

Linguistic Agency and Mobilization: Persuasion in Political Discourse and Action-Oriented Communication

Jan Nikadon, Marta Beneda, Marta Witkowska, Lejla Džanko, Paweł Jurek, Michał Olech,
Tomaso Erseghe, Caterina Suitner, Magdalena Formanowicz



UNIVERSITÀ
DEGLI STUDI
DI PADOVA

How to mobilize / encourage others to act?

Sub-Questions

- Do people who aim to encourage others “to do something” use **specific linguistic devices**?
- Are such devices **effective**? (Is that communication understood by recipients according to the speaker’s intention?)

How to mobilize / encourage others to act?

Action Coordination [AC]

- Requires ability to form shared representations of tasks/actions
 - a “**cornerstone of social cognition**”,
 - enables **functional human interactions** (typically based on common goals).
- **Communication** is crucial,
 - → we explored **linguistic factors** involved in **encouraging / mobilizing** others
- Ubiquity of AC →
 - possibility of **universal linguistic components / devices** that are clear for both message **authors** and **recipients**. (persuasion-knowledge model, Friestad & Wright, 1994)

How to mobilize / encourage others to act?

Goal Pursuit Theoretical Framework (Gollwitzer & Oettingen, 2012)

- Action coordination requires
 - **Action-setting:** [“drive”]:
 - Establishing intention to achieve a goal;
 - **Action planning:** [“direction”]
 - Establishing concrete particularities of how to achieve it.
- Ubiquity + Structure of AC →
 - Possibility of (potentially two) **universal linguistic components / devices** that are clear for both message **authors** and **recipients**.
 - Reflecting **both aspects** of AC

Action Orientation [AO] and Verbs

- Pursuit of goals of primary importance to all organisms (Frith & Frith 2010);
- Attention to agency of others (Abele & Wojciszke 2007);
- General attentional bias towards cues of agency (New et al. 2007);
- Multiple indicators of agency in language (Formanowicz et al. 2017);
- Attentional bias towards those cues in language processing (Bornkessel & Schlesewsky 2006);
- Verbs, as grammatical vehicles of action, are linguistic markers of agency (Formanowicz et al. 2017);
- Verbs representing agency are both encoded in and decoded from language (Formanowicz et al. 2017).

Action Orientation [AO] and Verbs

- Multiple indicators of AO (agency) in language (Formanowicz et al. 2017);
- **Verbs**, as **grammatical vehicles of action**, are
 - **Linguistic (grammatical) markers of agency** (Formanowicz et al. 2017);
- Verbs representing agency are both encoded in and decoded from language (Formanowicz et al. 2017);
- Verb sentences more vivid and easy to imagine than noun sentences (Hansen & Wänke, 2010).

Action Orientation [AO] and Verbs

- Multiple indicators of AO (agency) in language (Formanowicz et al. 2017);
- **Verbs**, as **grammatical vehicles of action**, are
 - **Linguistic (grammatical) markers of agency** (Vigliocco et al., 2011; Formanowicz et al. 2017).
 - E.g., Girls were more likely to engage in science activities when encouraged with a verb (e.g., “Let’s **do** science!”) than with a noun (e.g., “Let’s be scientists!”). (Rhodes et al., 2019)

Action Planning [AP] and Concreteness

- How to approach a given action (Liberman & Trope, 2008)
- Imaginable qualities (Paivio, 1971, 2013)
- Concrete utterances are:
 - Easier to **remember** than abstract ones
 - Enable **faster** and more **in-depth information processing** (Schwanenflugel & Stowe, 1989);
 - Elicit more **engagement** in readers (Sadoski et al., 2000).
- Concrete speakers evaluated as more *action oriented* (Palmeira, 2015).
- “*How to engage in an action*” rated as more concrete and action oriented than “*why to engage*” (Palmeira, 2015);

Action Planning [AP] and Concreteness

- How to approach a given action (Liberman & Trope, 2008)
- Concrete utterances are:
 - Provide **imaginable qualities** (Paivio, 1971, 2013)
 - Easier to **remember** than abstract ones
 - Enable **faster** and more **in-depth information processing** (Schwanenflugel & Stowe, 1989);
 - Elicit more **engagement** in readers (Sadoski et al., 2000).

- Studies 1, 2 and 3
 - Behavioral experiments
 - Published (PSPB).
- Study 4:
 - Social media data
 - Under review
- Bonus Study:
 - Behavioral experiments

Empirical Research Paper

Mobilize Is a Verb: The Use of Verbs and Concrete Language Is Associated With Authors' and Readers' Perceptions of a Text's Action Orientation and Persuasiveness

Magdalena Formanowicz¹ , Marta Beneda^{1,2},
Marta Witkowska¹, Jan Nikadon¹, and Caterina Svitner³

Abstract

In three studies, we investigated the role of linguistic features characterizing texts aiming to mobilize others. In Study 1 ($N = 728$), participants produced a leaflet either mobilizing others to engage in an action or expressing their thoughts about that action, and evaluated how action-oriented their text was. Mobilizing texts included more verbs and concrete words, and the presence of these linguistic characteristics was positively linked to participants' evaluations of their messages as action-oriented. In Studies 2 and 3 ($N = 557$ and $N = 556$), independent groups of participants evaluated texts produced in Study 1. Readers' perceptions of texts as action-oriented were associated with the same linguistic features as in Study 1 and further positively linked to perceived message effectiveness (Study 2) and behavioral intention (Study 3). The studies reveal how encoding and decoding of verbs and concrete words serve as distinct persuasive tools in calls to action.

Keywords

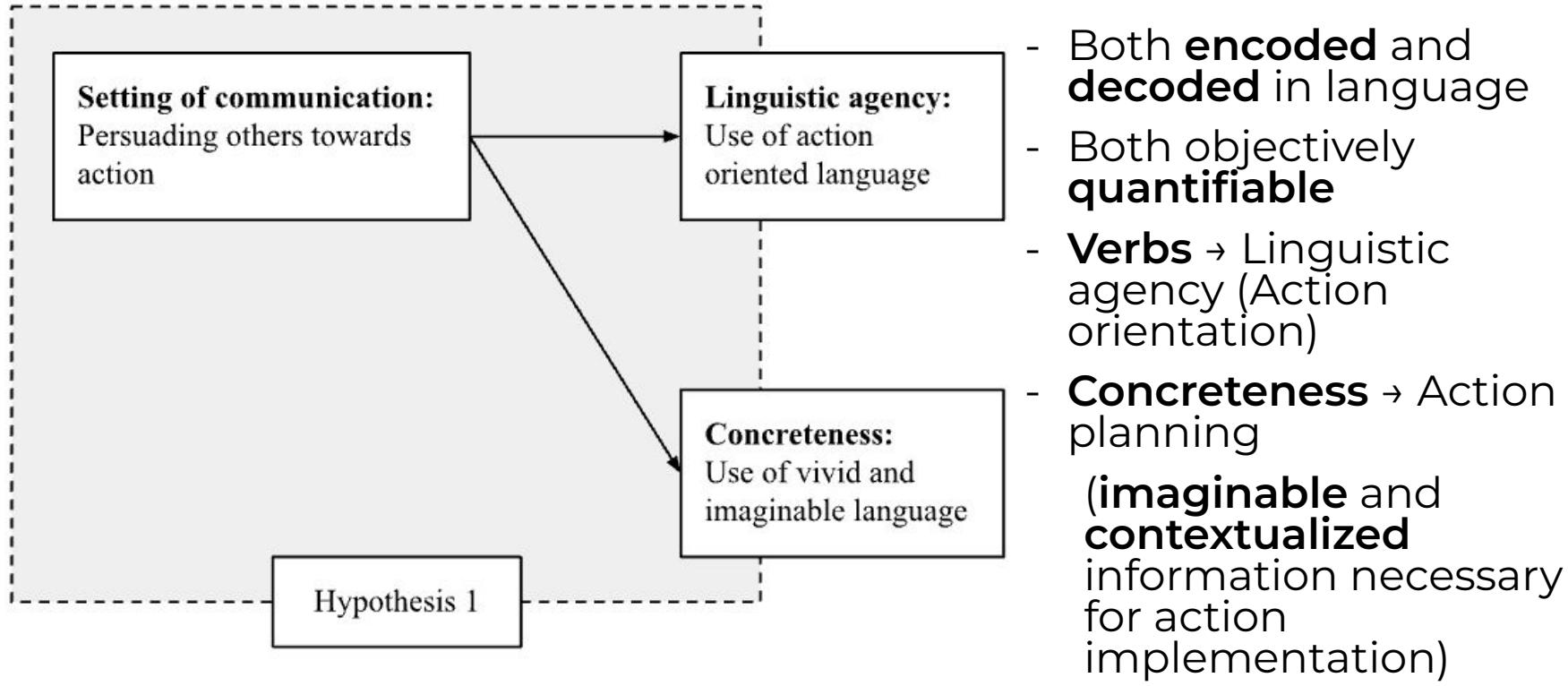
agency, persuasion, language, concreteness

Received September 18, 2023; revision accepted February 12, 2024

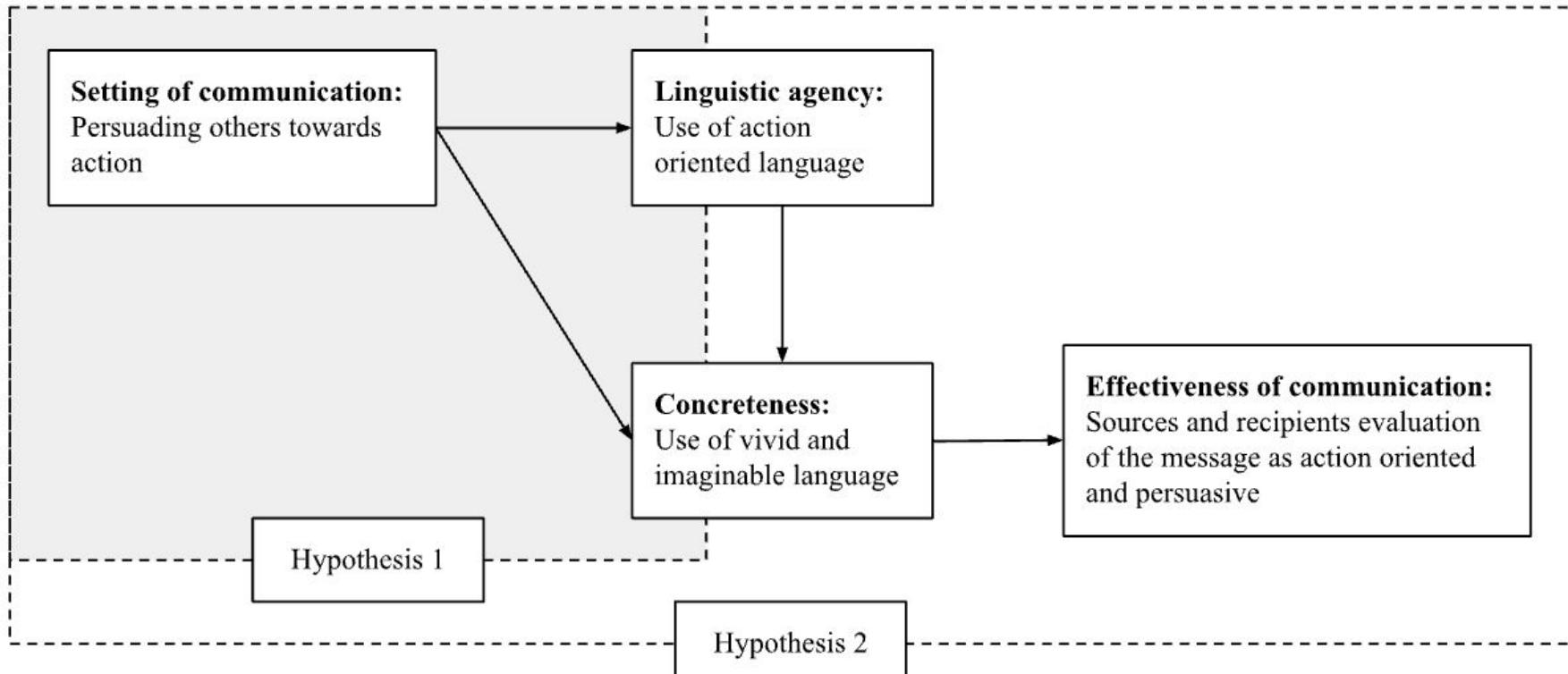
Personality and Social Psychology Bulletin
1–16
© 2024 by the Society for Personality and Social Psychology, Inc.
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/0146167224123841
journals.sagepub.com/home/pspb



Hypothesis 1



Hypothesis 2



Study 1: Participants

- 445 English native speakers recruited through Prolific
- 312 women, 128 men, and five people who indicated other gender
- Aged between 18 and 77 ($M = 33.78$, $SD = 11.73$)

Study 1: Procedure

- Write a short text on the topic related to **environmental action** (context A) or **volunteering** (context B)
- At least 100 words long
- Either
 - Encouraging others to participate in the behaviour (**'encouraging others' condition**);
 - Expressing their thoughts on participating in the behaviour (**'expressing thoughts' condition**);
- Participants (authors) asked to evaluate the text they had written in terms of **action orientation**:
 - how much the message conveyed by text you wrote could be considered: **"practical"**, **"task-oriented"**, and **"focused on getting things done"** (Cronbach's $\alpha = .81$).

Study 1: Measures

- **Verbs** (← Grammatical Agency, Action Orientation):
 - the percentage of lexical verbs in their base form (VB; e.g., ‘work’, ‘love’) relative to the total number of words in the text; (SpaCy, Explosion Ai, Honnibal and Montani, 2017);
- **Linguistic Concreteness** (Action Planning):
 - concreteness ratings provided for over 40,000 English words by over 4,000 participants (Brysbaert et al., 2014);
- **Author’s Ratings of Action Orientation:**
 - Participants were asked to indicate on a 7-point scale the extent to which the text written by them could be considered: “**practical**”, “**task-oriented**”, and “**focused on getting things done**”.

Study 1: Examples

Encourage:

Please take care of our environment. This is really important as we only have one planet and our actions are causing it harm. We can do this in many different ways things like walking or using a bike where possible instead of motorised fossil fuel transport. Turning the heating or air conditioner down and instead dressing suitably for the weather. Drying clothes outside instead of using a tumble dryer and only washing clothes when actually dirty. Skipping fast fashion makes a huge difference as fast fashion is a major polluter. Wear clothes for as long as possible repair when needed. Avoiding buying new clothes due to them being trendy. You can also buy clothes from thrift shops, ebay, vinted etc instead of buying new.

Express thoughts:

Environmental action has never had so much traction and focus as it has nowadays. Up to this point in human history, it has been about advancement and marvelling at our intelligence and what we can do. In the last couple of decades, awareness has grown around the impact we are having on the planet. There is much enlightenment and positive action to reduce the impact we are having on the planet in an effort to be more sustainable. Yes there are certainly many doubts over "green label" initiatives and the benefits that they purport to yield - zero carbon badges can sometimes hide scenarios where they are actually worse than conventional "non green" actions. So environmental action is a great thing in general, and I do and will participate, but am also mindful of the bigger picture and what I'm trying to achieve. Blocking a road for the purpose of "Insulate Britain" is actually harmful to the cause and I believe actually is a hindrance to taking positive steps.

Study 1: Examples

Encourage:

Please take care of our environment. This is really important as we only have one planet and our actions are causing it harm. We can do this in many different ways things like walking or using a bike where possible instead of motorised fossil fuel transport. Turning the heating or air conditioner down and instead dressing suitably for the weather. Drying clothes outside instead of using a tumble dryer and only washing clothes when actually dirty. Skipping fast fashion makes a huge difference as fast fashion is a major polluter. Wear clothes for as long as possible repair when needed. Avoiding buying new clothes due to them being trendy. You can also buy clothes from thrift shops, ebay, vinted etc instead of buying new.

Express thoughts:

Environmental action has never had so much traction and focus as it has nowadays. Up to this point in human history, it has been about advancement and marvelling at our intelligence and what we can do. In the last couple of decades, awareness has grown around the impact we are having on the planet. There is much enlightenment and positive action to reduce the impact we are having on the planet in an effort to be more sustainable. Yes there are certainly many doubts over "green label" initiatives and the benefits that they purport to yield - zero carbon badges can sometimes hide scenarios where they are actually worse than conventional "non green" actions. So environmental action is a great thing in general, and I do and will participate, but am also mindful of the bigger picture and what I'm trying to achieve. Blocking a road for the purpose of "Insulate Britain" is actually harmful to the cause and I believe actually is a hindrance to taking positive steps.

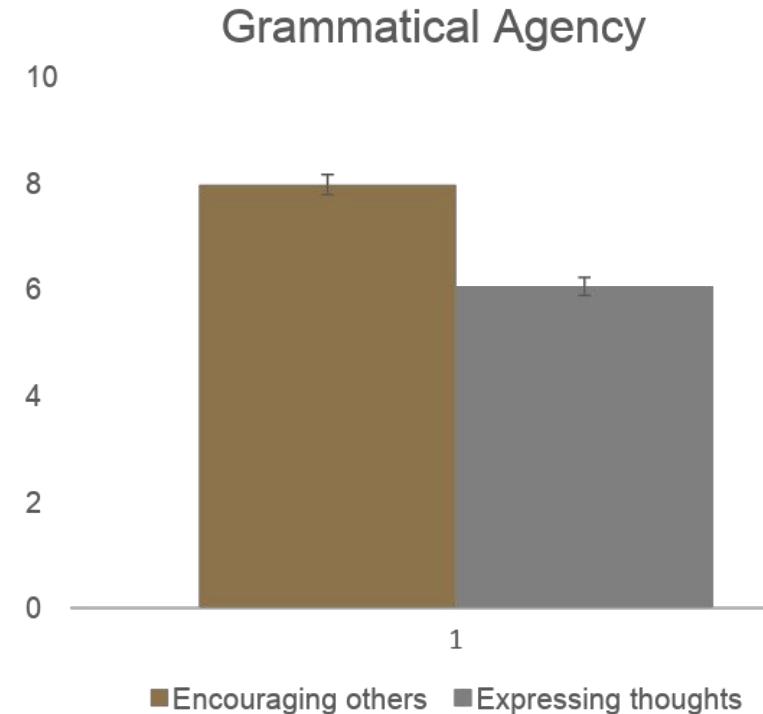
Study 1: Results: Grammatical Agency (Verbs)

We conducted a series of two-way ANOVAs in the following design: 2 (experimental condition: 'encouraging others' vs. 'expressing thoughts') \times 2 (study context: environmental action vs. volunteering)

Grammatical Agency (Verbs)

Main effect of experimental condition

$$F(1, 441) = 54.75, p < .001, \eta^2 = .11$$



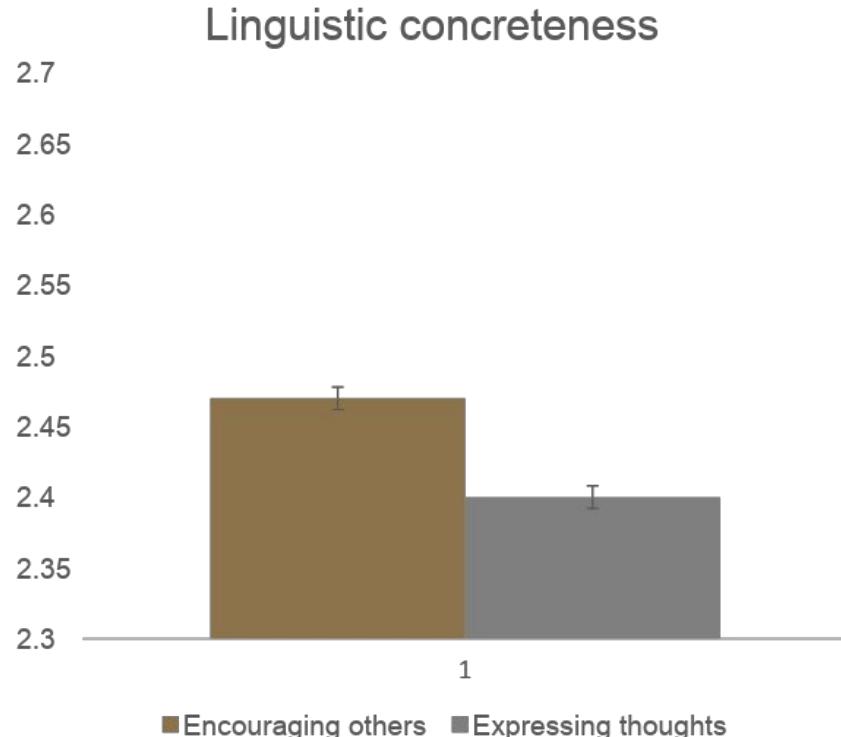
Study 1: Results: Linguistic Concreteness

We conducted a series of two-way ANOVAs in the following design: 2 (experimental condition: 'encouraging others' vs. 'expressing thoughts') \times 2 (study context: environmental action vs. volunteering)

Linguistic Concreteness:

Main effect of experimental condition:

$$F(1, 441) = 48.70, p < .001, \eta^2 = .10.$$



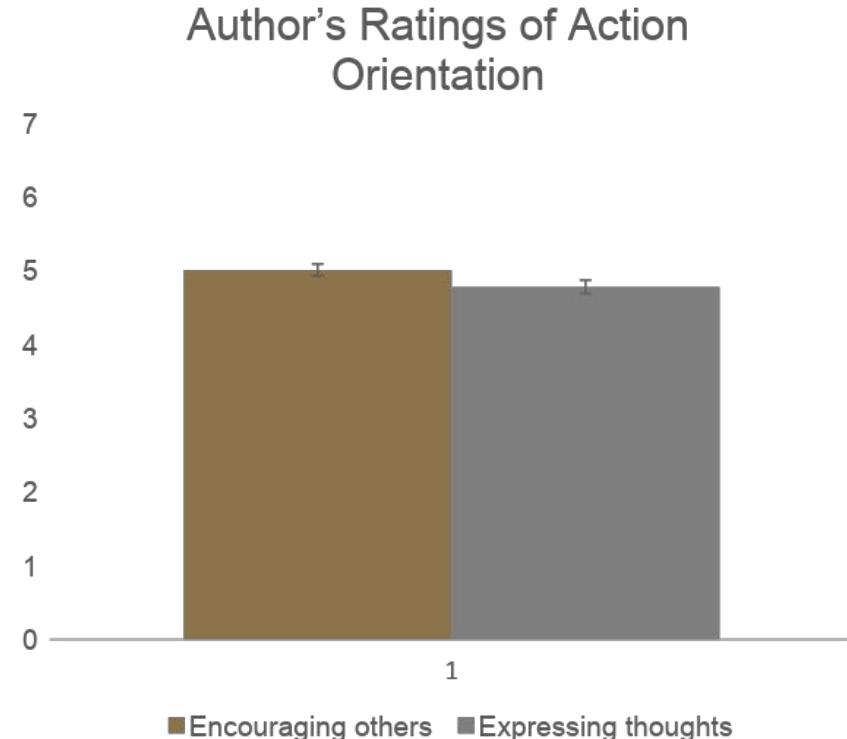
Study 1: Results: Action Orientation (Author)

We conducted a series of two-way ANOVAs in the following design: 2 (experimental condition: 'encouraging others' vs. 'expressing thoughts') x 2 (study context: environmental action vs. volunteering)

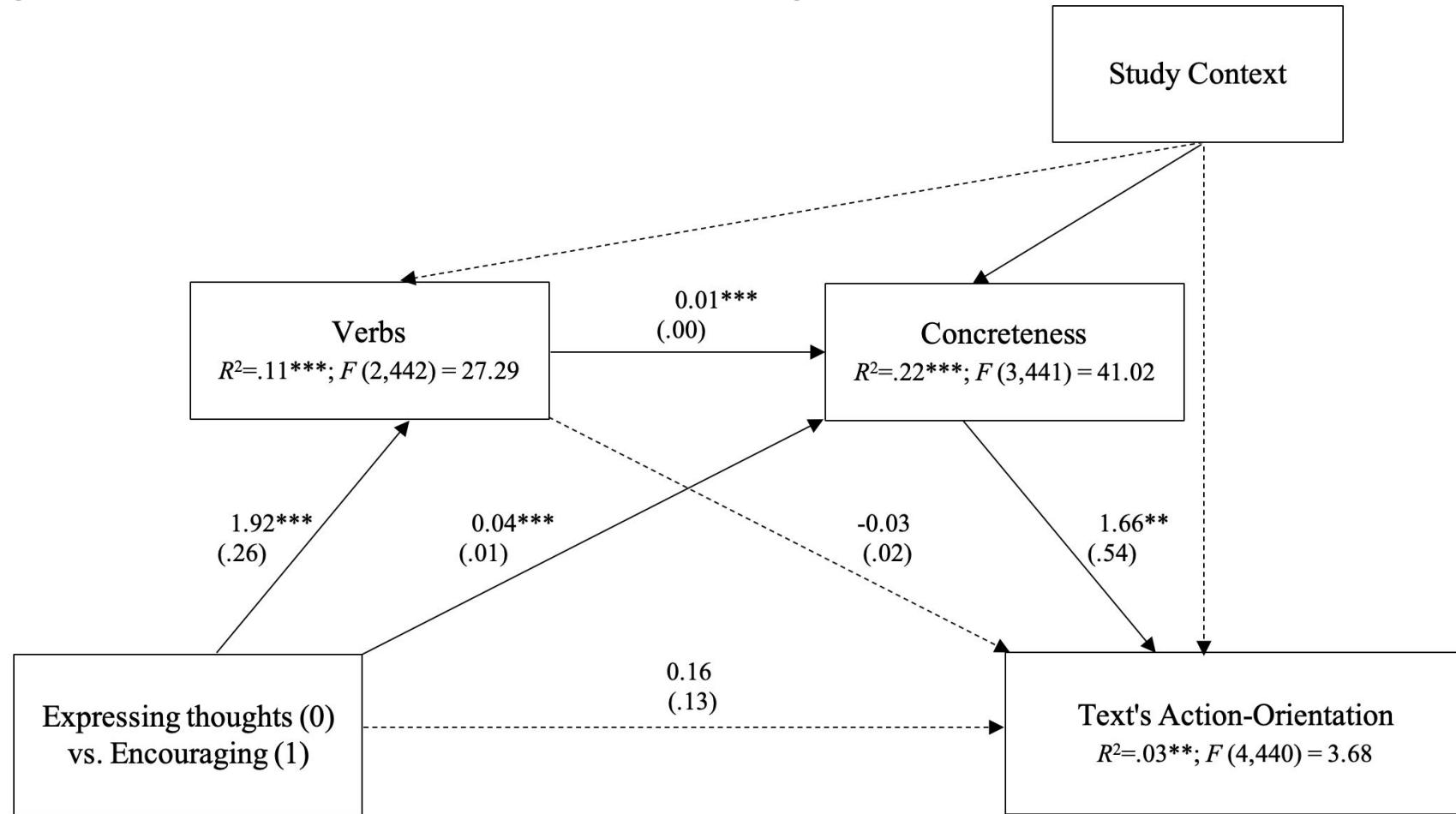
Author's Ratings of Action Orientation:

