

The evolution of signaling when interests conflict

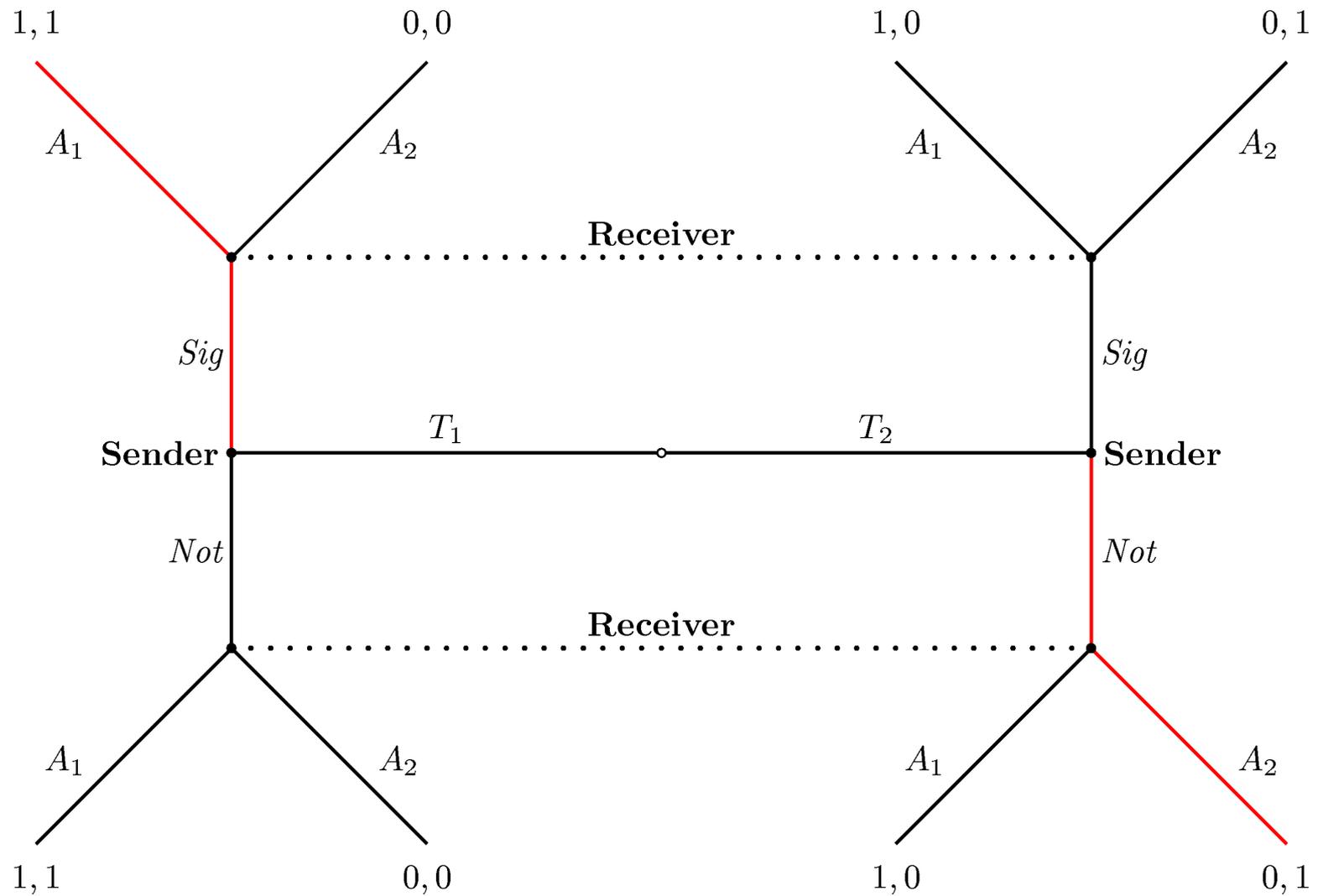
Kevin J.S. Zollman
Carnegie Mellon University

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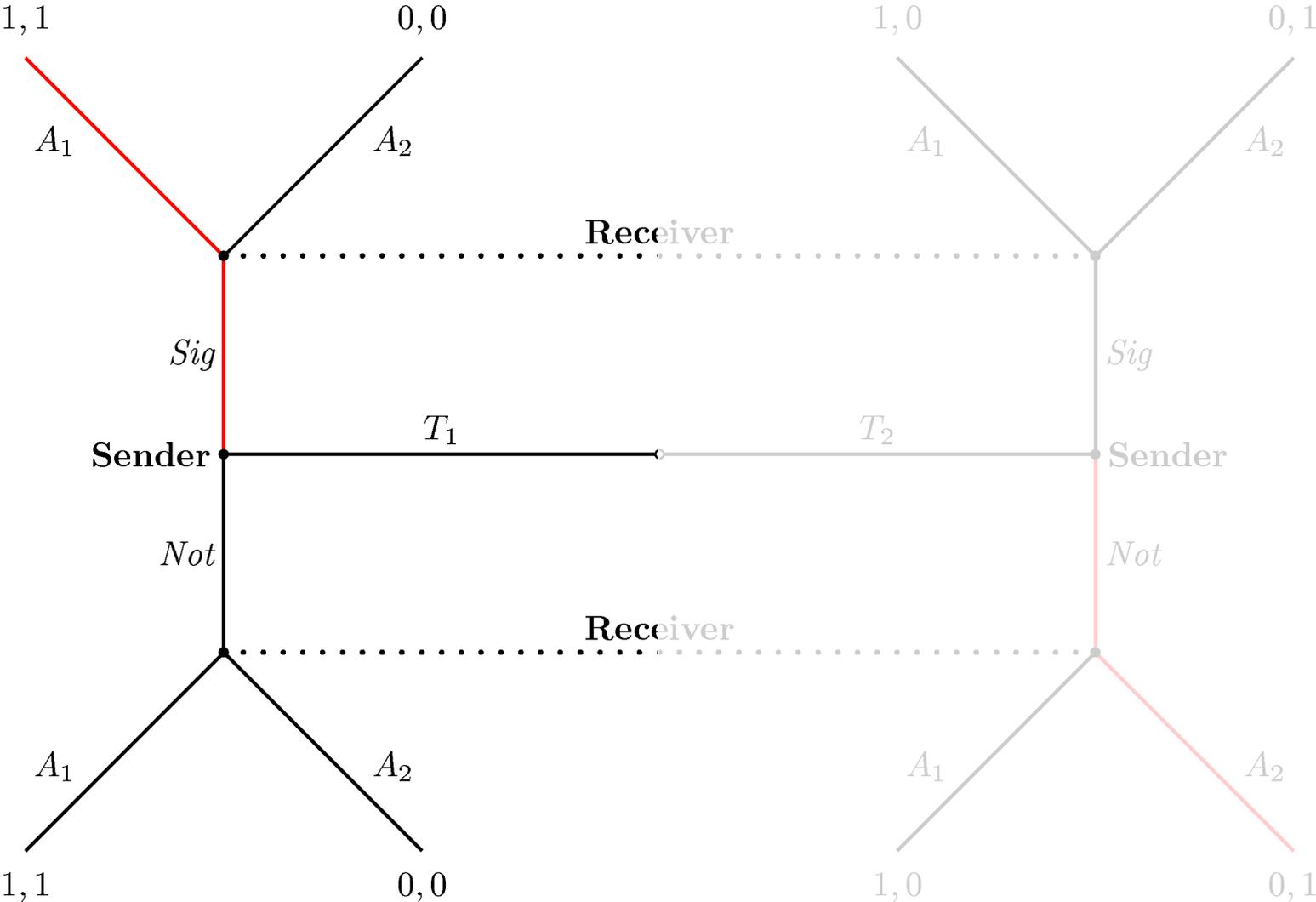
Examples



