Social Influence and Protective Behavior during Pandemic: Exploring the Impact of Descriptive Norms

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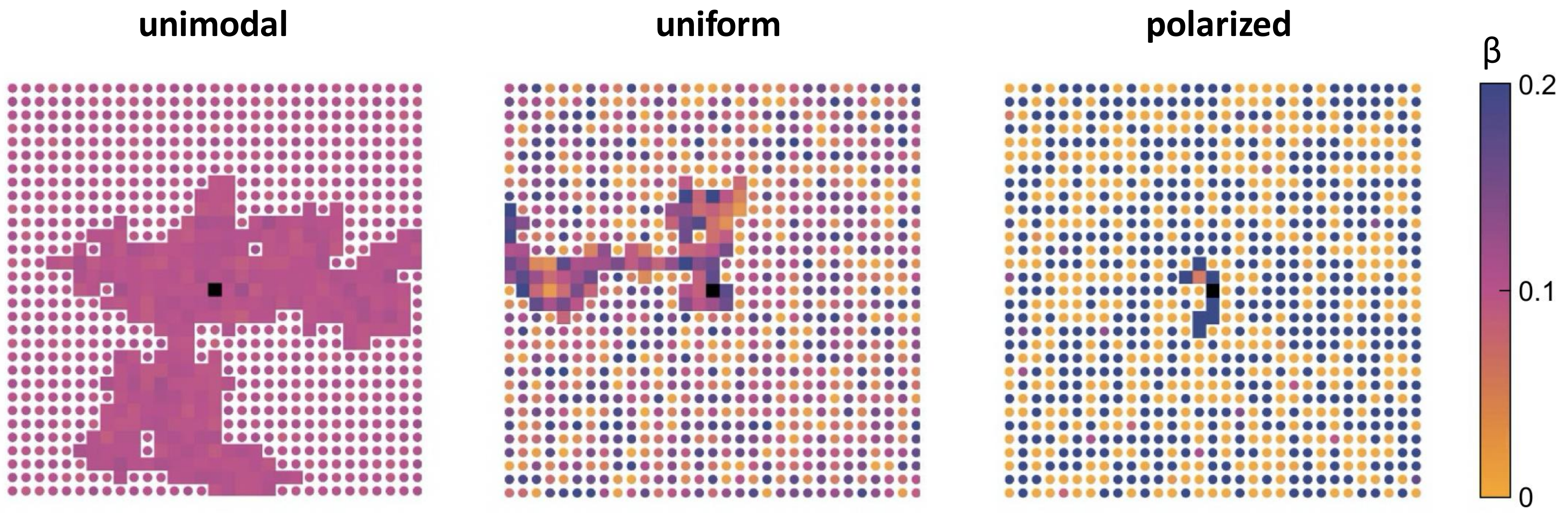
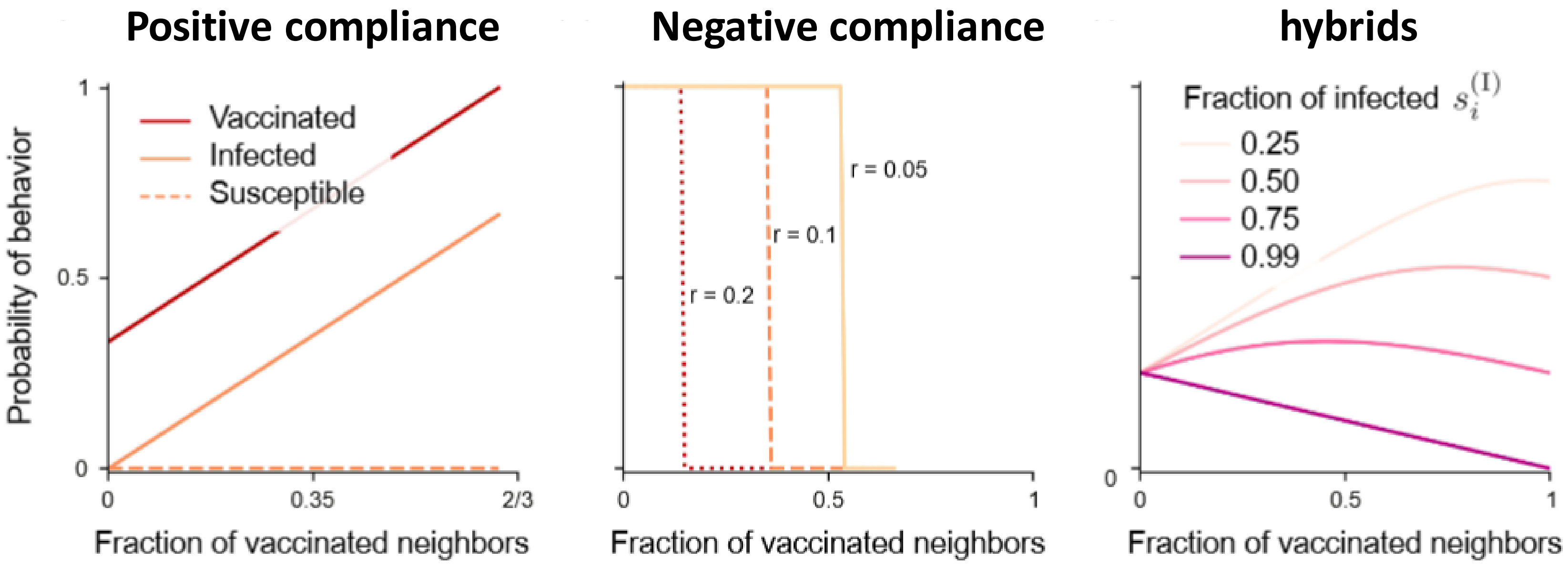
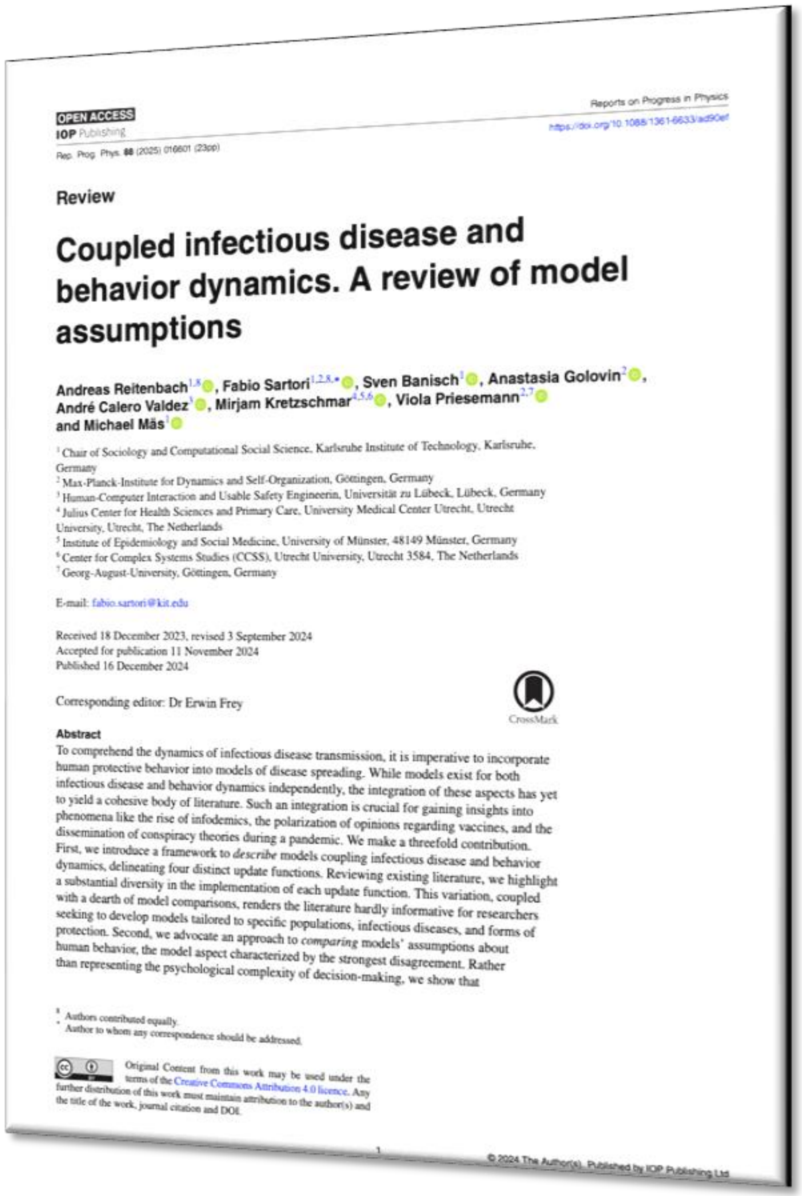
The distribution of protective behavior affects spreading dynamics