Main effect of experimental condition:

$$F(1, 441) = 4.38, p < .05, \eta^2 = .01.$$



Study 1: Results: Mediation Analysis



Studies 2 and 3 [Readers]: Procedure

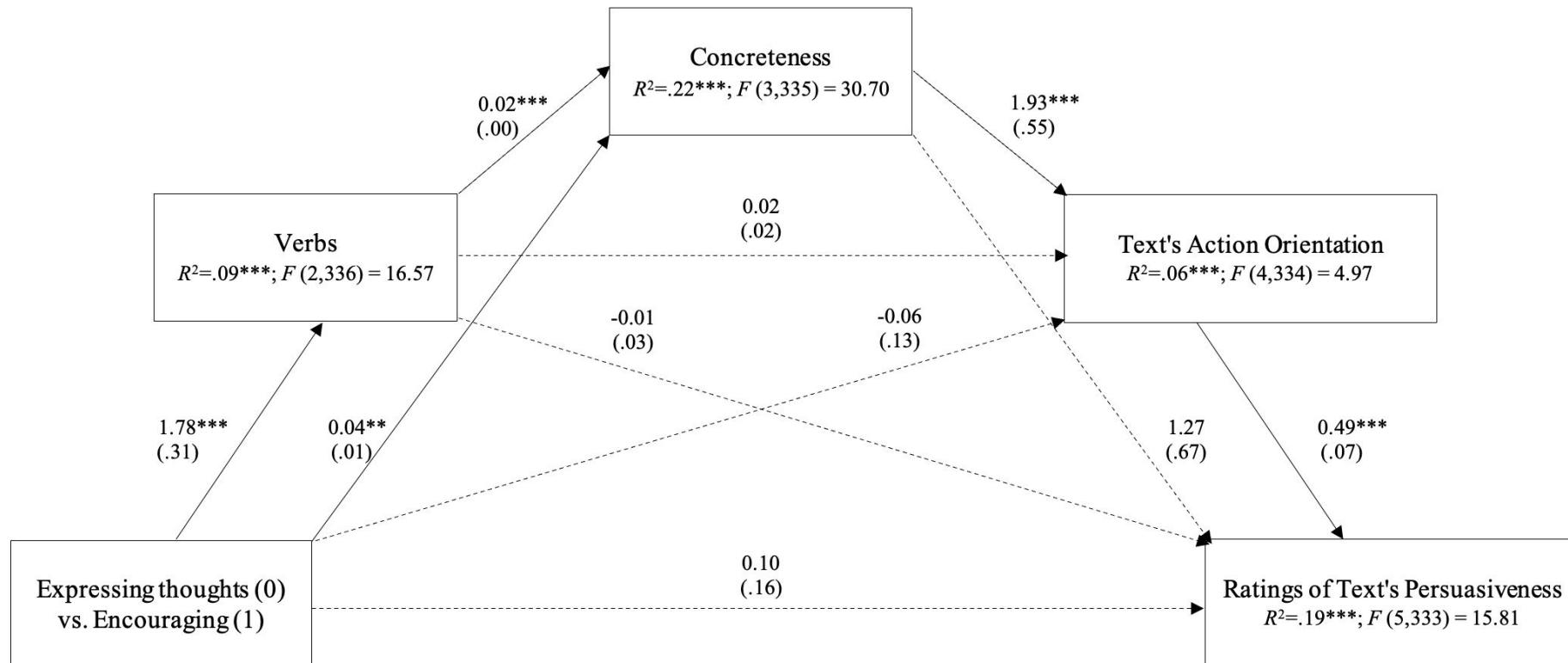
- Participants were randomly presented with one of the leaflets produced in Study 1, asked to read it carefully and to evaluate it in terms of agency and persuasiveness
- 47 leaflets were excluded because they were too long; two leaflets were excluded because they were not written on the topic
- We further excluded “badly written leaflets” (57 from Study 2 & 61 from Study 3);
- English native speakers recruited through Prolific (Study 2: N = 339, Study 3: N = 335).

Studies 2 and 3 [Readers]: Measures

- **Reader's Ratings of Action Orientation (Study 2 & 3):**
 - Participants were asked to indicate on a 7-point scale the extent to which the text presented to them could be considered: “*practical*”, “*task-oriented*”, and “*focused on getting things done*”
- **Reader's Ratings of Persuasiveness (Study 2):**
 - Participants were asked to indicate on a 7-point scale how much the text encourages them to participate in the behaviour specified (i.e., environmental action/volunteering) and how much it would encourage others to participate in said behaviour
- **Reader's Ratings of Behavioral Intention (Study 3):**
 - Participants were asked to indicate on a 7-point scale how much the text encouraged their environmental action or volunteering.

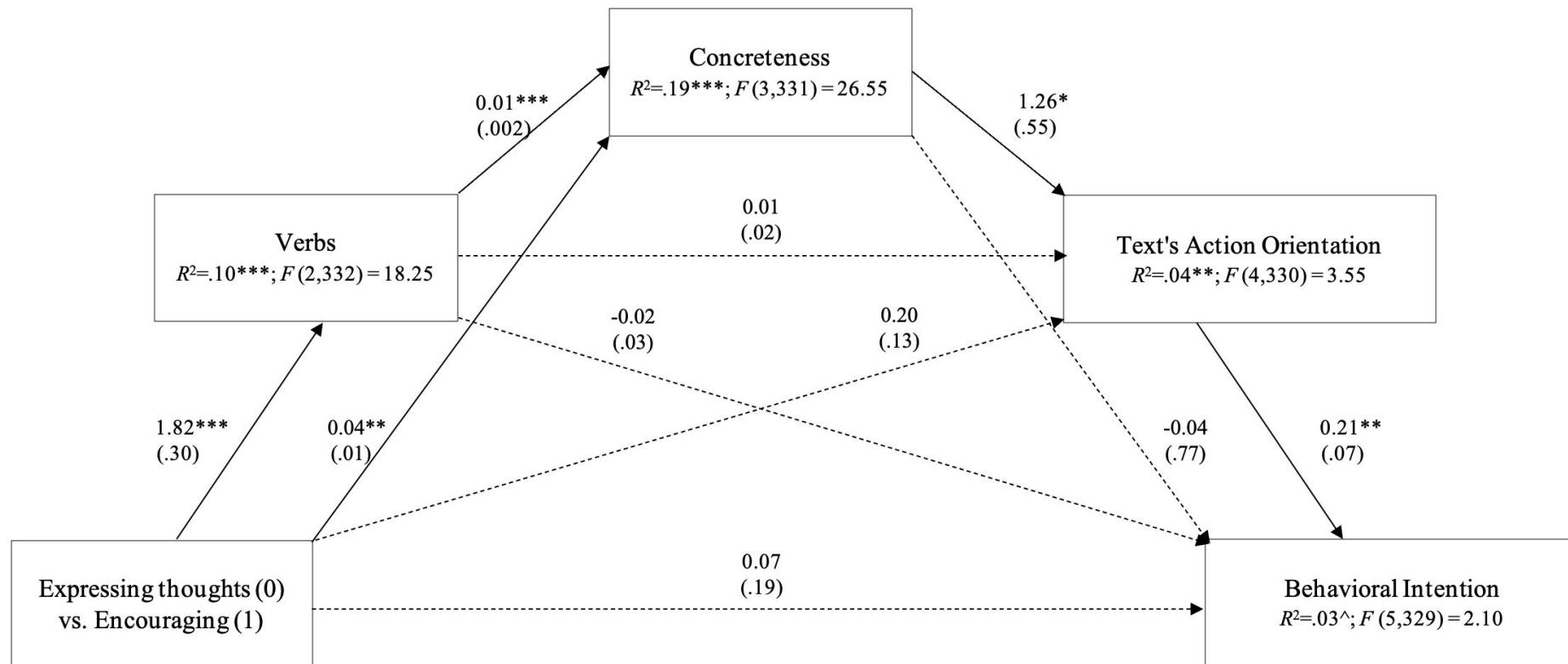
Study 2: Results: Mediation Analysis

Study Context



Study 3: Results: Mediation Analysis

Study Context



Study 4: 2020 U.S. Congressional Election Tweets

- **Real-life (election) Context**
- Politicians may **align their language** with their **persuasive goals**;
- Use of agentic language:
 - Function as a **catalyst for action orientation** among constituents, effectively serving as a **tool for mobilization**
 - Also, **enhances perceptions** of the speaker's **agency**, thereby boosting the perceived effectiveness of the campaign (Formanowicz et al., 2021)
- **Longitudinal approach:**
 - We examined whether as actors come closer to their goal they will also use more agentic language.







Text UNITED to 30330

**BUILD BACK
BETTER**

BIDEN

“

I will deal with the virus.

I will deal with
the economic crisis.

I will work to
**BRING EQUITY
& OPPORTUNITY
TO ALL.**



**BIDEN
HARRIS**



Vote Your Values Fight for Your Rights

ACLU Kentucky



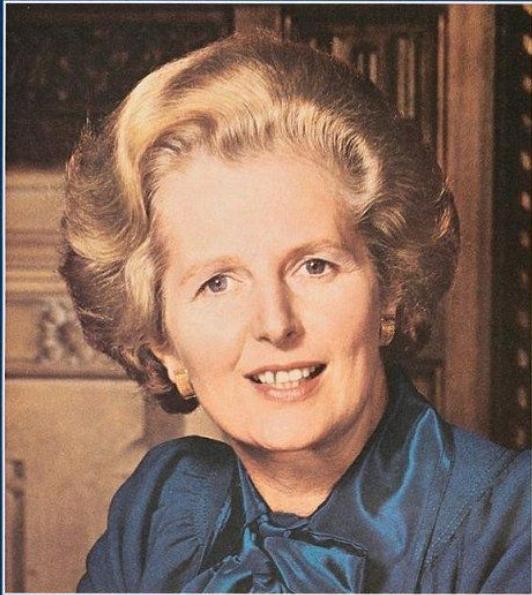
Honor the past,
support the future -

vote!



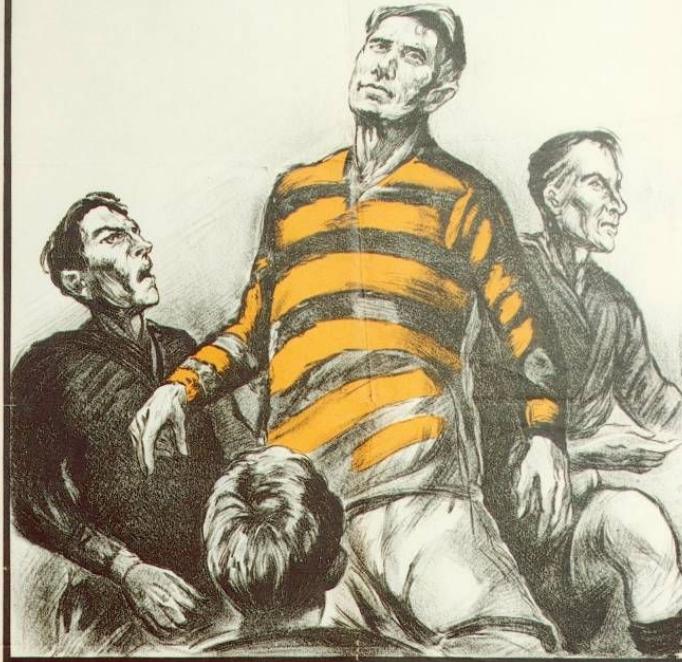


**Don't just hope
for a better life.
Vote for one.**



VOTE **CONSERVATIVE** X

USE YOUR HEAD!



**SUPPORT YOUR OWN TEAM
AND
VOTE LABOUR**

PUBLISHED BY THE LABOUR PARTY 33 EGGLESTON SQUARE, S.W.1 AND PRINTED BY THE CALEDONIAN PRESS, LTD., LONDON

Agency is also prevalent in commercial setting...



JUST DO IT

The text "JUST DO IT" is displayed in a large, bold, white sans-serif font. The words are stacked vertically, with "JUST" on the first line and "DO IT" on the second line, both centered horizontally on the page.



Think different.



DISCOVER KATOWICE



THE OLDEST PART OF KATOWICE

Although Katowice is a relatively young city – the municipal rights were granted in 1865 – it can boast the oldest city part that is comparatively well-preserved. The main artery of the old Katowice city is composed of 3 Maja street stretching from Wolności Square to Main Square as well as its extension towards the east, i.e. Warszawska Street. It is here that one can see the most impressive tenement houses dating from the end of 19th century and the beginning of 20th century, industrialists' mansions (e.g. The Goldstein Villa) as well as the oldest churches: the evangelical church from 1858 and the catholic church from 1870. The name "Mariacka" given to the street is closely connected with the latter. Mariacka street is a pedestrian precinct full of cafés and pubs buzzing with life nearly all night long. At the other end of the street one can notice an old railway station, which no longer serves its original purpose, but it still reminds us of how important the rail transport was for the origins and development of the city. From this place it is quite near the southern part of Katowice downtown where one can spot the voivodeship office and the Silesian Parliament buildings and the cathedral of Christ the King towering the town. There you can also walk along the Modern Route or visit the Museum of Katowice History.

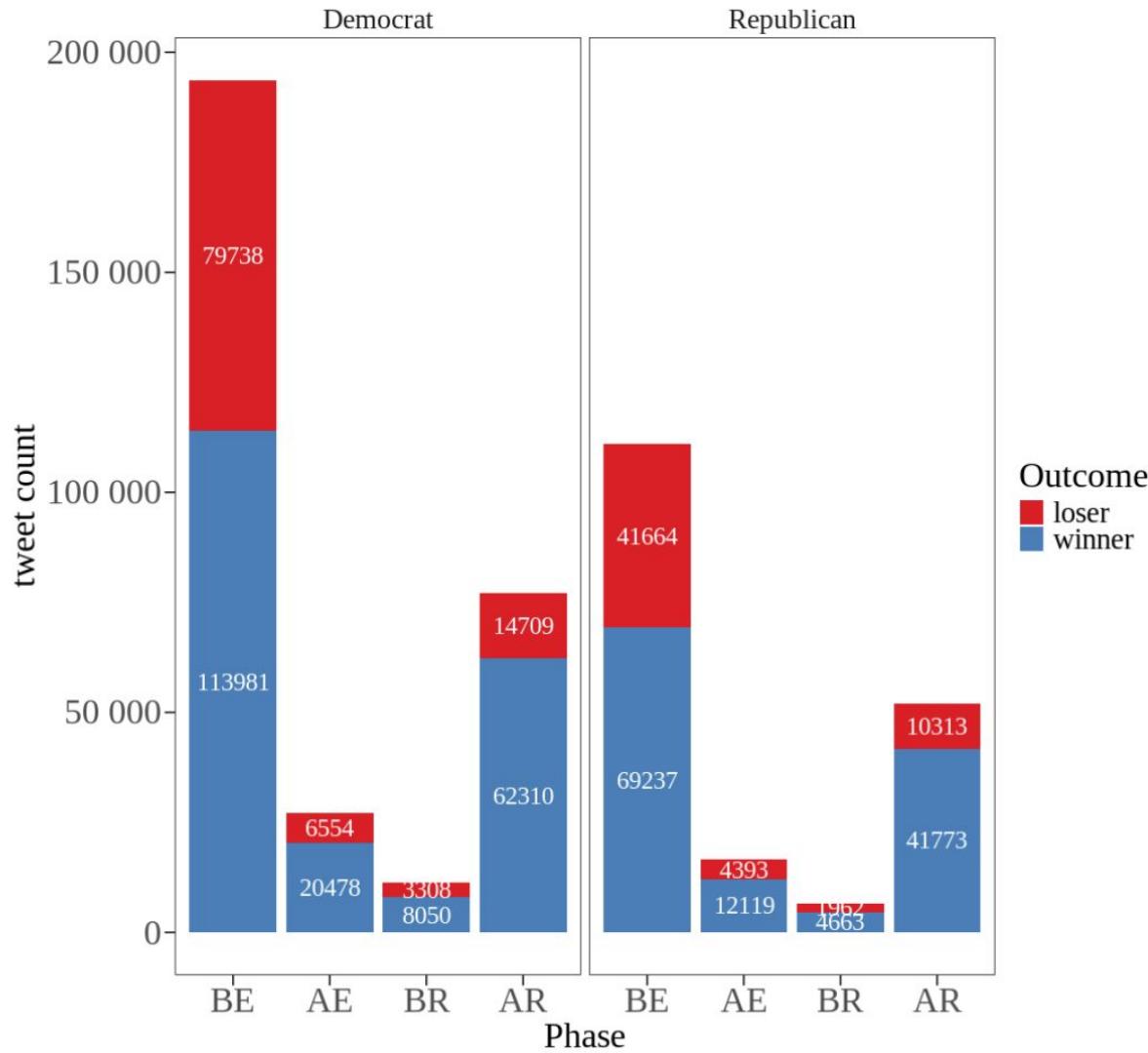
Study 4: 2020 U.S. Congressional Election Tweets

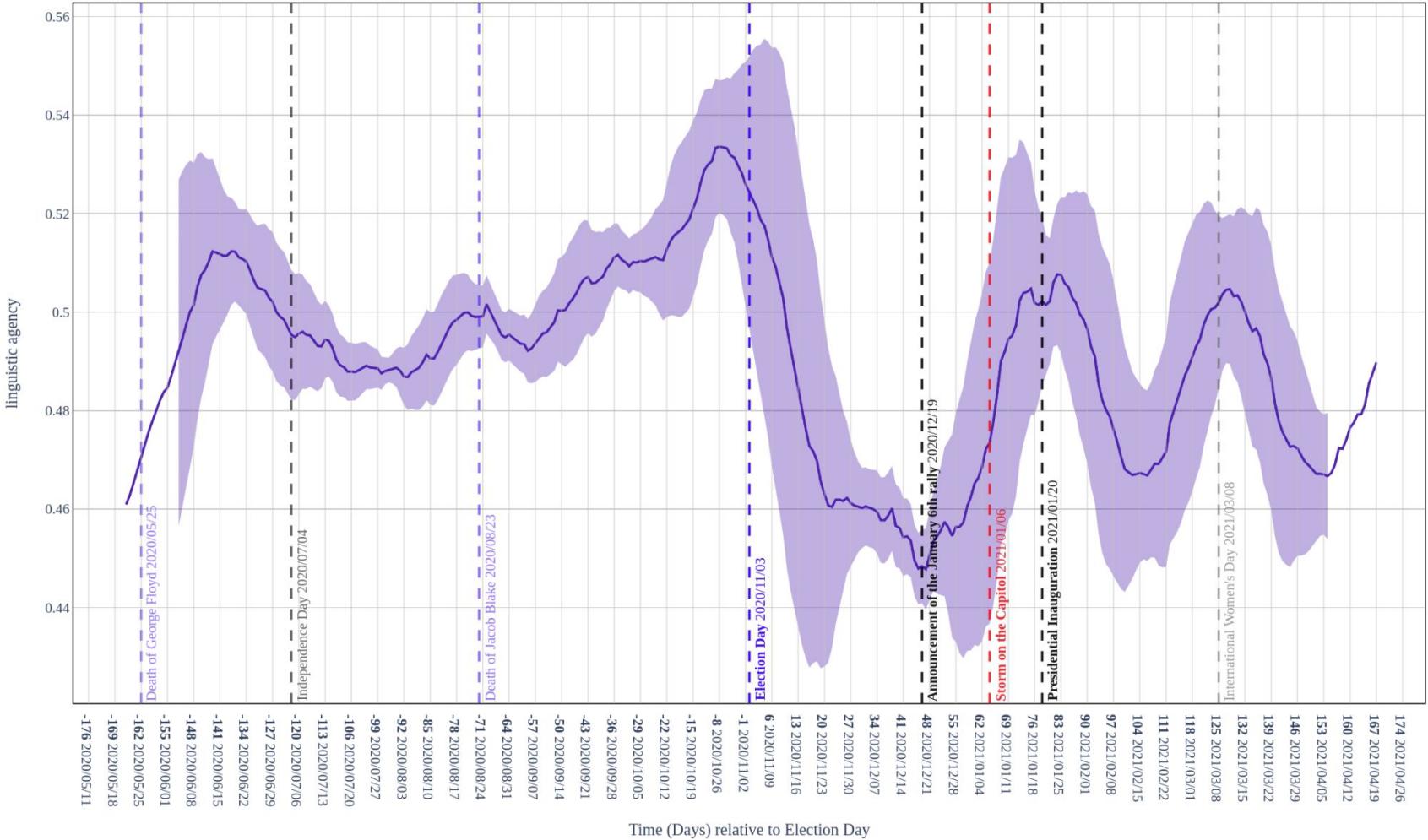
Based on the notion that **politicians may align their language with their persuasive goals** we hypothesized that:

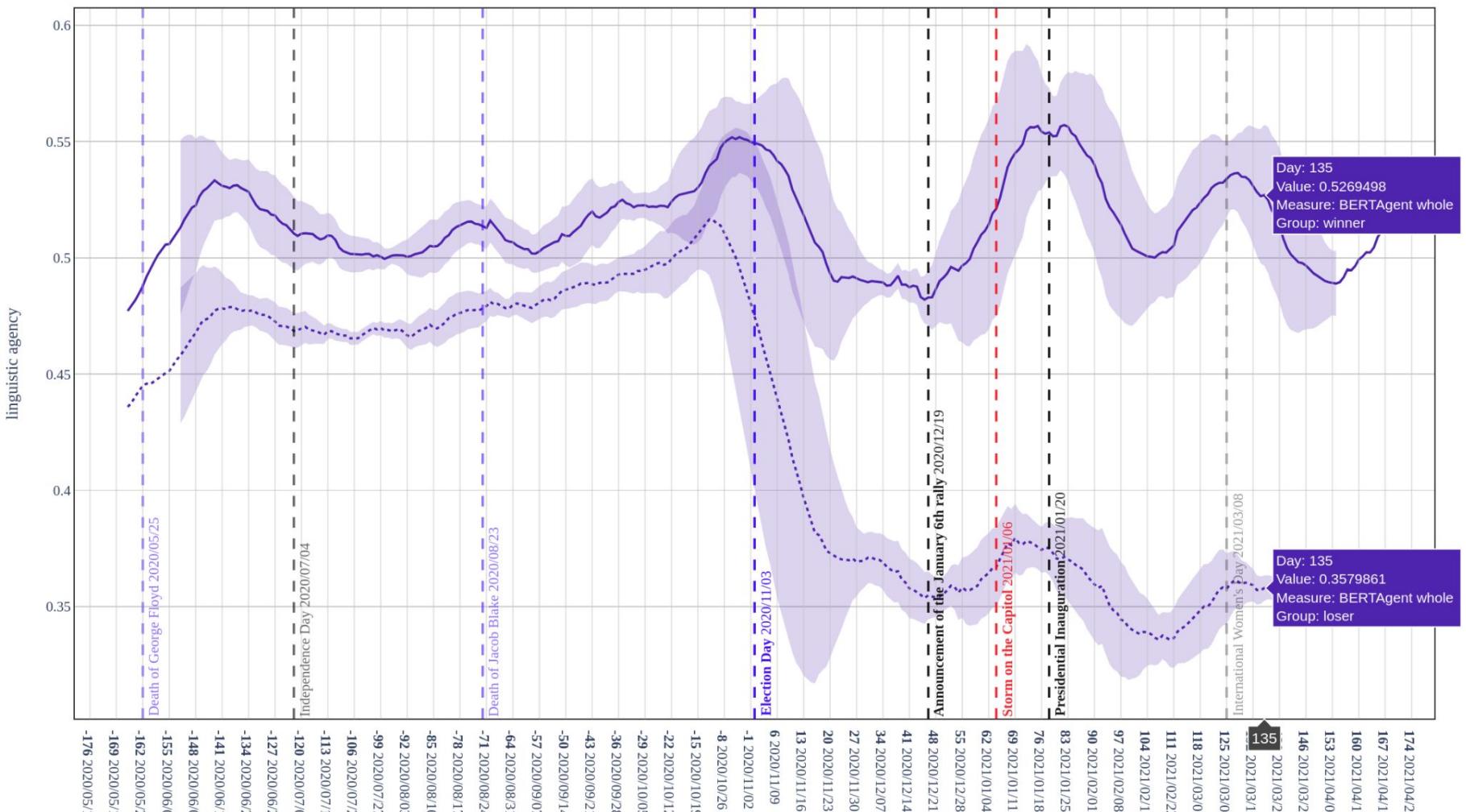
- The frequency of agentic language use **escalated** as the election approached (H1) and
- ... **declined** afterward (H2),
- Agentic communication will **increase** in before the January 6th Capitol riots (H3)
 - following Donald J. Trump's tweet announcing the January 6th rally, presumably with an intention to influence the Electoral College vote count ("Statistically impossible to have lost the 2020 Election. Big protest in D.C. on January 6th. Be there, will be wild!", Dec 19th).
- Following the Capitol riots - a **decrease** in agentic language (H4)

Study 4: 2020 U.S. Congressional Election Tweets

- ~ 0.5M original tweets from Democrat (D) and Republican (R) candidates;
- 180 days prior and after the election;
- 870 candidates (454 D and 416 R)
- 1283 Twitter profiles (671 D and 612 R)
- Agency was quantified in each tweet using **BERTAgent**;
- A daily average was computed for every candidate.



