04/09/18

1) Modelling infectious disease transmission potential as a function of human behaviour

2) Mobility data during the pandemic

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Modelling infectious disease transmission potential as a function of human behaviour

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doi: https://doi.org/10.1101/2021.07.16.21260521

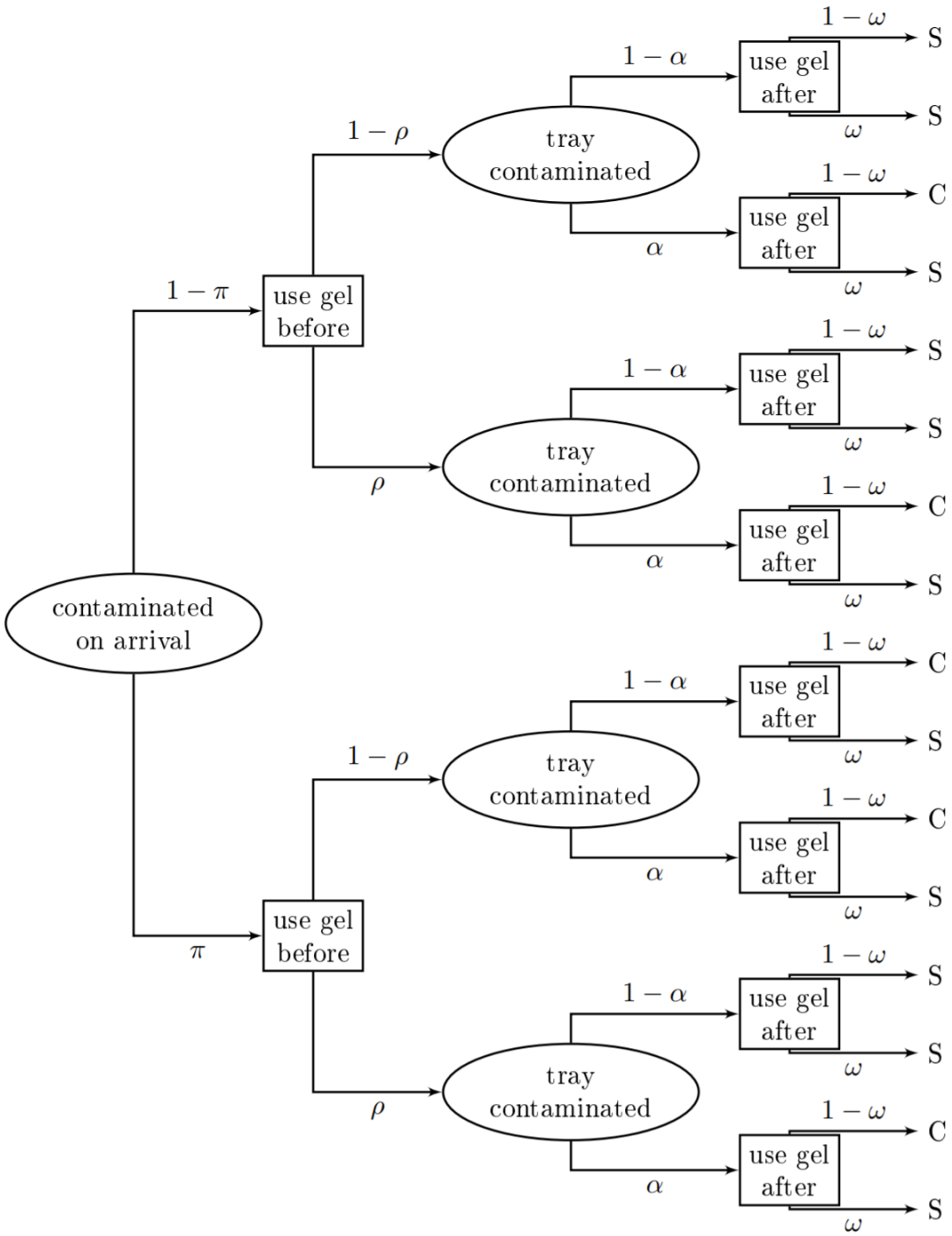
https://www.medrxiv.org/content/10.1101/2021.07.16.21260521v1

Motivation

- Project requirement: infectious disease interventions within transport hubs
- Collaborators highlighted airport security luggage screening as potential contamination risk

Contamination ≠ Infection

- Collaborators suggested hand hygiene intervention for influenza – antimicrobial gel
- Opportunity to explicitly model human behaviour – collaborate with behavioural scientists.
  Build's on recommendations in (Weston *et al*., 2018, BMC Public Health).