- Statistical distribution (unimodal → polarization)
- Distribution in the network (mixed → homophily)



Influence-Response Function





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Review

Coupled infectious disease and behavior dynamics. A review of model assumptions

Andreas Reitenbach[1,8], Fabio Sartori[1,2,8,*], Sven Banisch[1], Anastasia Golovin[2], André Calero Valdez[3], Mirjam Kretzschmar[4,5,6], Viola Priesemann[2,7] and Michael Mäs[1]

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Abstract

To comprehend the dynamics of infectious disease transmission, it is imperative to incorporate human protective behavior into models of disease spreading. While models exist for both infectious disease and behavior dynamics independently, the integration of these aspects has yet to yield a cohesive body of literature. Such an integration is crucial for gaining insights into phenomena like the rise of infodemics, the polarization of opinions regarding vaccines, and the dissemination of conspiracy theories during a pandemic. We make a threefold contribution. First, we introduce a framework to *describe* models coupling infectious disease and behavior dynamics, delineating four distinct update functions. Reviewing existing literature, we highlight a substantial diversity in the implementation of each update function. This variation, coupled with a dearth of model comparisons, renders the literature hardly informative for researchers seeking to develop models tailored to specific populations, infectious diseases, and forms of protection. Second, we advocate an approach to *comparing* models' assumptions about human behavior, the model aspect characterized by the strongest disagreement. Rather than representing the psychological complexity of decision-making, we show that