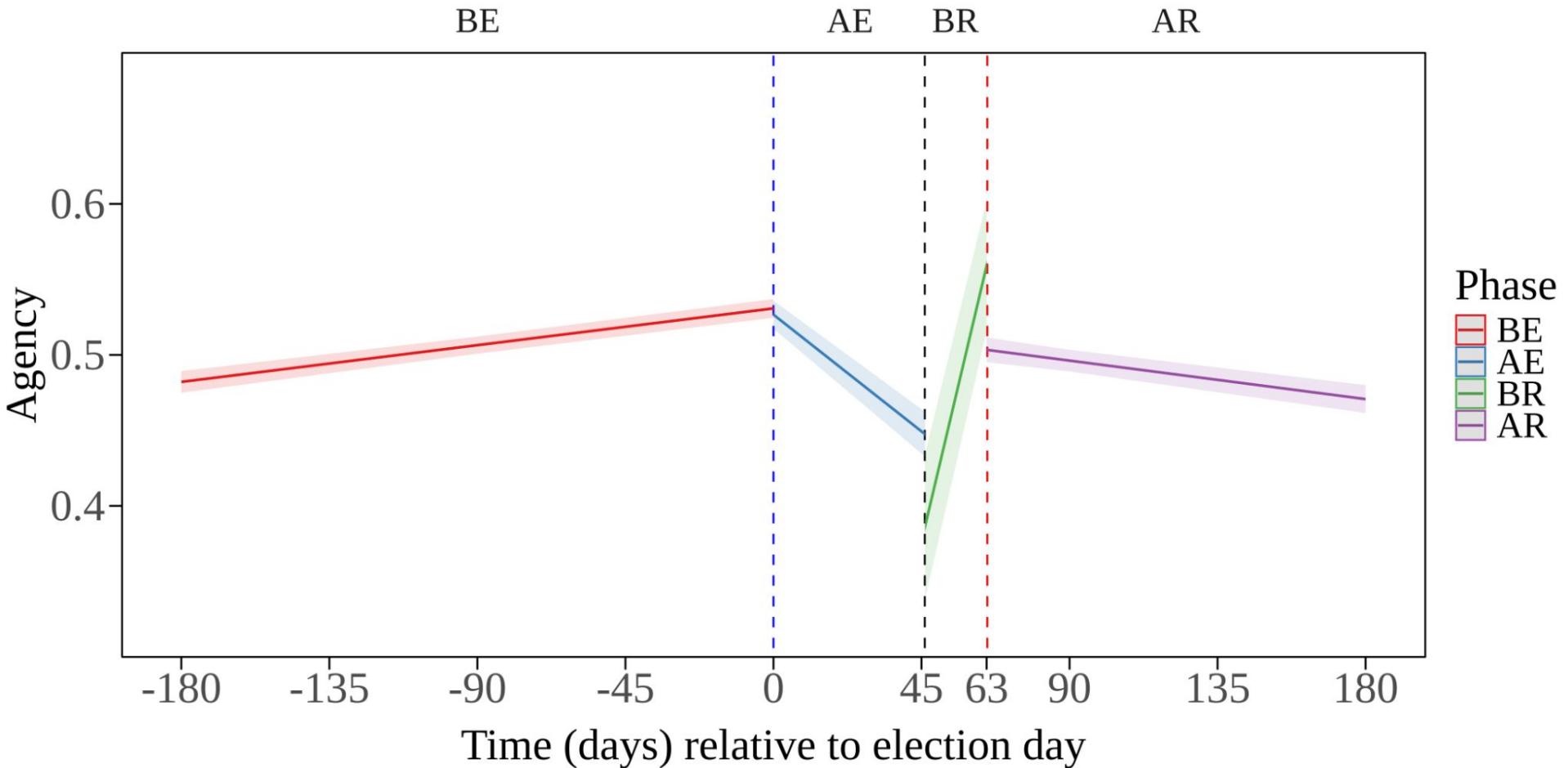




Study 4: Modelling of agency dynamics during election cycle

$$\text{Agency} \sim \text{Time} * \boxed{\text{Period}} + (\text{Time} | \text{Name})$$

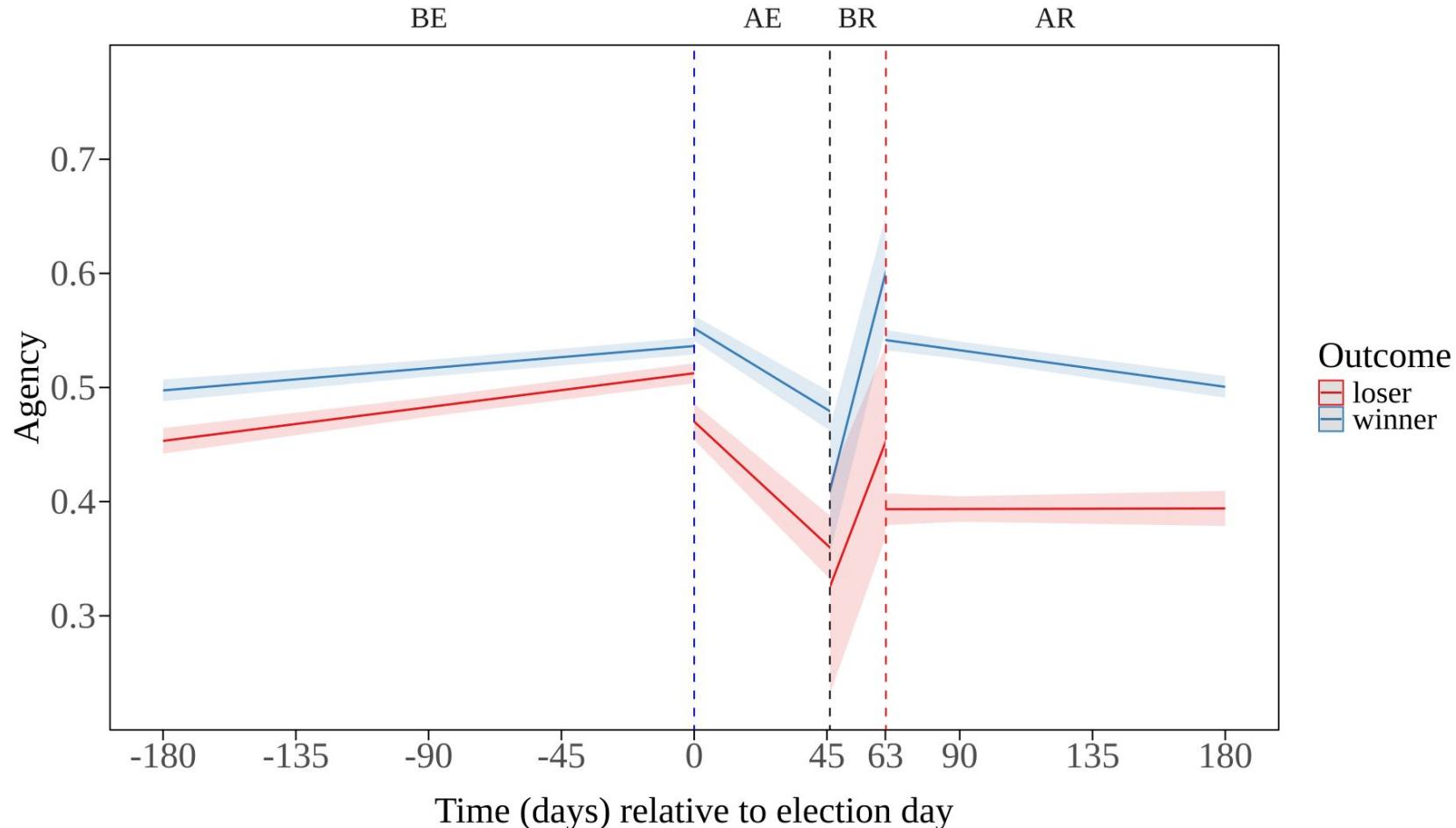
Average predicted values of Agency



Study 4: Modelling of agency dynamics during election cycle

Agency ~ Time * Period * Outcome + (Time | Name)

Average predicted values of Agency



Predictors	Model 3		Model 4	
	Estimates	CI	Estimates	CI
(Intercept)	0.53 ***	0.52 – 0.53	0.52 ***	0.51 – 0.52
Time	0.04 ***	0.04 – 0.05	0.06 ***	0.05 – 0.07
Phase [AE]	-0.00	-0.01 – 0.00	-0.04 ***	-0.06 – -0.03
Phase [BR]	-0.57 ***	-0.63 – -0.51	-0.50 ***	-0.61 – -0.38
Phase [AR]	-0.01	-0.02 – 0.00	-0.12 ***	-0.14 – -0.10
Time × Phase [AE]	-0.36 ***	-0.41 – -0.31	-0.49 ***	-0.59 – -0.39
Time × Phase [BR]	1.61 ***	1.42 – 1.80	1.15 ***	0.78 – 1.52
Time × Phase [AR]	-0.10 ***	-0.11 – -0.09	-0.06 ***	-0.09 – -0.03
Outcome [winner]			0.02 ***	0.01 – 0.04
Time × Outcome [winner]			-0.02 **	-0.03 – -0.01
Phase [AE] × Outcome [winner]			0.06 ***	0.04 – 0.08
Phase [BR] × Outcome [winner]			-0.09	-0.23 – -0.04
Phase [AR] × Outcome [winner]			0.15 ***	0.12 – 0.17
(Time × Phase [AE]) × Outcome [winner]			0.17 **	0.05 – 0.28
(Time × Phase [BR]) × Outcome [winner]			0.63 **	0.19 – 1.06
(Time × Phase [AR]) × Outcome [winner]			-0.04 **	-0.08 – -0.01

Concussions¹

- People whose **communicative goal** is to **persuade others** employ **linguistic devices** that are associated with action orientation □ **agentic** and **concrete language**
- These devices are associated with recipients evaluations of the message: both in terms of **perceived agency** and **persuasive appeal**
- **Political** communicators also employ these linguistic devices in line with the unfolding of their persuasive goals.
- Politician's linguistic agency **increases while getting closer to a critical p**



Bonus Study (Preliminary Results):

1) Topics

*Raise awareness of **mental health issues***

*Prevent **climate change** and protect environment*

*Increase **voting turnout** in elections*

*Reduce **economic inequality***

*Increase **volunteering***

*Advocate for **free speech***

*Protect **human rights***

*Ensure **food security** and **sustainable agriculture***

*Advocate for **digital privacy and security***

2) **Highlights** by **Authors** (N = 800) and **Readers** (N = 800)

raise awareness
of mental health
issues No

Hey everyone, let's come together to shine a light on mental health! It's crucial to start conversations, offer support, and break the stigma. By raising awareness, sharing our stories, and educating others, we can make a difference in the lives of those struggling. Let's share resources, show empathy, and foster understanding. Every conversation counts in making a positive difference in someone's life. Together, we can create a more compassionate and supportive community for everyone dealing with mental health challenges. Let's build a safe space for everyone to openly talk about their struggles and seek help without fear of judgment or shame. Join us in this important mission!

Bonus Study (Preliminary Results):

Linguistic Feature ~ (1 | OrigResId) + (1 | Topic) + Chunk * Type

	Concreteness		Base-Form Verbs WOBH		Agency Pos		Agency Neg		Agency Abs	
Predictors	Estimates	CI	Estimates	CI	Estimates	CI	Estimates	CI	Estimates	CI
(Intercept)	2.38 ***	2.34 – 2.42	6.15 ***	5.57 – 6.73	13.50 ***	11.33 – 15.67	5.34 ***	4.12 – 6.56	18.82 ***	17.35 – 20.28
Chunk [HL]	0.12 ***	0.10 – 0.14	2.53 ***	1.96 – 3.09	1.92 ***	1.20 – 2.64	1.90 ***	1.31 – 2.48	3.82 ***	3.10 – 4.53
Type [READER]	-0.01	-0.02 – 0.01	-0.17	-0.65 – 0.31	-0.45	-1.06 – 0.16	0.04	-0.45 – 0.54	-0.39	-1.00 – 0.21
Chunk [HL] × Type [READER]	0.01	-0.01 – 0.03	0.90 **	0.23 – 1.58	0.99 *	0.13 – 1.84	0.36	-0.34 – 1.06	1.35 **	0.50 – 2.20
Random Effects										
σ^2	0.03		33.48		54.40		35.81		53.31	
τ_{00}	0.01	OrigResId	10.49	OrigResId	41.93	OrigResId	20.70	OrigResId	18.71	OrigResId
	0.00	Topic	0.24	Topic	9.75	Topic	2.75	Topic	4.12	Topic
ICC	0.31		0.24		0.49		0.40		0.30	
N	802	OrigResId	802	OrigResId	802	OrigResId	802	OrigResId	802	OrigResId
	9	Topic	9	Topic	9	Topic	9	Topic	9	Topic
Observations	5456		5463		5480		5480		5480	
Marginal R ² / Conditional R ²	0.089 / 0.368		0.055 / 0.284		0.016 / 0.496		0.019 / 0.407		0.071 / 0.349	

* p<0.05 ** p<0.01 *** p<0.001

Linguistic Feature ~ (1 | OrigResId) + (1 | Topic) + Chunk * Type



Lejla Džanko

SWPS University



Caterina Suitner

University of Padova



Michał Olech
Gdański Uniwersytet Medyczny



Marta Witkowska
SWPS University



Magdalena Formanowicz

SWPS University



Jan Nikadon

SWPS University



Tomaso Erseghe

University of Padova



Paweł Jurek
Uniwersytet Gdańskie

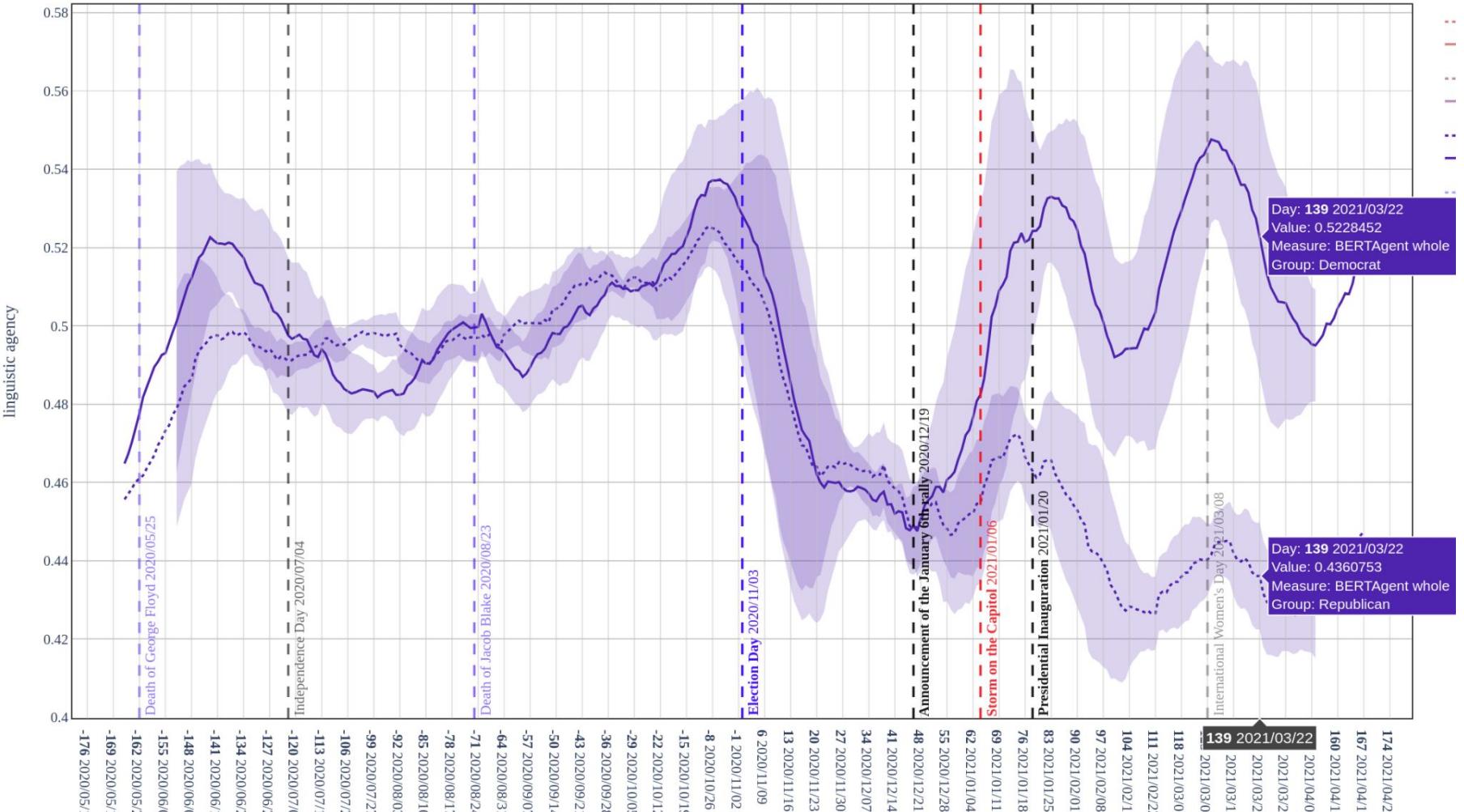


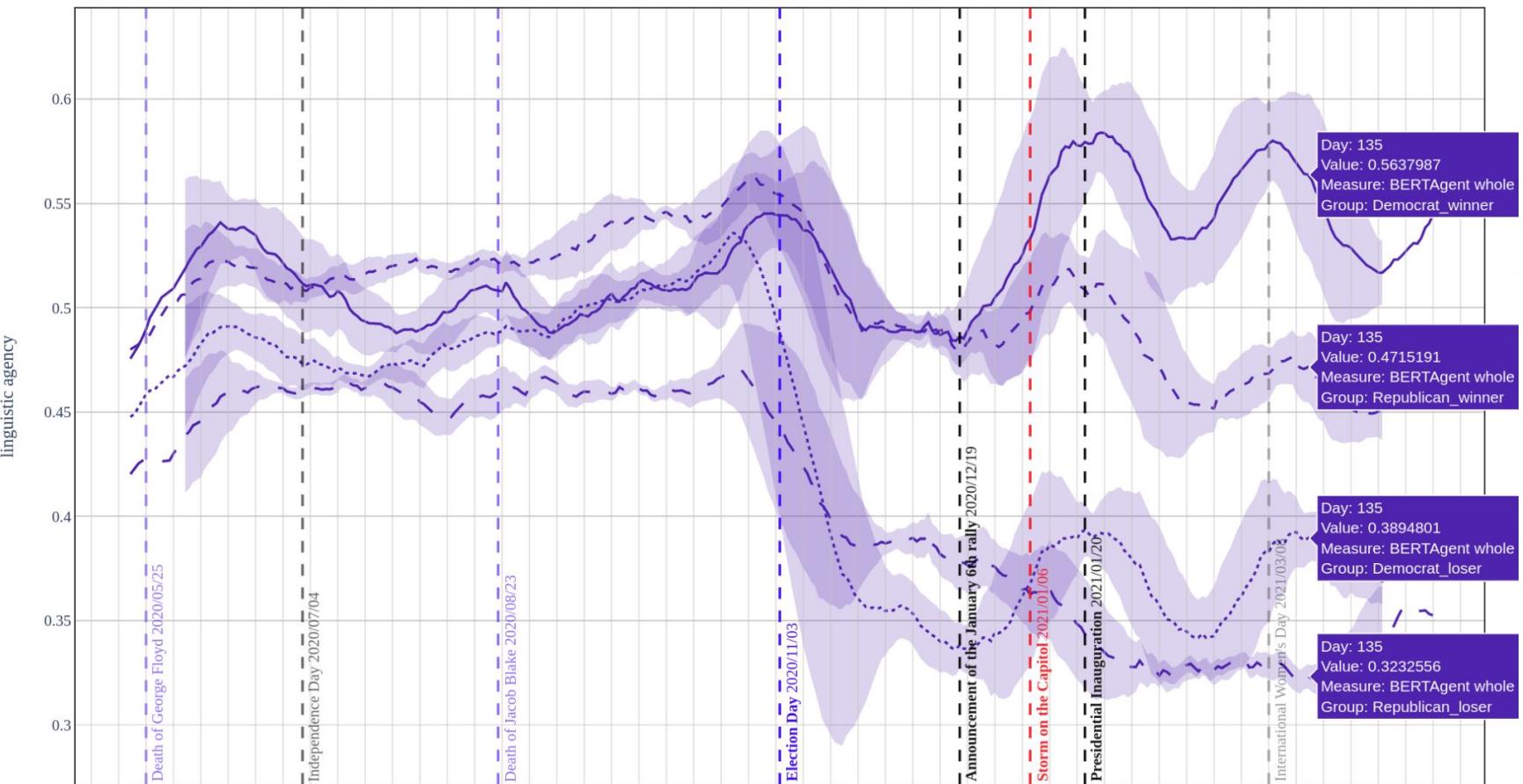
Marta Beneda
New York
University Abu
 Dhabi

**Thank
you!**

https://cogsys.io/polit/scatter_batch_0021_GAUSS_4.html

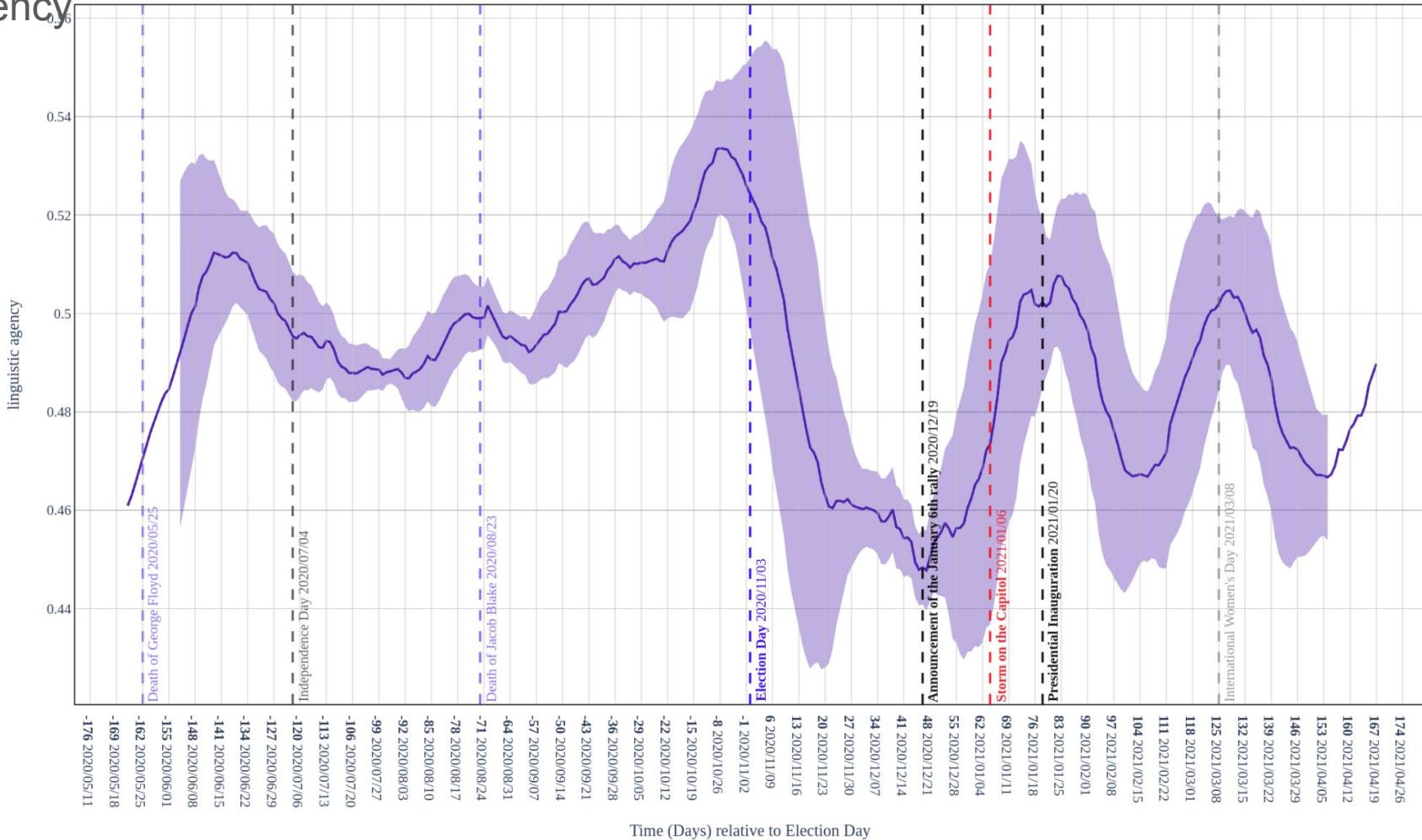
<https://cogsys.io/polit/n0008-init.html>



