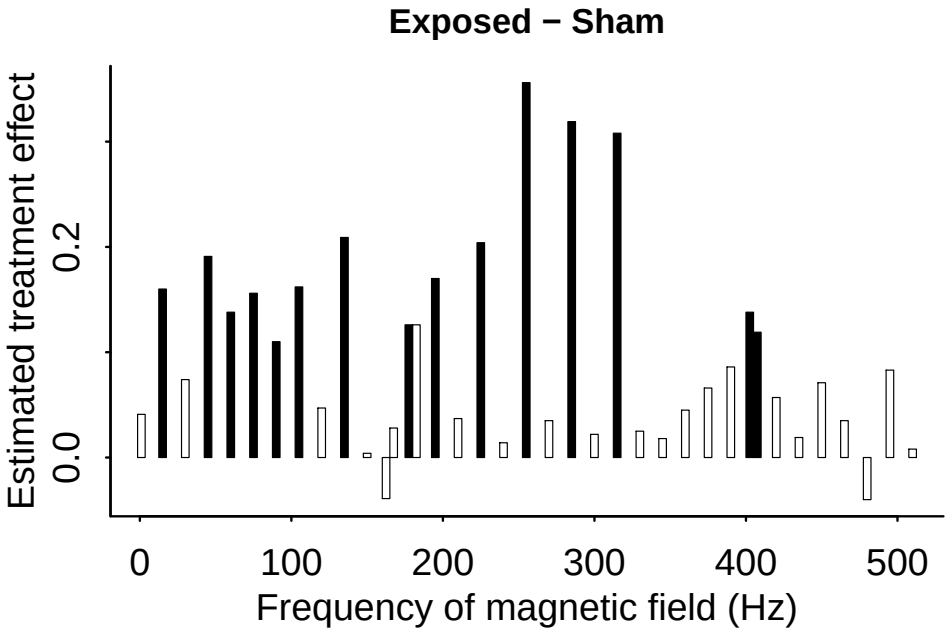
Keynote Presentation: Prof. Andrew Gelman (Columbia University)

