Cover letter: Recognising and evaluating the effectiveness of extortion in the Iterated Prisoner's Dilemma

To whom it may concern,

We present strong and novel results indicating that extortionate behaviours are not as robust as adaptable behaviours, extending and improving on fundamental recent results in evolutionary game theory including highly-cited manuscripts appearing in Nature Communications. All research software designed for the work and all data is made available for all to use according to the very best open scientific principles.

In 2012, Press and Dyson published a paper in PNAS entitled: "Iterated Prisoner's Dilemma contains strategies that dominate any evolutionary opponent". This work has obtained a lot of interest as it seemed to indicate an evolutionary advantage to extortionate behaviour which puts in doubt a large amount of work showing how and why cooperative behaviour emerges in complex systems.

This area of research is within the scope of Physical Review E as demonstrated by a number of publications in the field. One such example is the work of Hao, Rong and Zhou: "Extortion under uncertainty: Zero-determinant strategies in noisy games" which in 2015 was published in Physical Review E and explored the performance of strategies discussed in our paper. Their work identified limitations of these strategies in noise claiming that "dominant extortion does not exist".

The work we present here extends this observations and looks in to identifying when and were extortion takes place. We analyze more than 200 strategies/behaviours from the literature and many original contributors, obtained through open scientific processes and available to all to use. A linear algebraic approach is used to determine if a given strategy is behaving in an extortionate way against a given opponent. Some of these strategies are classic strategies from the literature and others have been recently developed using machine learning and reinforcement learning techniques. This allows us to obtain experimental evidence detailing that whilst extortionate behaviour can be advantageous, it needs to be combined with adaptability to be evolutionarily beneficial.

Sincerely,

The authors