Comparing Theories of One-Shot Play Out of Treatment
Online Appendix

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The most recent version of this Online Appendix
can be found under http://hdg.kuelpmann.org.

Description

This is the Online Appendix for "Comparing Theories of One-Shot Play Out of Treatment," which provides supplemental information about the data as well as theories that we did and did not use in our analysis.

In addition, Section 3 provides log-likelihoods for all theories, based on their predictions, for every game. Section 4 provides an overview of the data used for all games. For the data in a machine-readable format and/or the full data please contact philipp@kuelpmann.org.

To get access to the z-tree code for the experiment and to the code for the data analysis (in R) please also contact philipp@kuelpmann.org. Both the data and the code will be made publicly available after publication.

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1 Theories

1.1 Risk aversion

We use the CRRA utility function given by

$$u_{\text{CRRA}}(x) = \frac{x^{1-\rho}}{1-\rho}.$$

The parameter $\rho \approx 0.575$ is a convex combination (weighted by subjects) of the parameter estimates provided by Hey and Orme (1994) and its replication as reported and recommended in Harrison and Rutström (2009).

They used an extensive random lottery pair design in which they asked subjects to make choices between lotteries using four fixed prices and varying probabilities. Fortunately, their results are robust in the payment domain that we are using and also across different countries and currencies, as shown by Harrison and Rutström (2009) and Harrison and Rutström (2008, p121-122).

1.2 Level k reasoning

The predictions provided by level k reasoning models depend on two parameters: level 0 behavior and the distribution of levels among the players. Usually, mixing uniformly over all actions is assumed to be the natural level 0 assumption.

While mixing uniformly is the most commonly used level 0 assumption, let us have a look of what happens in the two-action games, if we allow for different level 0 assumptions. In the hawk-dove games, if we assume that a level 0 player plays U, every even level player plays U and every odd level player plays D. If we assume that a level 0 player plays $50-50$ (or D) or is mixing, every even level player plays D and every odd level player plays U.[1] Thus, the predictions (probability of U) for the HDG only depend on the distribution of levels (denote by $\text{prop}_{\text{even}}$ the proportion of even level players) and, assuming the level 0 behavior to be U, is given by

$$p_1 = p_2 = \text{prop}_{\text{even}}.$$

Assuming the level 0 behavior to be D or $50-50$ mixing, the level k model predicted probability of

[1]The only exception to this is when the level 0 player is assumed to play $50-50$ and $50-50$ is a Nash equilibrium (i.e., a fixed point of the best response correspondence). Then a best response for every player to $50-50$ is also to play $50-50$. This is the case for treatments 1 and 6 in both classes of games.

U is given by

$$p_1 = p_2 = \text{prop}_{\text{odd}} = 1 - \text{prop}_{\text{even}}.$$

For matching pennies games, predictions depend on the assumption of level 0 behavior of both players. If level 0 behavior is given by U we obtain

$$p_1 = \text{prop}_{\text{even}}, p_2 = \text{prop}_{\text{odd}}$$

or vice versa for the other level 0 behavior.

We have taken the type distribution from Arad and Rubinstein (2012, p. 3566, footnote 6): $L0 = 0.05$, $L1 = 0.13$, $L2 = 0.37$, $L3 = 0.40$, and $L4 = 0.05$.

In the three-action games, we have chosen $(\frac{1}{3}, \frac{1}{3}, \frac{1}{3})$ to be the choice of level 0 players for both positions and, as before, we have taken the type distribution from Arad and Rubinstein (2012).

Remark (Structure of predictions)**.** *Note that strategy choices are independent of x and y and only depend on the level of the player (except in the case mentioned in Footnote 1). Therefore, in this class of games, adding risk aversion to level k reasoning does not change the predictions and we have excluded it from the analysis.*

1.3 (Poisson) cognitive hierarchy

Definition 1 ((Poisson) Cognitive Hierarchy (from Wright and Leyton-Brown (2017)))**.** Let $\pi_{i,m} \in \Pi(A_i)$ be the distribution of actions predicted by agent i with level m by the Poisson-CH model. Let $f(m) = \text{Poisson}(m; \tau)$. Let $BR_i^G(s_{-i})$ denote the set of i's best responses in game G to the strategy profile s_{-i}. Let

$$\pi_{i,0:m} = \sum_{l=0}^{m} f(l) \frac{\pi_{i,l}}{\sum_{l'=0}^{m} f(l')}$$

be the truncated distribution of actions predicted for an agent conditional on this agent having level $0 \leq l \leq m$. Then π is defined as

$$\pi_{i,0} = |A_i|^{-1}$$

$$\pi_{i,m} = \begin{cases} \left|BR_i^G\left(\pi_{i,0:m-1}\right)\right|^{-1} & \text{if } a_i \in BR_i^G\left(\pi_{i,0:m-1}\right) \\ 0 & \text{otherwise.} \end{cases}$$

The overall predicted distribution of actions is a weighted sum of the distributions for each level,

$$Pr(a_i|G, \tau) = \sum_{l=0}^{\infty} f(l)\pi_{i,l}(a_i).$$

The Poisson distribution's mean, τ, is thus this model's single parameter.

We have taken the parameter $\tau \approx 0.708$ from Wright and Leyton-Brown (2017).

Remark (Structure of predictions). *Due to the special structure of the level k reasoning predictions, the predictions of cognitive hierarchy are also independent of the payoffs. Again, as in the case of level k reasoning, Footnote 1 also applies here.*

1.4 Noisy introspection

We use the version of noisy introspection as proposed by Goeree and Holt (2004) and as defined in Wright and Leyton-Brown (2017, Definition 6):

Definition 2 (NI model (Wright and Leyton-Brown)). Define $\pi_{i,k}^{\mathrm{NI},n}$ as

$$\pi_{i,k}^{\mathrm{NI},n} = \begin{cases} \mathrm{QBR}_i^G\left(\pi_{-i,k+1}^{NI,n}; \frac{\lambda_0}{t^k}\right) & \text{if } k < n, \\ \mathrm{QBR}_i^G\left(\pi_0; \frac{\lambda_0}{t^k}\right) & \text{otherwise,} \end{cases}$$

where p_0 is an arbitrary mixed profile, $\lambda_0 \geq 0$ is a level of precision, and $t > 1$ is a "telescoping" parameter that determines how quickly noise increases with depth of reasoning. Given these parameters, the NI model predicts that each agent will play according to

$$\pi_i^{\mathrm{NI}} = \lim_{n \to \infty} \pi_{i,0}^{\mathrm{NI},n}.$$

The parameters $\lambda_0 \approx 0.052$ and $t \approx 4.463$ are taken from Wright and Leyton-Brown (2017).