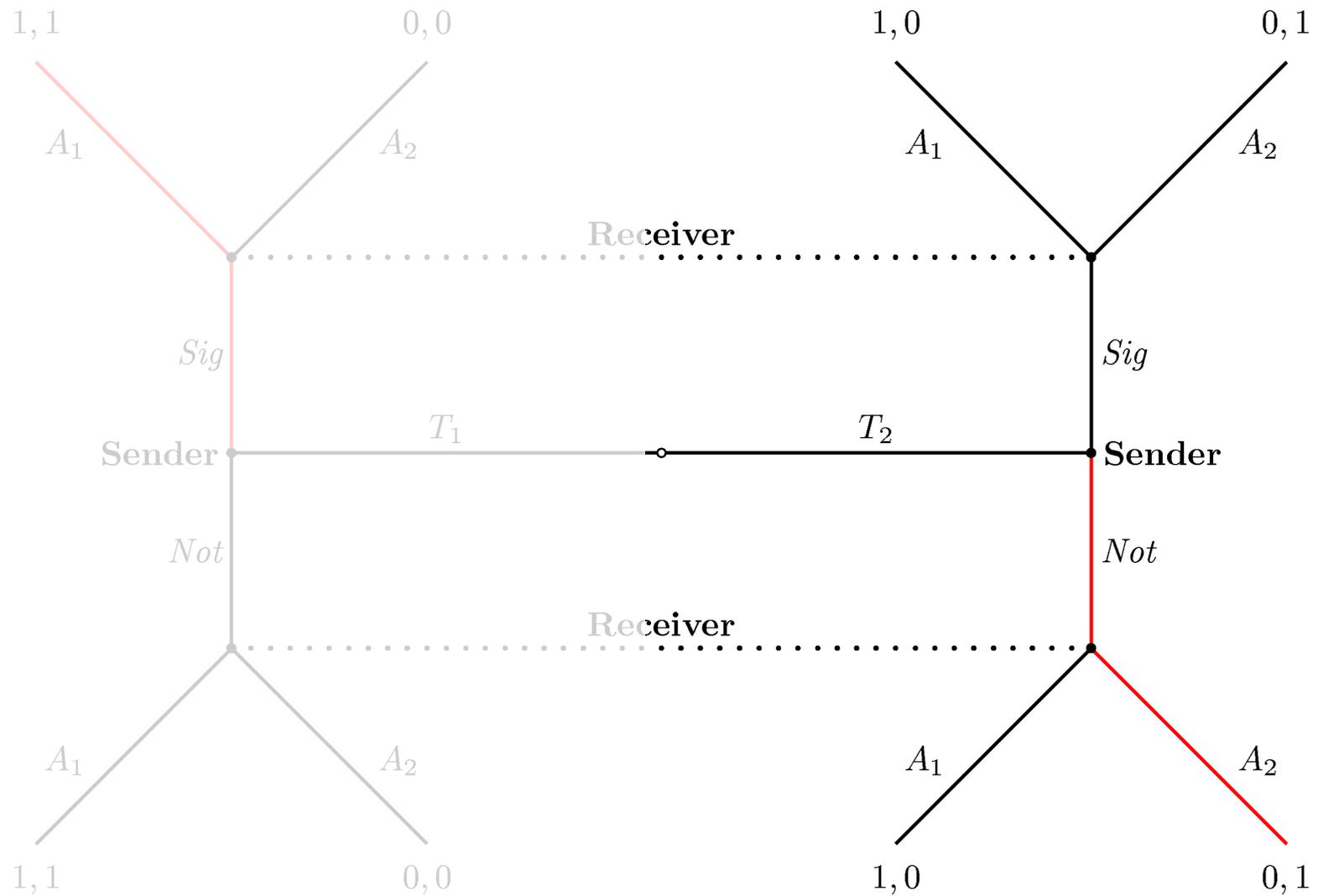
Partial conflict of interest



Partial conflict of interest



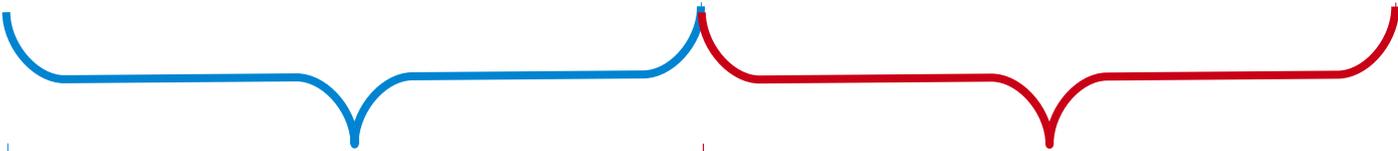
Partial conflict of interest



Partial conflict of interest

High type → Signal → Respond

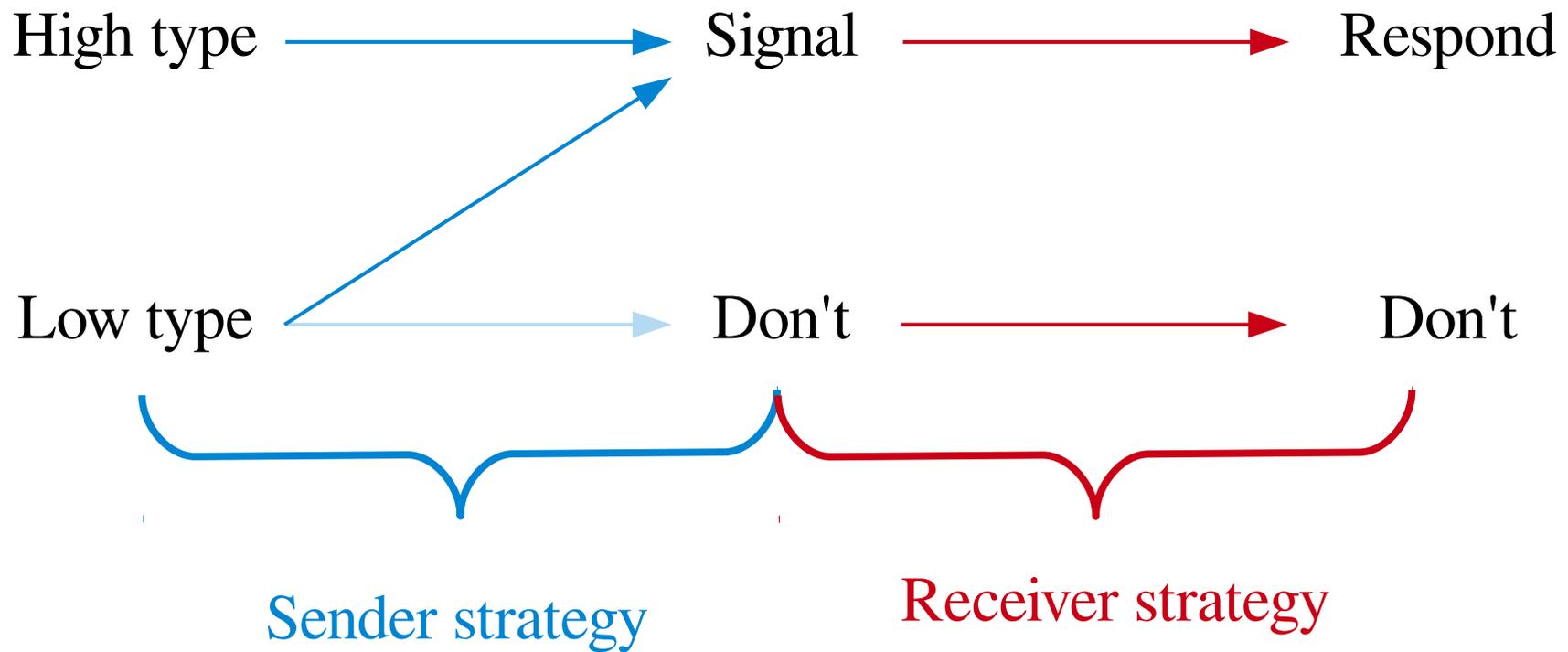
Low type → Don't → Don't



Sender strategy

Receiver strategy

Partial conflict of interest



Puzzle

How can signaling persist when there is partial conflict of interest?