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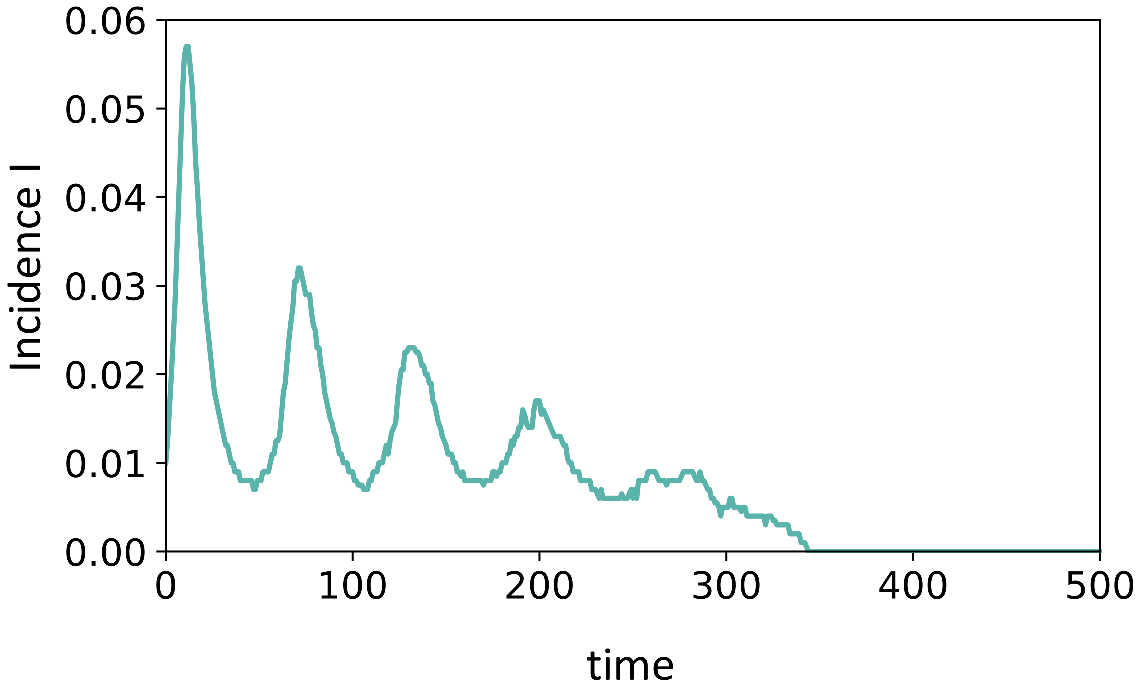
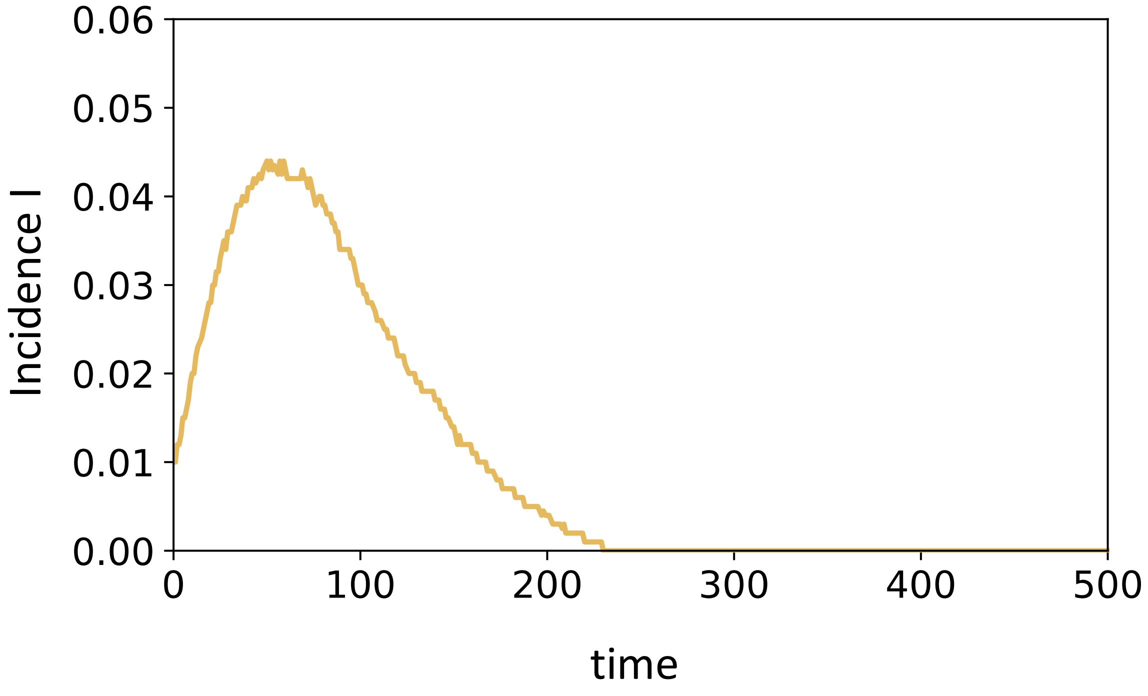
Reitenbach, Andreas, et al. (2024): Coupled infectious disease and behavior dynamics. A review of model assumptions, in: Reports on Progress in Physics

Disease dynamics depend on Micro-assumption

Positive compliance



Negative compliance



Results by Andreas Reitenbach

Factorial Survey Design – Vignette Setting

A 30-years-old person enters a train and has a journey of 10 minutes ahead of them during which she could wear a FFP2 face mask. When she enters the train, she sits down next to an 30-years-old woman. Of the 140 other people in the carriage, about half of the people (50%) wear an FFP2 face mask. The Robert-Koch-Institute has recently issued a warning about a particularly high risk of infection. The person decides not to wear a FFP2 face mask.