1.5 Quantal responses and quantal response equilibria

A logit quantal response $\mathrm{QBR}_i(s_{-i}, \lambda)$ of player i is a reaction to the strategy profile s_{-i}, s.t.:

$$s_i(a_i) = \frac{\exp(\lambda u_i(a_i, s_{-i}))}{\sum\limits_{\forall a' \in A} \exp(\lambda u_i(a_{i'}, s_{-i}))}$$

Like Nash equilibrium, quantal response equilibrium is an equilibrium concept; i.e., every player's strategy is a quantal best response to the strategy of the other player, i.e., $p_i^* = \mathrm{QBR}(p_j^*, \lambda)$ and $p_j^* = \mathrm{QBR}(p_i^*, \lambda)$.

Quantal responses are not invariant with regard to scaling; i.e., the results depend on the scaling of payments, as has already been pointed out by Wright and Leyton-Brown (2010).

We have chosen the same scaling as Wright and Leyton-Brown (2017); i.e., we normalized the payments to expected (USD) cents.[2]

Using the parameter from Wright and Leyton-Brown (2017) and adjusting for the exchange rate, we obtain a parameter value of $\lambda \approx 0.395$.

1.6 Quantal level k

The second to last theory we consider is a model of quantal level k as suggested by Wright and Leyton-Brown (2017):

We restrict the model to four levels (i.e., the max level is 3) with homogeneous precision but general beliefs about the precision of others.

Therefore, we have seven parameters. Among these there are four precision parameters: the real precision parameter for all types, λ, the perceived precision parameter level 2 has about level 1, the perceived precision parameter level 3 has about level 2 and all levels below and the perceived precision parameter level 3 thinks level 2 has about level 1.

Furthermore, we have three parameters that define the proportions of level 1, 2, and 3 players (with the rest being of level 0).

If we denote the probability distribution of player i with level j over actions a_i by $p_{i,j}$, then

$$\begin{aligned} p_{i,0}(a_i) &= |A_i|^{-1} = \frac{1}{2} \\ p_{i,1} &= \mathrm{QBR}_i(p_{-i,0}, \lambda) \\ p_{i,1(2)} &= \mathrm{QBR}_i(p_{-i,1}, \lambda_{1(2)}) \\ p_{i,2} &= \mathrm{QBR}_i(p_{-i,1(2)}, \lambda) \\ p_{i,1(2(3))} &= \mathrm{QBR}_i(p_{-i,1}, \lambda_{1(2(3))} \\ p_{i,2(3)} &= \mathrm{QBR}_i(p_{-i,1(2(3))}, \lambda_{2(3)}) \\ p_{i,3} &= \mathrm{QBR}_i(p_{-i,2(3)}, \lambda), \end{aligned}$$

where $p_{i,1(2)}$ is the mixed strategy profile representing level 2 player's prediction regarding how players 1 and 2 will play; $p_{i,2(3)}$ is level 3's prediction of how level 2 players will play; and $p_{i,1(2(3))}$ is level 3's prediction of how level 2 players predict level 1 players will play.

[2] As the experiment was run in the UK, we had to fix the exchange rate from GBP to USD and we decided to fix it at a rate of 1.41, which is the rounded and weighted (by subjects or sessions) average of exchange rates on the days on which the experiment was run.

Again, the following parameters were taken from Wright and Leyton-Brown (2017): The proportion of level 1 players is $a_1 \approx 0.275$, the proportion of level 2 players is $a_2 \approx 0.248$ and the proportion of level 3 players is $a_3 \approx 0.138$. Furthermore, the precision parameters are: $\lambda \approx 0.441$, $\lambda_{1_2} \approx 0.025$, $\lambda_{1_{2_3}} \approx 0.033$, and $\lambda_{2_3} \approx 1.840$.

1.7 Quantal cognitive hierarchy

The last theory we consider here was also suggested by Wright and Leyton-Brown (2017): Logit quantal cognitive hierarchy with homogeneous and accurate beliefs.

This is a version of cognitive hierarchy (Section 1.3) but logit quantal best responses $\mathrm{QBR}_i(\cdot;\lambda)$, as in Section 1.5, are used instead of best responses $\mathrm{BR}_i(\cdot)$.

Thus, this theory has two parameters $\lambda = 0.20$ and $\tau = 1.12$ which were taken from Wright and Leyton-Brown (2017).

1.8 Predictions

In this section you can find the predictions for all theories in every game. Predictions are written as mixed strategies, rounded to three decimal places.

	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10
CH	(0.5, 0.5)	(0.656, 0.344)	(0.656, 0.344)	(0.656, 0.344)	(0.656, 0.344)	(0.5, 0.5)	(0.656, 0.344)	(0.656, 0.344)	(0.656, 0.344)	(0.656, 0.344)
CH-RA	(0.5, 0.5)	(0.587, 0.413)	(0.599, 0.401)	(0.656, 0.344)	(0.656, 0.344)	(0.344, 0.656)	(0.401, 0.599)	(0.587, 0.413)	(0.587, 0.413)	(0.403, 0.597)
LK	(0.5, 0.5)	(0.53, 0.47)	(0.53, 0.47)	(0.53, 0.47)	(0.53, 0.47)	(0.53, 0.47)	(0.53, 0.47)	(0.53, 0.47)	(0.53, 0.47)	(0.53, 0.47)
NE	(0.5, 0.5)	(0.667, 0.333)	(0.75, 0.25)	(0.833, 0.167)	(0.909, 0.091)	(0.5, 0.5)	(0.75, 0.25)	(0.889, 0.111)	(0.875, 0.125)	(0.833, 0.167)
NE-RA	(0.5, 0.5)	(0.573, 0.427)	(0.615, 0.385)	(0.665, 0.335)	(0.727, 0.273)	(0.202, 0.798)	(0.39, 0.61)	(0.569, 0.431)	(0.516, 0.484)	(0.405, 0.595)
NI	(0.5, 0.5)	(0.52, 0.48)	(0.539, 0.461)	(0.577, 0.423)	(0.66, 0.34)	(0.5, 0.5)	(0.539, 0.461)	(0.629, 0.371)	(0.612, 0.388)	(0.577, 0.423)
NI-RA	(0.5, 0.5)	(0.516, 0.484)	(0.527, 0.473)	(0.544, 0.456)	(0.573, 0.427)	(0.465, 0.535)	(0.483, 0.517)	(0.515, 0.485)	(0.503, 0.497)	(0.485, 0.515)
QCH	(0.5, 0.5)	(0.516, 0.484)	(0.531, 0.469)	(0.56, 0.44)	(0.619, 0.381)	(0.5, 0.5)	(0.531, 0.469)	(0.598, 0.402)	(0.586, 0.414)	(0.56, 0.44)
QCH-RA	(0.5, 0.5)	(0.574, 0.426)	(0.608, 0.392)	(0.645, 0.355)	(0.699, 0.301)	(0.309, 0.691)	(0.4, 0.6)	(0.57, 0.43)	(0.517, 0.483)	(0.411, 0.589)
QLK	(0.5, 0.5)	(0.548, 0.452)	(0.593, 0.407)	(0.675, 0.325)	(0.791, 0.209)	(0.5, 0.5)	(0.593, 0.407)	(0.76, 0.24)	(0.737, 0.263)	(0.675, 0.325)
QLK-RA	(0.5, 0.5)	(0.76, 0.24)	(0.783, 0.217)	(0.782, 0.218)	(0.701, 0.299)	(0.171, 0.829)	(0.208, 0.792)	(0.756, 0.244)	(0.631, 0.369)	(0.219, 0.781)
QRE	(0.5, 0.5)	(0.538, 0.462)	(0.57, 0.43)	(0.622, 0.378)	(0.707, 0.293)	(0.5, 0.5)	(0.57, 0.43)	(0.679, 0.321)	(0.662, 0.338)	(0.622, 0.378)
QRE-RA	(0.5, 0.5)	(0.526, 0.474)	(0.543, 0.457)	(0.567, 0.433)	(0.603, 0.397)	(0.433, 0.567)	(0.47, 0.53)	(0.524, 0.476)	(0.505, 0.495)	(0.473, 0.527)
RND	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)