How can signaling be an equilibrium when there is partial conflict of interest?

Costly signaling

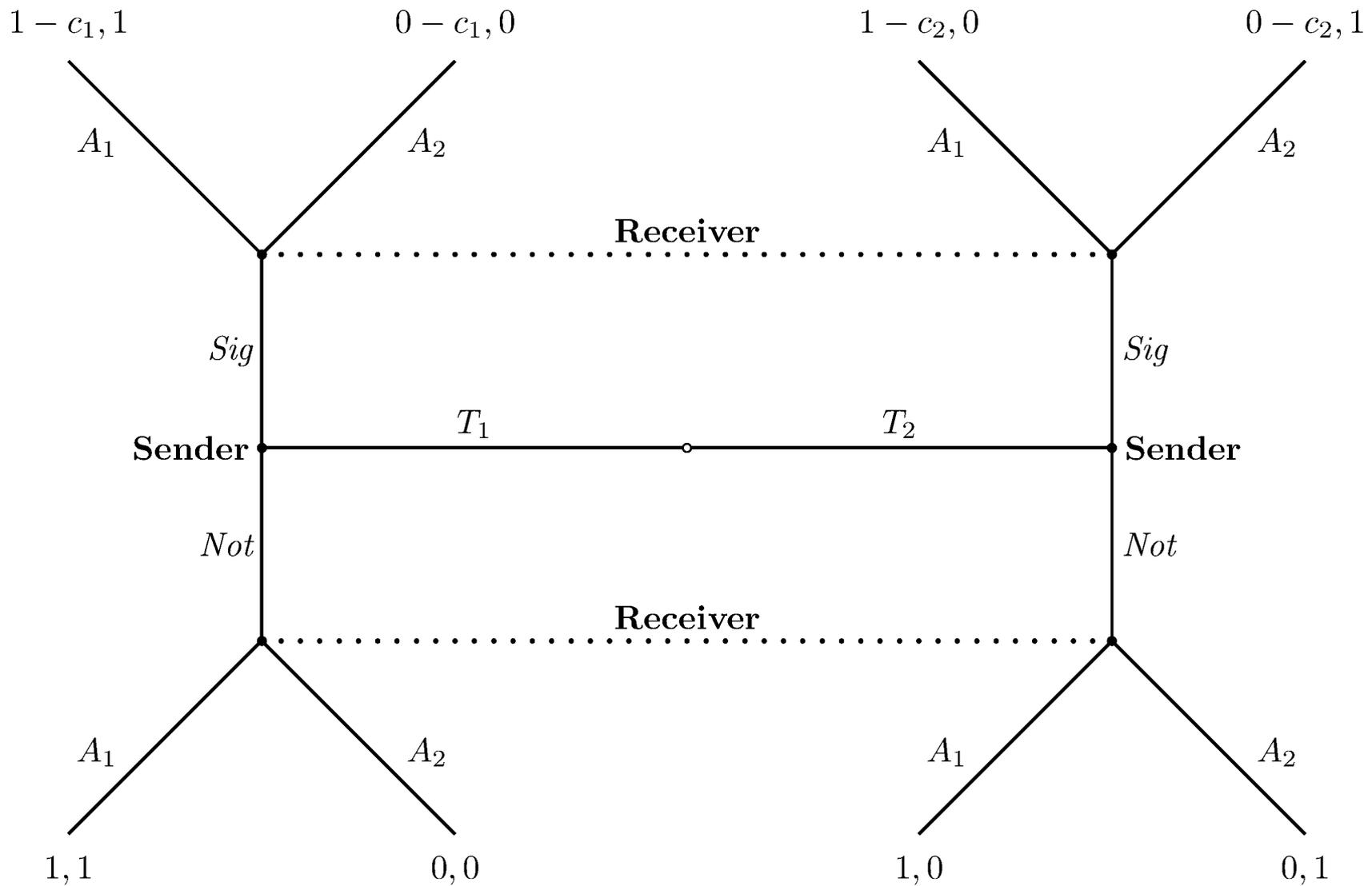
- Differential cost, constant benefit

Spence, M. (1973). Job Market Signaling. *The Quarterly Journal of Economics*, 87(3), 355–374.

Zahavi, A. (1975). Mate Selection -- A selection for a Handicap. *Journal of theoretical biology*, 53, 205–214.

Grafen, A. (1990). Biological Signals as Handicaps. *Journal of Theoretical Biology*, 144, 517–546.

Differential cost



$$c_2 > 1 > c_1$$

Costly signaling

- Differential cost, constant benefit

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Costly signaling

- Differential cost, constant benefit
- Constant cost, differential benefit
- Differential cost, differential benefit

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Costly signaling

- Differential cost, constant benefit
- Constant cost, differential benefit
- Differential cost, differential benefit