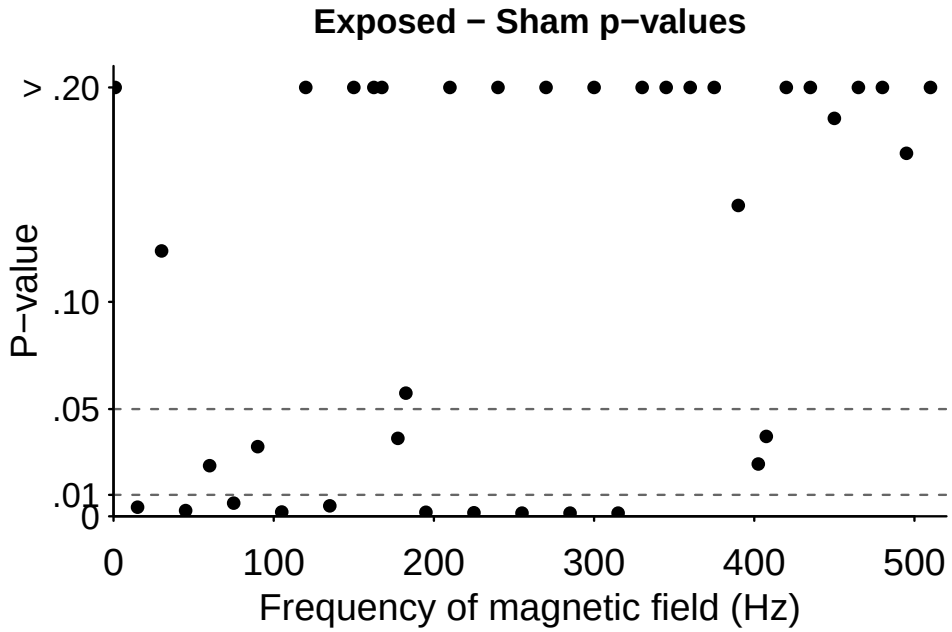
Andrew Gelman

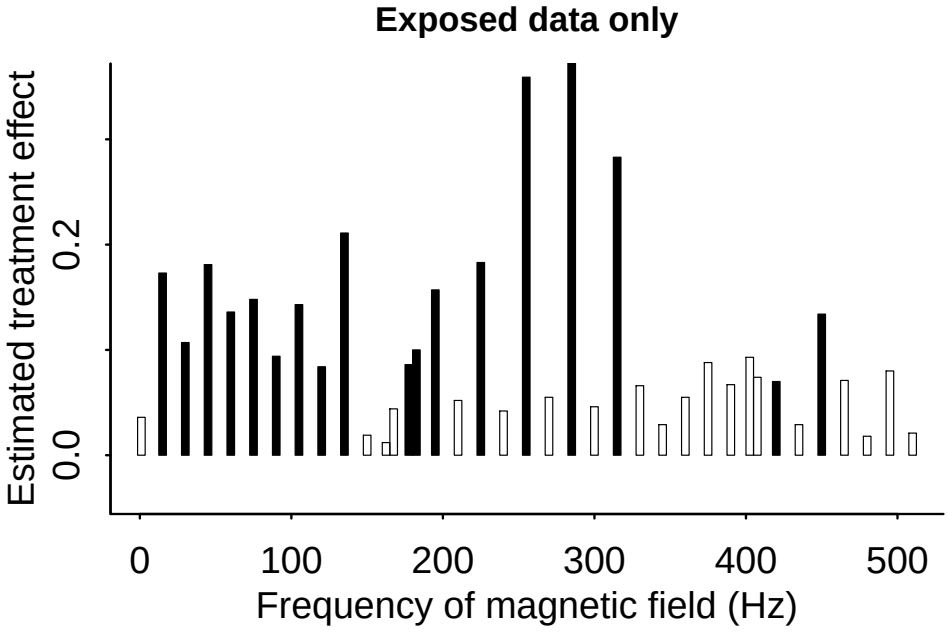
is a professor of statistics and political science at Columbia University. He has received the Outstanding Statistical Application award three times from the American Statistical Association, the award for best article published in the American Political Science Review, and the Council of Presidents of Statistical Societies award for outstanding contributions by a person under the age of 40. His books include Bayesian Data Analysis (with John Carlin, Hal Stern, David Dunson, Aki Vehtari, and Don Rubin), Teaching Statistics: A Bag of Tricks (with Deb Nolan), Data Analysis Using Regression and Multilevel/Hierarchical Models (with Jennifer Hill), Red State, Blue State, Rich State, Poor State: Why Americans Vote the Way They Do (with David Park, Boris Shor, and Jeronimo Cortina), A Quantitative Tour of the Social Sciences (co-edited with Jeronimo Cortina), and Regression and Other Stories (with Jennifer Hill and Aki Vehtari).

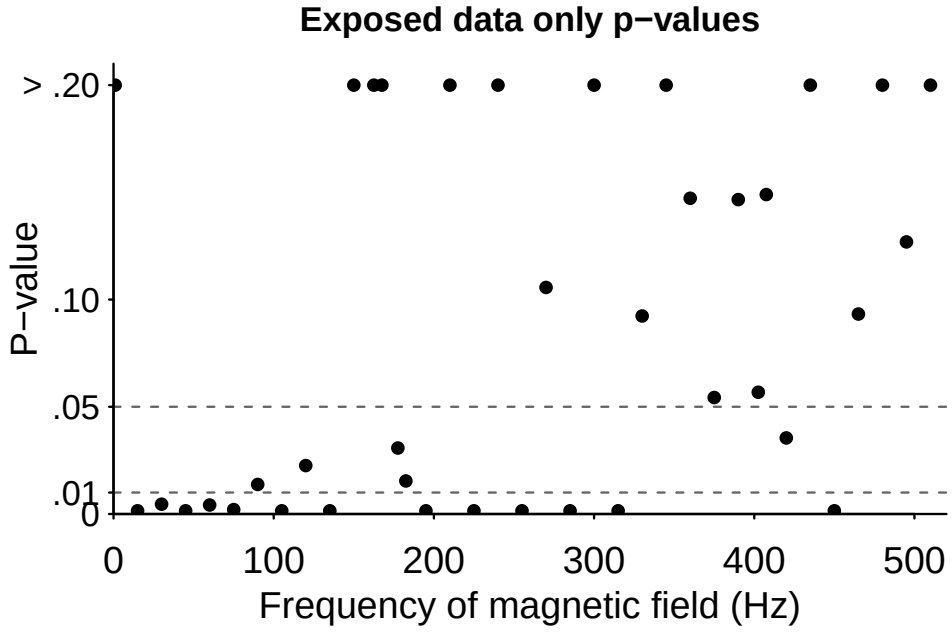
Andrew has done research on a wide range of topics, including: why it is rational to vote; why campaign polls are so variable when elections are so predictable; why redistricting is good for democracy; reversals of death sentences; police stops in New York City, the statistical challenges of estimating small effects; the probability that your vote will be decisive; seats and votes in Congress; social network structure; arsenic in Bangladesh; radon in your basement; toxicology; medical imaging; and methods in surveys, experimental design, statistical inference, computation, and graphics.

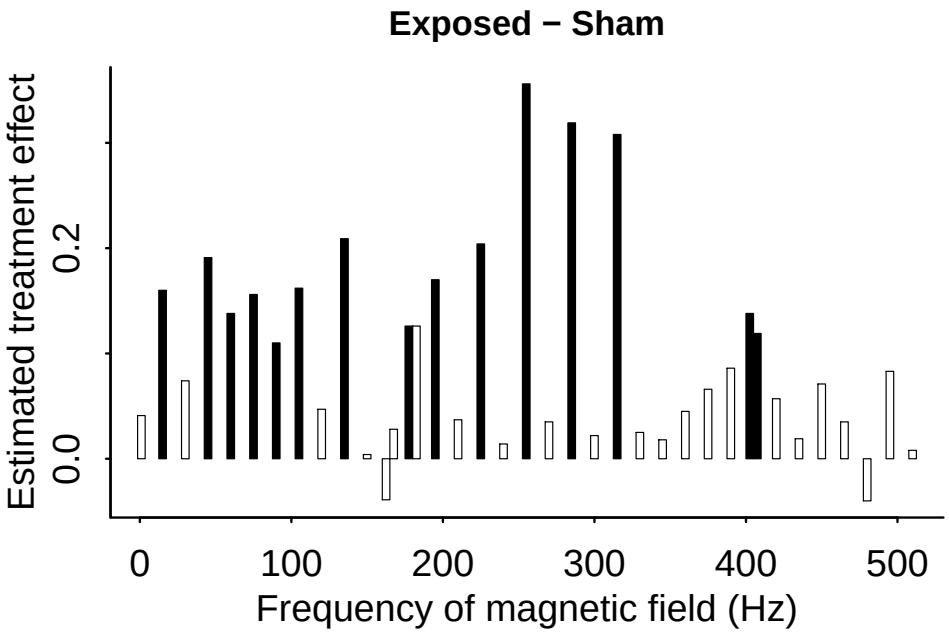
	Sham treatment		Real exposure	
Frequency (Hz)	n	Estimate (s.e.)	n	Estimate (s.e.)
1	32	−0.005 (0.041)	32	0.036 (0.041)
15	32	0.013 (0.042)	36	0.173 (0.034)
30	32	0.033 (0.032)	32	0.107 (0.035)
45	32	−0.010 (0.032)	32	0.181 (0.052)
...	...	...	...	...