	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
CH	(0.5, 0.5)	(0.656, 0.344)	(0.656, 0.344)	(0.656, 0.344)	(0.656, 0.344)	(0.5, 0.5)	(0.465, 0.535)	(0.465, 0.535)	(0.465, 0.535)	(0.465, 0.535)
CH-RA	(0.5, 0.5)	(0.656, 0.344)	(0.656, 0.344)	(0.656, 0.344)	(0.656, 0.344)	(0.5, 0.5)	(0.465, 0.535)	(0.465, 0.535)	(0.465, 0.535)	(0.465, 0.535)
LK	(0.5, 0.5)	(0.53, 0.47)	(0.53, 0.47)	(0.53, 0.47)	(0.53, 0.47)	(0.5, 0.5)	(0.47, 0.53)	(0.47, 0.53)	(0.47, 0.53)	(0.47, 0.53)
NE	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.333, 0.667)	(0.25, 0.75)	(0.167, 0.833)	(0.091, 0.909)
NE-RA	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.427, 0.573)	(0.385, 0.615)	(0.335, 0.665)	(0.273, 0.727)
NI	(0.5, 0.5)	(0.52, 0.48)	(0.541, 0.459)	(0.581, 0.419)	(0.676, 0.324)	(0.5, 0.5)	(0.5, 0.5)	(0.499, 0.501)	(0.498, 0.502)	(0.497, 0.503)
NI-RA	(0.5, 0.5)	(0.517, 0.483)	(0.529, 0.471)	(0.547, 0.453)	(0.579, 0.421)	(0.5, 0.5)	(0.499, 0.501)	(0.499, 0.501)	(0.498, 0.502)	(0.497, 0.503)
QCH	(0.5, 0.5)	(0.516, 0.484)	(0.532, 0.468)	(0.563, 0.437)	(0.628, 0.372)	(0.5, 0.5)	(0.5, 0.5)	(0.499, 0.501)	(0.499, 0.501)	(0.498, 0.502)
QCH-RA	(0.5, 0.5)	(0.644, 0.356)	(0.697, 0.303)	(0.723, 0.277)	(0.728, 0.272)	(0.5, 0.5)	(0.437, 0.563)	(0.43, 0.57)	(0.428, 0.572)	(0.428, 0.572)
QLK	(0.5, 0.5)	(0.549, 0.451)	(0.596, 0.404)	(0.674, 0.326)	(0.782, 0.218)	(0.5, 0.5)	(0.496, 0.504)	(0.493, 0.507)	(0.487, 0.513)	(0.478, 0.522)
QLK-RA	(0.5, 0.5)	(0.678, 0.322)	(0.692, 0.308)	(0.693, 0.307)	(0.693, 0.307)	(0.5, 0.5)	(0.334, 0.666)	(0.314, 0.686)	(0.308, 0.692)	(0.307, 0.693)
QRE	(0.5, 0.5)	(0.546, 0.454)	(0.591, 0.409)	(0.67, 0.33)	(0.818, 0.182)	(0.5, 0.5)	(0.491, 0.509)	(0.482, 0.518)	(0.466, 0.534)	(0.437, 0.563)
QRE-RA	(0.5, 0.5)	(0.532, 0.468)	(0.554, 0.446)	(0.586, 0.414)	(0.636, 0.364)	(0.5, 0.5)	(0.485, 0.515)	(0.475, 0.525)	(0.46, 0.54)	(0.437, 0.563)
RND	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)	(0.5, 0.5)