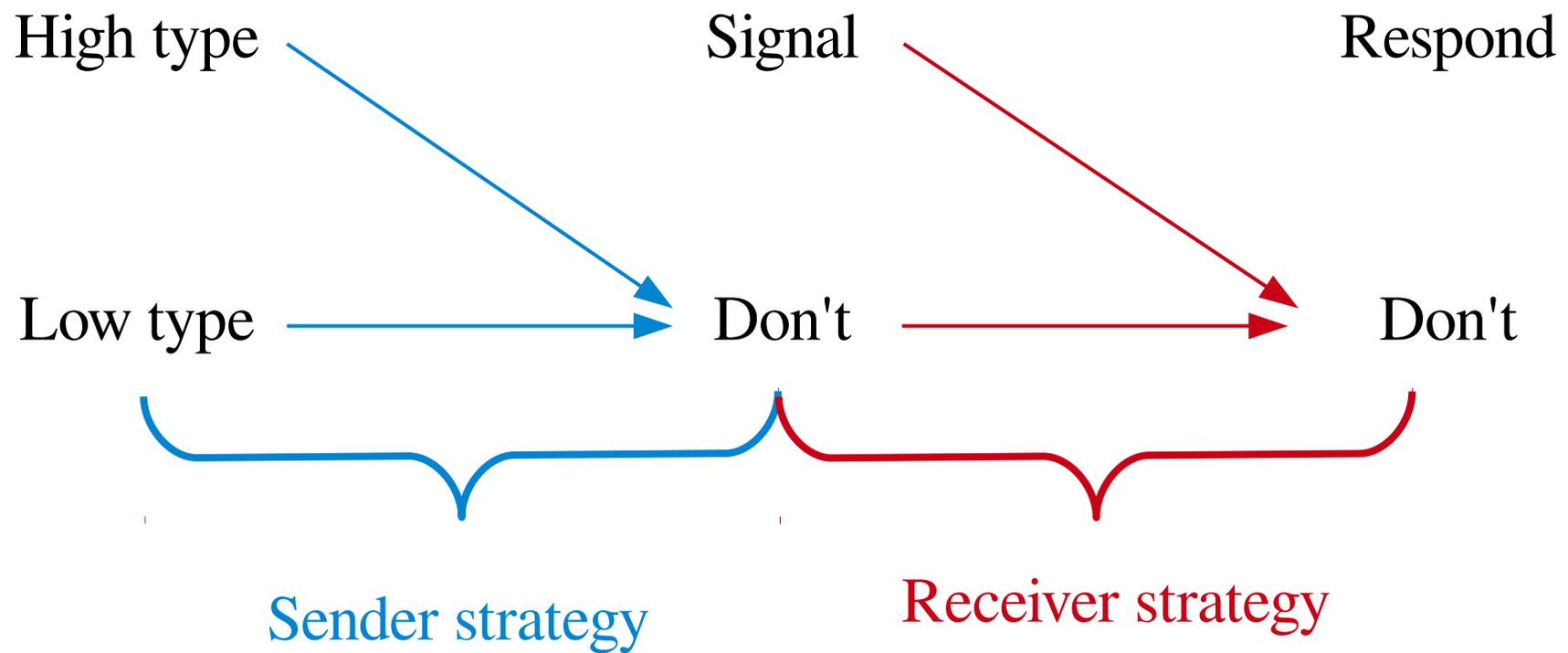
Marginal cost to
“lying” outweighs
marginal
benefit

Spence, M. (1973). Job Market Signaling. *The Quarterly Journal of Economics*, 87(3), 355–374.

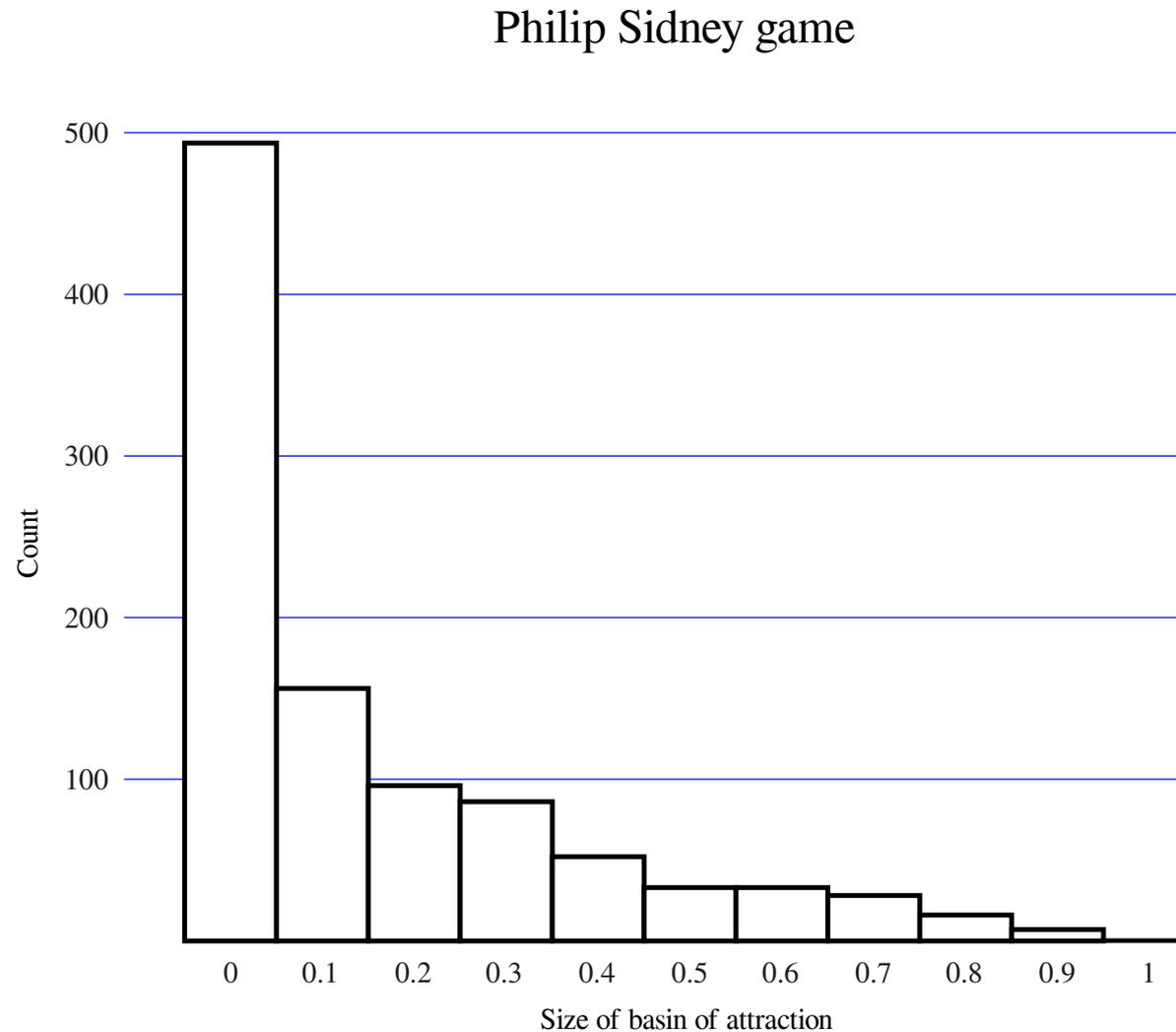
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Pooling equilibria