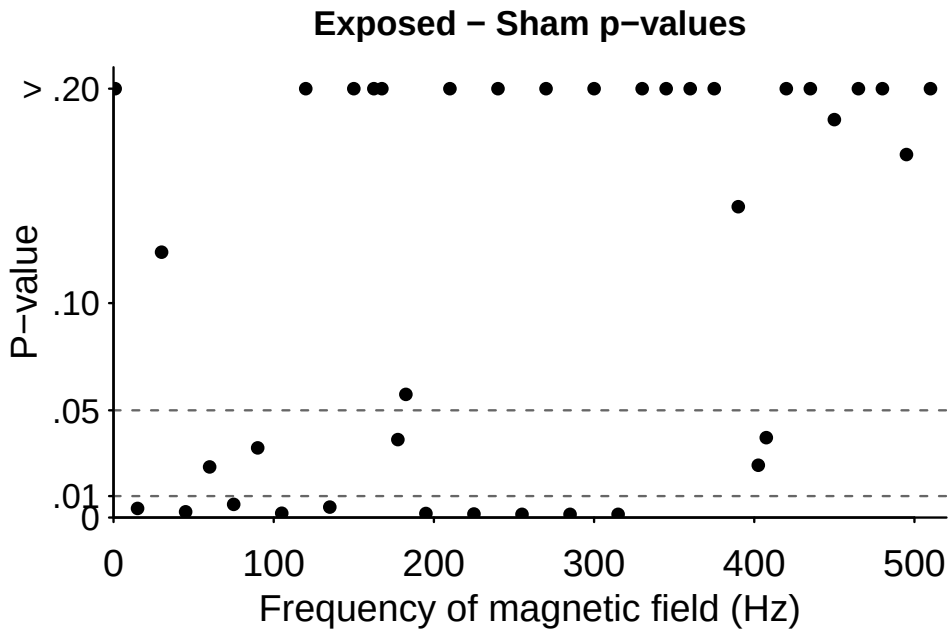

Exposed − Sham
Estimated treatment effect
0.0
0.2
0
100
200
300
400
500
Frequency of magnetic field (Hz)


Exposed − Sham p−values
P−value
> .20
.10
.05
.01
0
0
100
200
300
400
500
Frequency of magnetic field (Hz)


Exposed data only
Estimated treatment effect
0.0
0.2
0
100
200
300
400
500
Frequency of magnetic field (Hz)

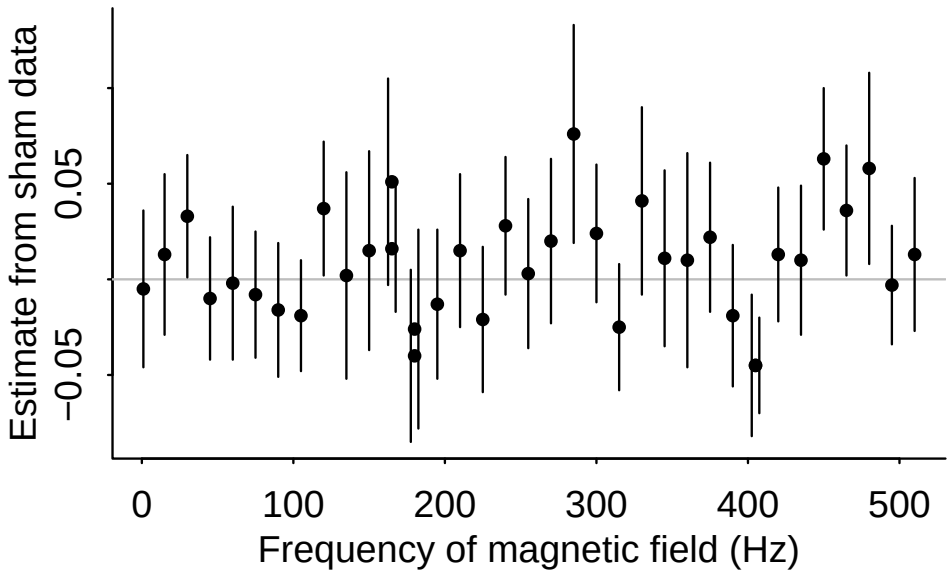

Exposed data only p−values
P−value
> .20
.10
.05
.01
0
0
100
200
300
400
500
Frequency of magnetic field (Hz)