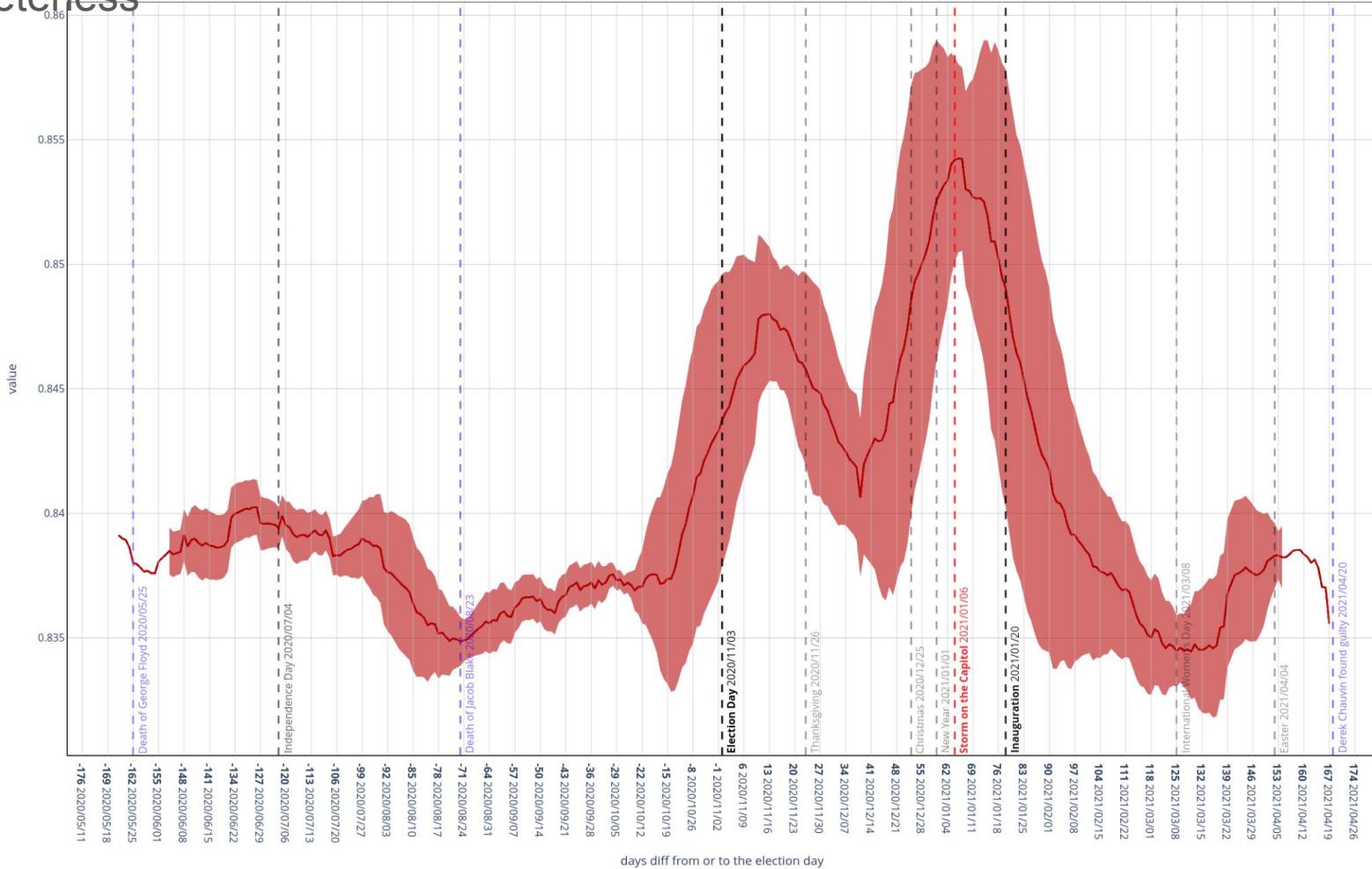


-113	2020/07/13
-120	2020/07/06
-127	2020/06/29
-134	2020/06/22
-141	2020/06/15
-148	2020/06/08
-155	2020/06/01
-162	2020/05/25
-169	2020/05/18
-176	2020/05/11

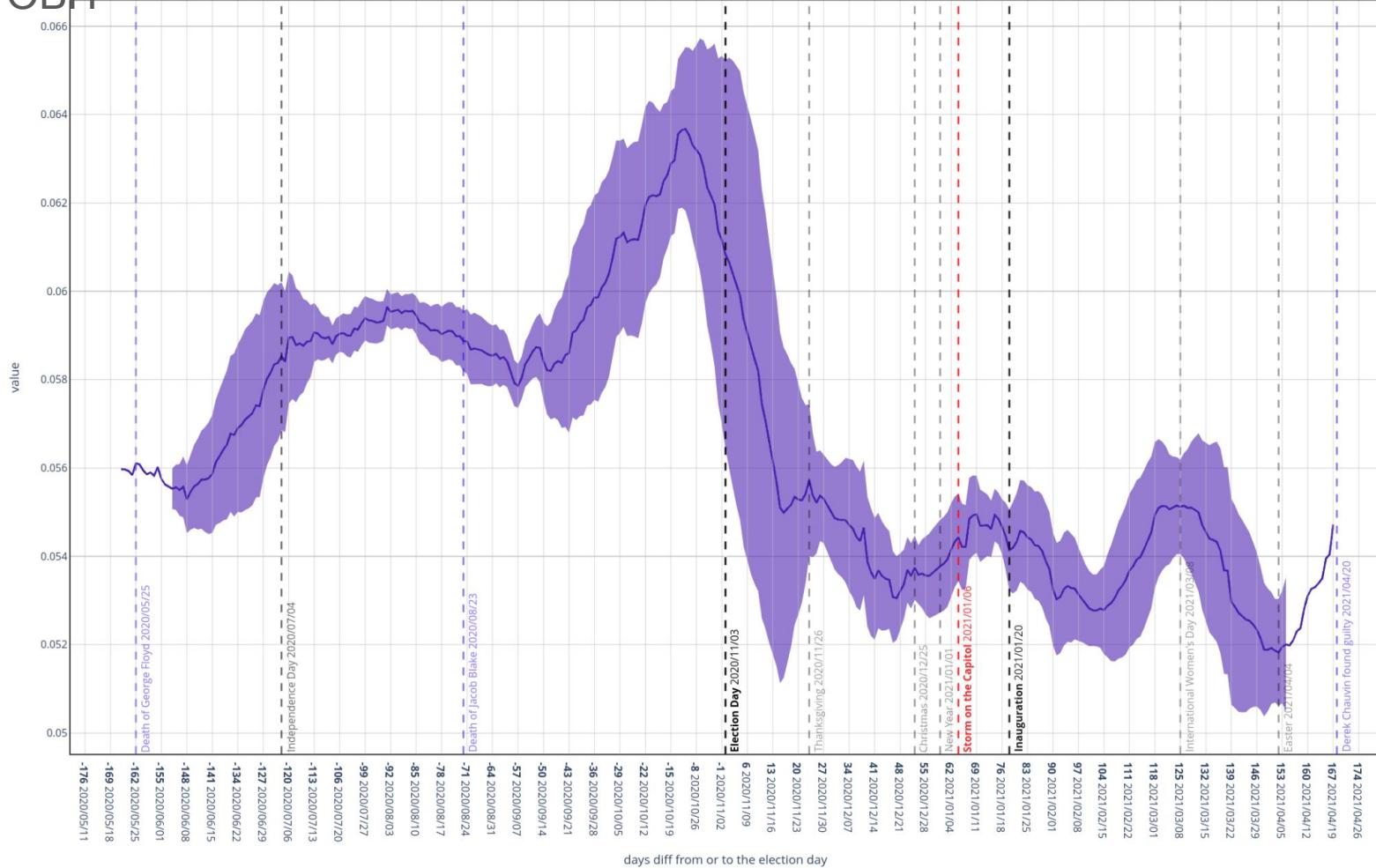
Agency



Concreteness



VB-WOBH



BERTAgent: Online resources

- Preprint: <https://psyarxiv.com/qw6u3/>
- SOM is available at <https://github.com/cogsys-io/BERTAgent-SOM/>
- Installation from <https://pypi.org/project/bertagent/>
 - **pip install bertagent**
 - Documentation + tutorial: <https://bertagent.readthedocs.io/>
 - Source code: <https://github.com/cogsys-io/bertagent/>



Search docs

CONTENTS:

bertagent

Installation

Tutorial

Process a list of sentences

Process a texts in pandas dataframe

Usage

Package modules

Contributing

Credits

History

```
# .readthedocs.yaml
build.tools:
    python: "3.11"
sphinx:
    configuration: conf.py
python.install:
    - requirements: pip.in
```

Supercharge your Sphinx docs with deployment on Read the Docs. [Sign up today!](#)

Ad by EthicalAds · i

Welcome to BERTAgent's documentation!

Edit on GitHub

Next ↗



Welcome to BERTAgent's documentation!

pypi v1.0.7 build passing docs passing license GNU General Public License v3

Contents:

- [BERTAgent](#)
 - [Features](#)
 - [Credits](#)
- [Installation](#)
 - [Stable release](#)
 - [From sources](#)
- [Tutorial](#)
 - [Process a list of sentences](#)
 - [Process a texts in pandas dataframe](#)
- [Usage](#)
- [Package modules](#)
 - [bertagent package](#)
- [Contributing](#)



BERTAgent: A novel tool for quantifying linguistic agency: An application in the analysis of mobilising election candidate support on Twitter during the 2020 U.S. congressional elections

Jan Nikadon¹, Lejla Džanko¹, Tomaso Erseghe², Caterina Suitner³, Michal Olech⁴, Paweł Jurek⁵, Magdalena Formanowicz¹

¹ Center for Research on Social Relations, SWPS University, Warsaw, Poland

² Department of Information Engineering, University of Padova, Italy

³ Department of Psychology of Development and Socialization, University of Padova, Italy

⁴ Medical University of Gdańsk, Poland

⁵ Institute of Psychology at the University of Gdańsk, Poland

nikadon@gmail.com



#ICLASP18, Tallinn, 2024/06/15

This research was funded by the OPUS 19 grant of the Polish National Science Center awarded to Magdalena Formanowicz (2020/37/B/HS6/02587).

Agency

- *The ability to assign goals and pursue their achievement* (Bakan, 1966; Bandura, 2001)
- *One of the most basal attributes of (all) biological systems* (Arnellos & Moreno, 2015; Barandiaran & Moreno, 2008; Levin, 2019; Moreno, 2018)
- *An inherently agent-profitable trait* (Frith & Frith, 2010)
- *For agents it provides a generalized functional value because...*
 - *it facilitates goal-achievement that translates into adaptive advantage* (Moreno, 2018)

Agency

- Enjoys **attentional privilege** (Abele & Wojciszke, 2007)
- Identification of agency is:
 - one of the most important, **privileged**, and
 - **deeply integrated** (rapid and automatic) aspects of human cognition (e.g., Hafri et al., 2013; Hafri et al., 2018; Rosander & von Hofsten, 2011)
- **Other agents** capture **our attention** because...
 - their actions can affect (align or disrupt) the achievement of our own goals (Frith & Frith, 2010; New et al., 2007)

Agency

Pertains to:

- *goal-orientation and achievement;*
- a fundamental aspect of human *cognition* and *behavior*.
 - [for individuals, for interpersonal and group relations]

Critical for the analysis of human...

- actions;
- interactions;
- social group dynamics;

Language

- *The most accessible and efficient tool for: reflecting, transmitting, and shaping/regulating socially relevant phenomena (Holtgraves & Kashima, 2008; Karasawa & Maass, 2008).*
- **Speech acts** are also inherently **behavioral acts** (Austin, 1962; Butler, 1997; Searle, 1969), and as such they convey (**signal** and **express**) agency.

Linguistic Agency

- *Agency is extensively **encoded in language** (de Hoop & Lamers, 2006; Formanowicz et al., 2017; Gardelle & Sorlin, 2018a, 2018b; Siewierska, 2004)*
- **Linguistic agency (LA) also enjoys **attentional privilege** (Bornkessel-Schlesewsky & Schlesewsky, 2009; Muralikrishnan et al., 2015)**

Tool Development Motivations

- Researchers need a tool that is capable of...
 - **detecting and quantifying** *linguistic agency* in text
(e.g. online textual exchanges):
 - with **high precision**,
 - **at scale**.
- Potential applications include investigation of:
 - trajectories of ***social relations***,
 - content of ***group stereotypes***,
 - emergence and unfolding of ***collective action***.

Existing Tools

- Based predominantly on the dictionary word-count (DWC) methodology;
- DWC was popularized by frameworks such as
 - General Inquirer (GI; Stone et al., 2007; Stone and Hunt, 1963)
 - Linguistic Inquiry and Word Count (LIWC; Pennebaker et al., 2015)
- LIWC and GI contain dozens of — partly thematic and partly grammatical — word dictionaries (categories) that are used to detect, measure, and statistically compare a variety of psychologically relevant phenomena;
- First problem: no agency-specific category in GI and LIWC.

Makeshift Solutions

- Researchers either:
 - use combinations of existing dictionaries as a proxy for agency (e.g., Madera et al., 2009 used Cognitive Processes, Motion and Achievement from LIWC), or
 - prepare custom agency-specific dictionaries (e.g., Pietraszkiewicz et al., 2019)

Example: Agency LIWC-style Dictionary

Agency Dictionary (A) by Pietraszkiewicz et al. (2019)

"able", "accomplish*", "accurac*", "accurate*", "achiev*", "acquir*", "actualiz*", "adaptab*", "adept*", "ambition*", "ambitious*", "aptitude*", "aptly", "aptness", "aspiration*", "aspire*", "aspiring", "assert*", "attain*", "authoritative*", "autonomous*", "autonomy", "capab*", "careful*", "choice", "choices", "clever*", "compet*", "completion", "confident", "confidently", "conquer*", "conscientious*", "contemplat*", "contend*", "contest*", "decid*", "decision*", "decisive*", "defeat*", "deliberat*", "dependable", "determin*", "difficult*", "do", "doable", "doing", "eager*", "earn", "earned", "earning", "earns", "easiness", "easy", "effective*", "efficien*", "effort*", "empowered", "enact*", "endeavor*", "establish", "established", "establishes", "establishing", "exact*", "expert*", "fail*", "fluen*", "freedom*", "freely", "goal", "goal-oriented", "goals", "importan*", "independ*", "individualist", "insight*", "intent*", "intuition", "intuitive*", "keen*", "know*", "liberties", "liberty", "logic*", "loner*", "made", "make", "makes", "making", "mastered", "masterful*", "mastering", "mastery", "motivat*", "need", "needed", "needing", "needs", "objectiv*", "obtain*", "opportun*", "overcame", "overcome", "overcomes", "overcoming", "persever*", "persist*", "persistent", "pioneer*", "practic*", "pragmat*", "prevail*", "pride", "prideful*", "priorit*", "proactive*", "productive*", "productivity", "proficien*", "prosper*", "proud*", "purpose*", "pursu*", "rational*", "realiz*", "rebel*", "recog*", "reliab*", "reputation*", "resilien*", "resolute*", "resolution", "resolv*", "responsib*", "reward*", "risk*", "savv*", "score", "scored", "scores", "scoring", "self", "self-*", "should*", "significant*", "skill", "skilled", "skillful*", "skills*", "smart", "smartly", "steadfast*", "strive*", "striving*", "struggl*", "stubborn*", "succeed*", "success*", "sure", "take", "takes", "taking", "tenac*", "think*", "thought", "took", "tried", "tries", "triumph*", "trying", "unaided", "unyielding*", "vanquish*", "victor*", "will", "willing*", "willpower", "win", "winner*", "winning*", "wins", "wit", "wits", "witting*", "won", "won't", "you", "you'*", "your", "yours", "yourself"

ccurate*", "achiev*", "acquir*", "actualiz*", "adaptab*", "adept*", "ambaptness", "aspiration*", "aspire*", "aspiring", "assert*", "attain*", "au'careful*", "choice", "choices", "clever*", "compet*", "completion", "conious*", "contemplat*", "contend*", "contest*", "decid*", "decision*", "de, "determin*", "difficult*", "do", "doable", "doing", "eager*", "earn", ', "effective*", "efficien*", "effort*", "empowered", "enact*", "endeavorhes", "establishing", "exact*", "expert*", "fail*", "fluen*", "freedom*" portan*", "independ*", "individualist", "insight*", "intent*", "intuitionrties", "liberty", "logic*", "loner*", "made", "make", "makes", "making" "motivat*", "need", "needed", "needing", "needs", "objectiv*", "obtain*" "overcoming", "persever*", "persist*", "persistent", "pioneer*", "practiciorit*", "proactive*", "productive*", "productivity", "proficien*", "prosonal*", "realiz*", "rebel*", "recog*", "reliab*", "reputation*", "resilie" "responsib*", "reward*", "risk*", "savv*", "score", "scored", "scores", cant*, "skill", "skilled", "skillful*", "skills*", "smart", "smartly", "stubborn*", "succeed*", "success*", "sure", "take", "takes", "taking", "tries", "triumph*", "trying", "unaided", "unyielding*", "vanquish*", "w', "winner*", "winning*", "wins", "wit", "wits", "witting*", "won", "won

ccurate*", "achiev*", "acquir*", "actualiz*", "adaptab*", "adept*", "ambaptness", "aspiration*", "aspire*", "aspiring", "assert*", "attain*", "a'careful*", "choice", "choices", "clever*", "compet*", "completion", "conious*", "contemplat*", "contend*", "contest*", "decid*", "decision*", "de, "determin*", "difficult*", "do", "doable", "doing", "eager*", "earn", ', "effective*", "efficien*", "effort*", "empowered", "enact*", "endeavorhes", "establishing", "exact*", "expert*", "fail*", "fluen*", "freedom*" portan*", "independ*", "individualist", "insight*", "intent*", "intuitionrties", "liberty", "logic*", "loner*", "made", "make", "makes", "making" "motivat*", "need", "needed", "needing", "needs", "objectiv*", "obtain*" "overcoming", "persever*", "persist*", "persistent", "pioneer*", "practiciorit*", "proactive*", "productive*", "productivity", "proficien*", "prosonal*", "realiz*", "rebel*", "recog*", "reliab*", "reputation*", "resilie "responsib*", "reward*", "risk*", "savv*", "score", "scored", "scores", cant*", "skill", "skilled", "skillful*", "skills*", "smart", "smartly", "stubborn*", "succeed*", "success*", "sure", "take", "takes", "taking", "tries", "triumph*", "trying", "unaided", "unyielding*", "vanquish*", ", "winner*", "winning*", "wins", "wit", "wits", "witting*", "won", "won

Existing tools: Pietraszkiewicz et al. 2019 and Nicolas et al. 2021

Dictionary word-count (DWC) methodology!

- E.g., Linguistic Inquiry and Word Count (LIWC).

Pros:

- methodological and applicational simplicity,
- extensive validation in numerous studies.

Cons:

- insensitivity to **polysemy**,
e.g., ***we can lead them*** vs. ***this water contains lead***;
- insensitivity to **negation**,
e.g., ***motivated*** vs. ***not motivated*** vs. ***not so much motivated***;
- insensitivity to **gradation** of agency conveyed by different concepts,
e.g., ***trying to work*** vs. ***striving to work***;
- [often] insensitivity to **directionality** (valence) of conveyed agency
e.g., ***we failed*** vs. ***we succeeded***.

BERTAgent = Agency Detection + LLM

Our aim:

Provide tool that can work at scale alleviating shortcomings of the existing methods.

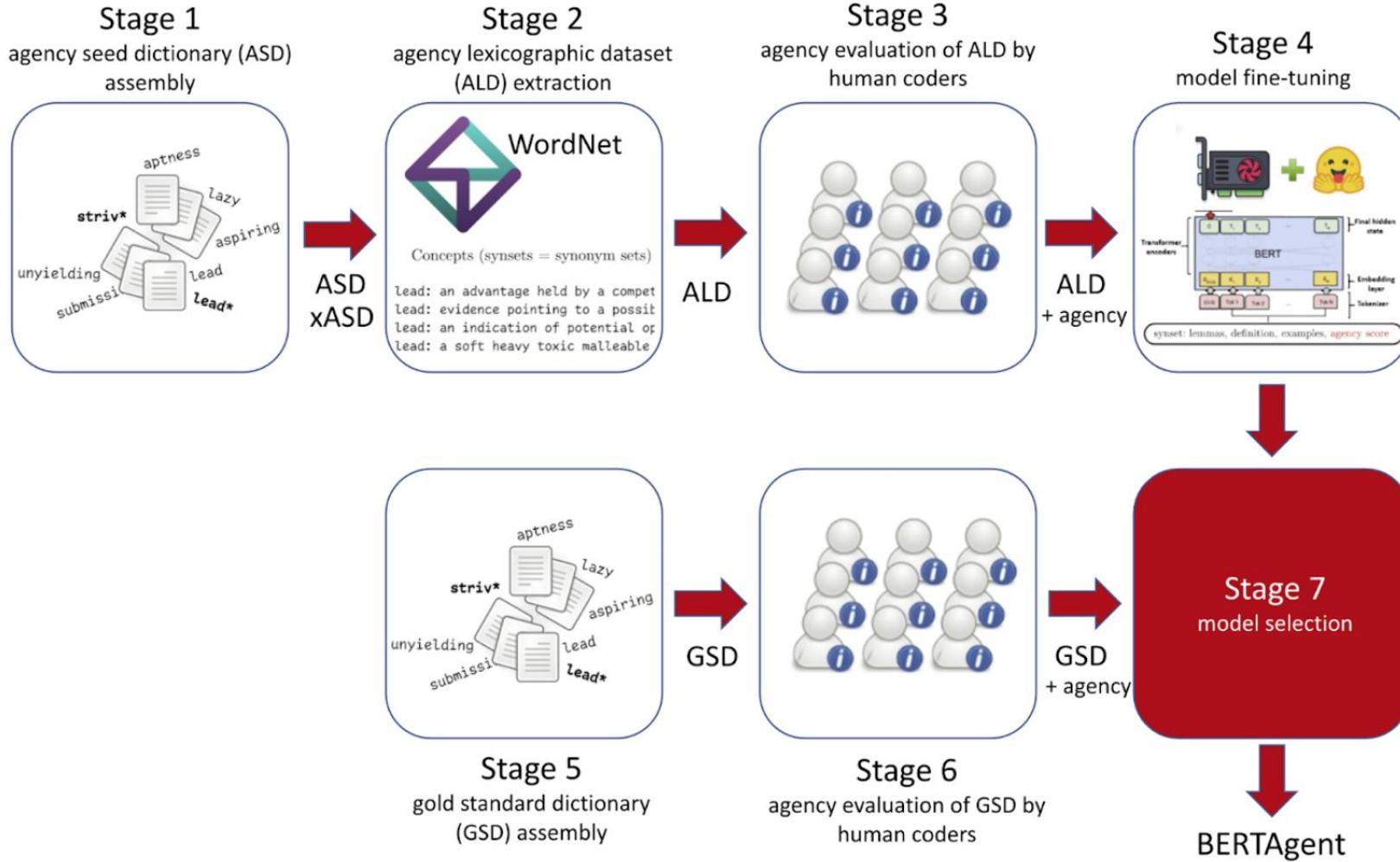
E.g., capable of handling *hard working individual* vs. *hardly working individual*.

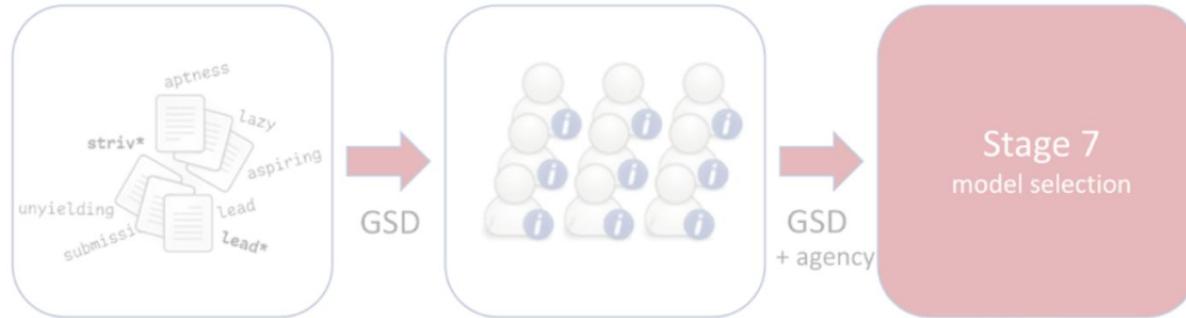
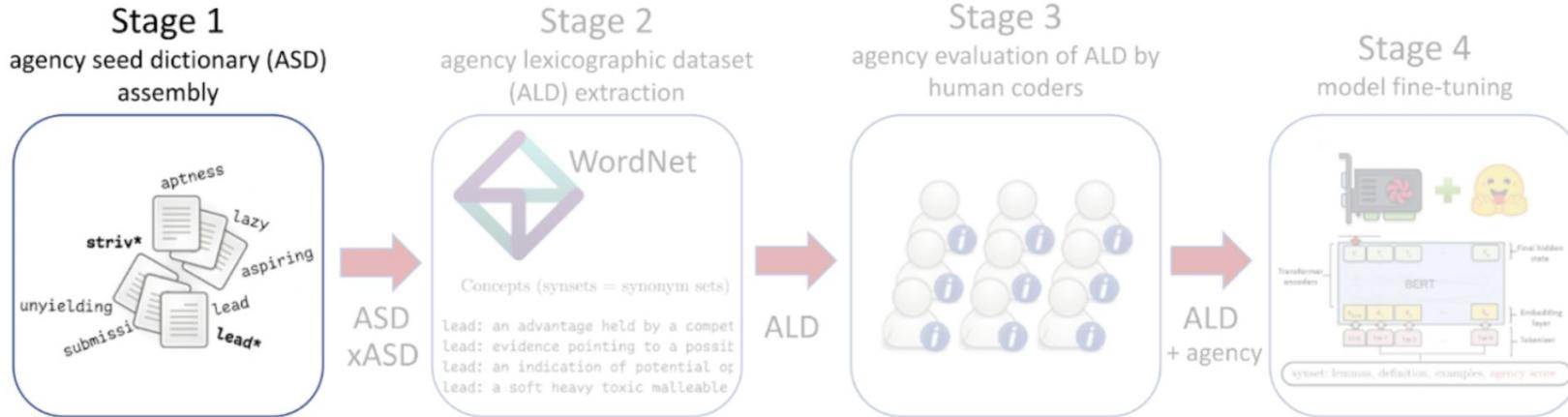
Technical solution:

Transformer-based large language models (LRMs)...

that process text in a context sensitive manner...

trained to detect agency.