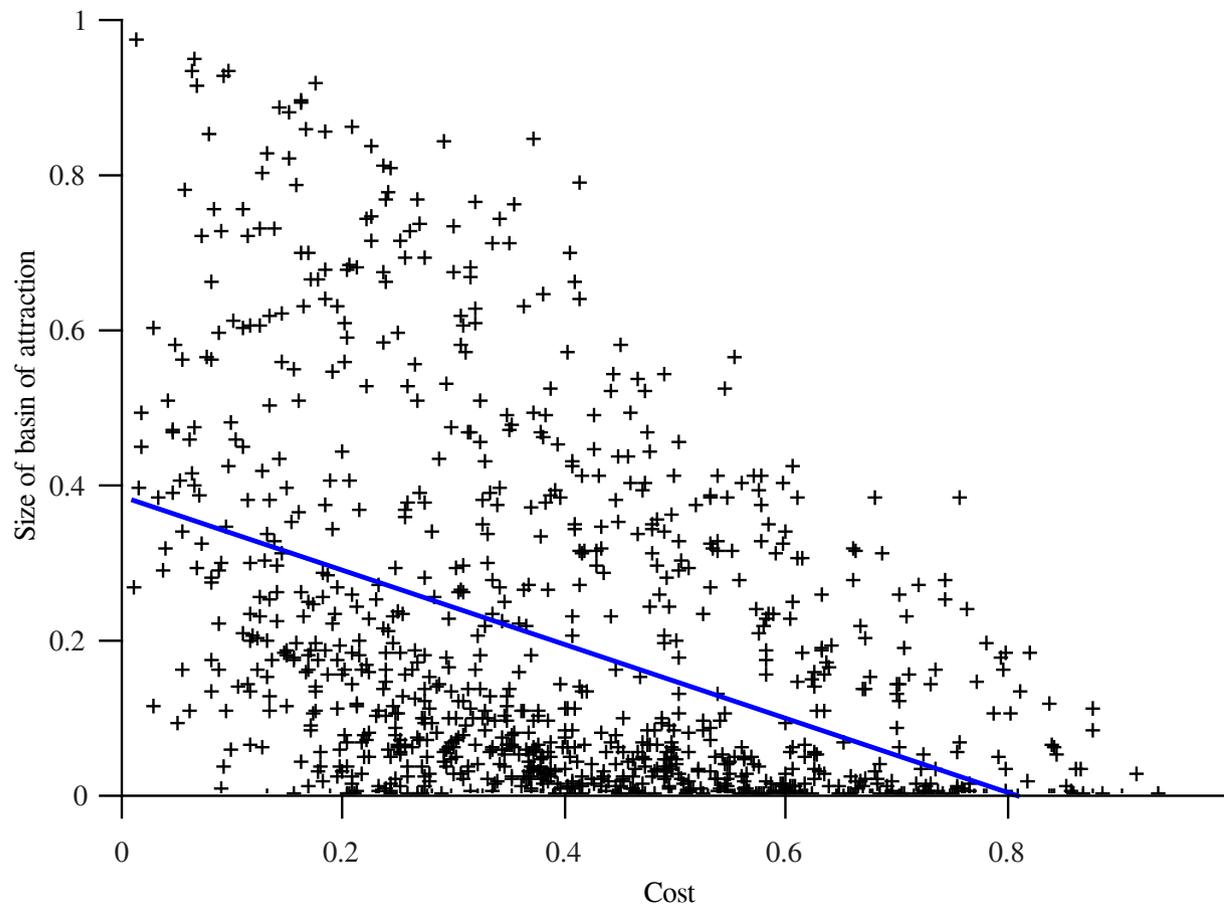


Equilibrium selection



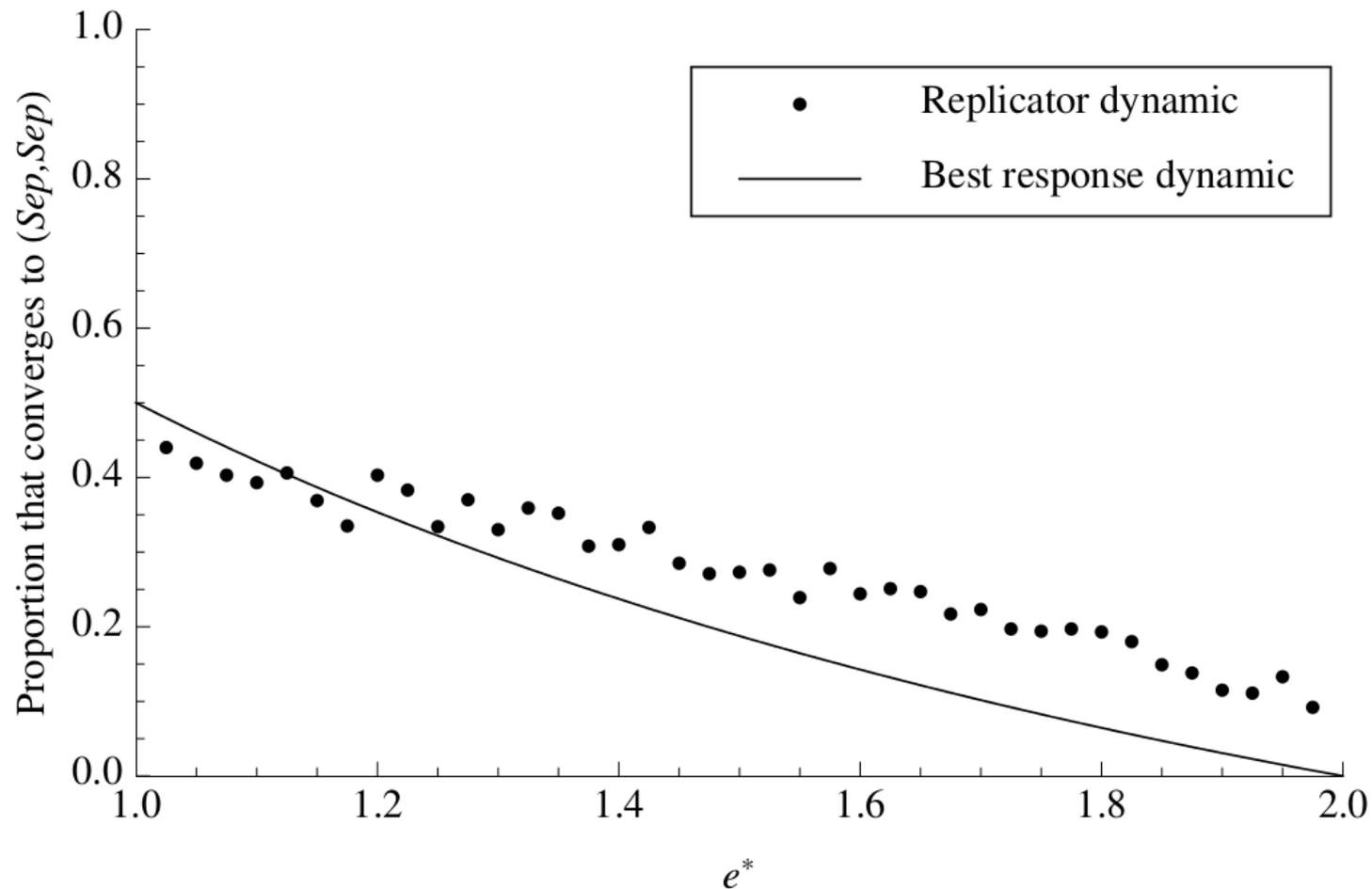
Equilibrium selection

Philip Sidney game



Equilibrium selection

Spence game ($p_H = 0.5$)



Dilemma

The very same conditions that make honest signaling an equilibrium, make learning or evolving a language difficult.

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- Huttegger, S. M., Zollman, K. J. S. (2010). Dynamic stability and basins of attraction in the Sir Philip Sidney game. *Proceedings of the Royal Society B: Biological Sciences*, 277(February), 1915–1922. doi:10.1098/rspb.2009.2105
- Zollman, K. J. S., Bergstrom, C. T., & Huttegger, S. M. (2013). Between cheap and costly signals: the evolution of partially honest communication. *Proceedings of the Royal Society B: Biological Sciences*, 280(1750), 20121878. doi:10.1098/rspb.2012.1878