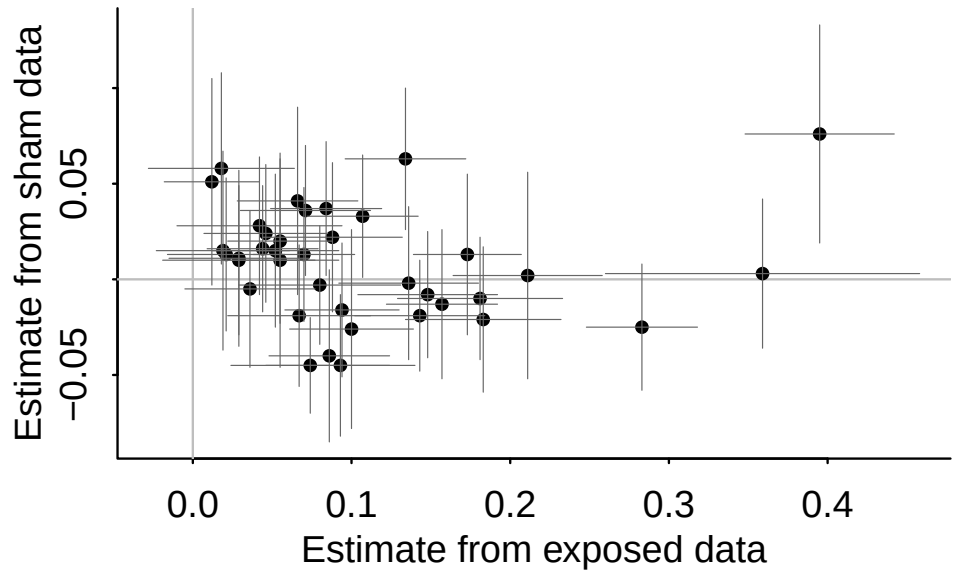




From the original study:

- "These results demonstrate that certain frequencies are effective ($P < .05$) in causing enhance calcium-ion efflux while others are not."
- "the data at 180 Hz could be the fundamental of a nonlinear mechanism . . . leading to subharmonic frequencies that manifest at 90 and 60 Hz."


Estimate from sham data
0.05
−0.05
0
100
200
300
400
500
Frequency of magnetic field (Hz)


Estimate from sham data
0.05
−0.05
0.0
0.1
0.2
0.3
0.4
Estimate from exposed data

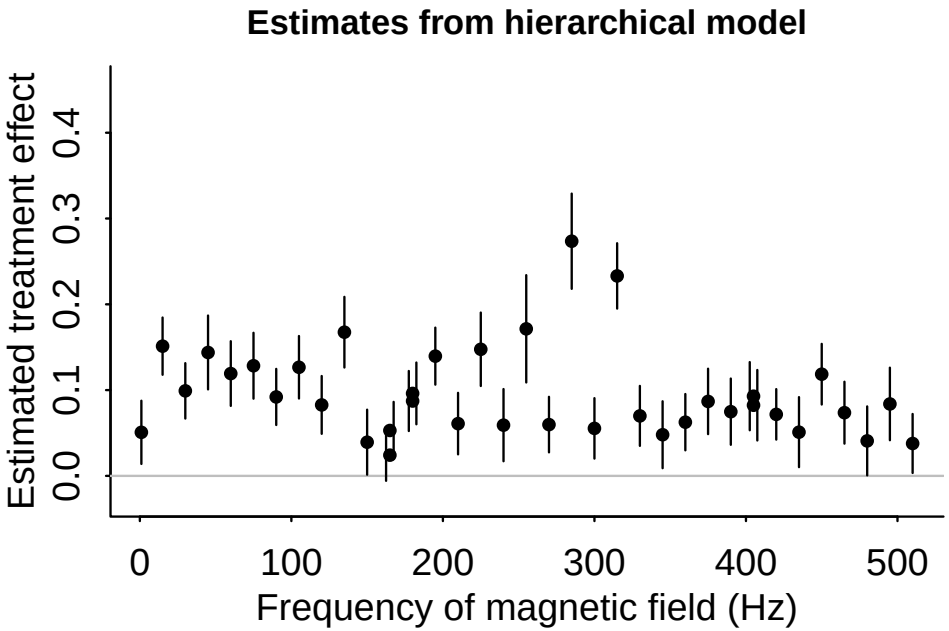
Data model:

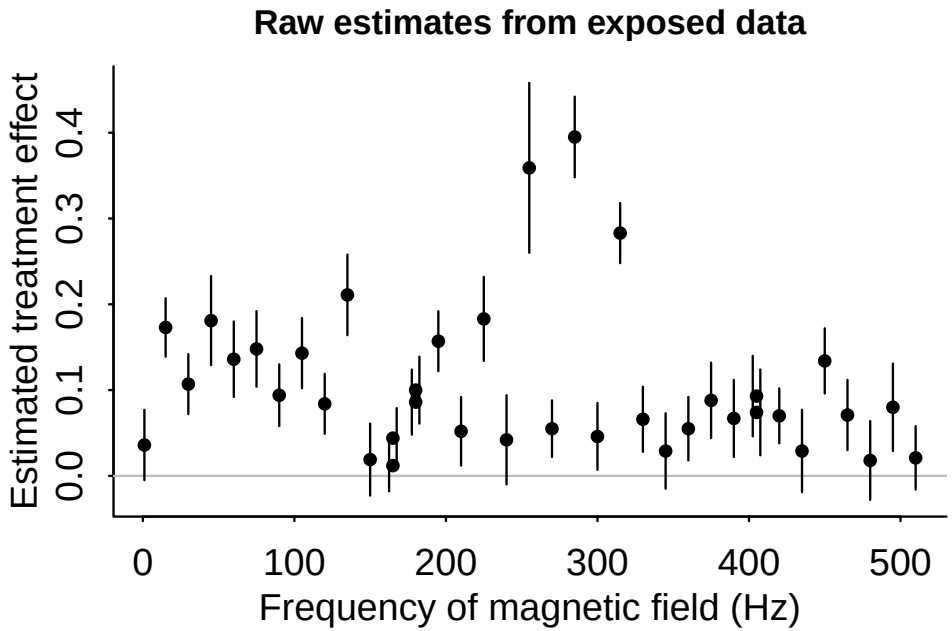
$$y_{j1} \sim \text{normal}(\theta_j + b_j, s_{j1})$$
$$y_{j0} \sim \text{normal}(b_j, s_{j0}).$$

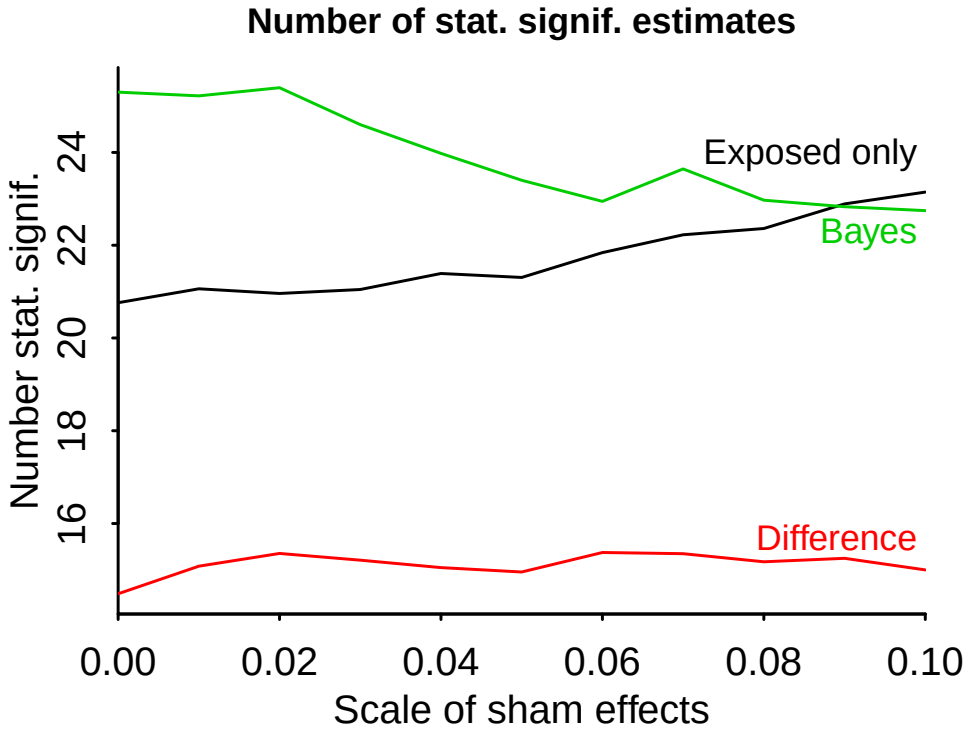
Priors:

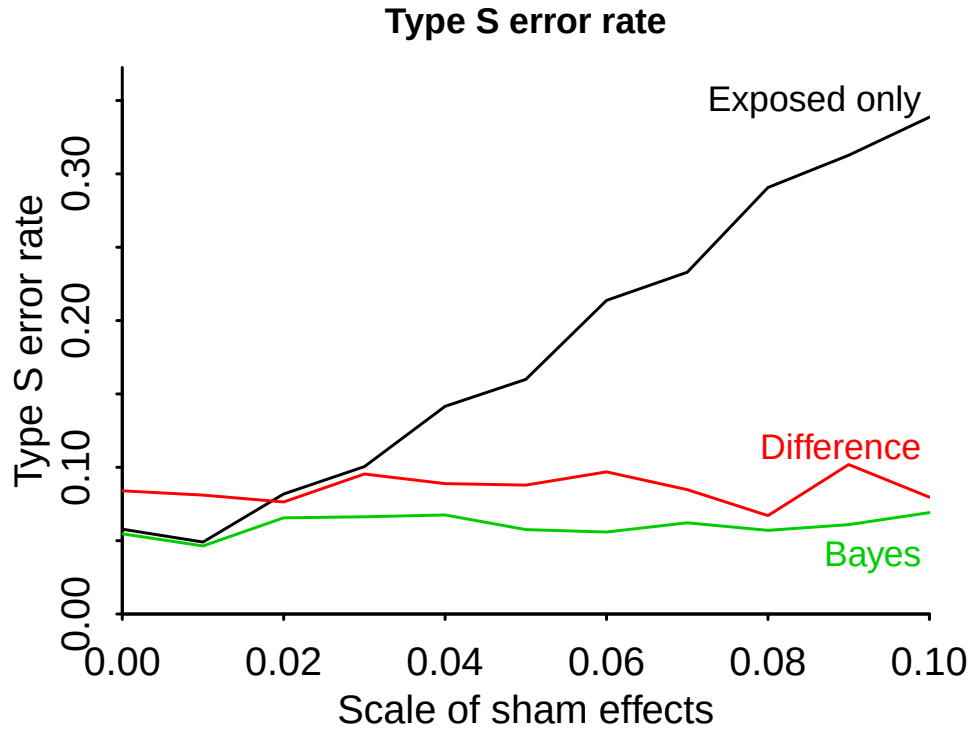
$$b_j \sim \text{normal}(\mu^b, \sigma^b)$$
$$\theta_j \sim \text{normal}(\mu^\theta, \sigma^\theta).$$