Table 1: Predictions: two-action games: hawk-dove and matching-pennies games

	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30
CH	(0.333, 0.333, 0.333)	(0.473, 0.298, 0.229)	(0.473, 0.298, 0.229)	(0.484, 0.287, 0.229)	(0.54, 0.231, 0.229)	(0.473, 0.229, 0.298)	(0.484, 0.287, 0.229)	(0.54, 0.231, 0.229)	(0.54, 0.231, 0.229)	(0.484, 0.229, 0.287)
CH-RA	(0.264, 0.473, 0.264)	(0.473, 0.297, 0.231)	(0.473, 0.298, 0.229)	(0.473, 0.298, 0.229)	(0.473, 0.298, 0.229)	(0.229, 0.229, 0.542)	(0.297, 0.229, 0.474)	(0.298, 0.229, 0.473)	(0.298, 0.229, 0.473)	(0.229, 0.229, 0.542)
LK	(0.333, 0.333, 0.333)	(0.547, 0.017, 0.437)	(0.547, 0.017, 0.437)	(0.547, 0.017, 0.437)	(0.547, 0.017, 0.437)	(0.547, 0.017, 0.437)	(0.547, 0.017, 0.437)	(0.547, 0.017, 0.437)	(0.547, 0.017, 0.437)	(0.547, 0.017, 0.437)
NE	(0.333, 0.333, 0.333)	(0.4, 0.4, 0.2)	(0.429, 0.429, 0.143)	(0.444, 0.444, 0.111)	(0.455, 0.455, 0.091)	(0.462, 0.231, 0.308)	(0.476, 0.333, 0.19)	(0.483, 0.379, 0.138)	(0.5, 0.333, 0.167)	(0.571, 0.143, 0.286)
NE-RA	(0.33, 0.341, 0.33)	(0.36, 0.372, 0.268)	(0.376, 0.389, 0.236)	(0.386, 0.399, 0.214)	(0.394, 0.407, 0.199)	(0.248, 0.144, 0.608)	(0.298, 0.219, 0.484)	(0.327, 0.262, 0.411)	(0.306, 0.217, 0.478)	(0.251, 0.1, 0.649)
NI	(0.333, 0.333, 0.333)	(0.348, 0.339, 0.313)	(0.362, 0.344, 0.294)	(0.375, 0.348, 0.276)	(0.388, 0.352, 0.26)	(0.345, 0.327, 0.327)	(0.36, 0.333, 0.308)	(0.374, 0.337, 0.289)	(0.369, 0.332, 0.299)	(0.357, 0.321, 0.321)
NI-RA	(0.333, 0.334, 0.333)	(0.34, 0.339, 0.321)	(0.345, 0.342, 0.313)	(0.349, 0.345, 0.306)	(0.352, 0.347, 0.3)	(0.323, 0.32, 0.357)	(0.327, 0.323, 0.349)	(0.331, 0.326, 0.343)	(0.328, 0.323, 0.349)	(0.323, 0.318, 0.358)
QCH	(0.333, 0.333, 0.333)	(0.339, 0.335, 0.325)	(0.345, 0.337, 0.318)	(0.35, 0.339, 0.311)	(0.356, 0.34, 0.304)	(0.338, 0.331, 0.331)	(0.344, 0.333, 0.323)	(0.349, 0.335, 0.316)	(0.347, 0.333, 0.32)	(0.343, 0.329, 0.329)
QCH-RA	(0.333, 0.334, 0.333)	(0.336, 0.336, 0.329)	(0.338, 0.337, 0.325)	(0.339, 0.338, 0.323)	(0.341, 0.339, 0.32)	(0.329, 0.328, 0.342)	(0.331, 0.33, 0.339)	(0.332, 0.331, 0.337)	(0.331, 0.329, 0.339)	(0.329, 0.328, 0.343)
QLK	(0.333, 0.333, 0.333)	(0.6, 0.273, 0.127)	(0.664, 0.221, 0.115)	(0.687, 0.199, 0.114)	(0.688, 0.198, 0.114)	(0.644, 0.175, 0.18)	(0.722, 0.159, 0.119)	(0.732, 0.153, 0.114)	(0.742, 0.143, 0.116)	(0.741, 0.128, 0.131)
QLK-RA	(0.285, 0.43, 0.285)	(0.487, 0.355, 0.158)	(0.516, 0.351, 0.132)	(0.532, 0.344, 0.124)	(0.542, 0.337, 0.121)	(0.13, 0.133, 0.737)	(0.165, 0.153, 0.683)	(0.225, 0.179, 0.596)	(0.171, 0.153, 0.675)	(0.128, 0.132, 0.74)
QRE	(0.355, 0.29, 0.355)	(0.259, 0.225, 0.516)	(0.145, 0.138, 0.717)	(0.068, 0.071, 0.861)	(0.031, 0.034, 0.935)	(0.15, 0.137, 0.712)	(0.075, 0.076, 0.849)	(0.033, 0.036, 0.931)	(0.035, 0.037, 0.928)	(0.037, 0.039, 0.924)
QRE-RA	(0.353, 0.293, 0.353)	(0.29, 0.251, 0.459)	(0.234, 0.211, 0.554)	(0.189, 0.177, 0.634)	(0.154, 0.148, 0.698)	(0.222, 0.192, 0.586)	(0.191, 0.171, 0.638)	(0.164, 0.15, 0.686)	(0.163, 0.148, 0.689)	(0.158, 0.142, 0.699)
RND	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)

	T31	T32	T33	T34	T35	T36	T37	T38	T39	T40
CH	(0.333, 0.333, 0.333)	(0.542, 0.229, 0.229)	(0.542, 0.229, 0.229)	(0.542, 0.229, 0.229)	(0.542, 0.229, 0.229)	(0.333, 0.333, 0.333)	(0.31, 0.38, 0.31)	(0.31, 0.38, 0.31)	(0.31, 0.38, 0.31)	(0.31, 0.38, 0.31)
CH-RA	(0.333, 0.333, 0.333)	(0.542, 0.229, 0.229)	(0.542, 0.229, 0.229)	(0.542, 0.229, 0.229)	(0.542, 0.229, 0.229)	(0.333, 0.333, 0.333)	(0.31, 0.38, 0.31)	(0.31, 0.38, 0.31)	(0.31, 0.38, 0.31)	(0.31, 0.38, 0.31)
LK	(0.333, 0.333, 0.333)	(0.517, 0.467, 0.017)	(0.517, 0.467, 0.017)	(0.517, 0.467, 0.017)	(0.517, 0.467, 0.017)	(0.333, 0.333, 0.333)	(0.11, 0.06, 0.83)	(0.11, 0.06, 0.83)	(0.11, 0.06, 0.83)	(0.11, 0.06, 0.83)
NE	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.2, 0.467)	(0.333, 0.143, 0.524)	(0.333, 0.091, 0.576)	(0.333, 0.048, 0.619)
NE-RA	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.314, 0.283, 0.403)	(0.303, 0.255, 0.442)	(0.29, 0.221, 0.489)	(0.273, 0.179, 0.547)
NI	(0.333, 0.333, 0.333)	(0.346, 0.327, 0.327)	(0.358, 0.321, 0.321)	(0.384, 0.308, 0.308)	(0.45, 0.275, 0.275)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.334, 0.333)	(0.333, 0.334, 0.333)	(0.333, 0.334, 0.332)
NI-RA	(0.333, 0.333, 0.333)	(0.343, 0.328, 0.328)	(0.351, 0.325, 0.325)	(0.362, 0.319, 0.319)	(0.382, 0.309, 0.309)	(0.333, 0.333, 0.333)	(0.333, 0.334, 0.333)	(0.333, 0.334, 0.333)	(0.334, 0.334, 0.333)	(0.334, 0.334, 0.332)
QCH	(0.333, 0.333, 0.333)	(0.338, 0.331, 0.331)	(0.343, 0.329, 0.329)	(0.353, 0.324, 0.324)	(0.378, 0.311, 0.311)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)
QCH-RA	(0.333, 0.333, 0.333)	(0.337, 0.331, 0.331)	(0.34, 0.33, 0.33)	(0.344, 0.328, 0.328)	(0.352, 0.324, 0.324)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)
QLK	(0.333, 0.333, 0.333)	(0.669, 0.166, 0.166)	(0.758, 0.121, 0.121)	(0.774, 0.113, 0.113)	(0.774, 0.113, 0.113)	(0.333, 0.333, 0.333)	(0.301, 0.42, 0.279)	(0.292, 0.44, 0.268)	(0.286, 0.464, 0.25)	(0.264, 0.515, 0.221)
QLK-RA	(0.333, 0.333, 0.333)	(0.631, 0.185, 0.185)	(0.722, 0.139, 0.139)	(0.765, 0.117, 0.117)	(0.774, 0.113, 0.113)	(0.333, 0.333, 0.333)	(0.306, 0.428, 0.266)	(0.3, 0.448, 0.253)	(0.297, 0.466, 0.236)	(0.29, 0.491, 0.218)
QRE	(0.333, 0.333, 0.333)	(0.333, 0.33, 0.336)	(0.333, 0.328, 0.339)	(0.333, 0.322, 0.345)	(0.333, 0.308, 0.359)	(0.333, 0.333, 0.333)	(0.319, 0.363, 0.319)	(0.304, 0.392, 0.304)	(0.274, 0.452, 0.274)	(0.202, 0.595, 0.202)
QRE-RA	(0.333, 0.333, 0.333)	(0.335, 0.327, 0.338)	(0.336, 0.323, 0.341)	(0.337, 0.317, 0.346)	(0.34, 0.306, 0.354)	(0.333, 0.333, 0.333)	(0.322, 0.355, 0.323)	(0.313, 0.371, 0.315)	(0.3, 0.396, 0.304)	(0.279, 0.437, 0.284)
RND	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)	(0.333, 0.333, 0.333)