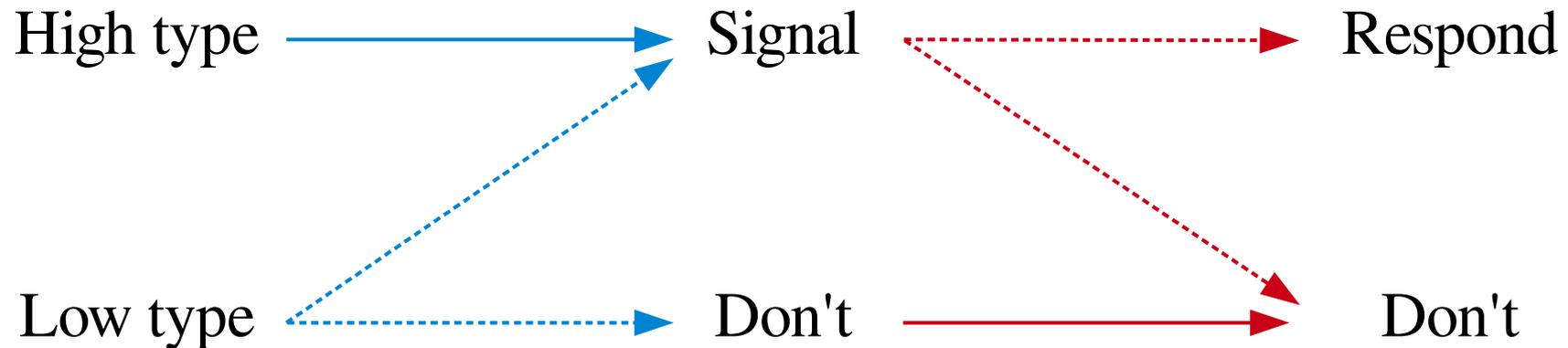
Alternative “solutions”

- Hybrid equilibria
- Partial pooling equilibria
- Reputation
- Noise

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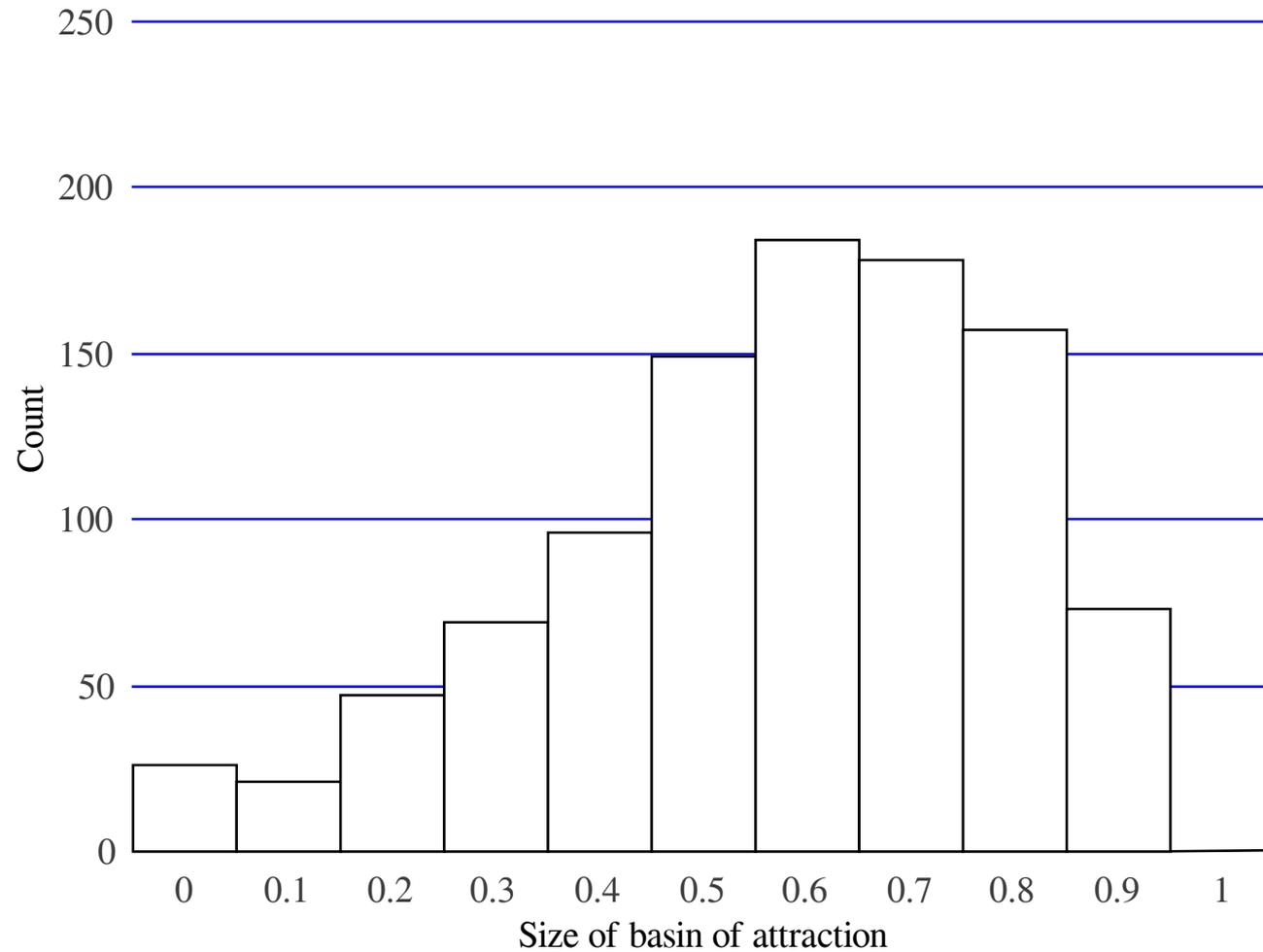
Hybrid equilibria



Exists with very low signal cost

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- Wagner, E. (2013). The Dynamics of Costly Signaling. *Games*, 4(2), 163–181. doi:10.3390/g4020163
- Huttegger, S. M., Zollman, K. J. S. (2010). Dynamic stability and basins of attraction in the Sir Philip Sidney game. *Proceedings of the Royal Society B: Biological Sciences*, 277(February), 1915–1922. doi:10.1098/rspb.2009.2105
- Zollman, K. J. S., Bergstrom, C. T., & Huttegger, S. M. (2013). Between cheap and costly signals: the evolution of partially honest communication. *Proceedings of the Royal Society B: Biological Sciences*, 280(1750), 20121878. doi:10.1098/rspb.2012.1878

