I. RANDOM MIXED STRATEGIES IN QUANTUM PRISONER'S DILEMMA

We will first consider a pure bimatrix classical game, one in which Alice and Bob are allowed to play "C" (I) and "D" (X) (representing the strategies corresponding to pure *Confess(C)* and *Defect(D)*) and a random strategy "RCD" where, both Alice and Bob plays C with probability p = q = 0.5 and D with 1-p and 1-q respectively. And then we will consider a pure Quantum game with the pure quantum strategies represented as "Q", defined as-

$$Q = U(0, \pi/2) = \begin{bmatrix} i & 0 \\ 0 & -i \end{bmatrix} \tag{1}$$

and the Miracle move defined as-

$$M = U(\pi/2, \pi/2) = \frac{1}{\sqrt{2}} \begin{bmatrix} i & -1 \\ 1 & -i \end{bmatrix} \tag{2}$$

and a random mixed Strategy "RQM" where, Alice and Bob plays Q with p = q = 0.5 and M with 1-p and 1-q respectively .

A. When Alice and Bob are restricted to play only the Classical Strategies

		Bob		
		C	D	RCD
Alice	C	(3,3)	(0,5)	(1.5, 4)
	D	(5,0)	(1,1)	(3, 0.5)
	RCD	(4, 1.5)	(0.5, 3)	(2.25, 2.25)

(3)

It's clear that (D, D) is still the Nash equilibrium after a adding mixed strategy to the payoff table.

B. When Alice and Bob are restricted to play only the Quantum Strategies

		Bob		
		Q	M	RQM
Alice	Q	(3,3)	(4, 1.5)	(3.5, 2.25)
	M	(1.5, 4)	(2.25, 2.25)	(1.88, 3.12)
	RQM	(2.25, 3.5)	(3.12, 1.88)	(2.69, 2.69)

(4)

In this case, clearly (Q, Q) is NE with an added Mixed Quantum strategy in the payoff table. But its clear the that payoff obtained here cannot be replicated in a pure classical game. Thereby, negating the Van Enk-Pikes assertion.

II. RANDOM MIXED STRATEGIES IN QUANTUM HAWK-DOVE GAME

Here we will choose, "H" as (X) and "D" as (I) (representing the strategies corresponding to pure *Hawk(H)* and *Dove(D)*)

A. When Alice and Bob are restricted to play only the Classical Strategies

		Bob		
		H	D	RHD
Alice	H	(-25,-25)	(50,0)	(12.5, -12.5)
	D	(0,50)	(15,15)	(7.5, 32.5)
	RHD	(-12.5, 12.5)	(32.5, 7.5)	(10, 10)

(5)

B. When Alice and Bob are restricted to play only the Quantum Strategies

		Bob		
		Q	M	RQM
Alice	Q	(15, 15)	(32.5, 7.5)	(23.75, 11.25)
	M	(7.5, 32.5)	(10, 10)	(11.25, -1.25)
	RQM	(-6.25, -18.75)	(-1.25, 11.25)	(-3.75, -3.75)

(6)

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But, if we had choosen "H" as (I) and "D" as (X), then our payoff matrix would be,

		Bob		
		Q	M	RQM
Alice	Q	(-25, -25)	(-12.5, 12.5)	(-18.75, -6.25)
	M	(12.5, -12.5)	(10, 10)	(8.75, 21.25)
	RQM	(11.25, 23.75)	(21.25, 8.75)	(16.25, 16.25)

(7)