How appropriate or inappropriate do you find the decision, not to wear a FFP2-mask?

-5	-4	-3	-2	-1	0	1	2	3	4	5
very in-appropriate										very appropriate

Suppose you get on the train described above. Would you wear a mask?

- ○ Probably no
- ● Probably yes

Factorial Survey Design – Vignett

D2 – Costs:
1 10 minutes
2 4 hours

A 30-years-old person enters a train and has a journey of 10 minutes ahead of them during which she could wear a FFP2 face mask. When she enters the train, she sits down next to an 30-years-old woman. Of the 140 other people in the carriage, about half of the people (50%) wear an FFP2 face mask. The Robert-Koch-Institute has recently issued a warning about a particularly high risk of infection. The person decides not to wear a FFP2 face mask.

D3 – Obligation to protect others:
1 30-years-old
2 80-years-old

D1 – One's own need for protection:
1 30-years-old
2 80-years-old

...nd the decision, not to wear a FFP2-mask?

-5 ver... appr... | -4 | -3 | -2 | -1 | ... | 5 very appropriate

D5 – Risk of infection:
1 has not recently issued a warning
2 has recently issued a warning

D4 – Descriptive Norm:
1 no one (0%)
2 a few people (25%)
3 about half of the people (50%)
4 some of them (75%)
5 everyone (100%)

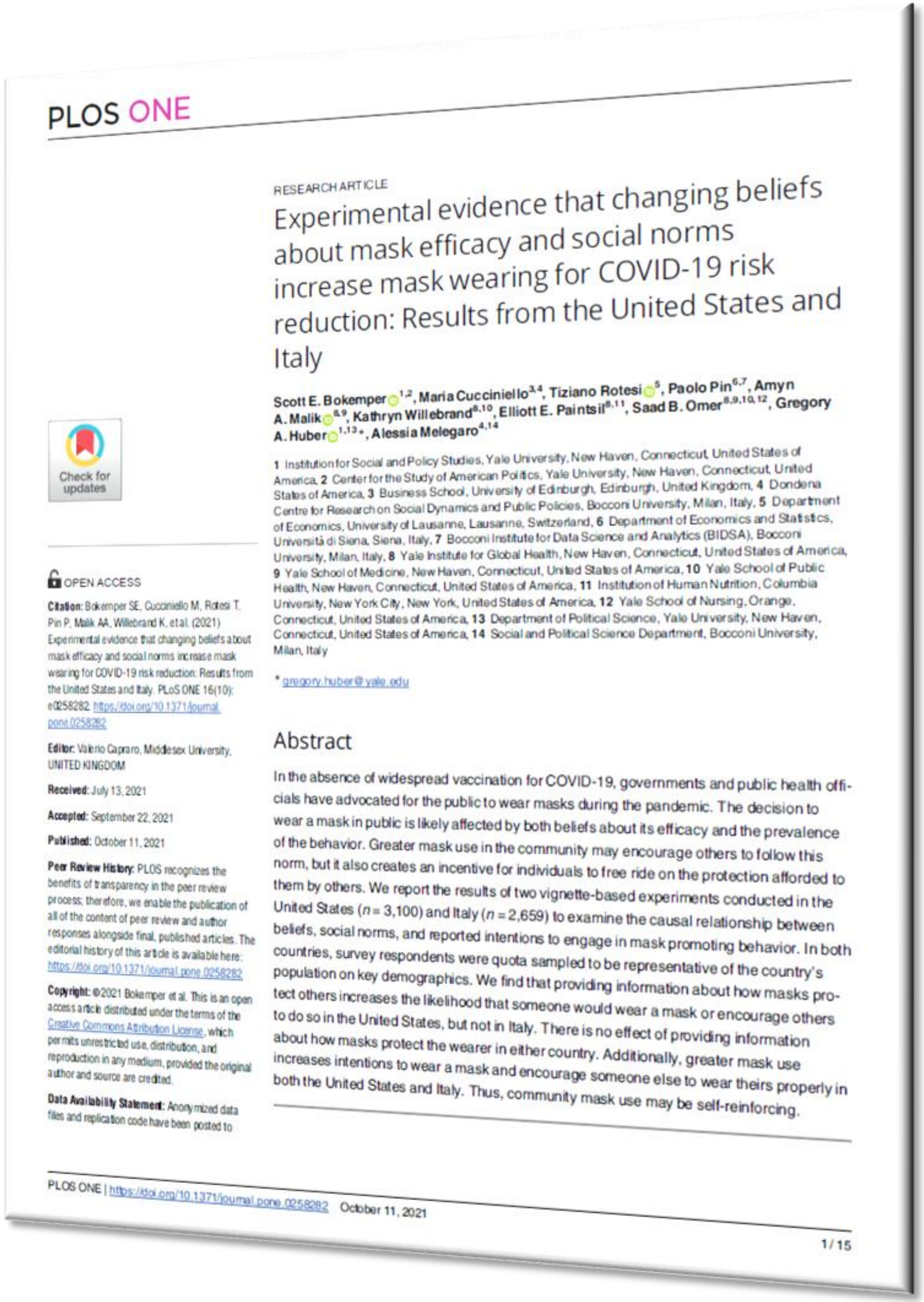
Suppose you get on the train described above. Would you wear a mask?