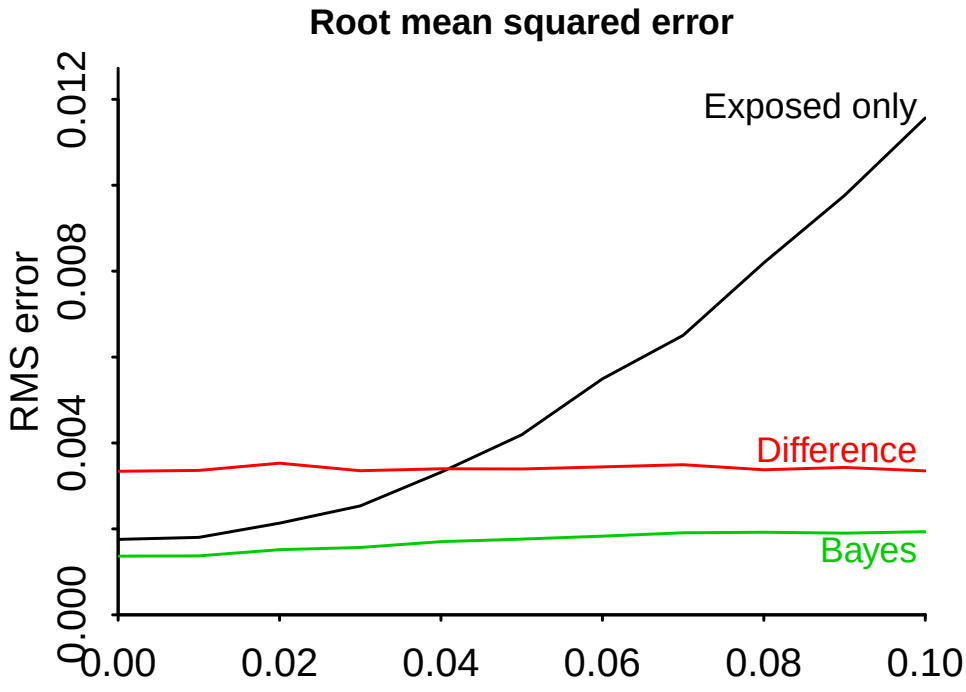
- $\mu^\theta, \sigma^\theta$ are mean and sd of true effects
- μ^b is avg experimental bias
- σ^b is sd of biases across experiments

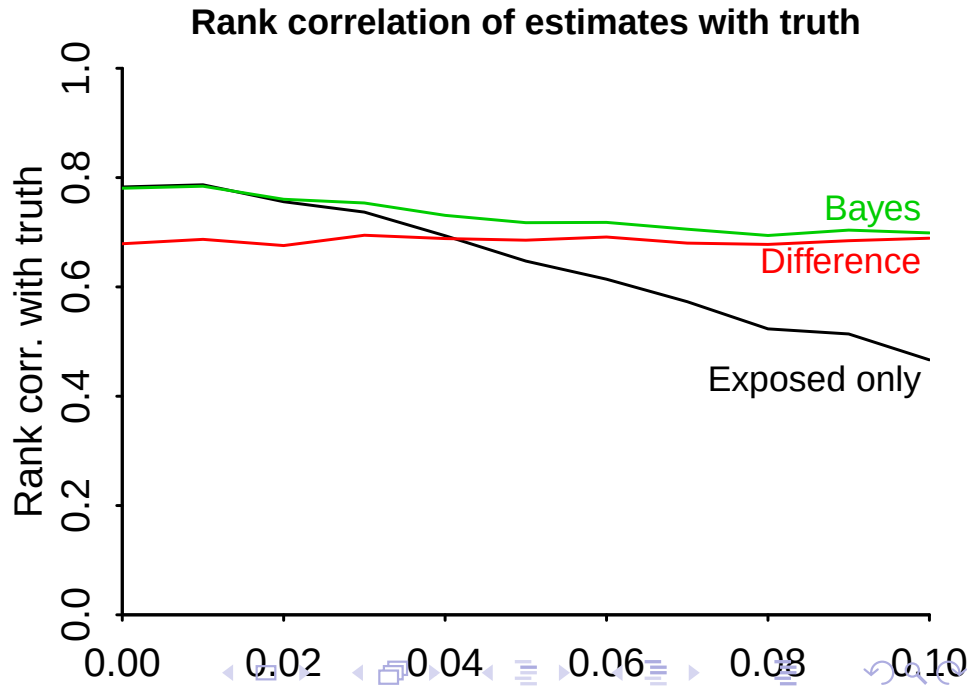

Estimates from hierarchical model
Estimated treatment effect
0.0
0.1
0.2
0.3
0.4
0
100
200
300
400
500
Frequency of magnetic field (Hz)