Table 2: Predictions: three-action games: hawk-middle-dove and rock-paper-scissors games

2 Omitted theories

This section provides a description of theories that we have omitted from our analysis either because they predict pure strategies in at least some games or because their predictions are identical to those provided by another theory, either in the two-action games or in both, the two- and three-action games.

2.1 Maximin play

The maximin strategy is the strategy that maximizes the minimal payoff a player can get. In all our hawk-dove games with $y > 0$, the maximin strategy is a pure strategy to play dove (D), i.e., $p = 0$. The strategy with which a player minimizes the maximal payoff of the opponent is also a pure strategy in these treatments; i.e., it is to play hawk (U) or $p = 1$.

2.2 Level 1(α)

Fudenberg and Liang (2019) suggested using a simple variation of level-k reasoning, what they call the level 1(α) model:

In this model, subjects are assumed to respond to a level 0 player who randomizes over all actions uniformly by maximizing their expected utility, with utility of monetary payment x given by $f(x) = x^{\alpha}$, with $\alpha \leq 1$.[3] This theory makes pure strategy predictions for the majority of our treatments.

To see this for our hawk dove games, note that, as players behave as if they respond to someone who mixes uniformly over U and D, the expected utility V from playing each action for a player i is given by

$$V_i(U_i) = \frac{1}{2}x^{\alpha}$$
$$V_i(D_i) = \frac{1}{2} + \frac{1}{2}y^{\alpha},$$

with

$$V_i(U_i) > V_i(D_i)$$
$$\Leftrightarrow x^{\alpha} > 1 + y^{\alpha}.$$

This implies that for hawk dove treatments T2 to T5, as well as T8 and T9, this model predicts pure

[3] Fudenberg and Liang (2019) estimated the parameter α to be 0.41 for lab data and 0.625 for the random game data.

strategy U, and for treatments T6, T7, and T10 it predicts pure strategy D. Only for treatment T1 could subjects randomize.

In our matching pennies treatments, player 2 could always randomize, but the prediction for player 1 in all treatments except when $z = 1$ (in T11) would be to play pure strategy U.

2.3 Ambiguity aversion (Eichberger Kelsey)

Eichberger and Kelsey (2011) proposed a model of ambiguity aversion to explain the results of the static games of Goeree and Holt (2001). Their model has two parameters, δ and α with $\delta, \alpha \in (0, 1)$.

In this model $\pi(a_i)$ is the belief of player $-i$ that i plays a_i, and V_i denotes the expected utilities of a player in our matching pennies games:

$$V_1(U_1) - V_1(D_1) = \delta\alpha z + (1 - \delta)z\pi(U_2) - \delta\alpha - (1 - \delta)\pi(D_2)$$
$$V_2(U_2) - V_2(D_2) = \delta\alpha + (1 - \delta)\pi(D_1) - \delta\alpha - (1 - \delta)\pi(U_1)$$

For $z = 1$, we get $\pi(U_1) = \pi(D_1) = \pi(U_2) = \pi(D_2) = \frac{1}{2}$.

Furthermore, U_1 will always be strictly preferred to D_1 if:

$$\begin{aligned} & V_1(U_1) - V_1(D_1) > 0 \\ \Leftrightarrow \quad & \delta\alpha z + (1 - \delta)z\pi(U_2) - \delta\alpha - (1 - \delta)\pi(D_2) > 0 \\ \Leftrightarrow \quad & \delta\alpha(z - 1) + (1 - \delta)(z - 1)\pi(U_2) > 0 \end{aligned}$$

As $\delta, \alpha > 0$, $\delta < 1$ and $z \in \{2, 3, 5, 10\}$ ($z = 1$ was covered above), we know that for every possible belief $\pi(U_2) \in [0, 1]$ player 1 will prefer U_1 over D_1.

Thus, the theory predicts, for every $z > 1$, that $\pi(U_1) = 1$; i.e., the first player plays a pure strategy in four out of five of our matching pennies games.

2.4 Fairness preferences

Fehr and Schmidt (1999) suggested a model in which players have a preference for fair outcomes given by

$$u_i(x_i, x_j) = x_i - \alpha_i \max\{(x_j - x_i), 0\} - \beta_i \max\{(x_i - x_j), 0\},$$

where x_i is the first player's payment and x_j the payment the other player receives.

Fehr and Schmidt (2004) suggest to use two types for applications: A "selfish" or payoff maximizing type with $\alpha = \beta = 0$ which makes up 60% of the population and a social type with $\alpha = 2$ and $\beta = 0.6$ which makes up the other 40%.

Thus, our hawk-dove game is now a Bayesian game in which the selfish type's utility is given by the payoff table in the paper, while the social type's utility function u_soc is now given by

$$u_{soc}(x, 1) = x - \beta(x - 1) = 0.6 + 0.4x$$

$$u_{soc}(1, x) = 3 - \alpha 2x = 3 - 2x$$

$$u_{soc}(0, 0) = u_{ego}(0, 0) = 0$$

$$u_{soc}(y, y) = u_{ego}(y, y) = y.$$

However, as 60% of the players are payment maximizers, this theory predicts the same outcomes as Nash equilibrium theory. This is due to a purification argument: 40% of the population plays a pure strategy (H) and the other 60% takes that into account and adjusts its mixing probability accordingly.