BERTAgent
<https://pypi.org/project/bertagent/>

Stage 1

agency seed dictionary (ASD)
assembly



Data collection



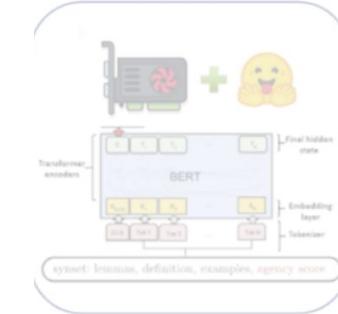
Dictionary patterns expansion

lead*: “leader”, “leading”, “leaden”, ...

striv*: “striving”, “strive”, ...

Stage 4

model fine-tuning

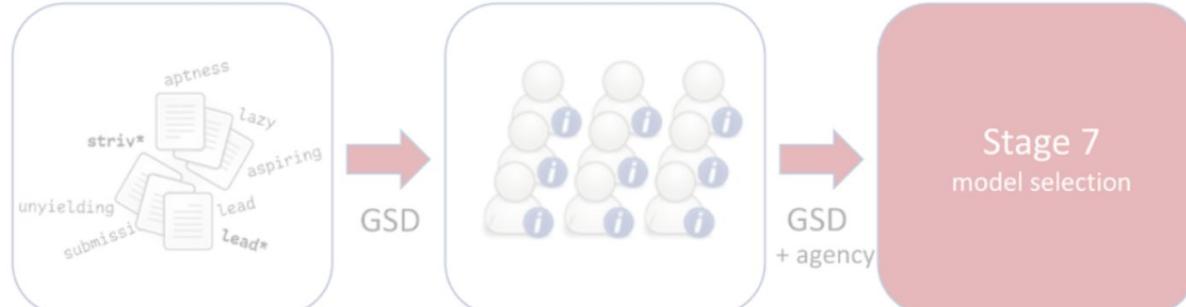
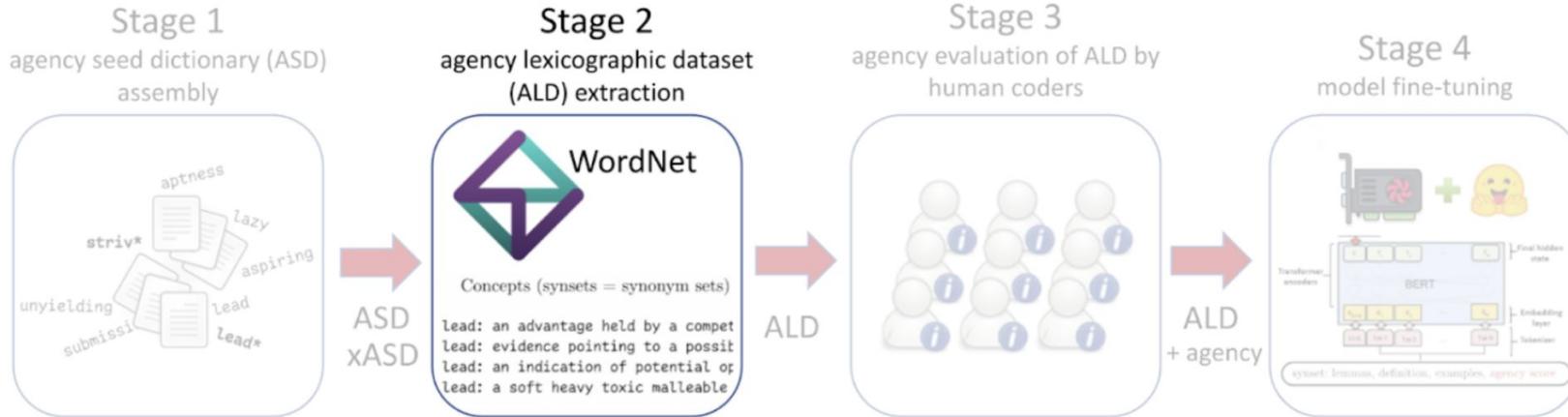


Stage 7

model selection

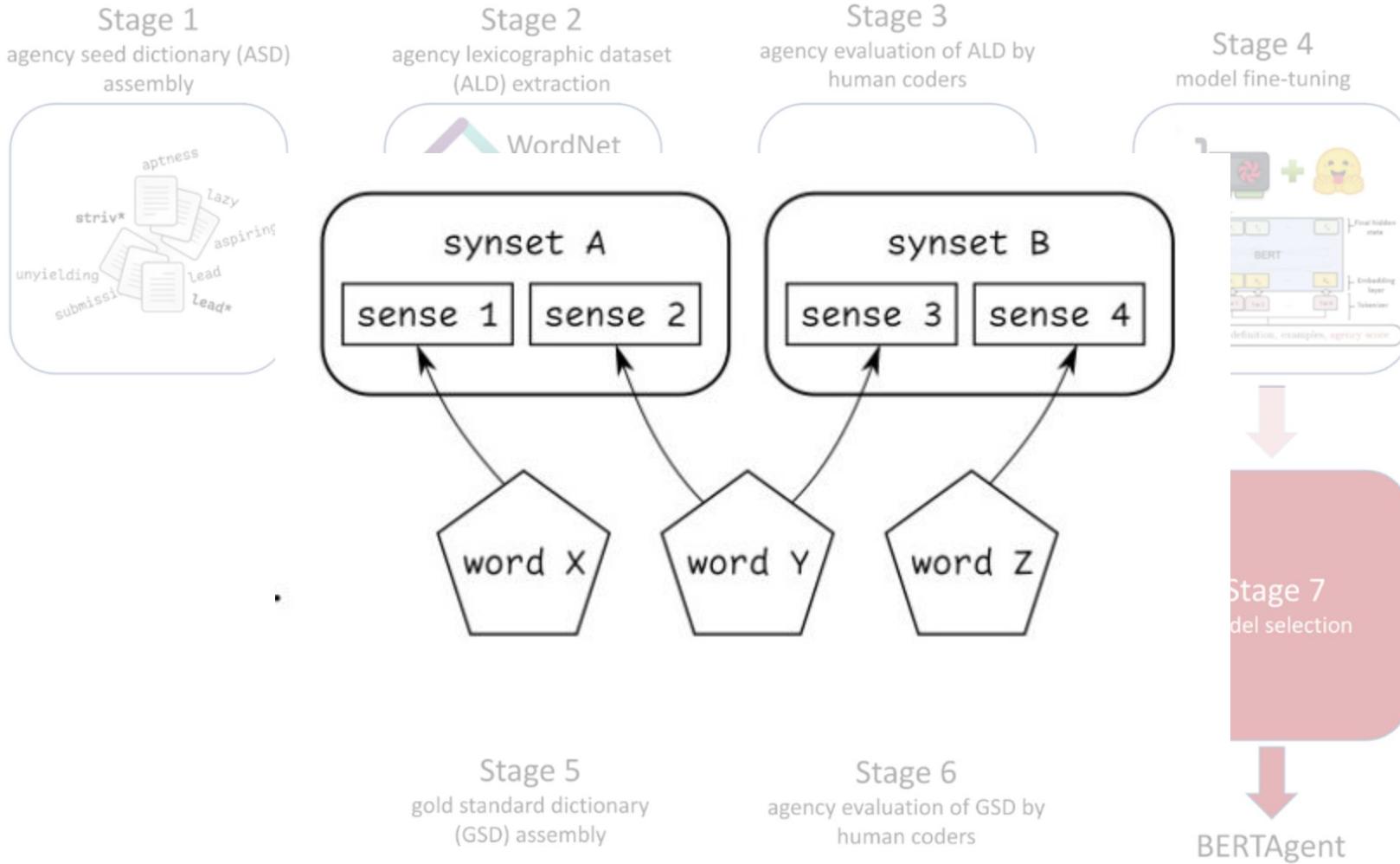


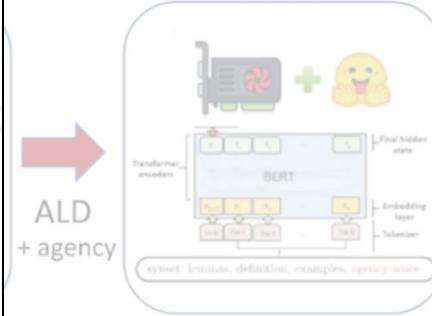
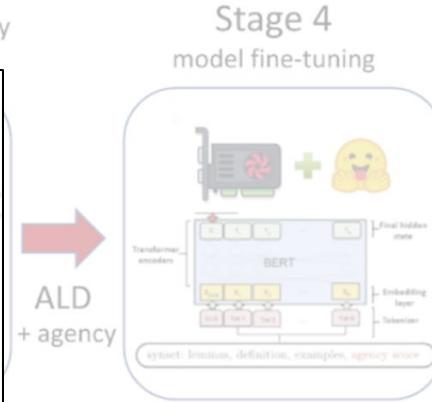
[://pypi.org/project/bertagent/](https://pypi.org/project/bertagent/)



BERTAgent

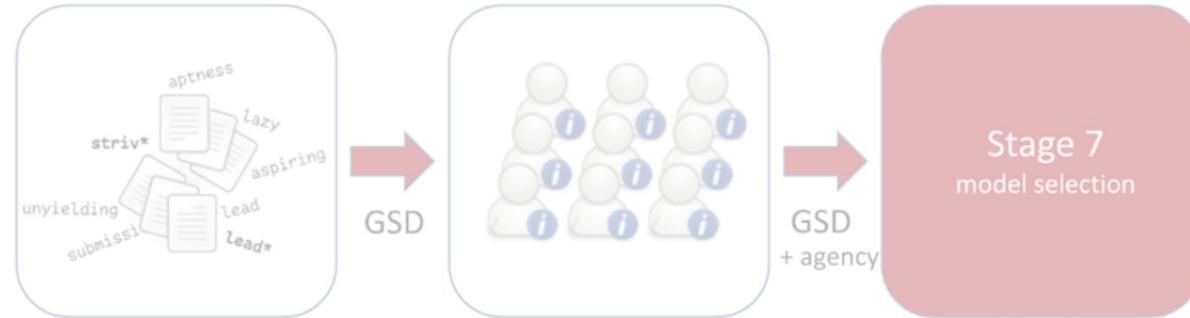
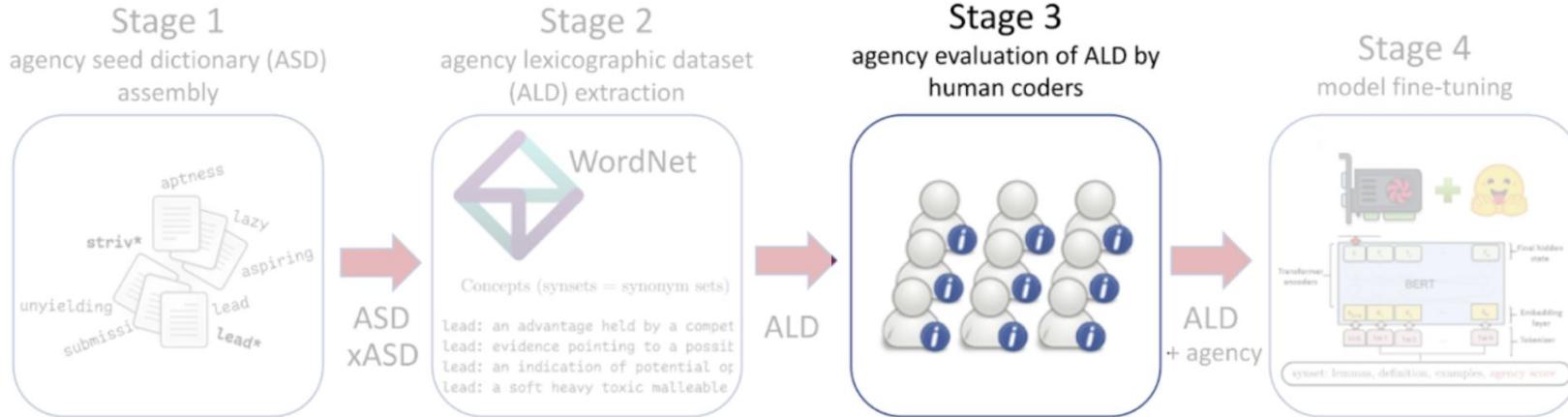
<https://pypi.org/project/bertagent/>





Stage 7
model selection

BERTAgent
<https://pypi.org/project/bertagent/>



<https://pypi.org/project/bertagent/>

What do we mean by a concept?

Each concept in the study consists of three parts:

- word(s) that represent this concept,
- definition of the concept,
- example(s) of how the concept can be used in a sentence.



Stage 1

agency seed dictionary
assembly



Stage 2

Stage 3

Below you can see an **example** of a three-part concept description:

Word(s) representing the concept:

- **car**
- **auto**
- **automobile**
- **motorcar**

Definition of the concept:

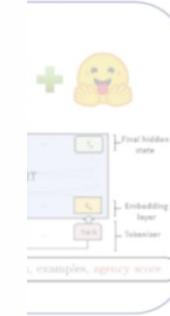
- **a motor vehicle with four wheels; usually propelled by an internal combustion engine**

Example(s) of the concept usage:

- **she needs a car to get to work**
- **he drove his car to the pharmacy**

e 4

e-tuning



Agent

Stage 1
agency seed dictionary (/assembly)



Does the following concept relate to agency? If so, what level of agency does it convey?

Word(s) representing the concept:

- **decisive**

Definition of the concept:

- **characterized by decision and firmness**

Example(s) of the concept usage:

- **an able and decisive young woman**
- **we needed decisive leadership**
- **she gave him a decisive answer**

very low agency	low agency	somewhat low agency	not related to agency	somewhat high agency	high agency	very high agency
<input type="radio"/>						

Stage 4
ne-tuning



Stage 7
Agent selection

TAgent
<https://project/bertagent/>

Stage 1
agency seed dictionary (/assembly)



Does the following concept relate to agency? If so, what level of agency does it convey?

Word(s) representing the concept:

- **electric charge**
- **charge**

Definition of the concept:

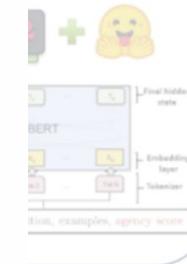
- **the quantity of unbalanced electricity in a body (either positive or negative) and construed as an excess or deficiency of electrons**

Example(s) of the concept usage:

- **the battery needed a fresh charge**



ge 4
ne-tuning



Stage 7
Agent selection

TAgent
<https://project/bertagent/>

Stage 1
agency seed dictionary (/assembly)



Does the following concept relate to agency? If so, what level of agency does it convey?

Word(s) representing the concept:

- **charge**

Definition of the concept:

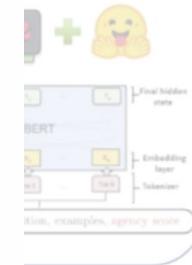
- **an impetuous rush toward someone or something**

Example(s) of the concept usage:

- **the wrestler's charge carried him past his adversary**
- **the battle began with a cavalry charge**

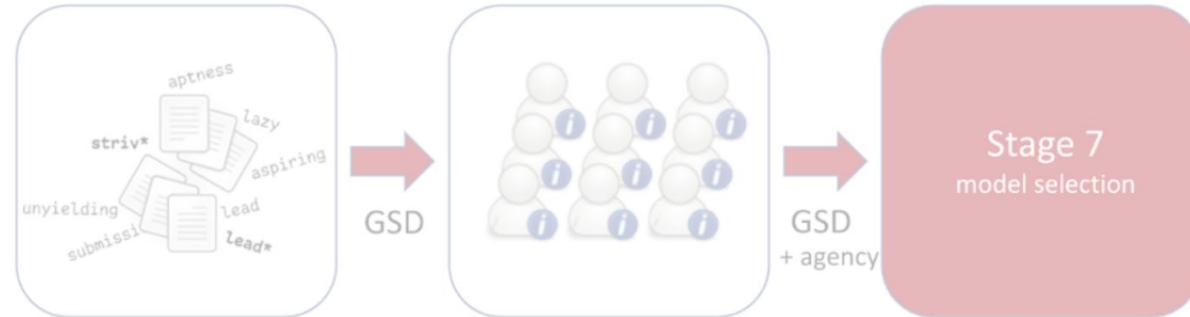
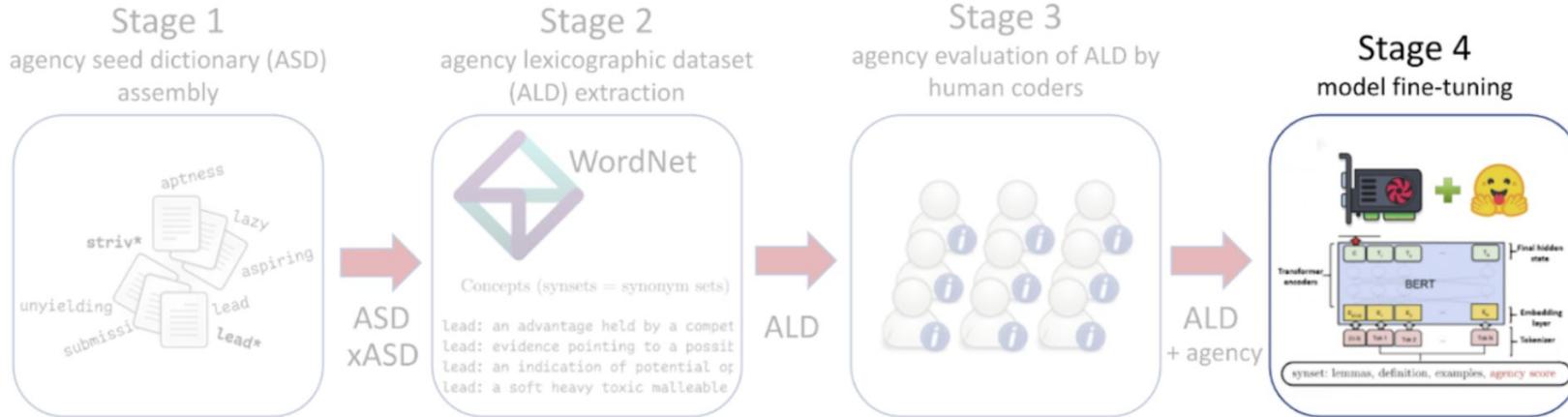


Stage 4
ne-tuning



Stage 7
selection

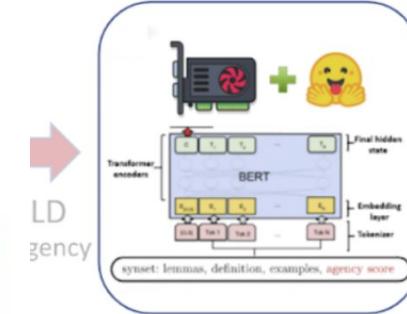
TAgent
<https://project/bertagent/>



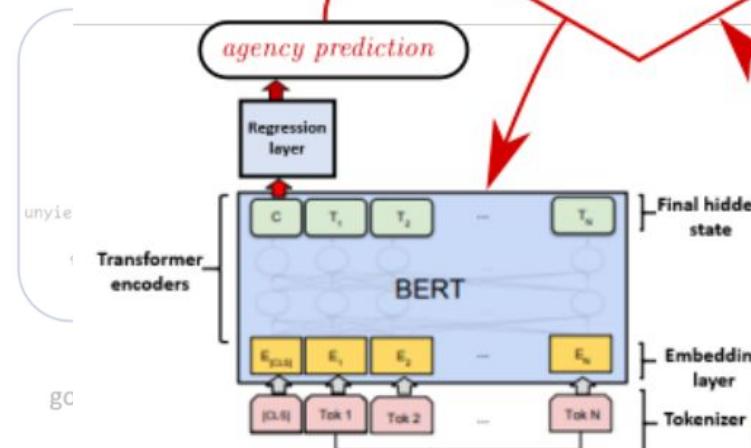
Stage 1 agency seed dictionary (ASD) assembly



Stage 4 model fine-tuning



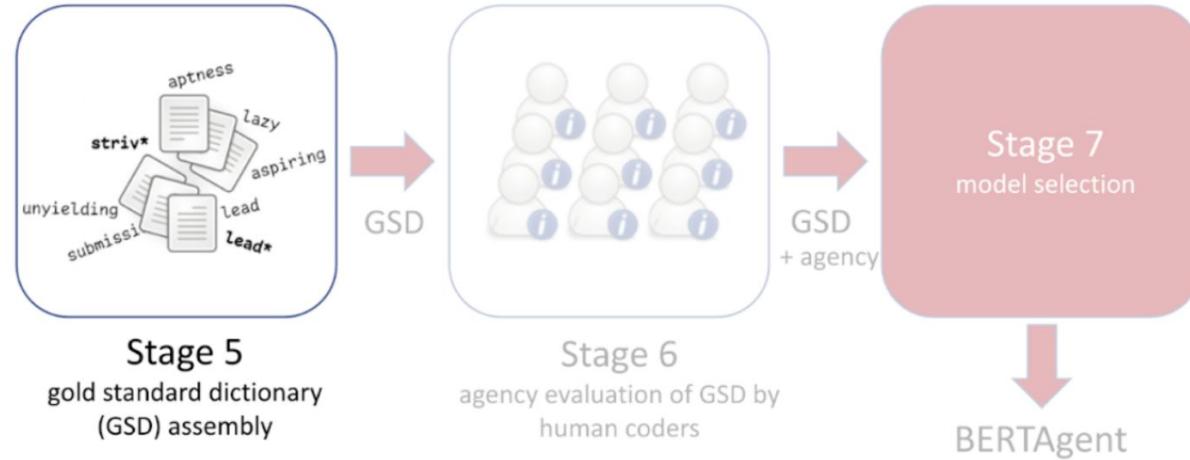
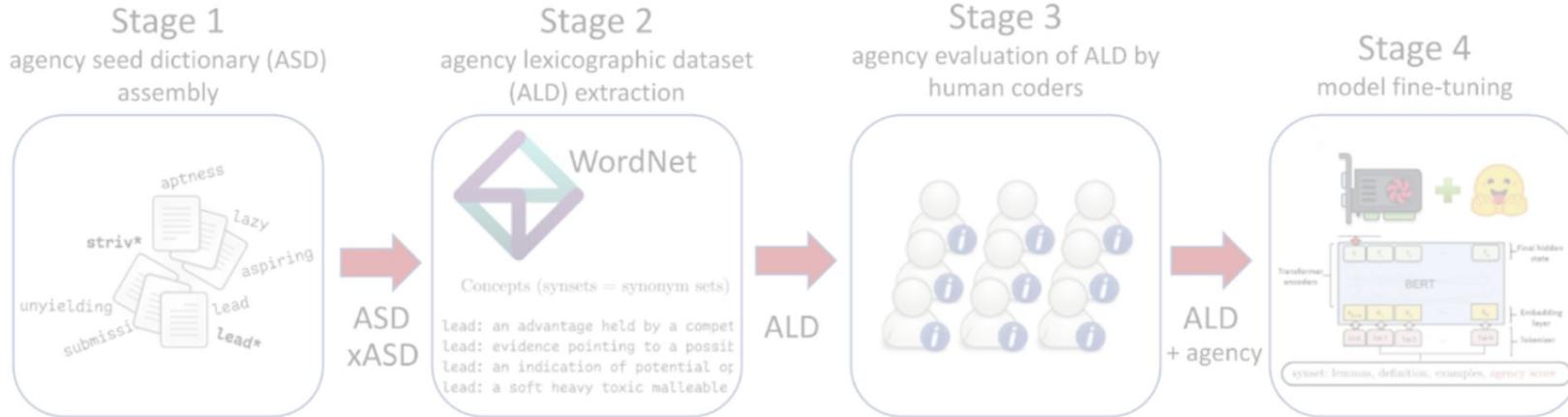
model
weights
update



Stage 7 model selection

BERTAgent

<https://pypi.org/project/bertagent/>



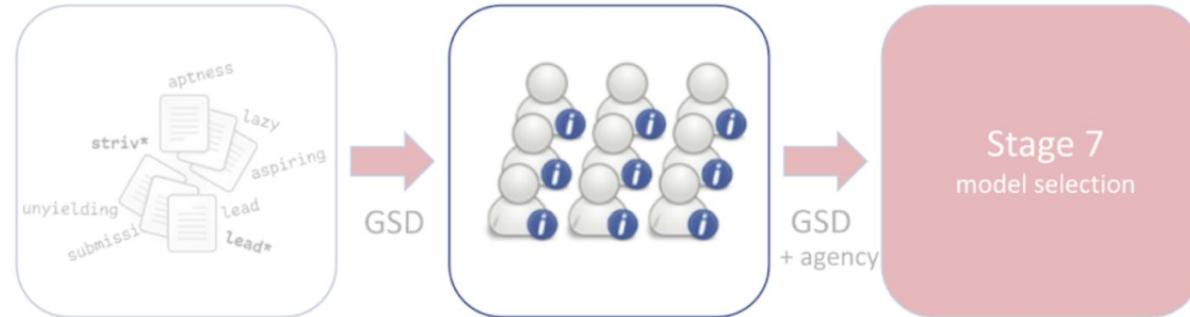
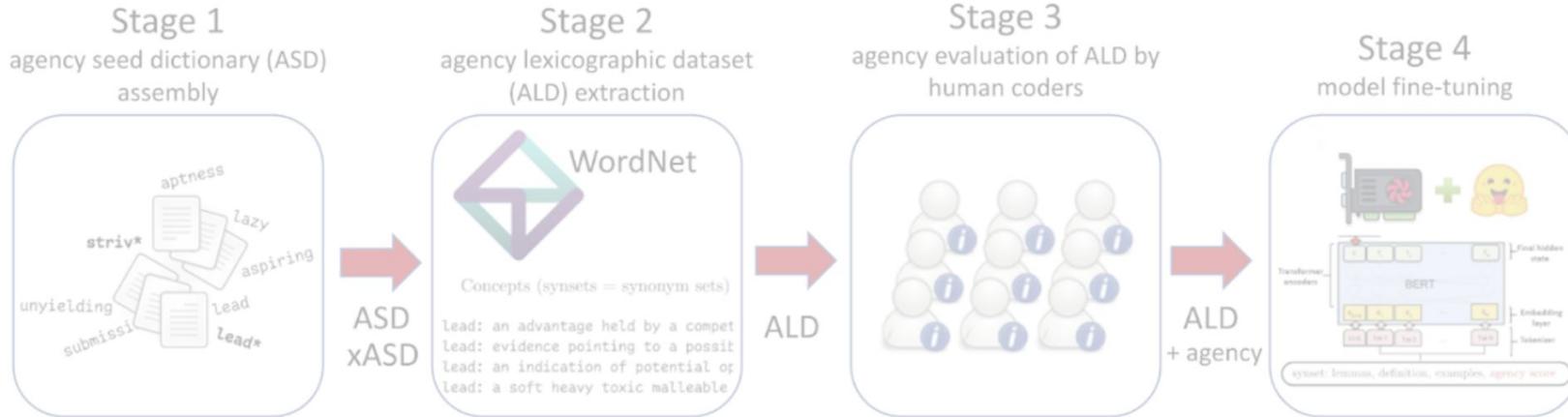
<https://pypi.org/project/bertagent/>



- participants were asked to write stories in which they (or somebody they know) were (was) “able to achieve their goal,” “active,” “unsuccessful,” or “lazy”
- we randomly selected 960 sentences stratifying conditions (320 sentences per condition).
- Sentences labeled them with respect to conveyed agency (-1=negative, 0=not related, 1=positive).