- ○ Probably no
- ● Probably yes

Macro-Level: Herding

Dependent Variable: How appropriate or inappropriate do you find the decision, not to wear a face mask?
1 = very appropriate – 11 = very inappropriate

Predictors	*Estimates*	*CI*	*p*
(Intercept)	3.73	3.58 – 3.89	**<0.001**
Ref.cat.: 30 years-old			
D1 [80 years-old]	0.16	0.08 – 0.25	**<0.001**
Ref.cat.: 10 minutes			
D2 [4 hours]	0.12	0.04 – 0.20	**0.005**
Ref.cat.: 30 years-old			
D3 [80 years-old]	0.22	0.16 – 0.28	**<0.001**
Ref.cat.: No one (0%)			
D4 [a few people (25%)]	0.36	0.25 – 0.46	**<0.001**
D4 [half of the people (50%)]	0.73	0.64 – 0.82	**<0.001**
D4 [some of them (75%)]	1.00	0.89 – 1.10	**<0.001**
D4 [everyone (100%)]	1.37	1.26 – 1.47	**<0.001**
Ref.cat.: no warning			
D5 [warning]	2.36	2.30 – 2.42	**<0.001**
Random Effects			
σ^2	4.53		
τ_{00} id	6.15		
ICC	0.58		
N id	1612		
Observations	19344		
Marginal R^2 / Conditional R^2	0.130 / 0.631		


PLOS ONE

RESEARCH ARTICLE

Experimental evidence that changing beliefs about mask efficacy and social norms increase mask wearing for COVID-19 risk reduction: Results from the United States and Italy

Scott E. Bokemper[1,2], Maria Cucciniello[3,4], Tiziano Rotesi[5], Paolo Pin[6,7], Amyn A. Malik[8,9], Kathryn Willebrand[8,10], Elliott E. Paintsil[8,11], Saad B. Omer[8,9,10,12], Gregory A. Huber[1,13*], Alessia Melegaro[4,14]

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Citation: Bokemper SE, Cucciniello M, Rotesi T, Pin P, Malik AA, Willebrand K, et al. (2021) Experimental evidence that changing beliefs about mask efficacy and social norms increase mask wearing for COVID-19 risk reduction: Results from the United States and Italy. PLoS ONE 16(10): e0258282. https://doi.org/10.1371/journal.pone.0258282

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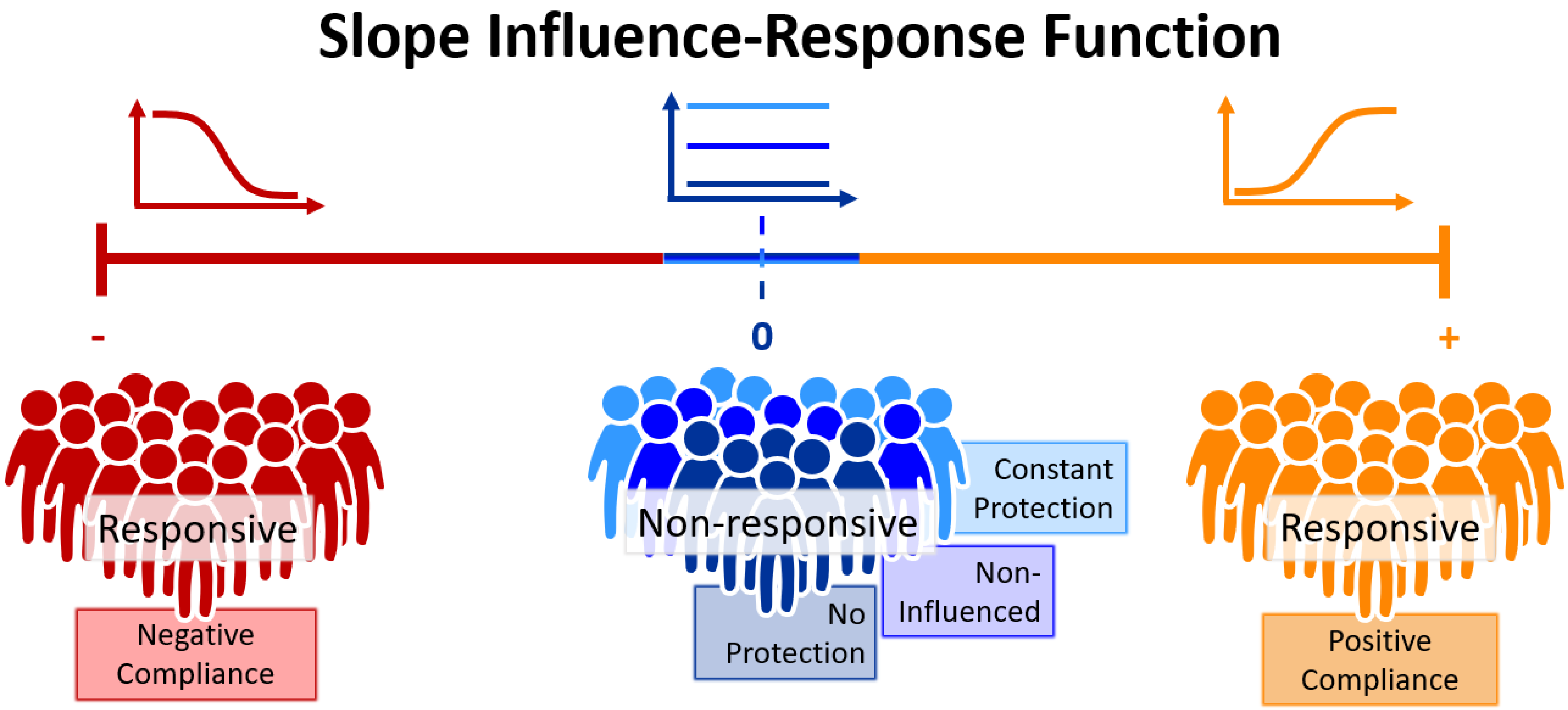
Data Availability Statement: Anonymized data files and replication code have been posted to