For example in T8 (HDG) the social type plays H, i.e., $p_{soc} = 1$ and the selfish type mixes with $p_{ego} = \frac{22}{27}$. Thus, the joint population "mixing" probability is: $\frac{2}{5} + \frac{3}{5}\frac{22}{27} = \frac{8}{9}$ which is equal to the Nash equilibrium prediction.

This purification argument works, in the same way, for all treatments except the symmetric ones T1 and T6, in which the two types are playing the same strategy. Furthermore, it works for both risk-neutral and risk-averse players. In this case, the theory predicts the same outcomes as the Nash equilibrium with risk aversion.

2.5 A theory of equity, reciprocity, and competition (ERC)

Bolton and Ockenfels (2000) suggested the ERC model as a competing model of social preferences. As described in the original paper, we use the parameterized version of ERC, the so-called alpha model. They assumed that there are two types: relativists (who minimize the difference between the payoffs) and egoists (who seek to maximize expected payment or, in the case with risk aversion, expected utility).

Again, we have a Bayesian game with two types of players: relativists and egoists. The utility function of the relativist depends on her payoff (x_i) and the payoff of the other person (x_j) as follows:

$$u_i(x_i, x_j) = -|x_i - x_j|.$$

In hawk dove games this means that we have the following "payoff" matrix:

$$\begin{array}{ccc} & H & D \\ H & 0 & -(x-1) \\ D & -(x-1) & 0. \end{array}$$

Given the symmetry and the knowledge that $x > 1$, it is easy to see what the relativists must play in equilibrium: whenever they face an average probability of U given by $p > \frac{1}{2}$ they choose $p_{rel} = 1$ and otherwise they choose $p_{rel} = 0$. They are indifferent between both pure strategies only if the population mixing is exactly $p = \frac{1}{2}$.[4]

Therefore, the resulting strategies are similar to the ones under fairness preferences (although, for different reasons): relativists always play $p_{rel} = 1$ and egoists adjust their mixture according to the Nash equilibrium (i.e., in HDG T8 for a $\alpha = 0.5$ this is given by $p = \alpha p_{rel} + (1-\alpha)p_{ego} = \frac{1}{2} + \frac{1}{2}\frac{7}{18} = \frac{8}{9}$).

Thus, the ERC model (or rather the alpha model) gives us the same predictions as NE (or, with risk aversion NE-RA).

3 Additional results

3.1 Log-likelihoods

In this section, you can find the log-likelihoods for each treatment and theory.

	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
CH	-101.89	-97.48	-91.01	-91.01	-77.43	-101.89	-102.01	-94.90	-103.95	-118.19	-101.89	-93.60	-84.55	-84.55	-77.43	-101.89	-98.71	-99.40	-97.46	-97.60
CH-RA	-101.89	-97.65	-93.40	-91.01	-77.43	-94.25	-109.43	-96.24	-101.17	-99.41	-101.89	-93.60	-84.55	-84.55	-77.43	-101.89	-98.71	-99.40	-97.46	-97.60
LK	-101.89	-99.94	-98.73	-98.73	-96.21	-104.98	-100.78	-99.45	-101.14	-103.78	-101.89	-99.21	-97.53	-97.53	-96.21	-101.89	-99.09	-99.69	-98.01	-98.13
NE	-101.89	-97.73	-91.73	-99.23	-69.27	-101.89	-110.40	-123.37	-146.11	-166.82	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-92.87	-100.52	-89.57	-106.11
NE-RA	-101.89	-98.03	-92.55	-90.83	-70.38	-101.90	-110.66	-97.06	-101.42	-99.40	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-95.97	-96.29	-86.72	-86.05
NI	-101.89	-100.53	-97.85	-94.82	-76.96	-101.89	-100.53	-95.08	-101.81	-107.84	-101.89	-100.01	-96.08	-91.24	-75.17	-101.89	-101.85	-101.83	-101.69	-101.44
NI-RA	-101.89	-100.80	-99.02	-97.42	-88.86	-98.96	-102.75	-100.64	-101.79	-101.15	-101.89	-100.35	-97.72	-95.26	-87.92	-101.89	-101.82	-101.79	-101.61	-101.43
QCH	-101.89	-100.80	-98.64	-96.11	-82.15	-101.89	-100.75	-95.85	-101.14	-106.19	-101.89	-100.39	-97.25	-93.33	-80.91	-101.89	-101.86	-101.85	-101.74	-101.58
QCH-RA	-101.89	-98.01	-92.92	-91.32	-72.85	-94.57	-109.52	-97.02	-101.40	-99.40	-101.89	-93.74	-82.24	-81.27	-70.25	-101.89	-96.58	-97.56	-93.41	-93.68
QLK	-101.89	-99.02	-93.73	-90.67	-66.42	-101.89	-100.16	-99.10	-111.82	-121.28	-101.89	-97.75	-89.70	-83.40	-66.79	-101.89	-101.53	-101.32	-100.14	-99.14
QLK-RA	-101.89	-103.76	-93.73	-93.65	-72.68	-106.42	-147.95	-98.76	-102.55	-112.66	-101.89	-93.61	-82.47	-82.41	-73.46	-101.89	-92.88	-96.83	-85.68	-86.48
QRE	-101.89	-99.50	-95.28	-92.19	-72.14	-101.89	-100.10	-95.11	-104.33	-113.18	-101.89	-97.96	-90.24	-83.63	-65.59	-101.89	-100.98	-100.52	-97.58	-94.63
QRE-RA	-101.89	-100.18	-97.52	-95.53	-84.32	-96.90	-103.56	-99.89	-101.72	-100.66	-101.89	-99.08	-94.42	-90.76	-79.92	-101.89	-100.45	-100.03	-96.87	-94.60
RND	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89	-101.89

Table 3: Loglikelihoods: Two-action games

[4]Under these conditions, we have a continuum of mixed equilibria in which $\alpha p_{rel} + (1-\alpha)p_{ego} = p = \frac{1}{2}$.

