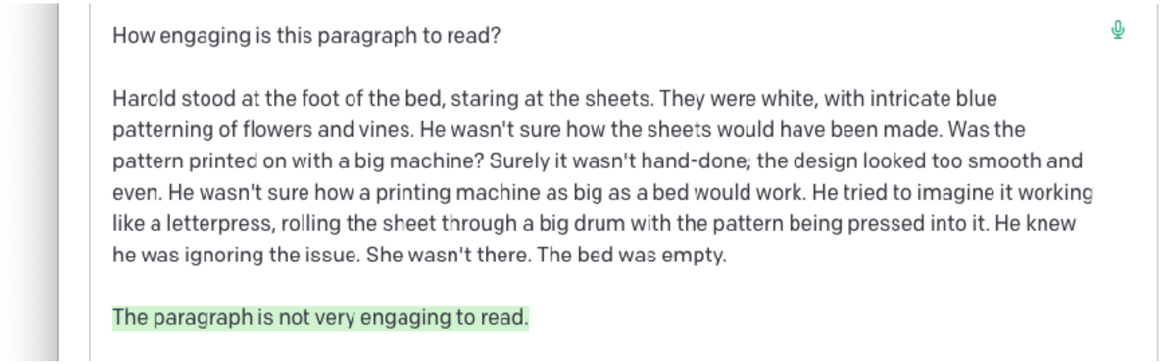
- Reduce the cognitive load of writing repetitive, technical text.
- Use fine-tuned language models to suggest concise, definitional sentences.

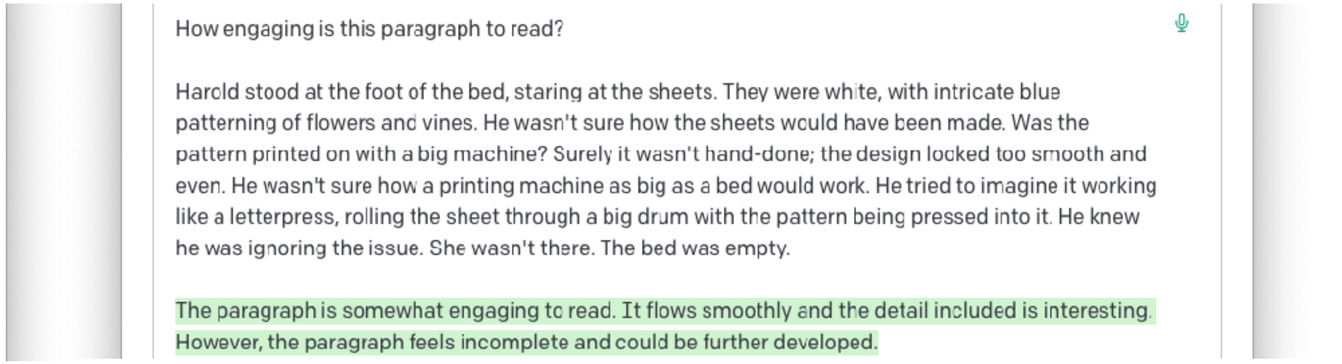


New Kinds of Writing Support

Providing ‘reader’ perspectives

- Writers mostly think about support in terms of external perspectives
- Writers will need to understand where the computer is coming from





How are Generative Systems Used

How do writers develop mental models of AI writing systems?

- Writers' develop *perceptions* (or mental models) of support actors — what are their perceptions of AI writing systems?
- What kind of misconceptions do they have, and are they corrected over time?
- What interventions speed up the development of an accurate mental model?