Hybrid equilibria



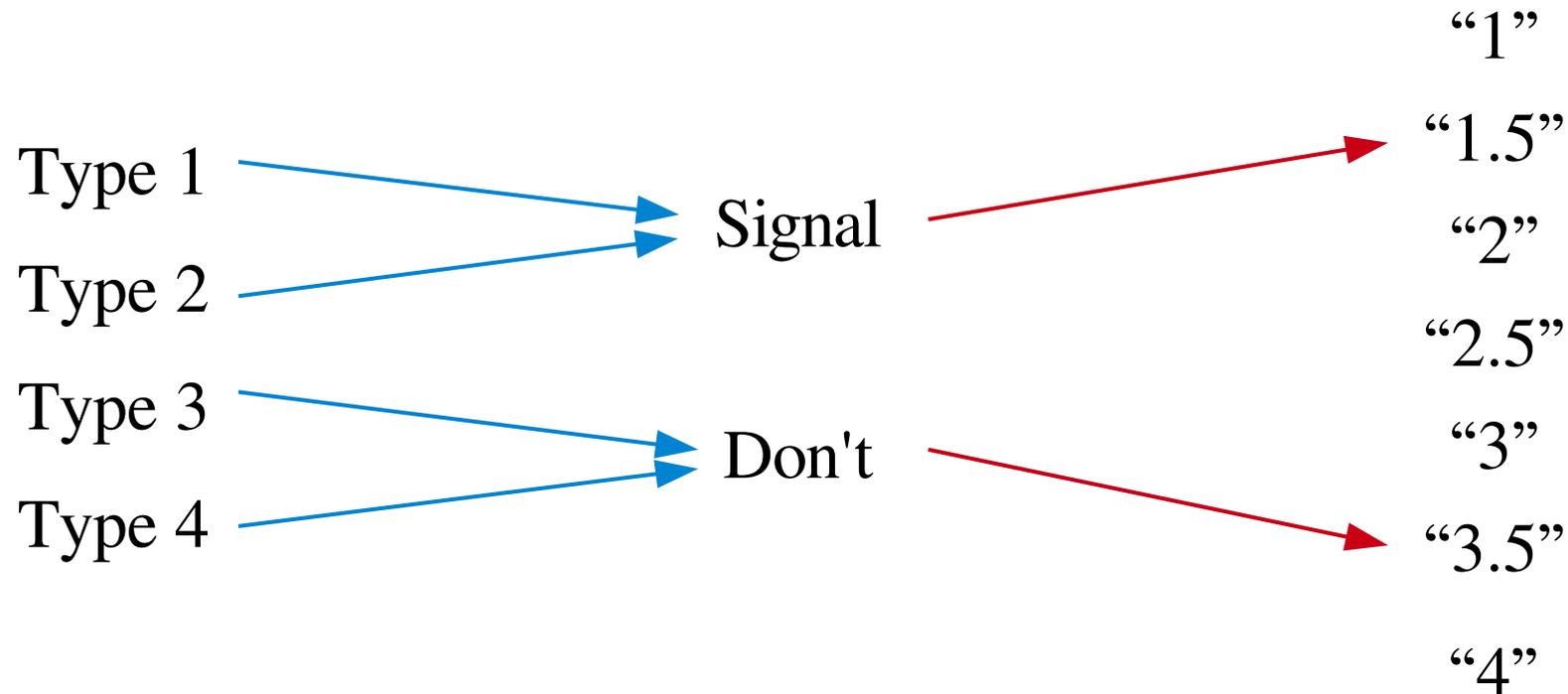
Alternative “solutions”

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Set up

- Sender's strength is represented by a number, x
- Sender wants the receiver to guess that he is a little stronger, i.e. “ $x + 0.5$ ”
- Receiver wants to guess correctly, i.e. “ x ”
- Getting closer to one's preferred guess is better (regardless of higher or lower)

Partial Pooling Equilibria



Crawford, V., & Sobel, J. (1982). Strategic Information Transmission. *Econometrica*, 50(6), 1431–1451.

Bergstrom, C. T., & Lachmann, M. (1998). Signaling among relatives. III. Talk is cheap. *Proceedings of the National Academy of Sciences of the United States of America*, 95(9), 5100–5.

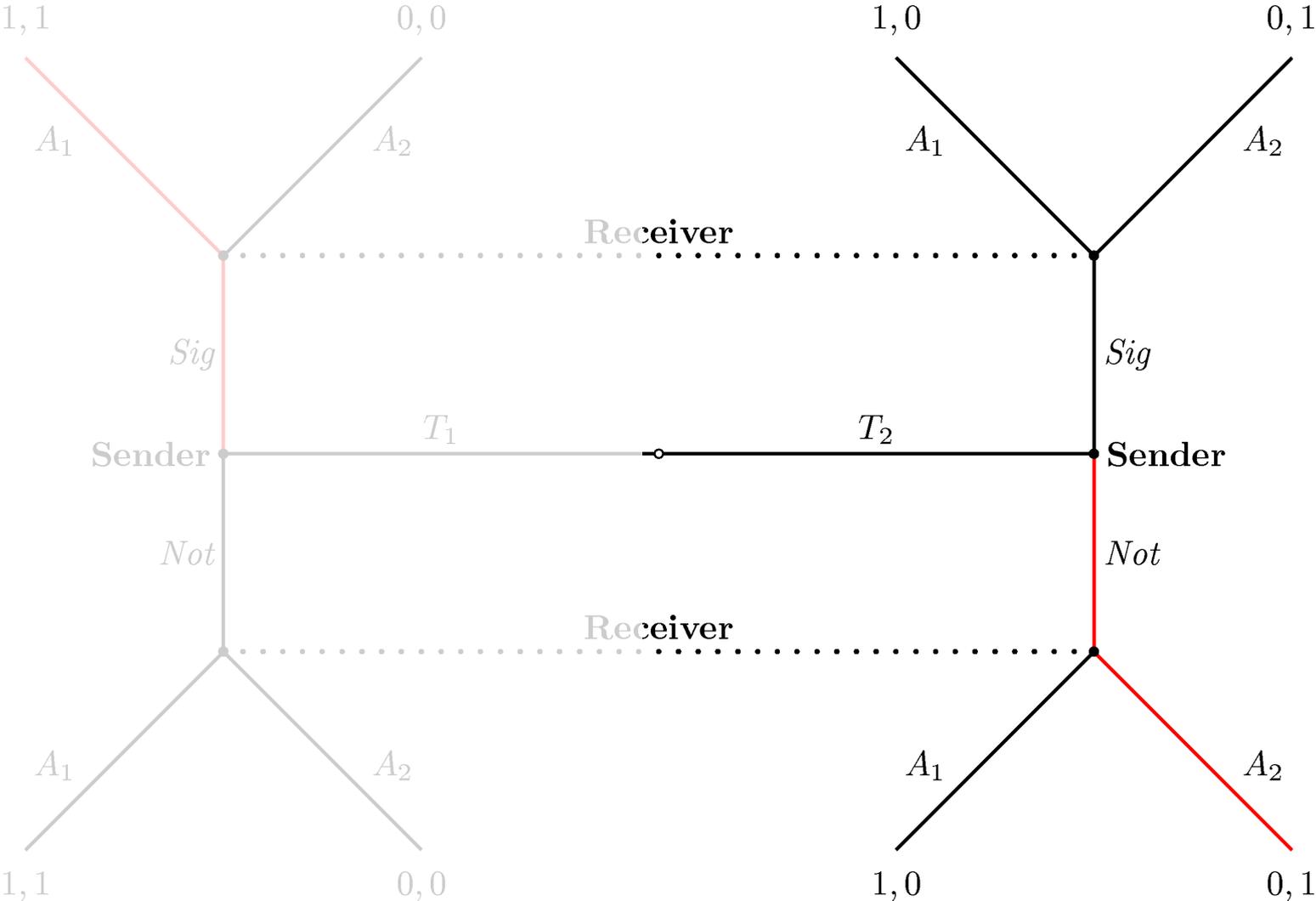
Evolution

?

Alternative “solutions”

- Hybrid equilibria
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Partial conflict of interest



Repeated interactions

- Like in the Prisoner's dilemma, repeated interactions can stabilize signaling
- Ignoring the signal creates a cost to lying
- This works even without perfect monitoring

Silk, J., Kaldor, E., & Boyd, R. (2000). Cheap talk when interests conflict. *Animal Behaviour*, 59(2), 423–432. doi:10.1006/anbe.1999.1312

Catteeuw, D., Han, T. A., & Manderick, B. (2014). Evolution of honest signaling by social punishment. *Proceedings of the 2014 Conference on Genetic and Evolutionary Computation - GECCO '14*, 153–160. doi:10.1145/2576768.2598312