Model

π	Probability of a person being contaminated on arrival
α	Probability of becoming contaminated after handling the trays
ρ	Probability of complying prior to handling the tray
ω	Probability of complying after handling the tray

Scenarios

Does antimicrobial gel before or after luggage screening most reduce the probability of contamination?

Compare scenarios:

1) gel available only before screening
2) gel available only after screening

At steady state:

if

compliance before = compliance after

then

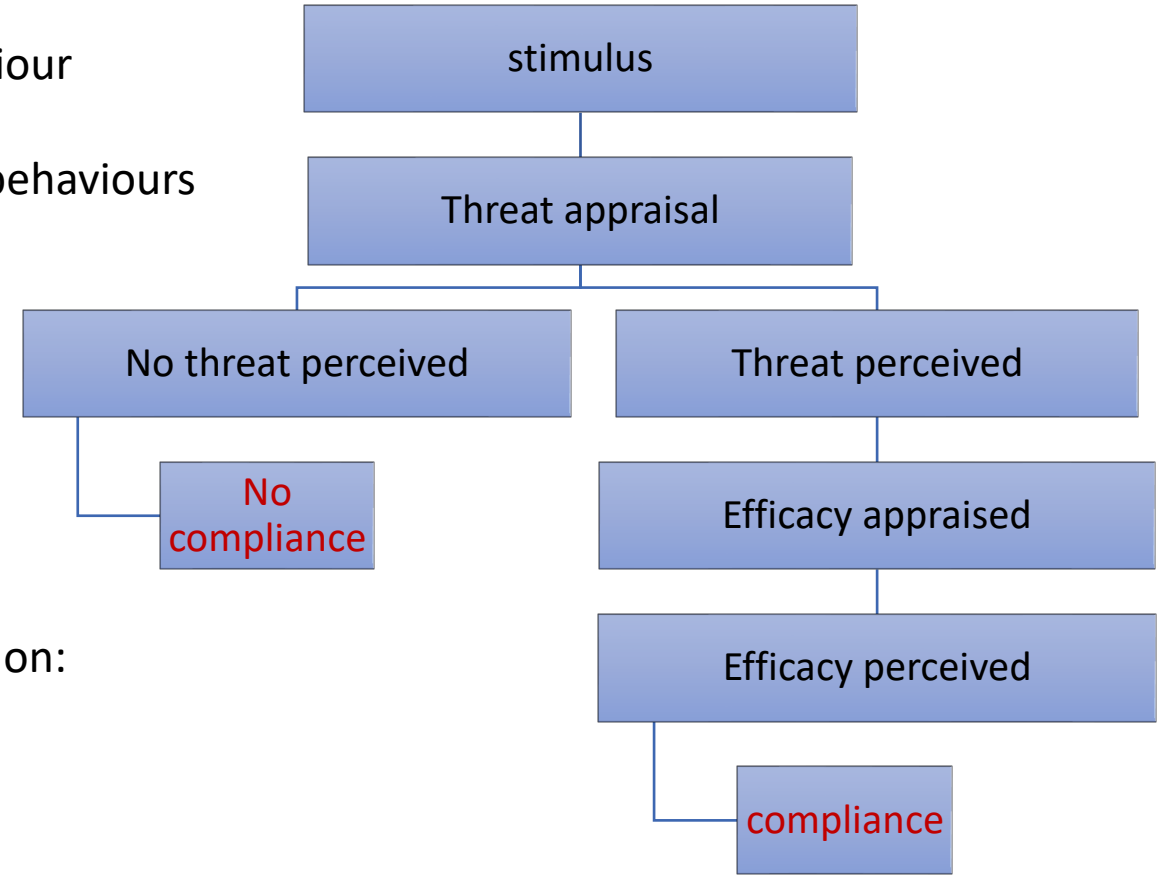
P(contamination | gel before) > P(contamination | gel after)

BUT compliance before ≠ compliance after ??