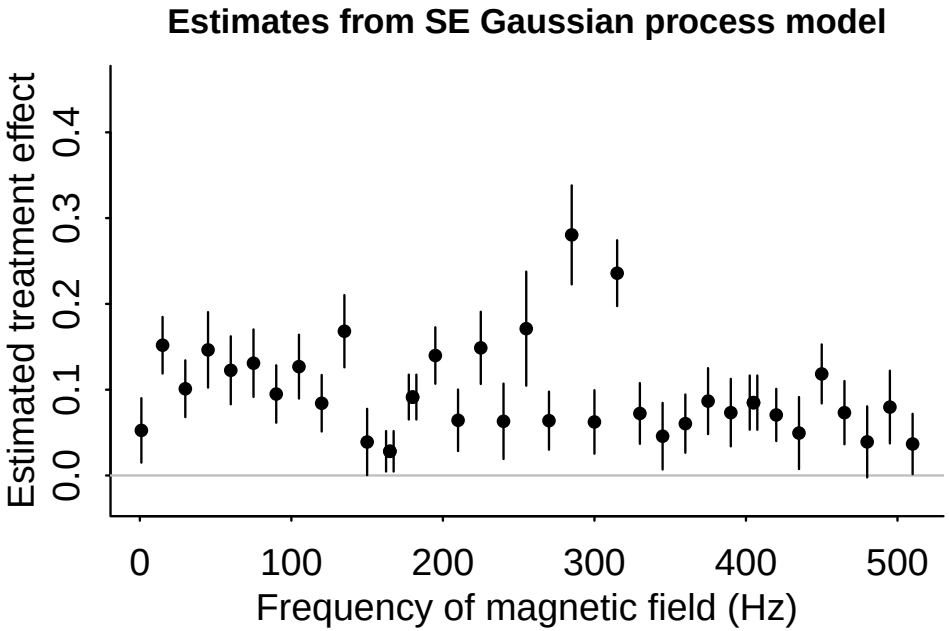

Raw estimates from exposed data
Estimated treatment effect
0.0
0.1
0.2
0.3
0.4
0
100
200
300
400
500
Frequency of magnetic field (Hz)

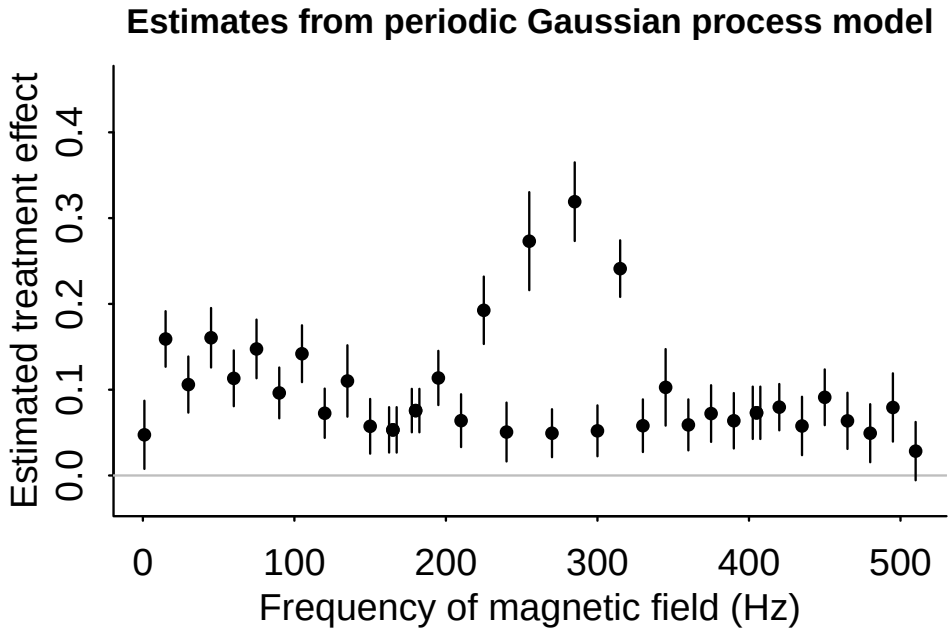

Number of stat. signif. estimates
Number stat. signif.
16
18
20
22
24
Exposed only
Bayes
Difference
0.00
0.02
0.04
0.06
0.08
0.10
Scale of sham effects

