Social Networks and Health

Spreading of depressive symptoms over adolescent friendship networks.

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Background

- Depression affects 350 million people worldwide[1].
- It is characterised by a set of symptoms which could be affected by social networks.
- We explore this possibility using a range of statistical methods.

Data

- National Longitudinal Study of Adolescent Health (Add Health) - health behaviours of United States adolescents in 1994-95 and 1996[2].
- Respondents form a friendship network.
- Respondents answered the Centre for Epidemiologic Depression (CES-D) scale questions, gaining a score rating their level of symptoms[3].

Parametric Inference

- Considered total CES-D score and 7 component symptoms - anhedonia, poor appetite, poor concentration, dysphoria, helplessness, tiredness, and worthlessness.
- p_k - probability of worsening (increasing in score). q_k - probability of improving (decreasing in score). k - number of better off (lower scoring) or worse off (higher scoring) friends.
- Transmission forms:

$$p_k = \alpha + \beta \sum_{l=0}^{k} \binom{10}{l} \gamma^l (1-\gamma)^{10-l} \qquad q_k = \delta + \epsilon \sum_{l=0}^{k} \binom{10}{l} \zeta^l (1-\zeta)^{10-l}$$

- No transmission forms:

$$p_k = \alpha \qquad q_k = \delta$$

- Model 1 - both p_k and q_k transmit. Model 2 - neither transmit. Model 3 - p_k only transmits. Model 4 - q_k only transmits.
- Model parameters were inferred from the data using maximum likelihood estimation.
- Models were compared using their Akaike Information Criterion.