	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32	T33	T34	T35	T36	T37	T38	T39	T40
CH	-182.37	-179.56	-177.11	-166.42	-174.78	-183.77	-197.40	-198.12	-192.14	-186.98	-182.37	-156.82	-152.52	-153.38	-136.17	-182.37	-187.23	-187.63	-185.82	-185.22
CH-RA	-204.33	-179.40	-177.11	-166.85	-172.51	-152.52	-169.29	-167.37	-168.42	-152.52	-182.37	-156.82	-152.52	-153.38	-136.17	-182.37	-187.23	-187.63	-185.82	-185.22
LK	-182.37	-244.57	-283.98	-264.06	-285.90	-173.16	-213.36	-207.06	-195.69	-173.16	-182.37	-236.09	-195.60	-212.36	-170.34	-182.37	-229.99	-228.78	-242.32	-254.24
NE	-182.37	-188.15	-185.69	-176.20	-185.60	-181.44	-209.76	-235.91	-215.17	-186.47	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-174.00	-175.08	-196.50	-227.22
NE-RA	-183.26	-183.70	-179.93	-174.06	-176.19	-143.14	-168.71	-171.20	-167.27	-140.68	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-176.47	-174.45	-178.24	-186.37
NI	-182.37	-181.73	-179.76	-175.20	-175.70	-182.96	-184.99	-188.34	-185.26	-183.64	-182.37	-179.88	-176.95	-172.20	-152.28	-182.37	-182.38	-182.40	-182.41	-182.44
NI-RA	-182.48	-182.20	-181.10	-179.24	-179.34	-177.08	-180.28	-180.86	-180.28	-176.61	-182.37	-180.35	-178.52	-176.27	-168.13	-182.37	-182.40	-182.42	-182.43	-182.45
QCH	-182.37	-182.08	-181.20	-179.23	-179.21	-182.59	-183.29	-184.40	-183.30	-182.83	-182.37	-181.40	-180.22	-178.17	-169.25	-182.37	-182.37	-182.37	-182.38	-182.38
QCH-RA	-182.41	-182.29	-181.83	-181.08	-181.09	-180.25	-181.53	-181.77	-181.54	-180.07	-182.37	-181.59	-180.86	-179.93	-176.60	-182.37	-182.37	-182.38	-182.38	-182.38
QLK	-182.37	-195.47	-194.83	-171.94	-186.71	-227.55	-246.48	-252.28	-240.16	-259.68	-182.37	-156.11	-154.25	-157.96	-119.50	-182.37	-193.60	-197.52	-197.48	-203.35
QLK-RA	-196.37	-189.94	-184.78	-168.04	-176.90	-152.69	-182.03	-168.60	-181.41	-153.03	-182.37	-155.13	-151.29	-156.93	-119.49	-182.37	-195.69	-200.08	-199.45	-201.30
QRE	-177.81	-193.79	-257.43	-368.06	-457.30	-149.34	-225.60	-273.00	-283.93	-202.21	-182.37	-182.30	-182.58	-182.51	-183.17	-182.37	-185.30	-189.30	-193.90	-216.65
QRE-RA	-178.11	-187.08	-210.73	-243.32	-261.23	-148.06	-176.48	-177.83	-183.69	-148.48	-182.37	-181.95	-182.12	-181.62	-180.89	-182.37	-184.48	-186.54	-187.21	-190.50
RND	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37	-182.37

Table 4: Loglikelihoods: Three-action games

3.2 Vuong scores

In this section, you can find the Vuong tables for all treatments of the two-action games combined and for all treatments of the three-action games combined.

	CH	CH-RA	LK	NE	NE-RA	NI	NI-RA	QCH	QCH-RA	QLK	QLK-RA	QRE	QRE-RA	RND
CH	0	-1.77	7.74	8.23	1.51	4.64	6.18	6.04	-4.01	1.74	0.7	-0.94	2.43	9.73
CH-RA	1.77	0	10.09	7.35	4.13	6.21	10.52	8.04	-7.54	2.53	2.2	1.18	6.59	13.17
LK	-7.74	-10.09	0	3.99	-4.27	-7.88	-3.36	-7.1	-10.97	-5.09	-2.79	-8.51	-12.42	15.68
NE	-8.23	-7.35	-3.99	0	-6.36	-5.93	-4.14	-5.15	-8.2	-8.09	-5.91	-8.14	-5.78	-2.31
NE-RA	-1.51	-4.13	4.27	6.36	0	0.89	3.78	2.14	-6.75	-0.64	-0.59	-1.98	0.15	7.4
NI	-4.64	-6.21	7.88	5.93	-0.89	0	6.05	8.89	-7.9	-2.9	-0.94	-7.98	-1.89	12.26
NI-RA	-6.18	-10.52	3.36	4.14	-3.78	-6.05	0	-4.38	-11.53	-4.25	-2.46	-7.48	-16.88	18.92
QCH	-6.04	-8.04	7.1	5.15	-2.14	-8.89	4.38	0	-9.3	-4.04	-1.65	-8.41	-5.92	13.39
QCH-RA	4.01	7.54	10.97	8.2	6.75	7.9	11.53	9.3	0	4.46	4.19	3.75	9.13	13.47
QLK	-1.74	-2.53	5.09	8.09	0.64	2.9	4.25	4.04	-4.46	0	0.1	-4.21	1.02	7.35
QLK-RA	-0.7	-2.2	2.79	5.91	0.59	0.94	2.46	1.65	-4.19	-0.1	0	-0.99	0.52	4.49
QRE	0.94	-1.18	8.51	8.14	1.98	7.98	7.48	8.41	-3.75	4.21	0.99	0	3.54	10.77
QRE-RA	-2.43	-6.59	12.42	5.78	-0.15	1.89	16.88	5.92	-9.13	-1.02	-0.52	-3.54	0	19.15
RND	-9.73	-13.17	-15.68	2.31	-7.4	-12.26	-18.92	-13.39	-13.47	-7.35	-4.49	-10.77	-19.15	0

Table 5: Vuong table: Two-action games

3.3 Testing theories individually

Let $\bar{p}_t$ be the empirical proportion of hawk in treatment t and let $p_{i,t}$ be the theoretical proportion in treatment t according to theory i. Let $z_{i,t} = \left(\bar{p}_t - p_{i,t}\right) / \sqrt{\left(p_{i,t}(1-p_{i,t})/n\right)}$. Then, by the usual central limit theorem argument, $z_{i,t}$ is asymptotically standard normally distributed under the null hypothesis that theory i is correct, i.e., that the true $p_t = p_{i,t}$. Let $\chi_i^2 = \sum_{t=1}^{10} z_{i,t}^2$. Then χ_i^2 is asymptotically chi-squared distributed with 10 degrees of freedom. Similarly, one can test the theories for both variations