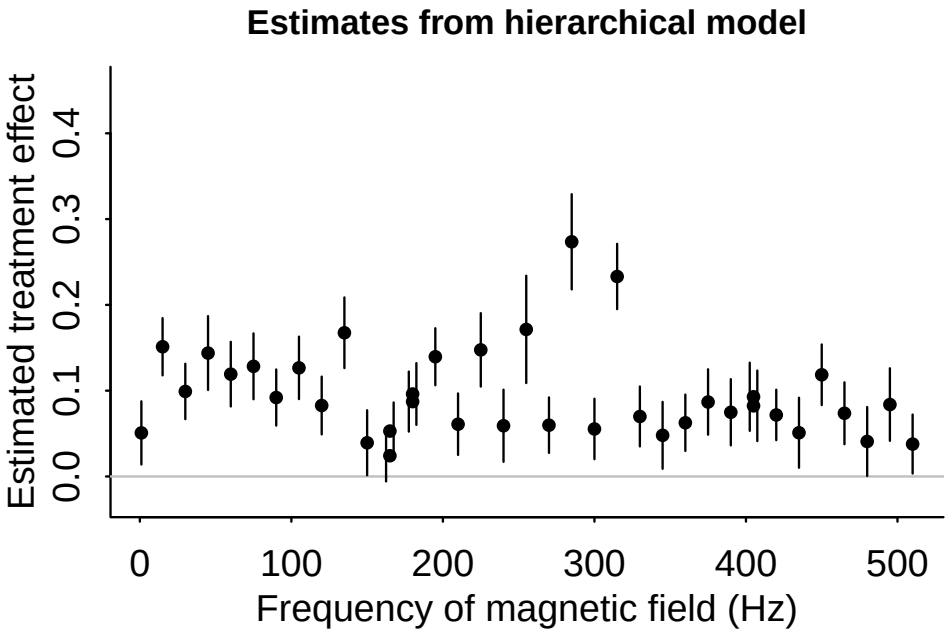

Type S error rate
Type S error rate
0.00
0.10
0.20
0.30
Exposed only
Difference
Bayes
0.00
0.02
0.04
0.06
0.08
0.10
Scale of sham effects

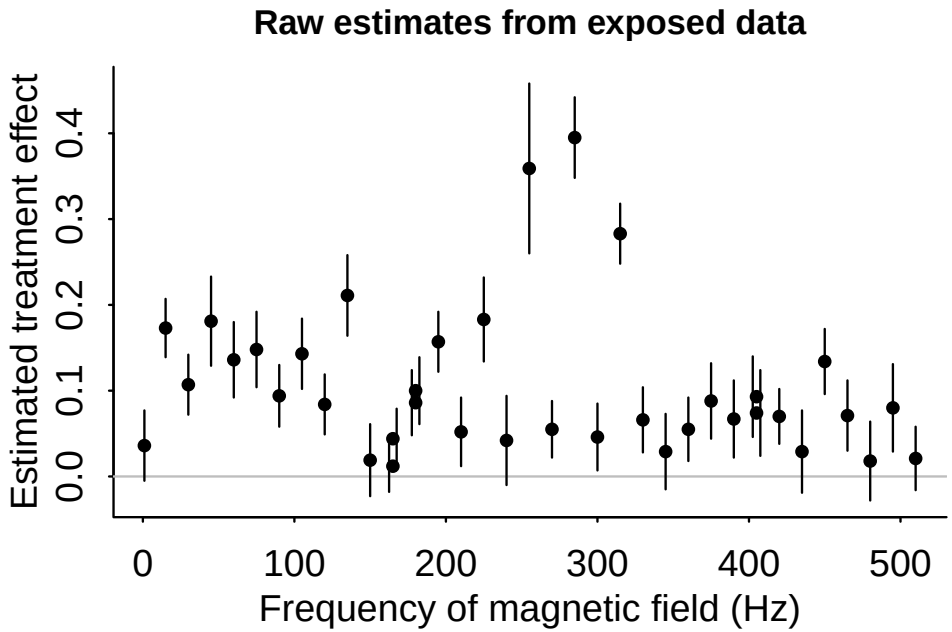

Root mean squared error
RMS error
0.000
0.004
0.008
0.012
Exposed only
Difference
Bayes
0.00
0.02
0.04
0.06
0.08
0.10


Rank correlation of estimates with truth
Rank corr. with truth
0.0
0.2
0.4
0.6
0.8
1.0
Bayes
Difference
Exposed only
0.00
0.02
0.04
0.06
0.08
0.10


Estimates from SE Gaussian process model
Estimated treatment effect
0.0
0.1
0.2
0.3
0.4
0
100
200
300
400
500
Frequency of magnetic field (Hz)


Estimates from periodic Gaussian process model
Estimated treatment effect
0.0
0.1
0.2
0.3
0.4
0
100
200
300
400
500
Frequency of magnetic field (Hz)


Estimates from hierarchical model
Estimated treatment effect
0.0
0.1
0.2
0.3
0.4
0
100
200
300
400
500
Frequency of magnetic field (Hz)


Raw estimates from exposed data
Estimated treatment effect
0.0
0.1
0.2
0.3
0.4
0
100
200
300
400
500
Frequency of magnetic field (Hz)

From the authors of the original study:

- "[We] very closely with a statistician...to optimize our procedures for maximum statistical power."
- "Plans were made to follow up . . . . but the experiment could not be brought to fruition."