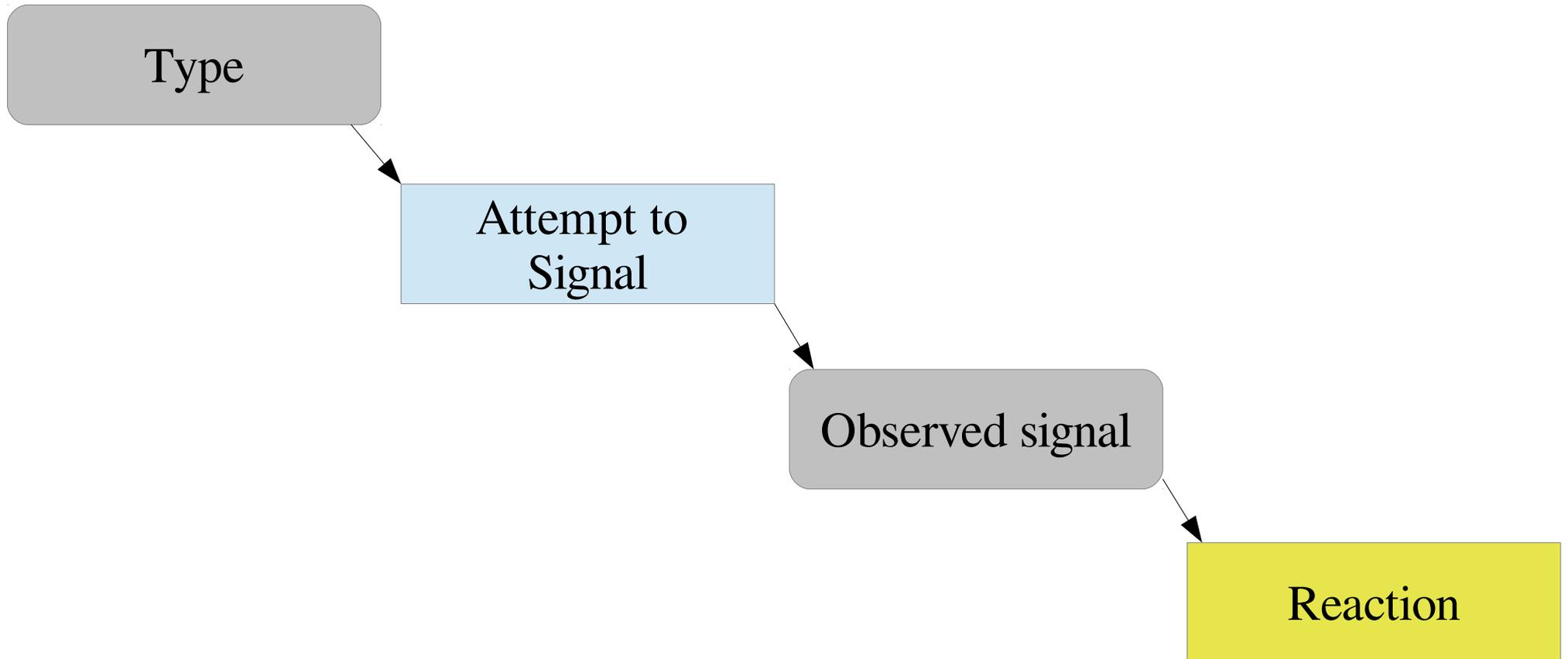
Rich, P. & Zollman, K.J.S. (2014). Honesty through repeated interactions. Manuscript

Franke, M., de Jager, T., & van Rooij, R. (2009). Relevance in cooperation and conflict. *Journal of Logic and Computation*, 22(1).

Alternative “solutions”

- Hybrid equilibria
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Pygmalion game



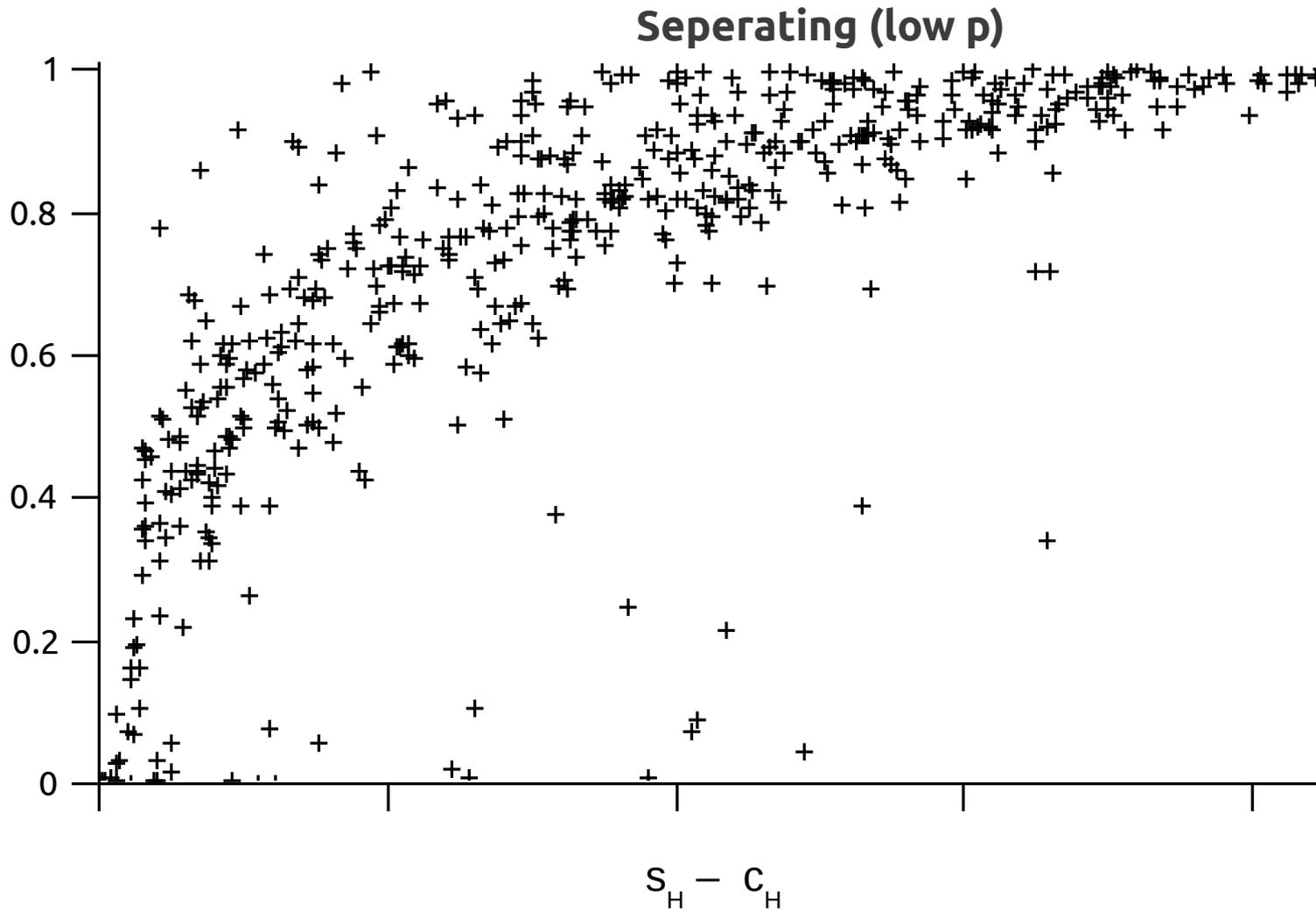
Stability

Difference in ability to
successfully signal

\propto

$\frac{1}{\text{Cost from attempting
to signal}}$

Evolution



Huttegger, S. J., Bruner, J. & Zollman, K.J.S. (forthcoming) The Handicap Principle is an Artifact.
Philosophy of Science

Applications

- Biology
- Economics
- Philosophy of language and linguistics