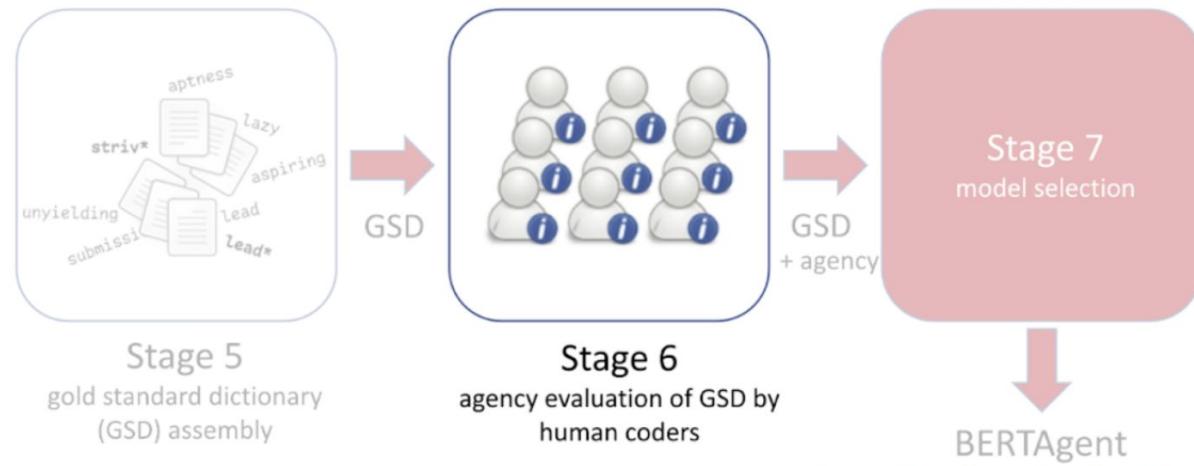
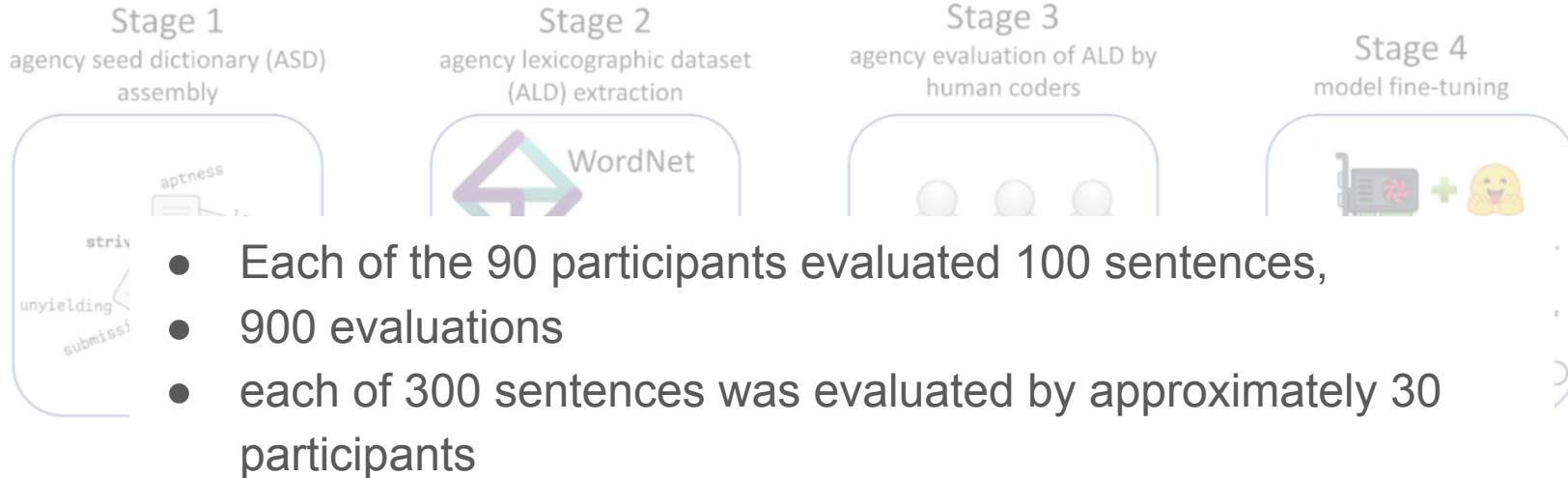


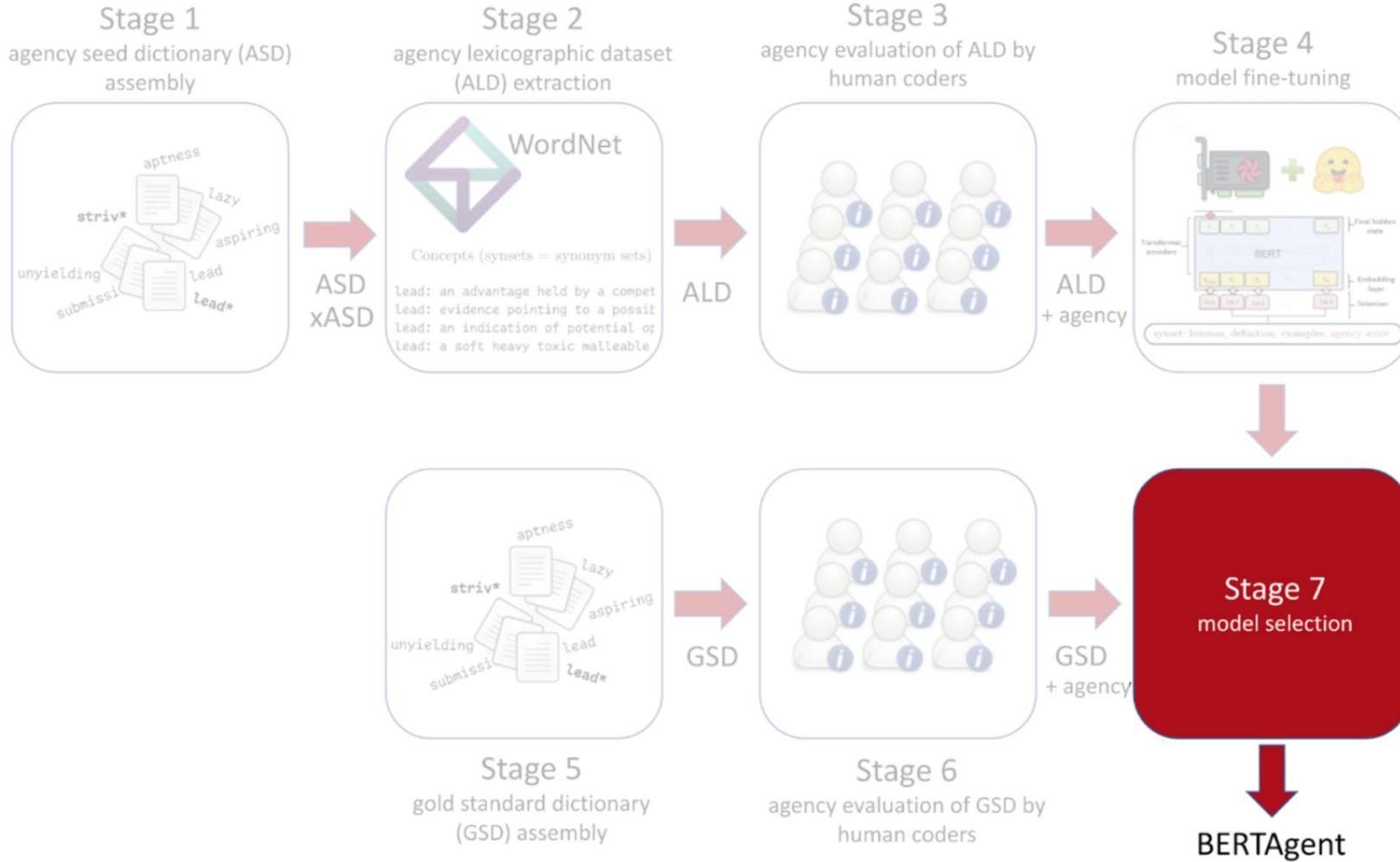
<https://pypi.org/project/bertagent/>

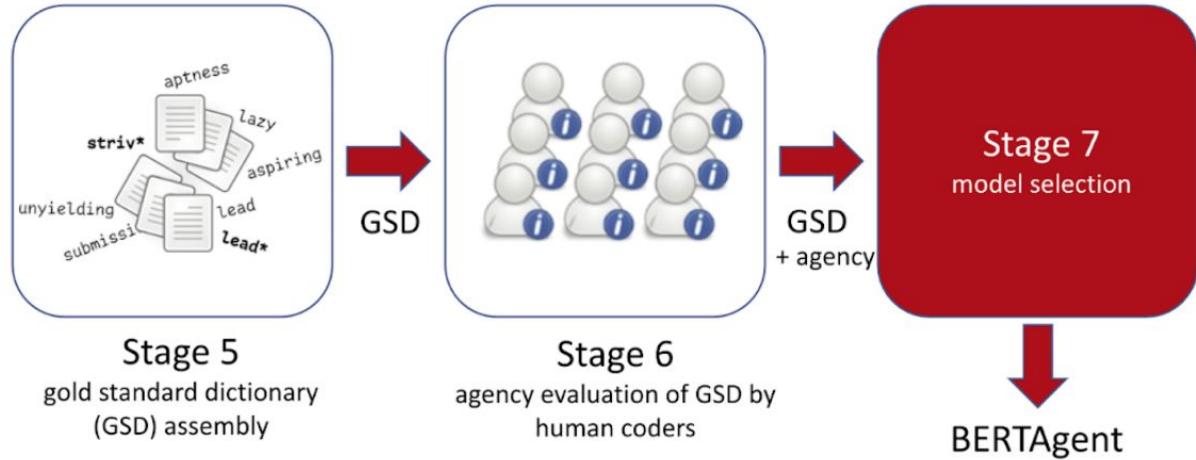
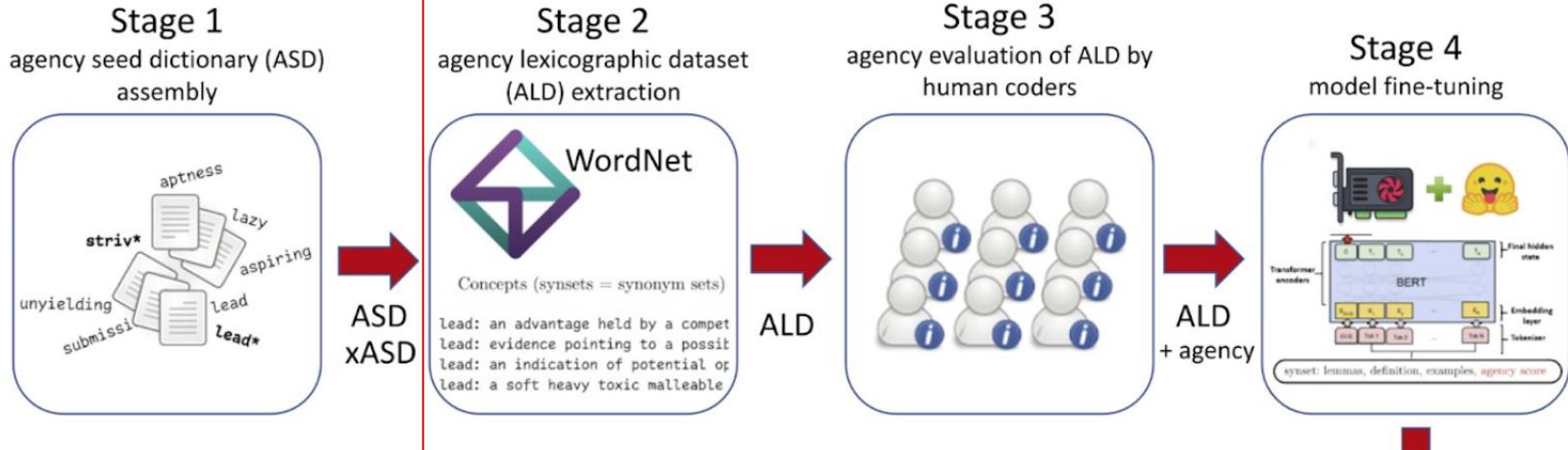


BERTAgent

<https://pypi.org/project/bertagent/>







First Test (sanity check)

Text	PietA	PietB	NicoCom	BATot
She is a hardly working individual	0.00	0.00	0.33	-0.62
She is a hard working individual	0.00	0.00	0.33	0.48
They are striving to achieve their goals	0.43	0.14	0.29	0.65
They are struggling to achieve their goals	0.43	0.14	0.29	-0.63
They are struggling to survive	0.20	0.00	0.20	-0.44
They are unable to survive	0.00	0.00	0.00	-0.61
This thing was made of lead	0.17	0.17	0.00	-0.04
This car runs on gasoline with lead	0.00	0.14	0.00	-0.02
This car runs on gasoline and it will lead us	0.10	0.10	0.10	0.09
This politician runs for office and he will lead us	0.10	0.10	0.10	0.58

First Test (sanity check)

Text	PietA	PietB	NicoCom	BATot
motivated	1.00	0.00	1.00	0.72
We are motivated	0.33	0.00	0.33	0.70
We are not motivated	0.25	0.00	0.25	-0.80
We are unmotivated	0.00	0.00	-0.33	-0.48
Lazy and unmotivated	0.00	0.00	-0.67	-0.85
I want to give up	0.00	0.00	0.00	-0.49
lost all hope	0.00	0.00	0.00	-0.57
We'll lose anyway	0.00	0.00	0.00	-0.43
We should give up and say nothing	0.14	0.00	0.00	-0.41
We must win	0.33	0.00	0.00	0.65

First Test (sanity check)

Text	PietA	PietB	NicoCom	BATot
motivated	1.00	0.00	1.00	0.72
We are motivated	0.33	0.00	0.33	0.70
We are not motivated	0.25	0.00	0.25	-0.80
We are unmotivated	0.00	0.00	-0.33	-0.48
Lazy and unmotivated	0.00	0.00	-0.67	-0.85
I want to give up	0.00	0.00	0.00	-0.49
lost all hope	0.00	0.00	0.00	-0.57
We'll lose anyway	0.00	0.00	0.00	-0.43
We should give up and say nothing	0.14	0.00	0.00	-0.41
We must win	0.33	0.00	0.00	0.65

Example of BERTAgent performance before and after re-fine-tuning on additional dataset containing various forms of negation.

No.	Text	Re-fine-tuning	
		FT3	FT3 + rFT3
1	I'm not lazy.	0.36	0.84
2	I'm in no way lazy.	0.11	0.86
3	I'm not at all lazy.	0.06	0.84
4	I'm anything but lazy.	-0.48	0.86
5	I'm one of the least lazy people you'll ever meet.	-0.51	0.19
6	I'm not motivated.	-0.83	-0.88
7	I'm in no way motivated.	-0.75	-0.87

Validation studies (4)

- Study 1: Comparison of available tools on the agency **GSD**;
Sourced from an unpublished study by Formanowicz, Nikadon, & Suitner, 2022 and evaluated by human coders
- Study 2: Correlations with human evaluations of **job occupations**;
Sourced from Imhoff et al. (2018)
- Study 3: Correlations with human evaluations of **supernatural concepts**;
Sourced from Sommer et al. (2022)
- Study 4: Discriminant power on **inform vs. mobilize** others to act.
Sourced from an unpublished study by Formanowicz, Beneda et al. (2022)

Validation studies (4)

- Study 1: Comparison of available tools on the agency **GSD**;
Sourced from an unpublished study by Formanowicz, Nikadon, & Suitner, 2022 and evaluated by human coders
- Study 2: Correlations with human evaluations of **job occupations**;
Sourced from Imhoff et al. (2018)
- Study 3: Correlations with human evaluations of **supernatural concepts**;
Sourced from Sommer et al. (2022)
- Study 4: Discriminant power on **inform vs. mobilize** others to act.
Sourced from an unpublished study by Formanowicz, Beneda et al. (2022)

Comparison of agency evaluation on gold standard dataset.

Variable	M	SD	1	2	3	4	5
1. HumEval	0.12	1.54					
2. PietA	4.23	5.20	.18** [.06, .28]		-1.10	-0.71	-12.07**
3. PietB	1.87	3.35	.25** [.14, .35]	.36** [.26, .46]		0.23	-11.26**
4. NicoTot	1.67	4.95	.23** [.12, .33]	.13* [.02, .24]	.13* [.02, .24]		-11.92**
5. BATot	1.88	33.55	.82** [.78, .86]	.16** [.04, .27]	.18** [.07, .29]	.26** [.15, .37]	

Example Application:

2020 U.S. Congressional Election Tweet Data

- Election is a type of **collective action**.
- Agency may play an important role in its development and unfolding
- Politicians may align their language with their persuasive goals
- Use of agentic language
 - enhances **perceptions of the speaker's agency**, thereby boosting the perceived effectiveness of the campaign
(Formanowicz et al., 2021)
 - might also function as a **catalyst for action orientation among constituents**, effectively serving as a tool for mobilization



YES WE CAN





Text UNITED to 30330

**BUILD BACK
BETTER**

BIDEN

“

I will deal with the virus.

I will deal with
the economic crisis.

I will work to
**BRING EQUITY
& OPPORTUNITY
TO ALL.**



**BIDEN
HARRIS**



Vote Your Values Fight for Your Rights

ACLU Kentucky



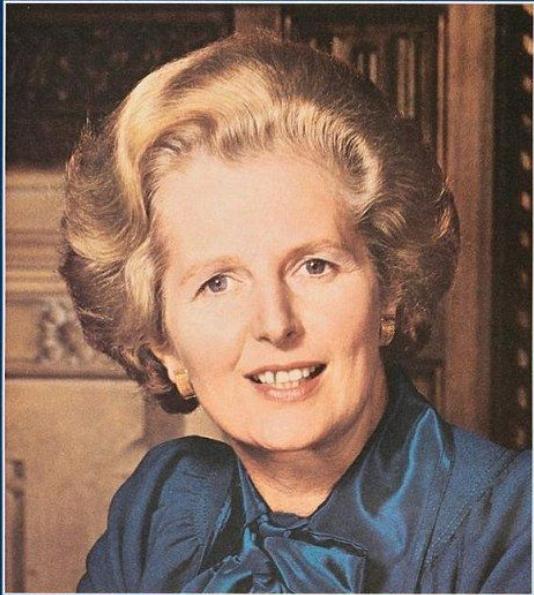
Honor the past,
support the future -

vote!



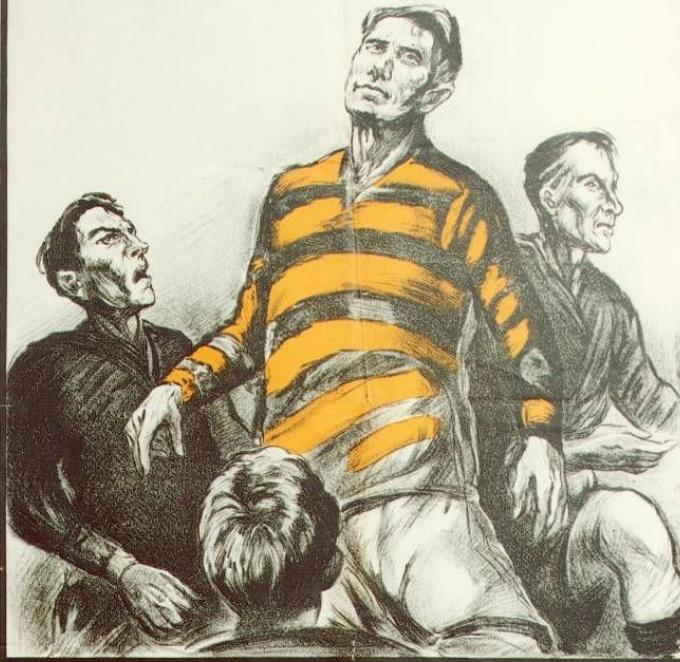


**Don't just hope
for a better life.
Vote for one.**



VOTE **CONSERVATIVE** X

USE YOUR HEAD!



**SUPPORT YOUR OWN TEAM
AND
VOTE LABOUR**

PUBLISHED BY THE LABOUR PARTY 33 EGGLESTON SQUARE, S.W.1 AND PRINTED BY THE CALEDONIAN PRESS LTD., LONDON

Agency is also prevalent in commercial setting...



JUST DO IT

The text "JUST DO IT" is centered below the swoosh. The words are in a bold, sans-serif font, with each word on a new line. The letters are white against the red background.



Think different.