Abstract

In the absence of widespread vaccination for COVID-19, governments and public health officials have advocated for the public to wear masks during the pandemic. The decision to wear a mask in public is likely affected by both beliefs about its efficacy and the prevalence of the behavior. Greater mask use in the community may encourage others to follow this norm, but it also creates an incentive for individuals to free ride on the protection afforded to them by others. We report the results of two vignette-based experiments conducted in the United States ($n = 3,100$) and Italy ($n = 2,659$) to examine the causal relationship between beliefs, social norms, and reported intentions to engage in mask promoting behavior. In both countries, survey respondents were quota sampled to be representative of the country's population on key demographics. We find that providing information about how masks protect others increases the likelihood that someone would wear a mask or encourage others to do so in the United States, but not in Italy. There is no effect of providing information about how masks protect the wearer in either country. Additionally, greater mask use increases intentions to wear a mask and encourage someone else to wear theirs properly in both the United States and Italy. Thus, community mask use may be self-reinforcing.

Similar results by:
Bokemper, Scott E., et al.(2021): "Experimental evidence that changing beliefs about mask efficacy and social norms increase mask wearing for COVID-19 risk reduction: Results from the United States and Italy." *PloS one*

Influence-Response Functions:
The Behavior of Others as Descriptive Norm



Factorial Survey Design – Decks

- **Full Factorial Design** with 80 vignettes should be divided in **different decks**

  → usually, this is done randomly or by optimalDesign-Algorithms

- **BUT:** This counteracts the balance and orthogonality within the decks that characterize full factorial designs

- **What can be done? –** dividing systematically into decks

Factorial Survey Design – Decks: D3, D4, and D5

D3 – Obligation to protect others:	D4 – Descriptive Norm:	D5 – Risk of Infection:
1 (30-years-old)	1 (0%)	1 (no warning)
1 (30-years-old)	2 (25%)	2 (warning)
1 (30-years-old)	3 (50%)	1 (no warning)
1 (30-years-old)	4 (75%)	2 (warning)
1 (30-years-old)	5 (100%)	1 (no warning)
2 (80-years-old)	1 (0%)	2 (warning)
2 (80-years-old)	2 (25%)	1 (no warning)
2 (80-years-old)	3 (50%)	2 (warning)
2 (80-years-old)	4 (75%)	1 (no warning)
2 (80-years-old)	5 (100%)	2 (warning)

orthogonal orthogonal

D3 and D5 are not orthogonal

Factorial Survey Design – Decks: D3, D4, and D5

D3 – Obligation to protect others:	**D4 – Descriptive Norm:**	**D5 – Risk of Infection:**
1 (30-years-old)	1 (0%)	1 (no warning)
1 (30-years-old)	2 (25%)	2 (warning)
1 (30-years-old)	3 (50%)	1 (no warning)
1 (30-years-old)	4 (75%)	2 (warning)
1 (30-years-old)	5 (100%)	1 (no warning)
2 (80-years-old)	1 (0%)	2 (warning)
2 (80-years-old)	2 (25%)	1 (no warning)
2 (80-years-old)	3 (50%)	2 (warning)
2 (80-years-old)	4 (75%)	1 (no warning)
2 (80-years-old)	5 (100%)	2 (warning)
1 (30-years-old)	**3 (50%)**	**2 (warning)**
2 (80-years-old)	**3 (50%)**	**1 (no warning)**

orthogonal **orthogonal**

D3 and D5 are now orthogonal

One deck consists of 12 vignettes

Decks – D1 and D2 in Deck 1 to Deck 4

DECK 1

D1	D2	D3	D4	D5
1	1	1	1	1
1	1	1	2	2
1	1	1	3	1
1	1	1	4	2
1	1	1	5	1
1	1	2	1	2
1	1	2	2	1
1	1	2	3	2
1	1	2	4	1
1	1	2	5	2
1	1	1	3	2
1	1	2	3	1

DECK 2

D1	D2	D3	D4	D5
2	1	1	1	1
2	1	1	2	2
2	1	1	3	1
2	1	1	4	2
2	1	1	5	1
2	1	2	1	2
2	1	2	2	1
2	1	2	3	2
2	1	2	4	1
2	1	2	5	2
2	1	1	3	2
2	1	2	3	1