Parametric Inference - Example Results

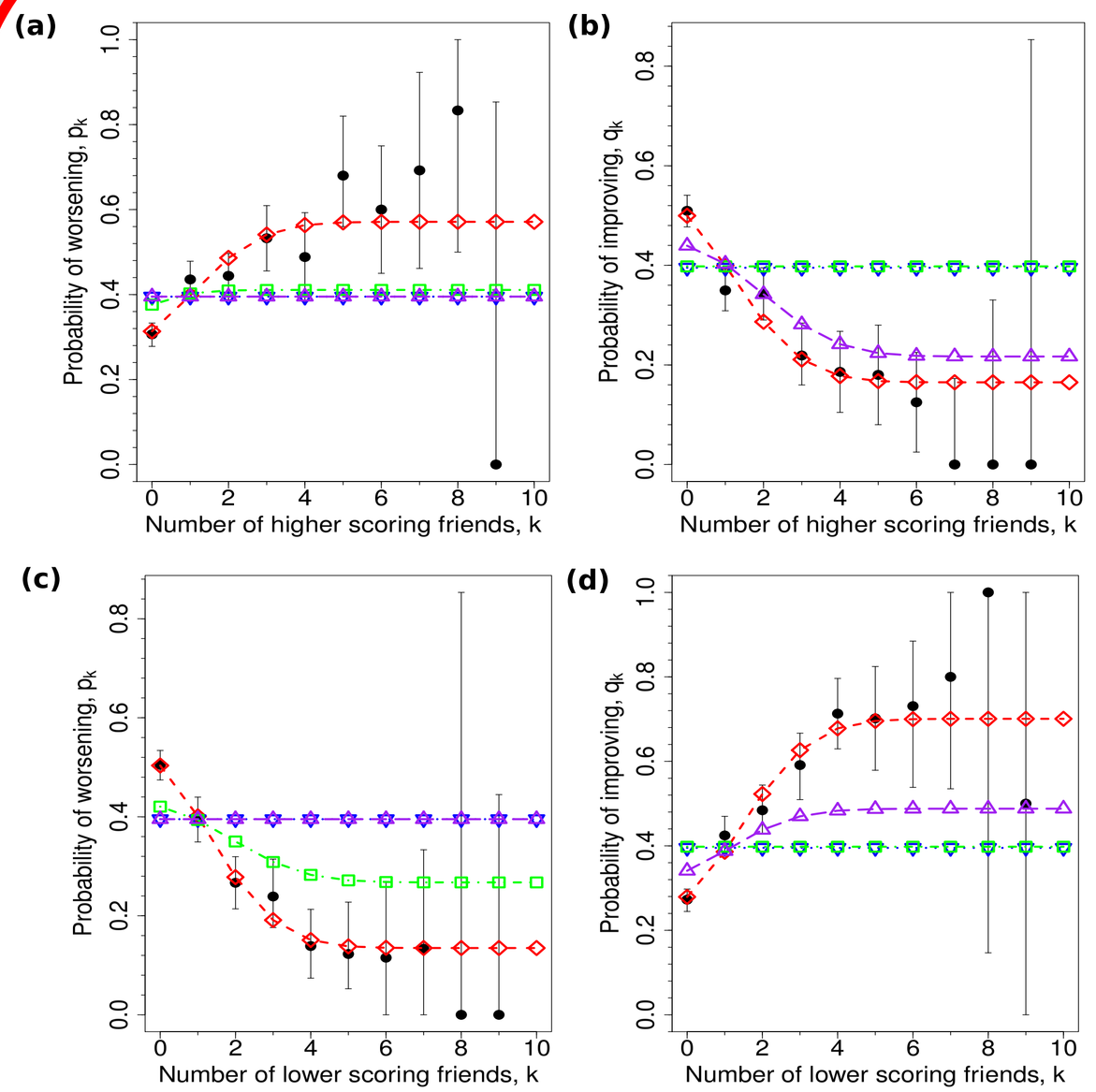

Figure 2: Results for Helplessness. Red - model 1. Blue - model 2. Green - model 3. Purple - model 4. Black - observed frequencies. **(a)** and **(b)** depend on higher scoring friends, **(c)** and **(d)** on lower scoring friends. Model 1 is preferred for all symptoms except poor appetite.

Empirical Data Analysis

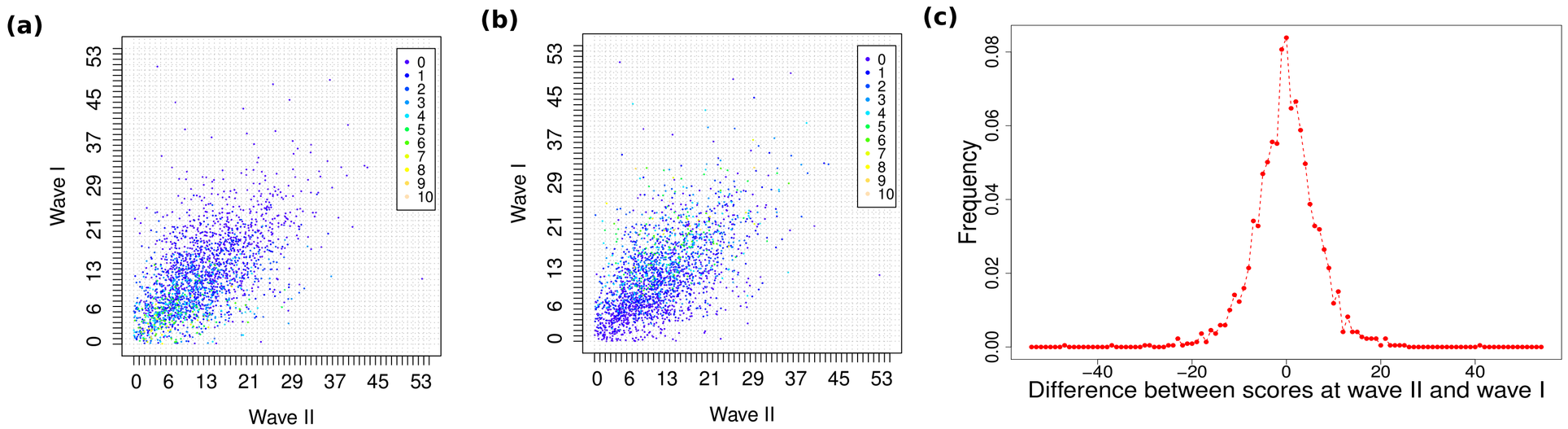

Figure 1: **(a)** and **(b)** - grid plots of CES-D scores at the first time point (wave I) against the second time point (wave II). **(a)** - coloured by higher scoring friends. **(b)** - coloured by lower scoring friends. **(c)** - Empirical distribution of CES-D score change.

- Empirical data shows an effect from higher and lower scoring friends on the change in CES-D score.
- The score changes appear to follow an exponential distribution.

Conclusions

- For most symptoms, the emotional state of friends can have both a positive or negative effect on the state of an individual.
- This effect only occurs for smaller numbers of friends.
- These symptoms reflect the total CES-D score.
- Appetite is the only symptom to not follow this pattern.
- Empirical findings suggest that the change in symptoms occurs progressively between time points - more testing is needed.

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[1] World Health Organisation. *Depression - Fact Sheet No. 369*. 2014. URL: http://www.who.int/mediacentre/factsheets/fs369/en/.
[2] E. Whitsel, J. Hussey, J. Tabor, P. Entzel, K. Harris, C. Halpern, and J. Udry. *The National Longitudinal Study of Adolescent Health: Research Design*. 2009. URL: http://www.cpc.unc.edu/projects/addhealth/design.
[3] L. S. Radloff. "The CES-D scale a self-report depression scale for research in the general population". *Applied psychological measurement* 1.3 (1977), pp. 385-401.