Visitor Professional



Favourites | Map News

Type your search



Visit Tallinn

See & do

Plan your trip

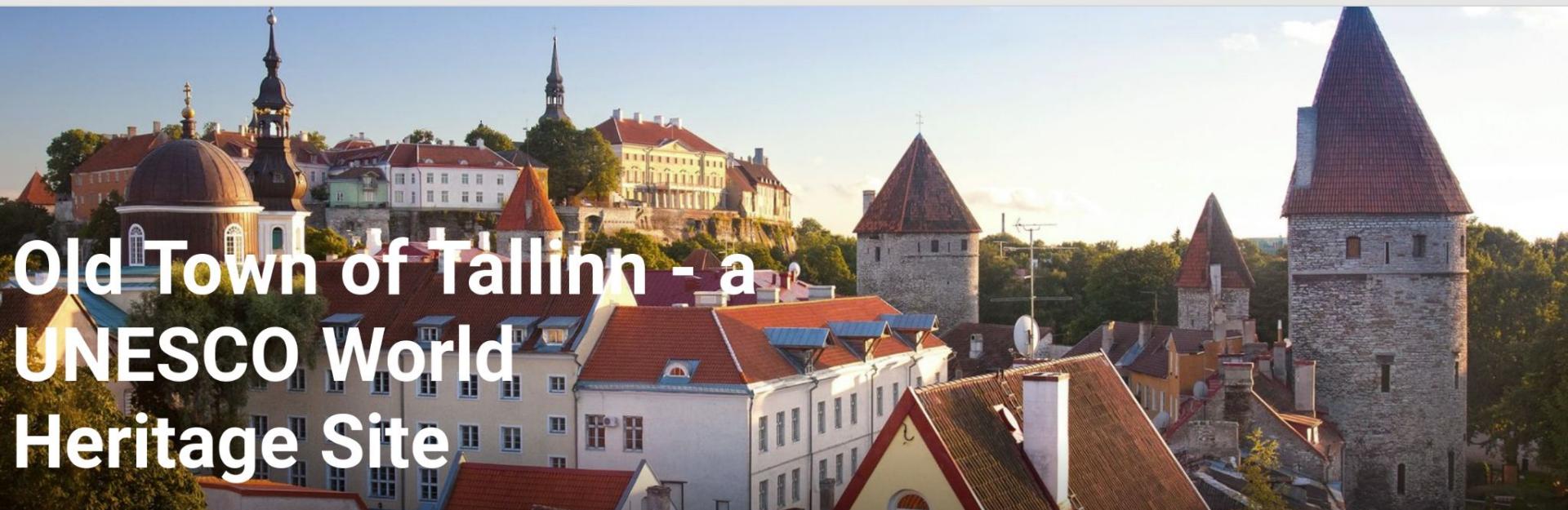
Eat & drink

Ideas & tips

Buy Tallinn
Card

ENG ▾

Tallinn Card





VisitCopenhagen

@visitcopenhagennofficial 4.44K subscribers 148 videos

Welcome to the official VisitCopenhagen channel. We're Wonderful Copen... >

Subscribe

TORUŃ PORUSZA

KULTURĄ



TORUŃSKA
AGENDA
KULTURALNA



CENTRUM
SZTUKI
WSPÓŁCZESNEJ
W TORUŃ



Centrum Kultury
Zamek Krzyżacki



TORUŃSKA
ORKIESTRA
SYMFOŃCZNA

Visitor Professional



Favourites | Map News

Type your search



Visit Tallinn

See & do

Plan your trip

Eat & drink

Ideas & tips

Buy Tallinn
Card

ENG ▾

Tallinn Card



DISCOVER KATOWICE



THE OLDEST PART OF KATOWICE

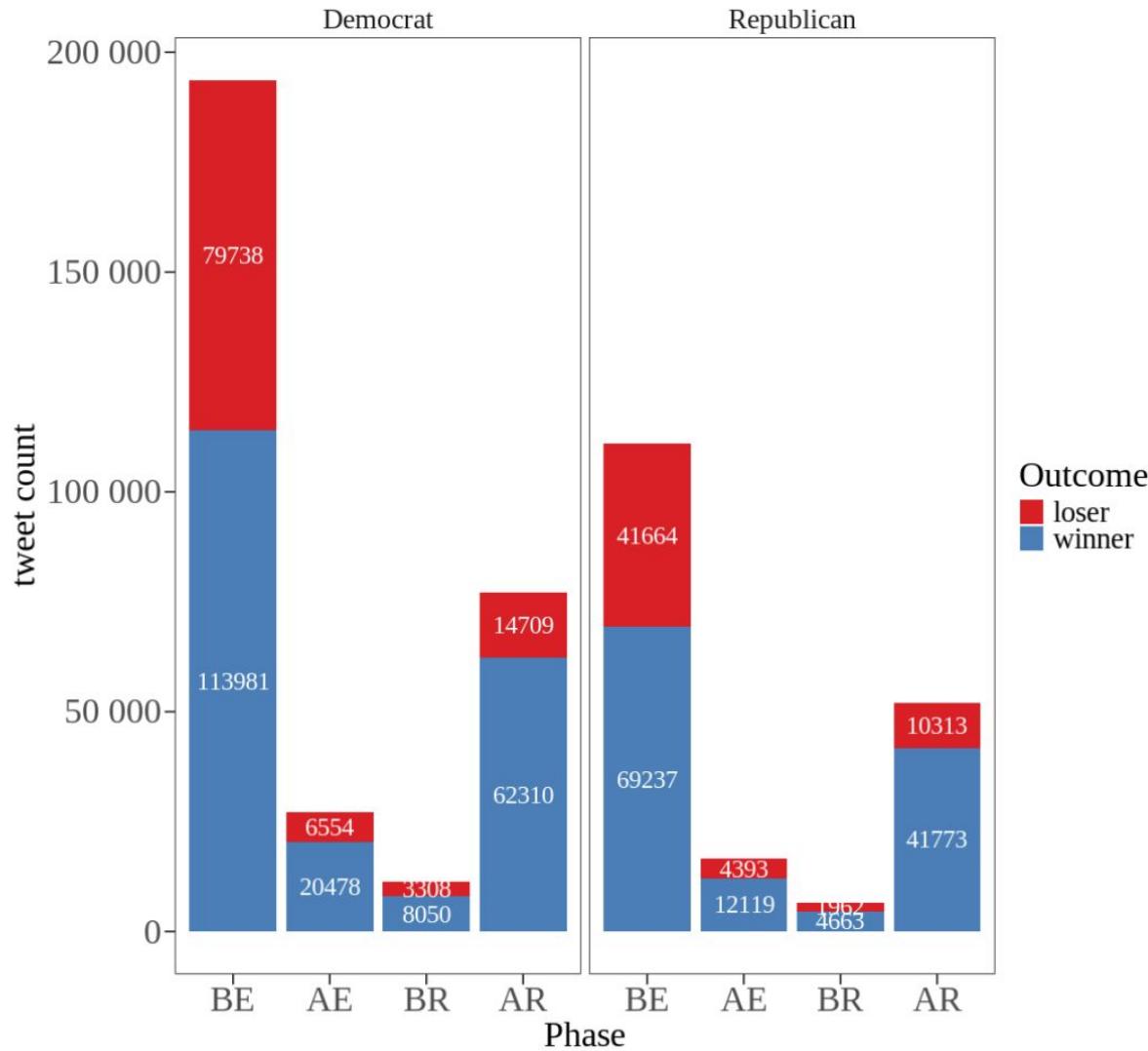
Although Katowice is a relatively young city – the municipal rights were granted in 1865 – it can boast the oldest city part that is comparatively well-preserved. The main artery of the old Katowice city is composed of 3 Maja street stretching from Wolności Square to Main Square as well as its extension towards the east, i.e. Warszawska Street. It is here that one can see the most impressive tenement houses dating from the end of 19th century and the beginning of 20th century, industrialists' mansions (e.g. The Goldstein Villa) as well as the oldest churches: the evangelical church from 1858 and the catholic church from 1870. The name "Mariacka" given to the street is closely connected with the latter. Mariacka street is a pedestrian precinct full of cafés and pubs buzzing with life nearly all night long. At the other end of the street one can notice an old railway station, which no longer serves its original purpose, but it still reminds us of how important the rail transport was for the origins and development of the city. From this place it is quite near the southern part of Katowice downtown where one can spot the voivodeship office and the Silesian Parliament buildings and the cathedral of Christ the King towering the town. There you can also walk along the Modern Route or visit the Museum of Katowice History.

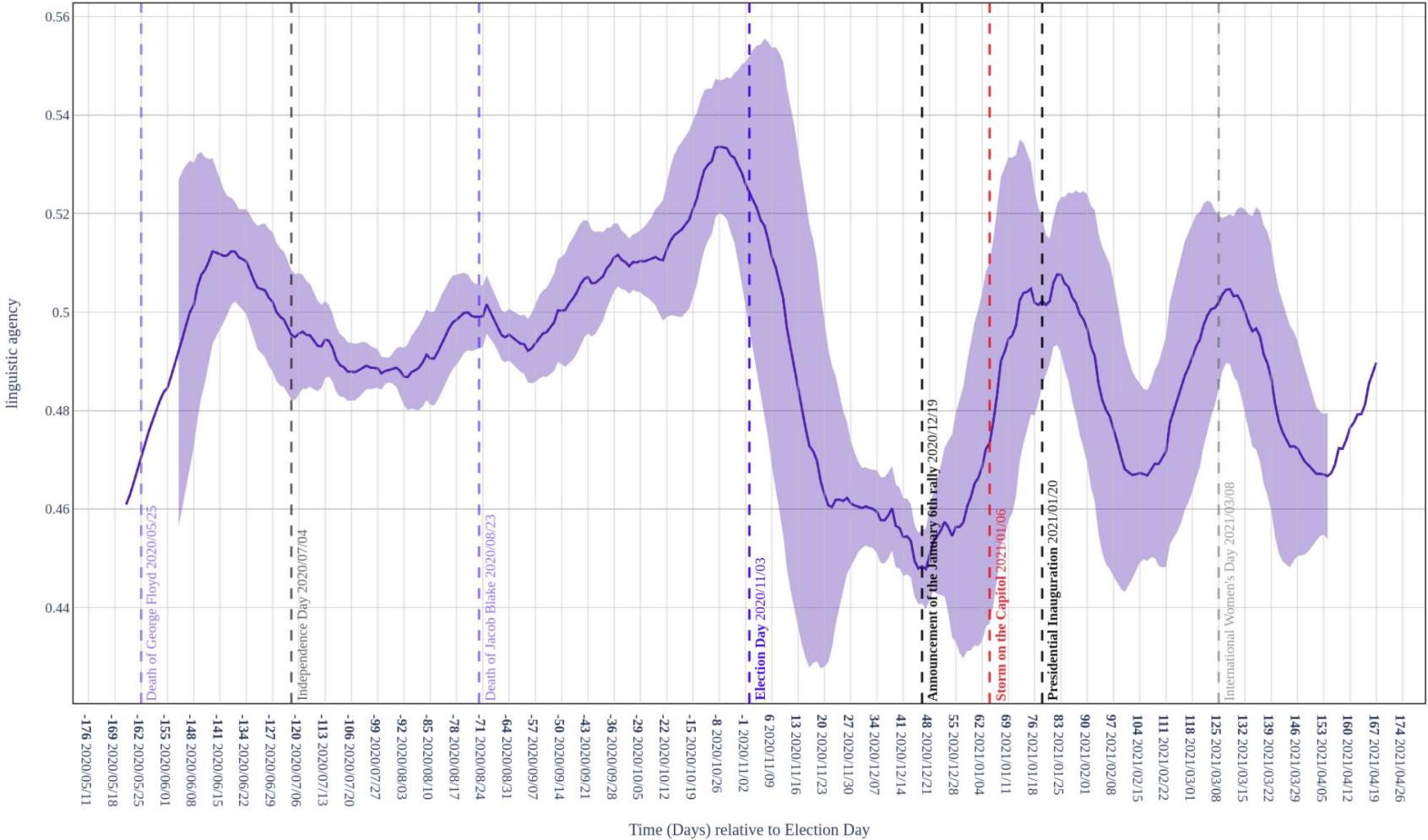
Example Application: 2020 U.S. Congressional Election Tweet Data

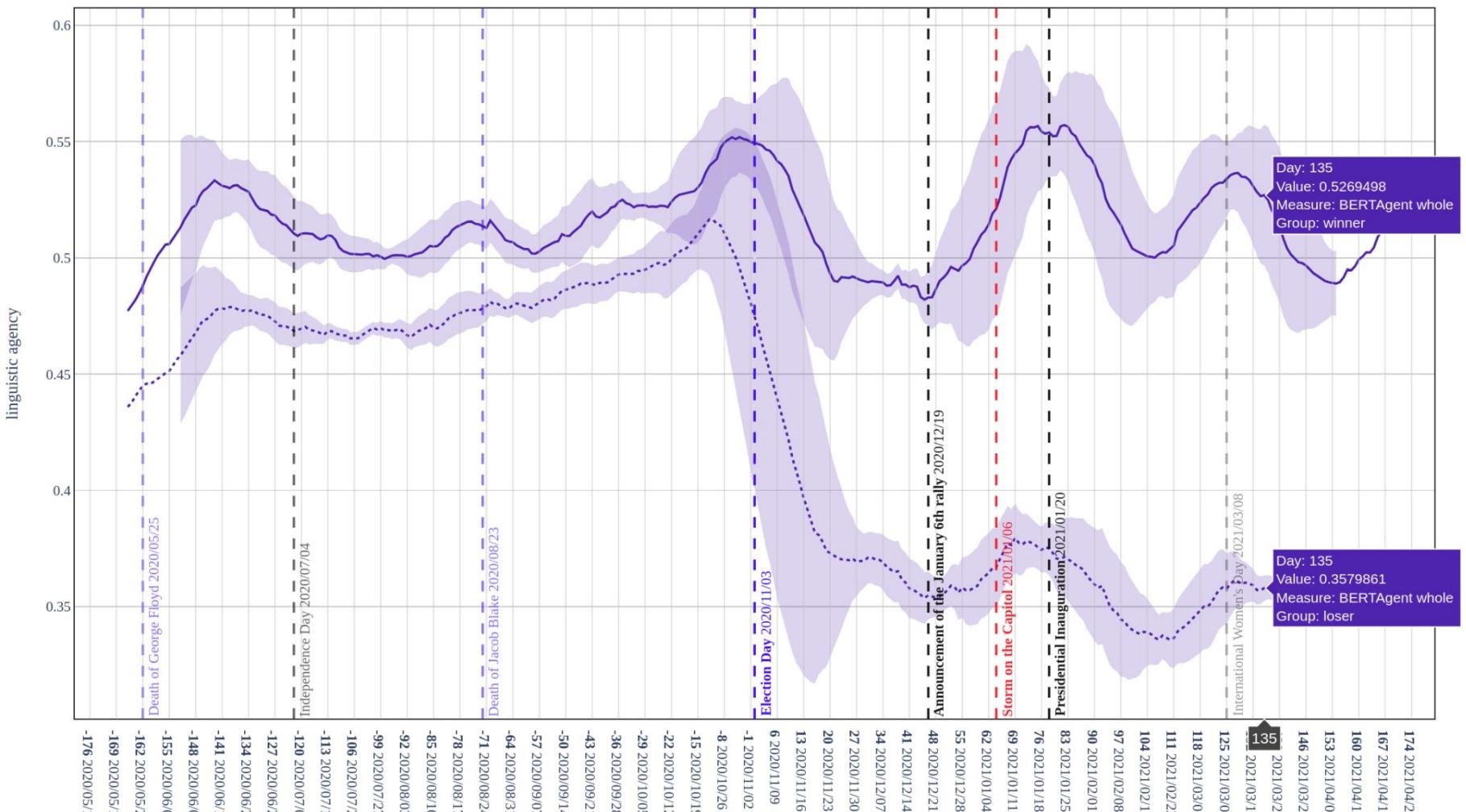
- Based on the notion that politicians align their language with their persuasive goals we hypothesized that:
- The frequency of agentic language use **escalated as the election approached** (H1) and
- ... **declined afterward** (H2),
- Agentic communication will **increase in before the January 6th Capitol riots** (H3)
 - following Donald J. Trump's tweet announcing the January 6th rally, presumably with an intention to influence the Electoral College vote count ("Statistically impossible to have lost the 2020 Election. Big protest in D.C. on January 6th. Be there, will be wild!").
- **Following the Capitol riots - a decrease** in agentic language (H4)

2020 U.S. Congressional Election Tweet Data

- ~ 0.5M **original tweets** from Democrat (D) and Republican (R) candidates;
- **180 days** prior and after the election;
- **870 candidates** (454 D and 416 R)
- 1283 Twitter profiles (671 D and 612 R) for ;
- Agency was quantified in each tweet using BERTAgent;
- A daily average was computed for every candidate.



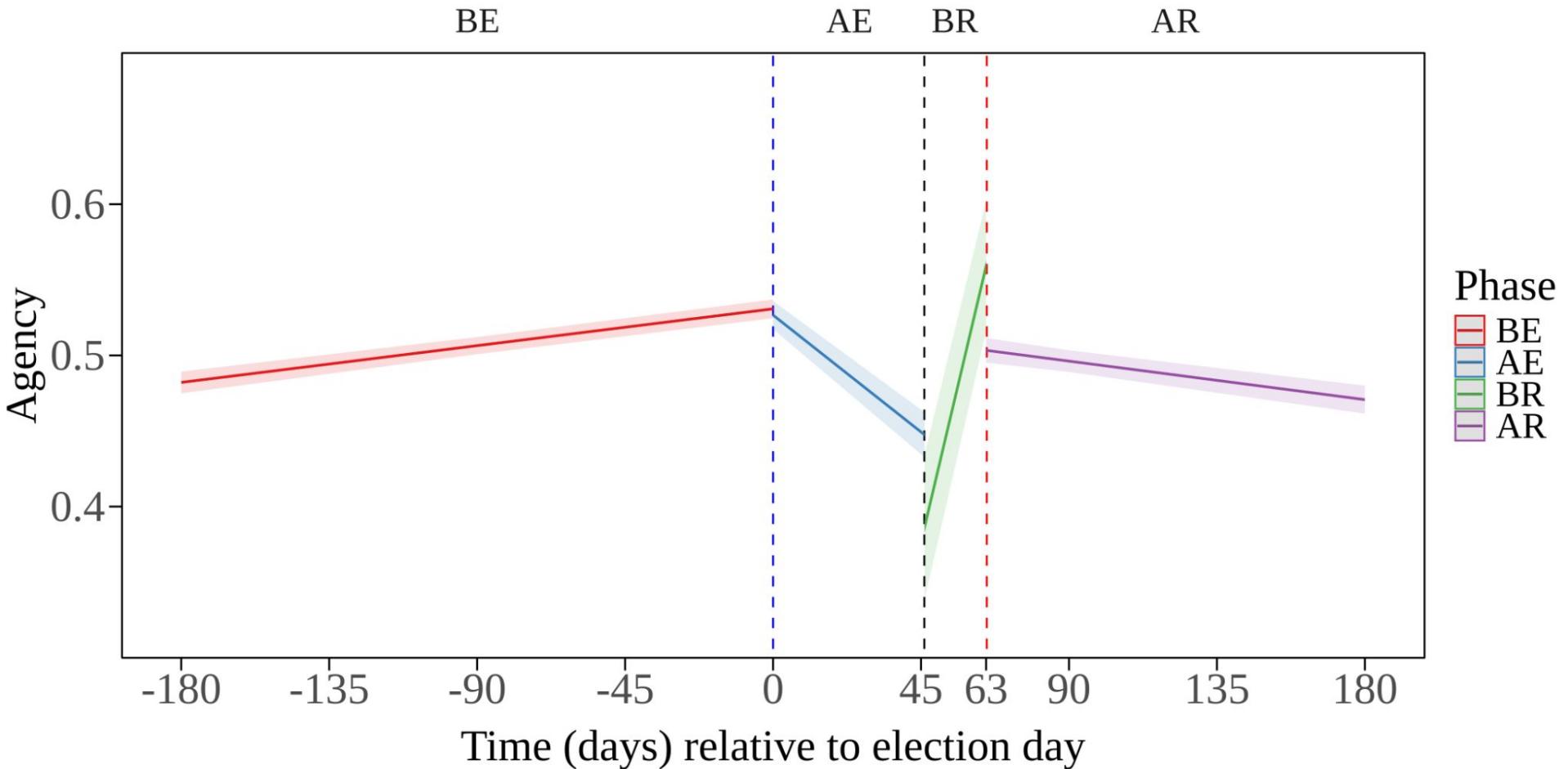




Modelling of agency dynamics during election cycle

Agency ~ Time * **Period** + (Time | Name)

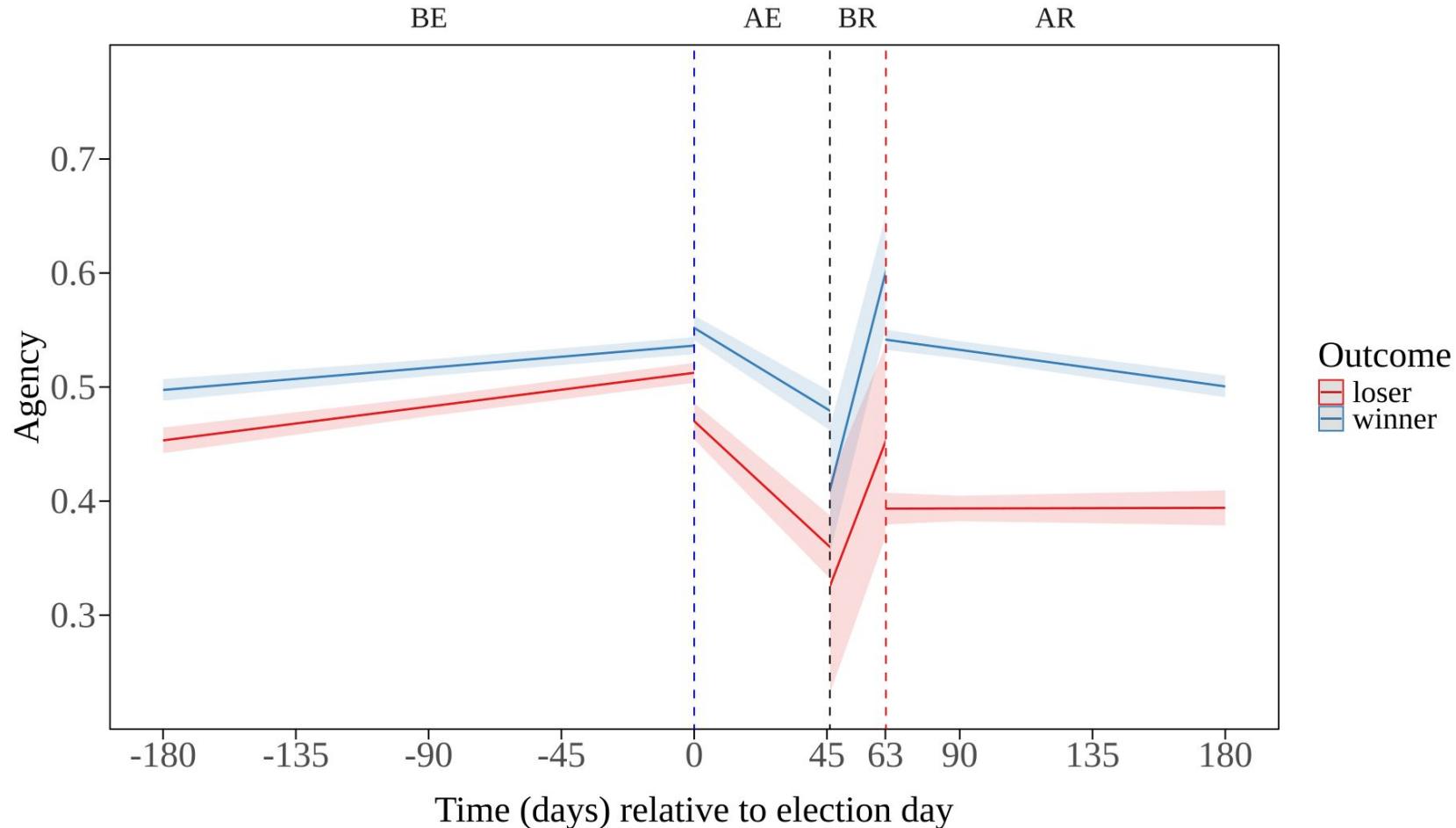
Average predicted values of Agency



Modelling of agency dynamics during election cycle

Agency ~ Time * Period * Outcome + (Time | Name)

Average predicted values of Agency



Predictors	Model 3		Model 4	
	Estimates	CI	Estimates	CI
(Intercept)	0.53 ***	0.52 – 0.53	0.52 ***	0.51 – 0.52
Time	0.04 ***	0.04 – 0.05	0.06 ***	0.05 – 0.07
Phase [AE]	-0.00	-0.01 – 0.00	-0.04 ***	-0.06 – -0.03
Phase [BR]	-0.57 ***	-0.63 – -0.51	-0.50 ***	-0.61 – -0.38
Phase [AR]	-0.01	-0.02 – 0.00	-0.12 ***	-0.14 – -0.10
Time × Phase [AE]	-0.36 ***	-0.41 – -0.31	-0.49 ***	-0.59 – -0.39
Time × Phase [BR]	1.61 ***	1.42 – 1.80	1.15 ***	0.78 – 1.52
Time × Phase [AR]	-0.10 ***	-0.11 – -0.09	-0.06 ***	-0.09 – -0.03
Outcome [winner]			0.02 ***	0.01 – 0.04
Time × Outcome [winner]			-0.02 **	-0.03 – -0.01
Phase [AE] × Outcome [winner]			0.06 ***	0.04 – 0.08
Phase [BR] × Outcome [winner]			-0.09	-0.23 – -0.04
Phase [AR] × Outcome [winner]			0.15 ***	0.12 – 0.17
(Time × Phase [AE]) × Outcome [winner]			0.17 **	0.05 – 0.28
(Time × Phase [BR]) × Outcome [winner]			0.63 **	0.19 – 1.06
(Time × Phase [AR]) × Outcome [winner]			-0.04 **	-0.08 – -0.01

~~Concussions~~ Conclusions

- We successfully **developed** and **validated BERTAgen** using a combination of:
 - existing trait-related datasets,
 - lexicographical data (WordNet),
 - human coder evaluations,
 - LLM (RoBERTa).
- We **captured** the **temporal dynamics** of linguistic agency in real data produced by 2020 U.S. Congressional Election candidates.

BERTAgent: Online resources

- Preprint: <https://psyarxiv.com/qw6u3/>
- SOM is available at <https://github.com/cogsys-io/BERTAgent-SOM/>
- Installation from <https://pypi.org/project/bertagent/>
 - **pip install bertagent**
 - Documentation + tutorial: <https://bertagent.readthedocs.io/>
 - Source code: <https://github.com/cogsys-io/bertagent/>



Search docs

CONTENTS:

BERTAgent

Installation

Tutorial

Process a list of sentences

Process a texts in pandas dataframe

Usage

Package modules

Contributing

Credits

History

```
# .readthedocs.yaml
build.tools:
    python: "3.11"
sphinx:
    configuration: conf.py
python.install:
    - requirements: pip.in
```

Supercharge your Sphinx docs with deployment on Read the Docs. [Sign up today!](#)

Ad by EthicalAds · i

» 🚀 Welcome to BERTAgent's documentation!

Edit on GitHub

Next ➔



Welcome to BERTAgent's documentation!

pypi v1.0.7 build passing docs passing license GNU General Public License v3

Contents:

- [BERTAgent](#)
 - [Features](#)
 - [Credits](#)
- [Installation](#)
 - [Stable release](#)
 - [From sources](#)
- [Tutorial](#)
 - [Process a list of sentences](#)
 - [Process a texts in pandas dataframe](#)
- [Usage](#)
- [Package modules](#)
 - [bertagent package](#)
- [Contributing](#)





Lejla Džanko
SWPS University



Caterina Suitner
University of Padova



Michał Olech
Gdański Uniwersytet Medyczny



Magdalena Formanowicz
SWPS University



Jan Nikadon
SWPS University



Tomaso Erseghe
University of Padova



Paweł Jurek
Uniwersytet Gdańskie

Thank you!

Bonus Slides ↓

Gold Standard Dataset

participants were asked to write stories in which they (or somebody they know) were (was) “able to achieve their goal,” “active,” “unsuccessful,” or “lazy” (i.e., the first two conditions aimed to induce agency-positive utterances and the remaining two - agency-negative utterances). From these texts, we randomly selected 960 sentences stratifying conditions (320 sentences per condition). Next, authors prescreened these sentences for quality issues (removing very short or poor quality utterances), and labeled them with respect to conveyed agency (-1=negative, 0=not related, 1=positive).

Each of the 90 participants evaluated 100 (randomly assigned to them) sentences, producing together 900 evaluations, each of 300 sentences was evaluated by approximately 30 participants.

ICCs for evaluations by human coders

- Synsets
 - We also used a multi-level model with a random intercept and the evaluated item (synset) as a fixed effect to assess the reliability of the evaluations using two forms of intraclass correlation coefficient (ICC; Muraki et al., 2022; Brysbaert, 2019). For the average correlation of synset evaluations between participants ICC was 0.43.
 - For the reliability of the average evaluations **ICC was 0.85**, indicating good reliability (Koo & Li, 2016).
- GSD
 - We assessed the reliability of human evaluations of sentences using two ICCs. For the average correlation of synset evaluations between participants ICC was 0.72. For the reliability of the average evaluations **ICC was 0.98**, indicating excellent reliability.

Example of BERTAgent performance before and after re-fine-tuning on additional dataset containing various forms of negation.

No.	Text	Re-fine-tuning	
		FT3	FT3 + rFT3
1	I'm not lazy.	0.36	0.84
2	I'm in no way lazy.	0.11	0.86
3	I'm not at all lazy.	0.06	0.84
4	I'm anything but lazy.	-0.48	0.86
5	I'm one of the least lazy people you'll ever meet.	-0.51	0.19
6	I'm not motivated.	-0.83	-0.88
7	I'm in no way motivated.	-0.75	-0.87

Comparison of computational evaluation of agency in descriptions of professions (N=132) from Imhoff et al. (2018) with human evaluations (HumEval, N=1,245).