DECK 3

D1	D2	D3	D4	D5
1	2	1	1	1
1	2	1	2	2
1	2	1	3	1
1	2	1	4	2
1	2	1	5	1
1	2	2	1	2
1	2	2	2	1
1	2	2	3	2
1	2	2	4	1
1	2	2	5	2
1	2	1	3	2
1	2	2	3	1

DECK 4

D1	D2	D3	D4	D5
2	2	1	1	1
2	2	1	2	2
2	2	1	3	1
2	2	1	4	2
2	2	1	5	1
2	2	2	1	2
2	2	2	2	1
2	2	2	3	2
2	2	2	4	1
2	2	2	5	2
2	2	1	3	2
2	2	2	3	1

D1 and D2
(person-related aspects)
are added
***between-subject* distributed**

Factorial Survey Design – Decks

What do we have now?

→ **4 different Decks with 12 different vignettes each**

→ **4 different Decks with 48 different vignettes in total**

What is still missing?

→ **8 possible combinations of D3, D4, and D5**

→ **D1 and D2 added to these additional 8 combinations**

Decks – D1 and D2 in Deck 5 to Deck 8

DECK 5

D1	D2	D3	D4	D5
1	1	2	1	1
2	2	2	2	2
2	2	1	4	1
1	1	1	5	2
2	1	1	1	2
1	2	1	2	1
1	2	2	4	2
2	1	2	5	1
1	1	2	3	1
1	2	1	3	2
2	2	1	3	1
2	1	2	3	2

DECK 6

D1	D2	D3	D4	D5
2	1	2	1	1
1	2	2	2	2
1	2	1	4	1
2	1	1	5	2
2	2	1	1	2
1	1	1	2	1
1	1	2	4	2
2	2	2	5	1
1	1	1	3	1
2	2	2	3	1
1	2	2	3	2
2	1	1	3	2

4 vignettes with D4 = Level 3 are doubled from Deck 1 to Deck 4 to have 12 vignettes

DECK 7

D1	D2	D3	D4	D5
1	2	2	1	1
2	1	2	2	2
2	1	1	4	1
1	2	1	5	2
1	1	1	1	2
2	2	1	2	1
2	2	2	4	2
1	1	2	5	1
1	1	2	3	2
2	1	2	3	1
2	2	1	3	2
1	2	1	3	1

DECK 8

D1	D2	D3	D4	D5
2	2	2	1	1
1	1	2	2	2
2	1	2	4	2
1	2	2	5	1
1	2	1	1	2
2	1	1	2	1
1	1	1	4	1
2	2	1	5	2
2	2	2	3	2
1	2	2	3	1
1	1	1	3	2
2	1	1	3	1

D1 and D2 are added *within-subject* distributed

Factorial Survey Design – Decks

- **Each** respondent gets a deck consisting of 12 vignettes each with **balanced** and **orthogonal** dimensions
- Thus, we are able to measure on the **individual level** and therefore can estimate an **Influence-Response Function** for **each respondent**

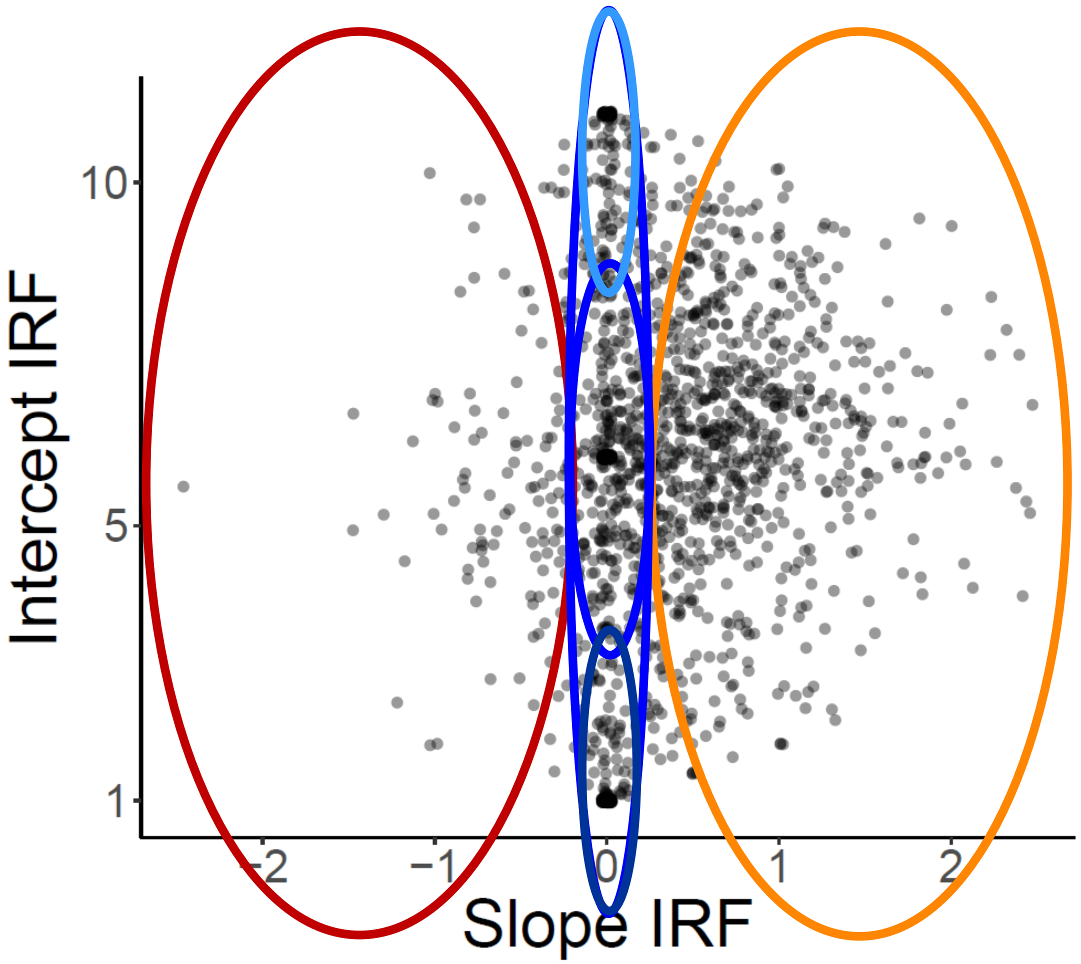
Factorial Survey Design – Representative Sample