Behavioural theory

Extended Parallel Processing Model ***(Witte, 1992, Comm. Monogr.)***

- Psychological model of behaviour
- Specific to health-protective behaviours



Individual's compliance depends on:

- perceived threat
- perceived efficacy

Assumptions

1) Threat before < threat after

2) Efficacy before = efficacy after

3) Compliance -> function (threat, efficacy)

What is this functional form?

Can we have

P(contamination | gel before) < P(contamination | gel after) ?

Compliance function forms

1) Linear in threat * efficacy

$f(t,e) = et, \qquad (t,e) \in (0,1]^2$

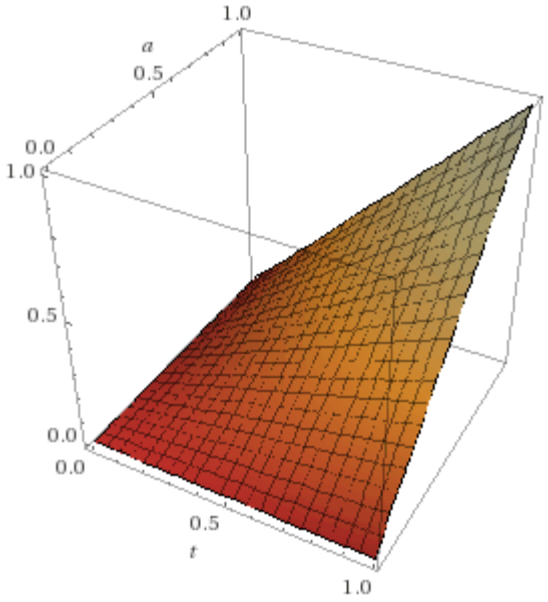
↑ threat ⇒ ↑ compliance

↑ efficacy ⇒ ↑ compliance

Simplest function

Could be representative of EPPM

Assume relative (t,e) could be estimated through psychology experiments.



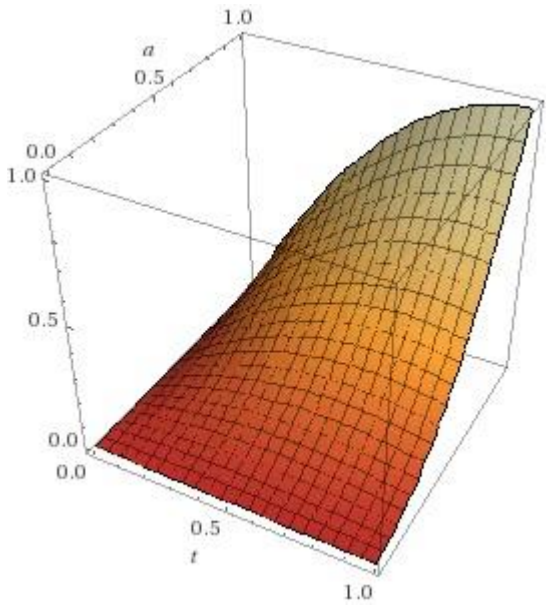
Gel before screening is never optimal

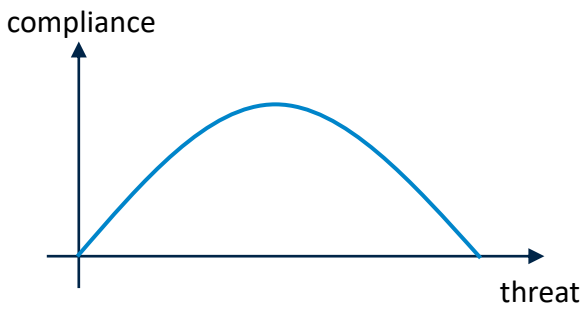
Compliance function forms

2) More complex function $\qquad f(t,e) = et(e - t + 1), \qquad (t,e) \in (0,1]^2$

↑ threat ⇒ ↑ ↓ compliance

↑ efficacy ⇒ ↑ compliance





Could be better representation of EPPM

Gel before screening is **sometimes optimal**

Conclusions

- More complex compliance function suggests different intervention strategy
- Possibly of benefit to understand underlying psychological decision-making processes

Further work (the dream…)

Stratify population on social identity – different efficacy values for different groups

e.g. solo business traveller
holiday with friends
travelling with children

Maybe get some data…?