The Omnivore's Dilemma
WORLD CHANGING
A USER'S GUIDE FOR THE 21ST CENTURY
EDITED BY ALEX STEFFEN
ABRAMS
SISTER OUTSIDER
Fractals, Chaos, Power Laws
Becoming Nicole
A Year Without a Name Cyrus Dunham
GÖDEL, ESCHER, BACH: DOUGLAS R. HOFSTADTER
Eternal Golden Braid
CARSON The SEA Around Us OXFORD
SONG CLIMATE LYRICISM
THE NEW JIM CROW MICHELLE ALEXANDER
Out of Gas
cradle
Oliver Sacks Hallucinations
THE SILENT WOMAN JANET MALCOLM
BEING WRONG KATHRYN SCHULZ
David Foster Wallace CONSIDER THE LOBSTER
RELATIVITY Albert Einstein
ZADIE SMITH CHANGING MY MIND
The Skeleton Key of Mathematics
THE PRINCE
Emerson Self-Reliance and Other Essays
Meander, Spiral, Explode Jane Alison
REEF
A Collection of Essays
JAMES BALDWIN THE FIRE NEXT TIME
Difficult Conversations
The FIRST ENGLISH DICTIONARY 1604
EMILY WITT FUTURE SEX
CATHY O'NEIL WEAPONS OF MATH DESTRUCTION
THOMAS S. KUHN The STRUCTURE OF SCIENTIFIC REVOLUTIONS
MALCOLM X AS TOLD TO ALEX HALEY
MAYA ANGELOU
Wasting Time on the Internet Kenneth Goldsmith
Raymond Queneau Exercises in Style
Around the World
Calarco A FIELD GUIDE TO GRAD SCHOOL
GREENE STOP GUESSING
EDGED ERIK FOGG & NATHANIEL GREENE
objective becoming OXFORD
CAUSATION, EXPLANATION, AND THE METAPHYSICS OF ASPECT OXFORD
may you kiss
A Year to Hit Believed YEATS
THE COMPLETE POEMS OF STEPHEN CRANE
SOUNDS KANDINSKY YALE
THE DREAM SONGS John Berryman
PABLO NERUDA 100 LOVE SONNETS
PETER SÍS THE CONFERENCE OF THE BIRDS
LOUISE GLÜCK THE SEVEN AGES
FAITHFUL AND VIRTUOUS NIGHT LOUISE GLÜCK
SELECTED POEMS GWENDOLYN BROOKS
DIỄN CẦI DẬU
CORNELIUS EADY
FRANK BIDART METAPHYSICAL DOG
Stag's Leap Sharon Olds
THE GOLD CELL SHARON OLDS
Odes Sharon Olds
CAROLYN FORCHÉ
CENZONTLE MARCELO HERNANDEZ CASTILLO
SEA CHANGE JORIE GRAHAM POEMS
Marie Howe WHAT THE LIVING DO
Erica Funkhouser
KAY RYAN ERRATIC FACTS
THE NIAGARA RIVER
SAY UNCLE
TONIGHT NO POETRY WILL SERVE ADRIENNE RICH
DIVING INTO THE WRECK
THE DREAM OF A COMMON LANGUAGE
THE BLACK UNICORN AUDRE LORDE
LEMONS IN THE CHICKEN WIRE
Jean Valentine BREAK THE GLASS
ReRiles · Human + A.I. Poetry
PARISH ARTICULATIONS COUNTERPATH
Our Sudden Museum Robert Fanning
JAMES GENDRON SEXUAL BOAT (SEX BOATS) OCTOPUS BOOKS
DANCING IN ODESSA ILYA KAMINSKY
DEAF REPUBLIC Ilya Kaminsky
ANNE CARSON AUTOBIOGRAPHY OF RED
CLAY TO MAKE ROOM FOR THE SEA
the black maria
Kingdom Animalia Aracelis Girmay
TEETH Aracelis Girmay
OCULUS
THEY AND WE WILL GET INTO TROUBLE FOR THIS
BALLOON POP OUTLAW BLACK PATRICIA LOCKWOOD
MOTHERLAND FATHERLAND SWITZERLAND
SOFT SCIENCE FRANKY CHOI
EMILY SKAJA BRUTE
GÓMEZ FRACTURES
TRACY K. SMITH WADE IN THE WATER GRAYWOLF PRESS
SPLIT CATHY LINH CHE
TERRANCE HAYES AMERICAN SONNETS FOR MY PAST AND FUTURE ASSASSIN
PRELUDE TO BRUISE
CLAUDIA RANKINE CITIZEN
MEIA GEDDES love letters to the world
Katherine Larson RADIAL SYMMETRY
NIGHT SKY WITH EXIT WOUNDS OCEAN VUONG
FIELD THEORIES SAMIYA BASHIR
ROSS GAY AGAINST WHICH
Rachel McKibbens blud
KAVEH AKBAR CALLING A WOLF A WOLF
LIMÓN THE CARRYING
A FORTUNE FOR YOUR DISASTER / HANIF ABDURRAQIB
Ode to Lithium
NATURE POEM TOMMY PICO
JUNK TOMMY PICO
MAGICAL NEGRO MORGAN PARKER
CASE & MANGUS 21 19
WE BEGIN IN GLADNESS CRAIG MORGAN TEICHER
Mary Oliver A Poetry Handbook
Rainer Maria Rilke LETTERS TO A YOUNG POET
STRUNK AND WHITE THE ELEMENTS OF STYLE
Sound and Sense
The Wadsworth Anthology of poetry
MARY KINZIE A POET'S GUIDE TO POETRY
the wind then turn from it
Hand Jive
TIM CAHILL A WOLVE
JAGUARS RIPPED MY FL
tim cahill pecked to de
WHY DON'T CATS LIKE T
DO PENGUINS HAVE K
An Imponderables® Book
WHY DO CLOCKS RUN CLO
A FINE AND PLEASANT MISERY
DIGITAL DICE COMPUTATIONAL S
PRACTICAL PROBABILITY PROBL
ROAD FEVER TIM CAHI
CLIMO the little world of
ADAM SAVAGE Every Too
Life Is What Y
WOODROW PHOENIX CRASH COU
The Audubon S
Field Guide to
North American
Mammals
THE SECRET TO SUPERHUMAN STRENGTH
Are You My Mother? Alison
Fun Home ALISON B
THE PELICAN SHAKESPEARE
THE FLICK ANNIE B
TOM STOPPARD ROSENCRANTZ & GUILDENST
La lejana
A CAFECITO STORY / EL CUENT
Crónica de una muerte anun
ONE HUNDRED YEARS OF SO
GABRIEL GARCÍA MÁRQ
Ficciones
Everything That Rises Must Converg
HER BODY AND OTH
N.K. JEMISIN HOW LONG
BLACK FUTU
TED CHIANG EXH
YOUR HOUSE WILL PAY
WEIGHT
ANTOINE DE SAINT-EXUPÉRY The Little Prince
JOSEPH CONRAD Heart of Darkness
HALF OF A YELLOW
HIMAMANDA NGOZ
F. SCOTT FITZGERALD
CRYING OF LOT 49
LITTLE BIRDS EROTICA BY AN
SEXING THE CHE
JOSTEIN GAARDER The
THE SOLITAIRE MYSTERY
INFINITE JES
How to Change
Your Mind
YOU ARE

Writing is about communicating complex ideas **with each other**.

Computers compel us to reflect on what we care about in writing.

Thanks to my advisor, my lab mates, my fellow PhD hopefuls at Columbia and elsewhere, my friends and family in NYC, Cambridge, Sydney, & beyond, my poetry and writer friends, and most definitely my dog, who is very good at computers.