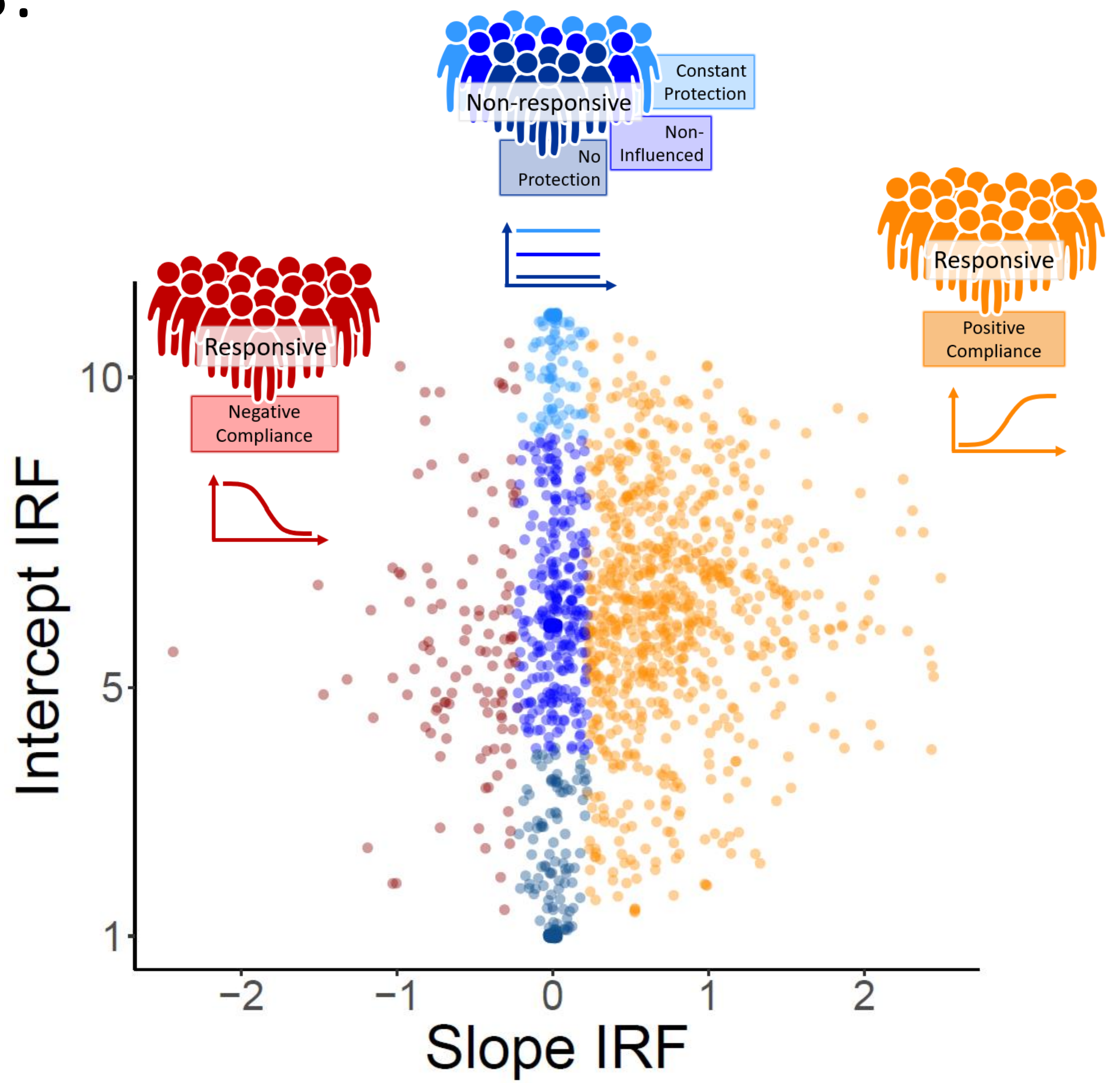
- 1,612 respondents from Germany

- 802 women, 807 men, and 3 individuals who identified as non-binary
- Average age: 44 years

- Average processing time: 20 minutes

Influence-Response Functions: Descriptive Norm





Thank you for your attention

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