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Mobility data during the COVID-19 pandemic

Caroline E. Walters

Figure 2. Consistent changes in mobility observed between Facebook data and mobile phone data.

- Corroborating trends
- Data not perfect from either source
- Confident to move forward with only Facebook

- 16th March:
  suggested lockdown
- 20th March:
  Schools, shops, hospitality shut down
- 23rd March:
  lockdown announced
  leave home once per day for exercise and for essentials
- 10th May:
  First relaxation of measures

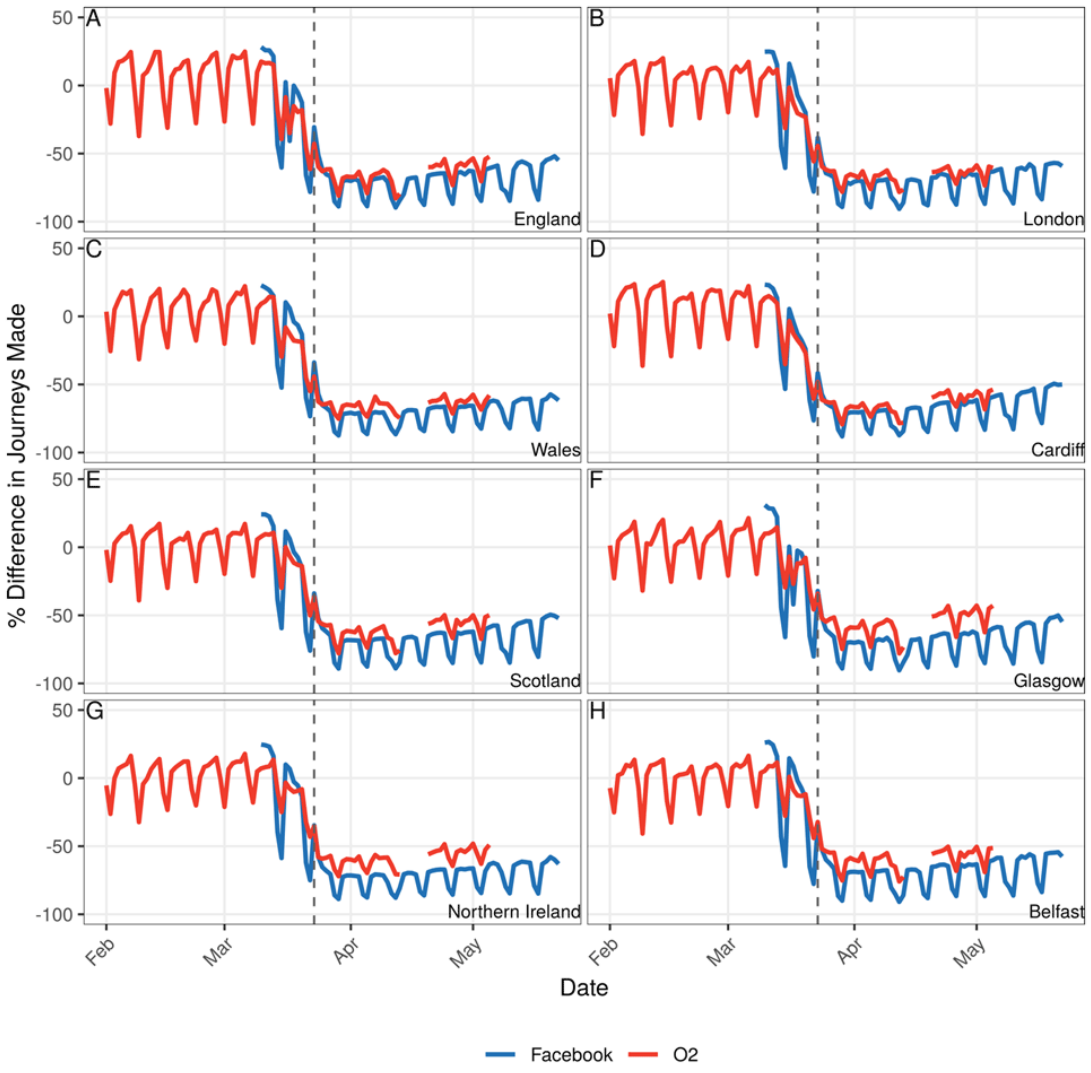

Figure 1.

