Figure 1: Payoffs to Self and Other

I. Mutual Gains
e.g., market exchange, symbiosis

II. Altruism
e.g., favors, parental investment

III. Vengeance
e.g., strikes, feuds

IV. Opportunism
e.g., shirking, predation and parasitism

Social gain
Social loss

Self's cost
Other's cost
Self's benefit
Other's benefit

\( r = \frac{1}{8} \)
Figure 2: Fitness Payoffs

A. Basic Trust Game

\[
\begin{array}{c|c}
\text{Self} & \text{T} & \text{Other} & \text{D} \\
\hline
\text{N} & (0, 0) & (1, 1) & (-1, 2) \\
\end{array}
\]

B. Extended Trust Game

\[
\begin{array}{c|c|c|c}
\text{Self} & \text{T} & \text{Other} & \text{Self*} \\
\hline
\text{N} & (0, 0) & (1, 1) & \text{[ } 0 \leq h \leq \infty \text{]} \\
\text{C} & & & (-1 - ch, 2 - h) \\
\end{array}
\]

*Utility payoff to Self is \(-1 - ch + \ln h\)

C. Reduced Trust with a vengeance

\[
\begin{array}{c|c}
\text{Self} & \text{T} & \text{Other} & \text{D} \\
\hline
\text{N} & (0, 0) & (1, 1) & (-1 - v, 2 - v/c) \\
\text{C} & & & \\
\end{array}
\]
Figure 3: Self’s Fitness $w$ as a Function of Vengefulness $v$
Figure 4: Game Tree

Note: O denotes Other; $S^{ij}$ denotes Self with vengeance level $i$ and perception $j$, as determined by Nature’s move. The four branch labels are Nature’s move probabilities.
Table 1: PBE Probabilities

<table>
<thead>
<tr>
<th>Choice</th>
<th>Fitness Payoff</th>
<th>Equilibrium Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self, Other</td>
<td>(NT, DC) Separating</td>
</tr>
<tr>
<td>( v = v_H )</td>
<td>(N, .)</td>
<td>( 0, 0 )</td>
</tr>
<tr>
<td>(T, C)</td>
<td>1, 1</td>
<td>( (1 - \epsilon)(1 - \alpha) )</td>
</tr>
<tr>
<td>(T, D)</td>
<td>-(1+(v)), 2(-v/c)</td>
<td>( (1 - \epsilon)\alpha )</td>
</tr>
</tbody>
</table>

| \( v = 0 \)      | (N, .)         | 0, 0                    | \( 1 - \epsilon \)    | \( \epsilon \)       | \( 1 - e \)          |
| (T, C)            | 1, 1           | \( \epsilon \alpha \)  | \( (1 - \epsilon)^2 \) | \( (1 - \epsilon)\epsilon \) | \( e \)              |
| (T, D)            | -1, 2          | \( \epsilon(1 - \alpha) \) | \( (1 - \epsilon)\epsilon \) | \( e \)              |

Note: Other observes \( s = 1 \) with probability \( a \) in \((0, \frac{1}{2})\) when \( v = 0 \), and observes \( s = 0 \) with probability \( a \) when \( v = v_H \). Other chooses his less preferred action with probability \( \alpha = a(1 - \epsilon) + \epsilon(1 - a) = \epsilon + a - 2ae \).
Figure 5: PBE Example

Parameter Values: $a = 0.1, e = 0.05, c = 0.5, v_H = 2$

Note: The vertical axis conflates $q$ and $r$ and so has no meaningful scale, but the vertical segments reflect the fact that the GH equilibrium coincides with GP at $q=0$ and with GM at $q=q^*$, while the BH equilibrium coincides with BP at $r=1$ and with BM at $r=r^*$. 
Table 2: PBE Calculations

<table>
<thead>
<tr>
<th></th>
<th>Fitness function</th>
<th>Value in example</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-vengeful type</td>
<td></td>
<td>Vengeful type</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( v = 0 )</td>
<td></td>
<td>( v = v_H )</td>
<td></td>
</tr>
<tr>
<td>Separating</td>
<td>( e(2\alpha - 1) )</td>
<td></td>
<td>( (1 - e)(1 - (2 + v_H) \alpha) )</td>
<td>- 0.036</td>
</tr>
<tr>
<td>Good Pooling</td>
<td>( (1 - e)(1 - 2e) )</td>
<td></td>
<td>( (1 - e)(1 - (2 + v_H) e) )</td>
<td>0.855</td>
</tr>
<tr>
<td>Bad Pooling</td>
<td>( -e(1 - 2e) )</td>
<td></td>
<td>( -e(1 + v_H - (2 + v_H) e) )</td>
<td>- 0.045</td>
</tr>
<tr>
<td>Good Mix</td>
<td>( (1 - e)[1 - 2e - 2q(1 - e - \alpha)] )</td>
<td></td>
<td>( (1 - e)[1 - (2 + v_H)e - q\alpha (2 + v_H) (1 - 2e)] )</td>
<td>0</td>
</tr>
<tr>
<td>Bad Mix</td>
<td>( e[-(1 - 2e) + 2(1 - r)(1 - \alpha - e)] )</td>
<td></td>
<td>( (1 - e)[1 - (2 + v_H) \alpha - r(2 + v_H) (1 - \alpha - 2e + 2e)] )</td>
<td>-0.646</td>
</tr>
</tbody>
</table>

Notes: Example parameter values are \( \alpha = 0.1, e = 0.05, c = 0.5, v_H = 2 \). The hybrid equilibria will involve the fitness functions indicated for the corresponding mixed equilibria, with \( q \) and \( r \) varying within their ranges rather than fixed at particular numerical values.
Figure 6: Best Responses and PBE

A. Other’s undominated strategies are on the NW frontier

B. Self’s BR to Other’s undominated strategies are also on the NW frontier

C. Self’s Best Response

To:

CC  q*  DC  r*  DD

Is:

TT  NT  NN

D. Other’s Best Response depends on \( L(x) \)

BR to TT or NN is:

CC  DC  DD

to NT is:

CC  DC  DD

for:

\( L_1 \)  \( L_2 \)  \( L_3 \)  \( L_4 \)

Resulting in PBE:

\( \text{GP} \)  \( \text{GM} \)  \( \text{BP} \)

\( \text{BM} \)

\( \text{SEP} \)

\( \text{GH} \)  \( \text{BH} \)