	CH	CH-RA	LK	NE	NE-RA	NI	NI-RA	QCH	QCH-RA	QLK	QLK-RA	QRE	QRE-RA	RND
CH	0	-7.35	13.05	10.39	-2.11	3.55	3.04	4.91	4.77	17.13	-1.6	15.97	6.08	5.88
CH-RA	7.35	0	15.06	12.27	4.8	11.26	11.96	12.66	12.99	14.08	4.42	23.24	14.32	13.63
LK	-13.05	-15.06	0	-8.1	-13.62	-11.5	-11.46	-11.04	-10.97	-6.96	-12.7	1.48	-9.17	-10.64
NE	-10.39	-12.27	8.1	0	-12.88	-9.15	-8.42	-7.61	-7.24	2.37	-6.98	9.63	-1.32	-6.44
NE-RA	2.11	-4.8	13.62	12.88	0	6.09	6.92	8.11	8.62	9.52	0	21.31	11.06	9.67
NI	-3.55	-11.26	11.5	9.15	-6.09	0	0.4	9.79	7.36	9.26	-3.08	17.29	6.17	10.95
NI-RA	-3.04	-11.96	11.46	8.42	-6.92	-0.4	0	14.1	21.89	8.42	-3.2	18.49	7.02	22.43
QCH	-4.91	-12.66	11.04	7.61	-8.11	-9.79	-14.1	0	2.18	7.86	-3.88	17.41	5.51	12.74
QCH-RA	-4.77	-12.99	10.97	7.24	-8.62	-7.36	-21.89	-2.18	0	7.5	-4	17.82	5.67	23.27
QLK	-17.13	-14.08	6.96	-2.37	-9.52	-9.26	-8.42	-7.86	-7.5	0	-9.67	7.58	-2.78	-6.89
QLK-RA	1.6	-4.42	12.7	6.98	0	3.08	3.2	3.88	4	9.67	0	20.49	7.87	4.52
QRE	-15.97	-23.24	-1.48	-9.63	-21.31	-17.29	-18.49	-17.41	-17.82	-7.58	-20.49	0	-28.56	-17.35
QRE-RA	-6.08	-14.32	9.17	1.32	-11.06	-6.17	-7.02	-5.51	-5.67	2.78	-7.87	28.56	0	-4.75
RND	-5.88	-13.63	10.64	6.44	-9.67	-10.95	-22.43	-12.74	-23.27	6.89	-4.52	17.35	4.75	0

Table 6: Vuong table: three-action games

of the matching pennies games and for all treatments of the two-action games by adjusting the degrees of freedom. The results for the two-action games can be found in Table 7.

Furthermore, we have tested the theories for the three-action games in a similar fashion (by adjusting to a multinomial distribution and adjusting the degrees for freedom) in ??.

	HDG: chi-sq	HDG: p-value	MP1: chi-sq	MP1: p-value	MP2: chi-sq	MP2: p-value	All: chi-sq	All: p-value
CH	90.65	< 0.00000001	46.16	0.00000001	63.93	< 0.00000001	200.74	< 0.00000001
CH-RA	52.48	0.00000009	46.16	0.00000001	63.93	< 0.00000001	162.57	< 0.00000001
LK	134.97	< 0.00000001	140.37	< 0.00000001	67.39	< 0.00000001	342.72	< 0.00000001
NE	482.47	< 0.00000001	174.02	< 0.00000001	78.64	< 0.00000001	735.13	< 0.00000001
NE-RA	61.20	< 0.00000001	174.02	< 0.00000001	9.99	0.07554233	245.21	< 0.00000001
NI	86.14	< 0.00000001	88.83	< 0.00000001	90.88	< 0.00000001	265.85	< 0.00000001
NI-RA	111.10	< 0.00000001	123.03	< 0.00000001	90.56	< 0.00000001	324.69	< 0.00000001
QCH	97.02	< 0.00000001	105.89	< 0.00000001	91.31	< 0.00000001	294.22	< 0.00000001
QCH-RA	47.70	0.00000070	23.49	0.00027150	40.83	0.00000010	112.03	< 0.00000001
QLK	109.56	< 0.00000001	43.06	0.00000004	81.58	< 0.00000001	234.19	< 0.00000001
QLK-RA	237.13	< 0.00000001	31.42	0.00000773	3.96	0.55480122	272.51	< 0.00000001
QRE	81.78	< 0.00000001	42.65	0.00000004	65.14	< 0.00000001	189.57	< 0.00000001
QRE-RA	90.01	< 0.00000001	91.24	< 0.00000001	61.67	< 0.00000001	242.92	< 0.00000001
RND	161.05	< 0.00000001	174.02	< 0.00000001	92.39	< 0.00000001	427.46	< 0.00000001

Table 7: Testing individual theories: Two-action games

	chi-sq	p-value	chi-sq	p-value	chi-sq	p-value	chi-sq	p-value
CH	468.09	< 0.00000001	52.34	< 0.00000001	83.12	< 0.00000001	603.56	< 0.00000001
CH-RA	140.40	< 0.00000001	52.34	< 0.00000001	83.12	< 0.00000001	275.86	< 0.00000001
LK	3577.85	< 0.00000001	1038.09	< 0.00000001	716.74	< 0.00000001	5332.68	< 0.00000001
NE	774.95	< 0.00000001	339.35	< 0.00000001	244.38	< 0.00000001	1358.68	< 0.00000001
NE-RA	104.95	< 0.00000001	339.35	< 0.00000001	24.10	0.00020800	468.39	< 0.00000001
NI	370.82	< 0.00000001	225.25	< 0.00000001	51.90	< 0.00000001	647.97	< 0.00000001
NI-RA	316.22	< 0.00000001	274.99	< 0.00000001	52.03	< 0.00000001	643.24	< 0.00000001
QCH	365.45	< 0.00000001	288.69	< 0.00000001	51.61	< 0.00000001	705.75	< 0.00000001
QCH-RA	347.19	< 0.00000001	312.96	< 0.00000001	51.62	< 0.00000001	711.77	< 0.00000001
QLK	1564.23	< 0.00000001	37.60	0.00000045	179.19	< 0.00000001	1781.02	< 0.00000001
QLK-RA	274.75	< 0.00000001	25.96	0.00009070	192.91	< 0.00000001	493.63	< 0.00000001
QRE	4181.46	< 0.00000001	340.69	< 0.00000001	164.19	< 0.00000001	4686.34	< 0.00000001
QRE-RA	629.95	< 0.00000001	330.52	< 0.00000001	88.61	< 0.00000001	1049.07	< 0.00000001
RND	368.69	< 0.00000001	339.35	< 0.00000001	51.57	< 0.00000001	759.60	< 0.00000001

Table 8: Testing individual theories: Three-action games

4 Data

Here you can find the frequency data for both, two- and three-action games. To get access to the entire data, please visit `http://hdg.kuelpmann.org`.

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
A	81	92	102	102	123	50	85	96	82	60	93	98	112	112	123	77	48	53	39	40
B	66	55	45	45	24	97	62	51	65	87	54	49	35	35	24	70	99	94	108	107

Table 9: Data: Two-action games

	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32	T33	T34	T35	T36	T37	T38	T39	T40
A	54	76	75	91	81	45	55	54	61	45	51	102	107	106	126	61	53	55	50	52
B	29	38	50	45	51	14	27	25	22	14	54	28	35	31	23	53	35	33	42	45
C	83	52	41	30	34	107	84	87	83	107	61	36	24	29	17	52	78	78	74	69

Table 10: Data: Three-action games

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