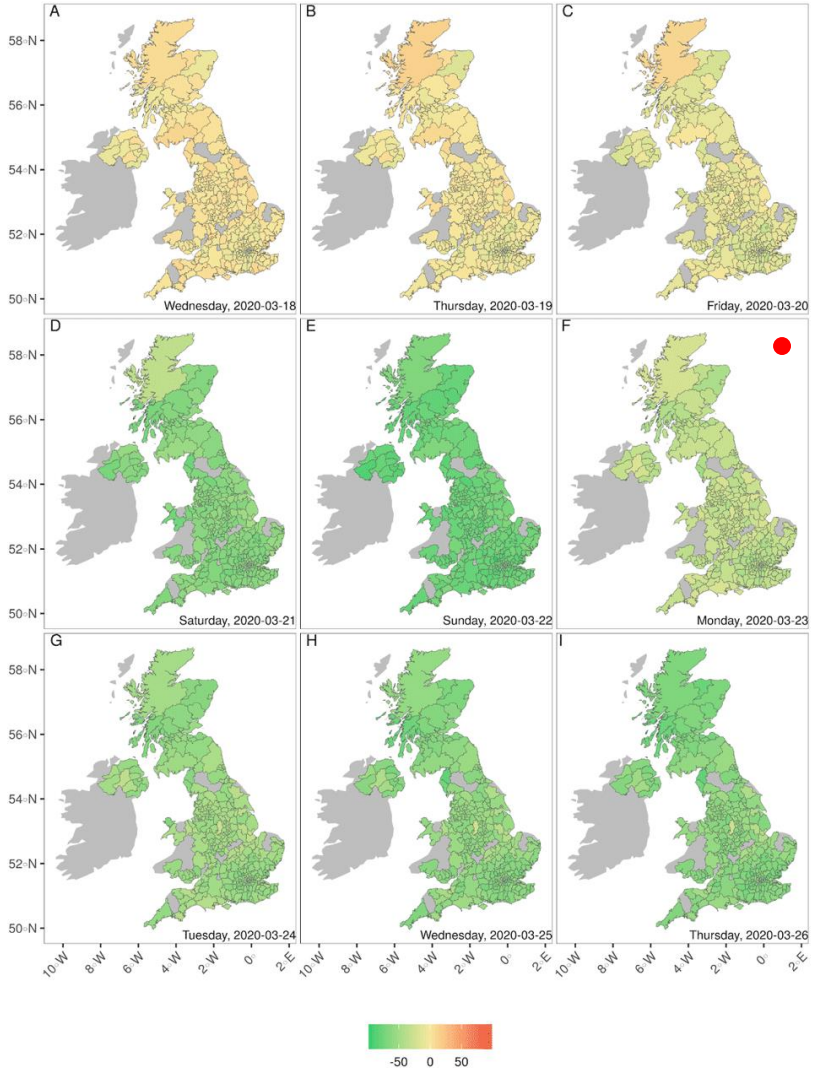

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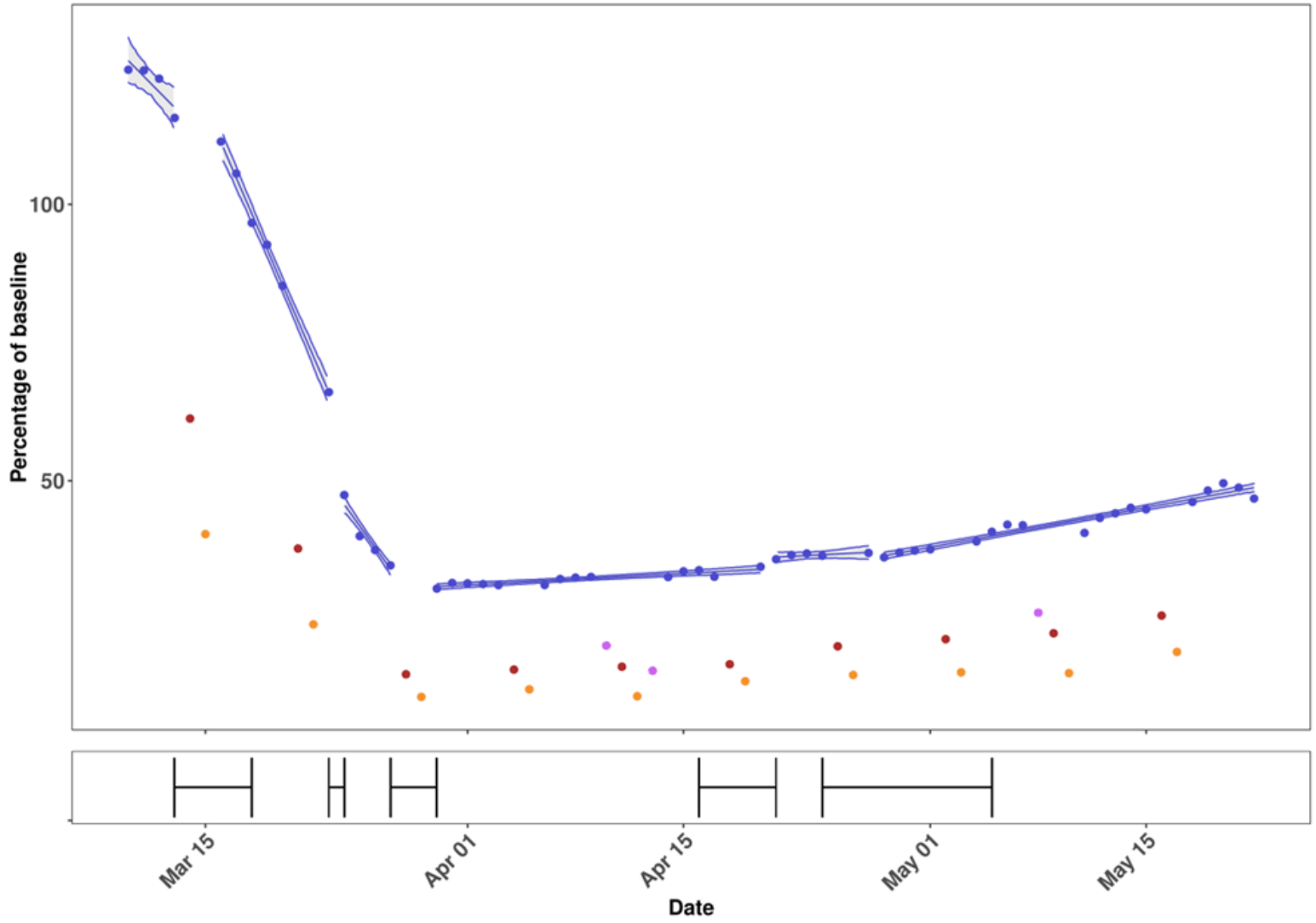
Figure 3. Fit of a segmented-linear model with 5 breakpoints to Facebook data



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RESEARCH ARTICLE

Anonymised and aggregated crowd level mobility data from mobile phones suggests that initial compliance with COVID-19 social distancing interventions was high and geographically consistent across the UK [version 1; peer review: 2 approved]

Benjamin Jeffrey [1*], Caroline E. Walters [1*], Kylie E. C. Ainslie [1*], Oliver Eales [1*], Constanze Ciavarella[1], Sangeeta Bhatia [1], Sarah Hayes [1], Marc Baguelin[1], Adhiratha Boonyasiri [2], Nicholas F. Brazeau [1], Gina Cuomo-Dannenburg [1], Richard G. FitzJohn[1], Katy Gaythorpe[1], William Green[1], Natsuko Imai [1], Thomas A. Mellan[1], Swapnil Mishra[1], Pierre Nouvellet[1,3], H. Juliette T. Unwin [1], Robert Verity[1], Michaela Vollmer[1], Charles Whittaker[1], Neil M. Ferguson[1], Christl A. Donnelly [1,4], Steven Riley[1]

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