Variable	M	SD	1	2	3	4	5	6
1. HumEval	52.31	12.21						
2. PietA	1.14	2.09	.19* [.02, .35]		-0.63	0.49	-2.18*	-2.15*
3. PietB	1.91	2.62	.25** [.08, .40]	.41** [.26, .54]		1.13	-1.81	-1.78
4. NicoTot	1.49	2.81	.13 [-.04, .30]	.00 [-.17, .17]	.25** [.09, .41]		-2.60**	-2.56*
5. BATot	16.40	9.46	.43** [.28, .56]	.07 [-.10, .24]	.22* [.05, .38]	.01 [-.16, .18]		0.37
6. BAAbs	16.77	9.19	.43** [.28, .56]	.09 [-.08, .26]	.23** [.06, .39]	.01 [-.16, .18]	.99** [.98, .99]	

Comparison of computational evaluation of “intentional agency” in descriptions of supernatural concepts (N=216) from Sommer et al. (2022) with human evaluations (HumEval, N=172).

Variable	M	SD	1	2	3	4	5	6
1. HumEval	2.64	1.26						
2. PietA	1.31	3.43	.09 [-.04, .22]		0.89	-1.00	-0.15	-3.41**
3. PietB	0.73	2.68	.01 [-.12, .15]	.18** [.05, .30]		-1.68	-1.20	-4.97**
4. NicoTot	0.55	2.45	.18** [.05, .31]	.12 [-.01, .25]	-.08 [-.21, .05]		0.81	-2.33*
5. BATot	1.18	12.51	.11 [-.03, .24]	.08 [-.05, .21]	.37** [.25, .48]	.04 [-.09, .17]		-3.23**
6. BAAbs	8.96	8.79	.39** [.27, .50]	.08 [-.05, .21]	.33** [.20, .44]	-.00 [-.14, .13]	.06 [-.07, .19]	

Comparison of computational evaluation of “strategic knowledge” in descriptions of supernatural concepts (N=216) from Sommer et al. (2022) with human evaluations (N=172).

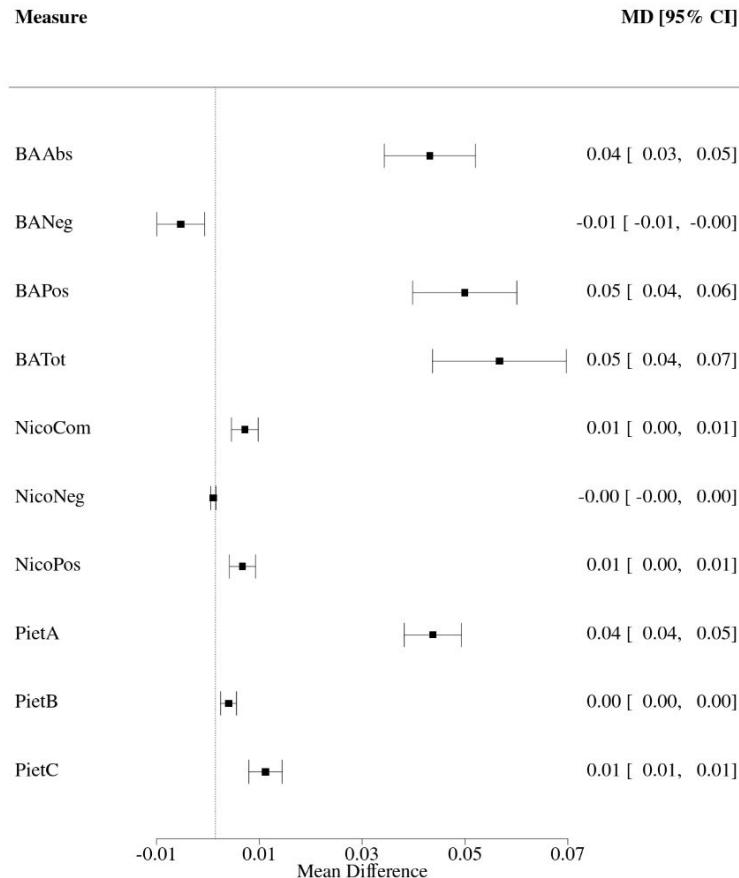
Variable	M	SD	1	2	3	4	5	6
1. HumEval	2.46	1.22						
2. PietA	1.31	3.43	.08 [-.05, .21]		-0.09	-1.19	-1.46	-3.88**
3. PietB	0.73	2.68	.09 [-.04, .22]	.18** [.05, .30]		-1.00	-1.66	-4.42**
4. NicoTot	0.55	2.45	.19** [.06, .32]	.12 [-.01, .25]	-.08 [-.21, .05]		-0.29	-2.60**
5. BATot	1.18	12.51	.22** [.09, .34]	.08 [-.05, .21]	.37** [.25, .48]	.04 [-.09, .17]		-2.40*
6. BAAbs	8.96	8.79	.42** [.31, .53]	.08 [-.05, .21]	.33** [.20, .44]	-.00 [-.14, .13]	.06 [-.07, .19]	

Comparison of computational evaluation of “acts in the world” in descriptions of supernatural concepts (N=216) from Sommer et al. (2022) with human evaluations (N=172).

Variable	M	SD	1	2	3	4	5	6
1. HumEval	3.20	0.98						
2. PietA	1.31	3.43	.04 [-.09, .17]		-1.13	-1.19	-1.98*	-3.38**
3. PietB	0.73	2.68	.14* [.01, .27]	.18** [.05, .30]		-0.09	-1.10	-2.69**
4. NicoTot	0.55	2.45	.15* [.02, .28]	.12 [-.01, .25]	-.08 [-.21, .05]		-0.80	-2.12*
5. BATot	1.18	12.51	.22** [.09, .35]	.08 [-.05, .21]	.37** [.25, .48]	.04 [-.09, .17]		-1.38
6. BAAbs	8.96	8.79	.35** [.22, .46]	.08 [-.05, .21]	.33** [.20, .44]	-.00 [-.14, .13]	.06 [-.07, .19]	

*Effect Sizes for “inform” vs. “mobilize” conditions on textual data produced by participants
in two studies (total N=972) by Formanowicz, Beneda, et al. (2022) expressed as mean
difference (MD) between agency measures across conditions*

Study 5: Discriminant power on inform vs. mobilize others to act



Import and initialize BERTAgent

```
>>> from bertagent import BERTAgent  
>>> ba0 = BERTAgent()
```

Provide example sentences

```
>>> sents = [  
>>>     ....:     "hardly working individual",  
>>>     ....:     "hard working individual",  
>>>     ....:     "striving to achieve my goals",  
>>>     ....:     "struggling to achieve my goals",  
>>>     ....:     "struggling to survive",  
>>>     ....:     "unable to survive",  
>>>     ....:     "this car runs on gasoline with lead",  
>>>     ....:     "this car runs on gasoline and it will lead us",  
>>>     ....:     "this politician runs for office and he will lead us",  
>>>     ....: ]
```

Assign agency

```
>>> vals = ba0.predict(sents)
```

Print results

```
>>> for item in zip(sents, vals):
>>>     print(f" {item[0]}!r : {item[1]:.2f}")
#
# 'hardly working individual' : -0.57
# 'hard working individual' : 0.44
# 'striving to achieve my goals' : 0.73
# 'struggling to achieve my goals' : -0.67
# 'struggling to survive' : -0.52
# 'unable to survive' : -0.57
# 'this car runs on gasoline with lead' : -0.03
# 'this car runs on gasoline and it will lead us' : 0.09
# 'this politician runs for office and he will lead us' : 0.58
#
# NOTE: exact values may differ slightly from the above
# depending on the BERTAgent model and version used.
```

How to use BERTAgent on DFs: An ultra brief tutorial

BERTAgent I/O:

- Input: List of sentences
- Output: List of agency scores (for each sentence)
 - Can be easily aggregated using, for example:
 - Mean
 - Min
 - Max
 - Sum of all values
 - Sum of positive only values
 - Sum of negative only values
 - Sum of absolute values

Process a texts in pandas dataframe

! Note

See in the example below we use `EXAMPLE_SENTENCES` data that is provided with `BERTAgent`.

Imports

```
>>> import pathlib  
>>> import pandas as pd  
>>> from tqdm import tqdm  
>>> from bertagent import BERTAgent  
>>> from bertagent import EXAMPLE_SENTENCES as sents  
>>> tqdm.pandas()  
>>>
```



Load BERTAgent

```
>>> ba0 = BERTAgent()
```

Prepare dataframe.

```
>>> df0 = pd.DataFrame(dict(text=sents))
```

Extract sentences from text.

```
>>> # NOTE: This is not an optimal method to get sentences from real data!
>>> df0["sents"] = df0.text.str.split(".")
```

Check input dataframe

```
>>> print(df0.head(n=4))
```

Input data (pandas dataframe containing lists of sentences)

	sents
0	['She is a hard working individual']
1	['She is a hardly working individual']
2	['This thing was made of lead']
3	['This is a car, it runs on gas']
4	['This is a Karen, she runs for office']
5	['This is a Jane, she runs for office']
6	['Striving to achieve my goals']
7	['Struggling to achieve my goals']

Evaluate agency

```
>>> model_id = "ba0"
>>> df0[model_id] = df0.sents.progress_apply(ba0.predict)
```

Compute more specific indices of agency (`tot` = total = sum af all values for all sentences, `pos` = only positive, `neg` = only negative, `abs` = sum of absolute values)

```
>>> df0["BATot"] = df0[model_id].apply(ba0.tot)
>>> df0["BAPos"] = df0[model_id].apply(ba0.pos)
>>> df0["BANeg"] = df0[model_id].apply(ba0.neg)
>>> df0["BAAbs"] = df0[model_id].apply(ba0.abs)
>>>
>>> cols0 = [
>>>     "sents",
>>>     "ba0",
>>>     "BATot",
>>>     "BAPos",
>>>     "BANeg",
>>>     "BAAbs",
>>> ]
>>>
```

Check output

```
>>> df0[cols0].tail(n=8)
```

Output data (pandas dataframe with agency evaluation)

	sents	ba0	BATot	BAPos
0	['She is a hard working individual']	[0.48]	0.48	0.48
1	['She is a hardly working individual']	[-0.62]	-0.62	0.0
2	['This thing was made of lead']	[-0.04]	-0.04	0.0
3	['This is a car, it runs on gas']	[0.01]	0.01	0.01
4	['This is a Karen, she runs for office']	[0.33]	0.33	0.33
5	['This is a Jane, she runs for office']	[0.35]	0.35	0.35
6	['Striving to achieve my goals']	[0.72]	0.72	0.72
7	['Struggling to achieve my goals']	[-0.6]	-0.6	0.0
8	['Striving to make it']	[0.13]	0.13	0.13
9	['Struggling to make it']	[-0.52]	-0.52	0.0

29	['Lazy and unmotivated']	[-0.85]	-0.85	0.0
30	['I want to give up']	[-0.49]	-0.49	0.0
31	['lost all hope']	[-0.57]	-0.57	0.0
32	["We'll lose anyway"]	[-0.43]	-0.43	0.0
33	['We should give up and say nothing']	[-0.41]	-0.41	0.0
34	['We must win']	[0.65]	0.65	0.65
35	['We will lead our way out of trouble']	[0.49]	0.49	0.49
36	['We must fight for our rights']	[0.29]	0.29	0.29
37	['We should take control and assert our position']	[0.71]	0.71	0.71
38	['We should take control']	[0.57]	0.57	0.57
39	['We shoud take controll']	[0.37]	0.37	0.37
40	['Hard working individual', ' Hardly working individual']	[0.42 -0.41]	0.0	0.21

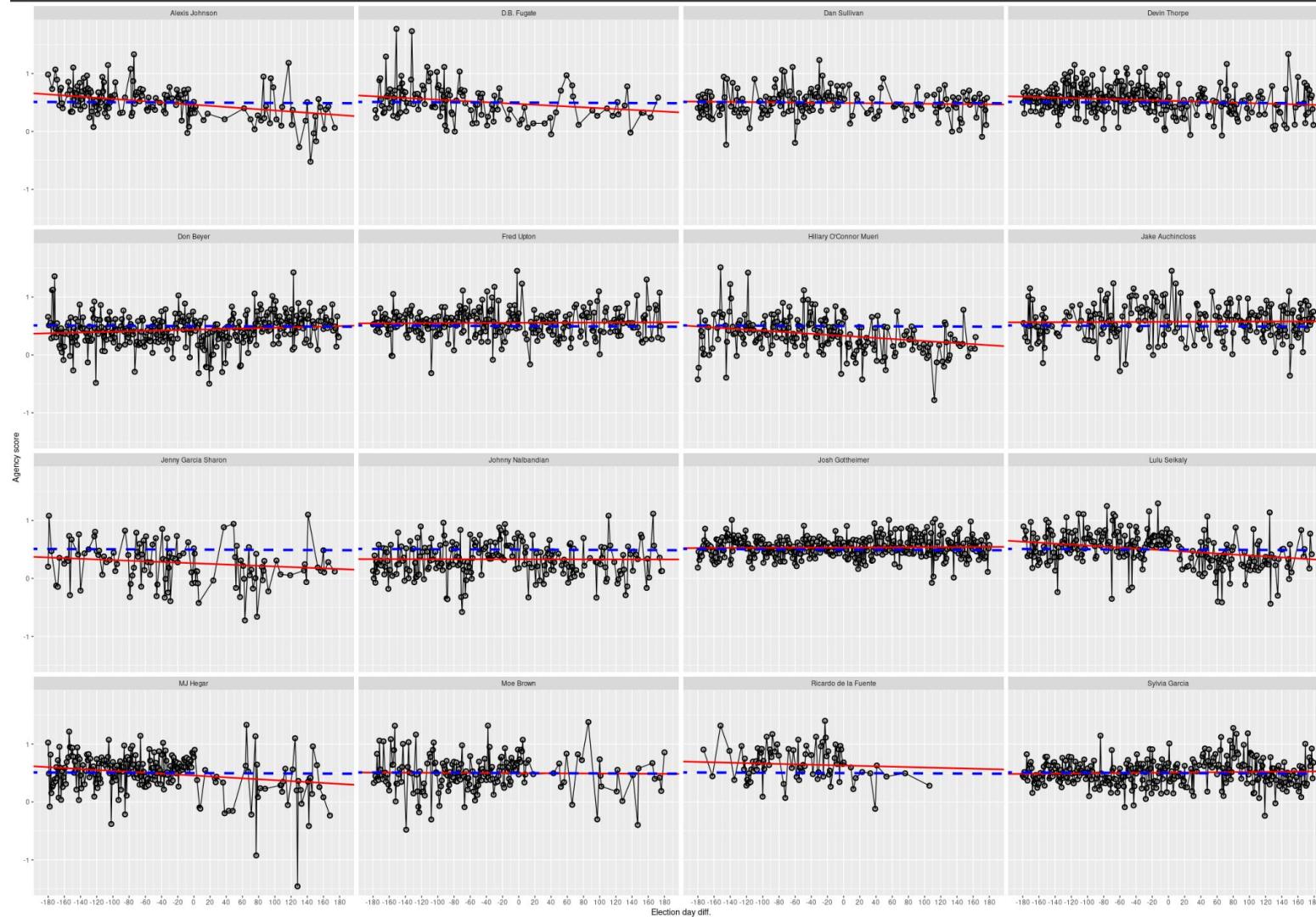
! Note

The last row demonstrates how a text that contains multiple sentences is handled, each sentence is assigned a separate agency score.

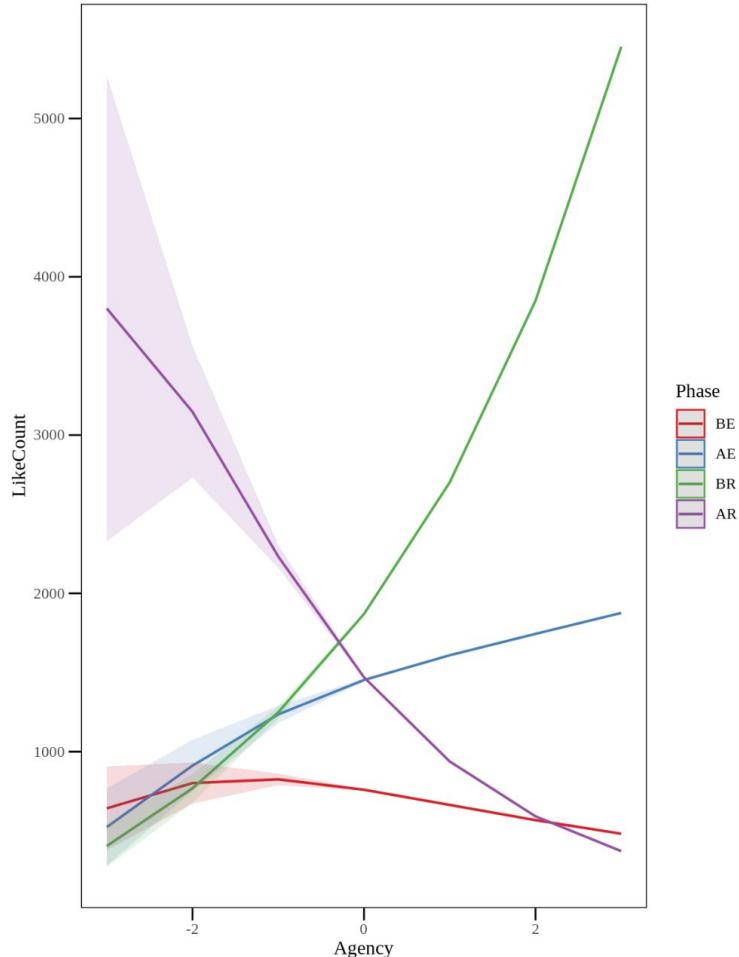
BERTAgent fine-tuning summary

Base model	Fine-tuning dataset	Epoch count	Batch size	RMSE		
				Training (xALD)	Evaluation (xALD)	Testing (GSD)
bert-base-uncased	FT0	12	64	0.0978	0.2168	0.3749
bert-base-uncased	FT1	12	64	0.0539	0.1699	0.3467
bert-base-uncased	FT2	12	64	0.0517	0.1477	0.3475
bert-base-uncased	FT3	12	64	0.0302	0.0411	0.3311
roberta-base	FT0	12	64	0.1767	0.2174	0.3720
roberta-base	FT1	12	64	0.0743	0.1751	0.3312
roberta-base	FT2	12	64	0.0761	0.1535	0.3283
roberta-base	FT3	12	64	0.0435	0.052	0.3172
roberta-base	rFT3	12	64	0.0490	0.065	0.3006

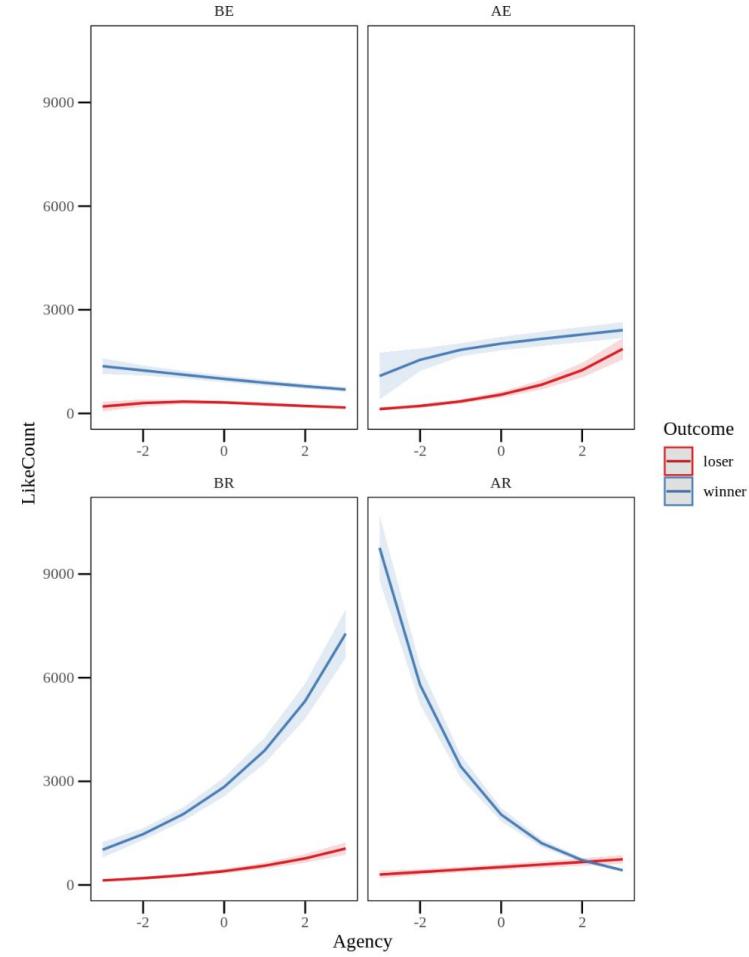
Note. RMSE = root mean square error; All training datasets contain text snippets derived from agency-related concepts that were extracted from the Open English WordNet (OEWN; McCrae et al., 2021) and evaluated by human coders with respect to agency conveyed. **FT0** contains only concept usage examples; **FT1** additionally contains lemmas concatenated with definitions; **FT2** contains additional augmented data that was derived using antonym relations form OEWN; **FT3** was an exploratory approach in which for each concept we combined all its lemmas, definition and all its usage examples; **rFT3** is an extension of FT3 to fully include more advanced forms of negation in the training data as described in Section Model updating (re-fine-tuning).



Average predicted counts of LikeCount



Average predicted counts of LikeCount



Further exploratory analyses can be found at:

<https://cogsys.io/temp/n0001-init.html>

https://cogsys.io/temp/scatter_batch_0021_GAUSS_2.html

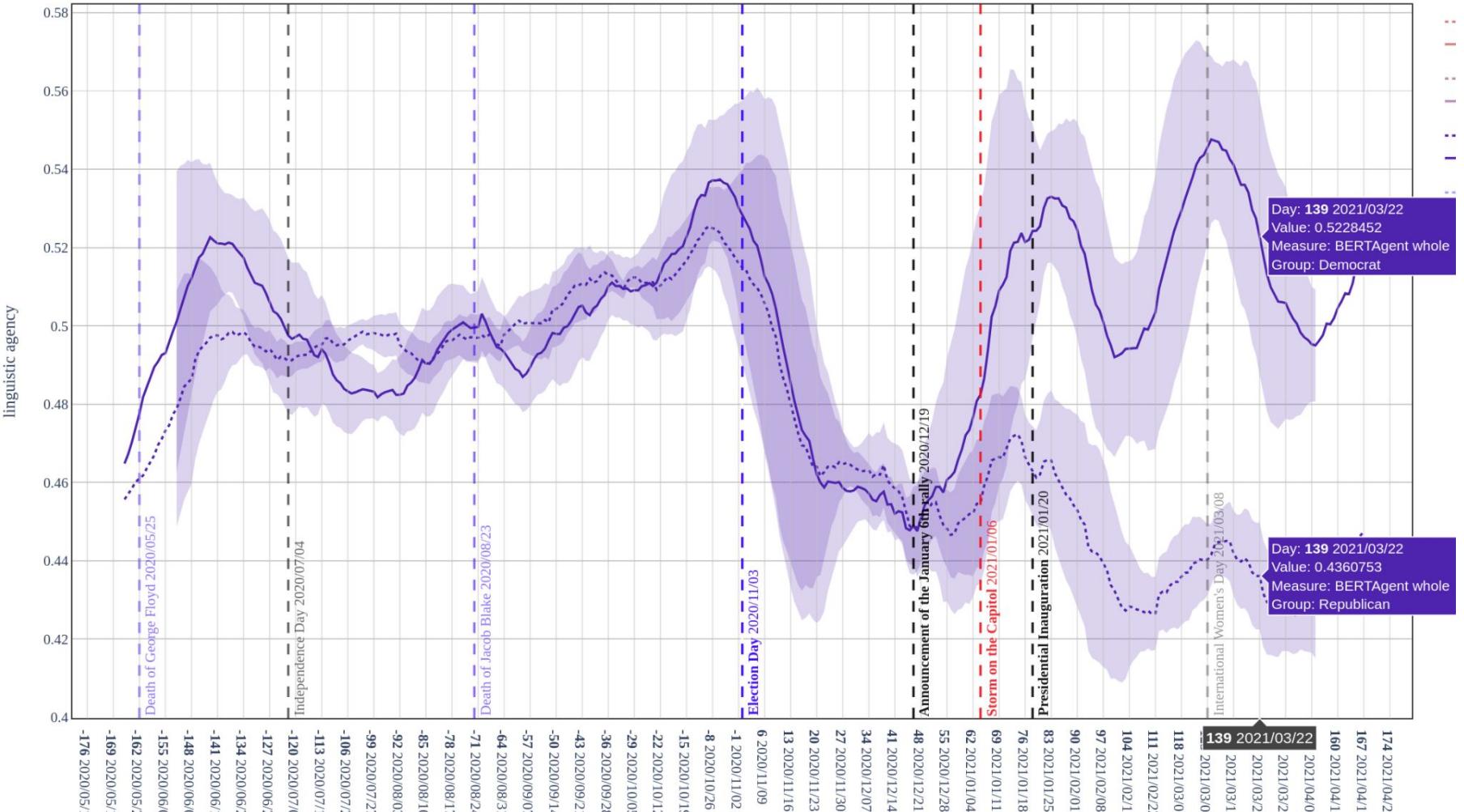
https://cogsys.io/temp/scatter_batch_0021_GAUSS_4.html

Collective Action

- any action aiming to improve the status of an entire group rather than of few individual members of that group (Van Zomeren & Iyer, 2009; also see: van Zomeren, Postmes, & Spears, 2008).

Concussions

- We successfully **developed** and **validated** **BERTAgen** using a combination of:
 - existing trait-related datasets,
 - lexicographical data (WordNet),
 - human coder evaluations,
 - LLM (RoBERTa).
- We captured the **temporal dynamics** of linguistic agency in real data produced by 2020 U.S. Congressional Election candidates.



Influence of Agency

