Sheets 14 Hawks and Doves in a Chicken Game

The 'ordering of orderings'

Figure The Persuader

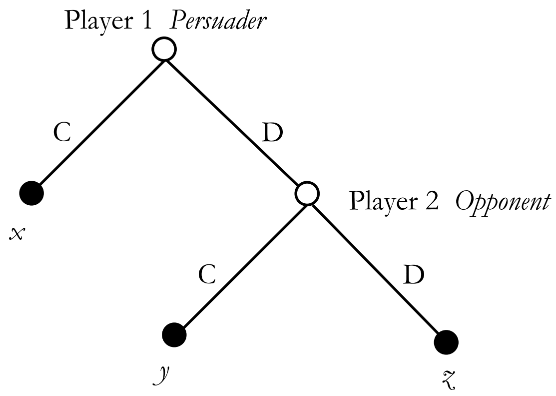


Figure 1 Ordering of orderings of the Persuader

	strategy C		strategy D			
player 1	$x>y>z$	$x>z>y$	$y>x>z$	$y>z>x$	$z>y>x$	$z>x>y$
	not aggressive		aggressive		most aggressive	

Figure The Opponent

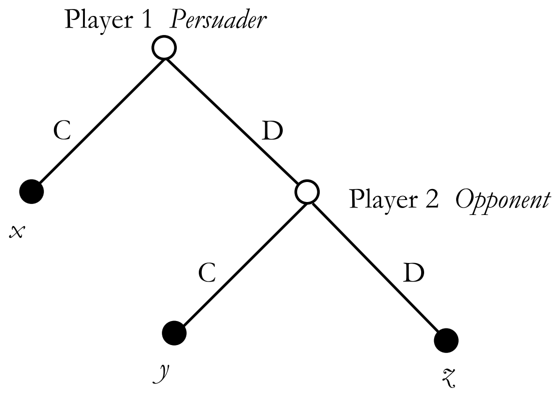


Figure 2 Ordering of orderings of the Opponent

	strategy C			strategy D		
player 2	$x>y>z$	$y>x>z$	$y>z>x$	$x>z>y$	$z>x>y$	$z>y>x$
	not aggressive			most aggressive		

Figure 3 Strategy D: air strike

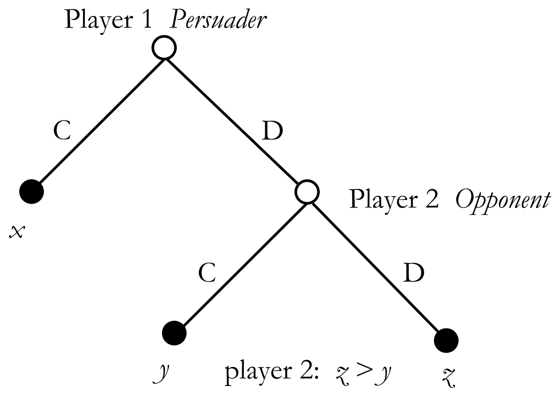


Figure 4   Strategy D: invasion

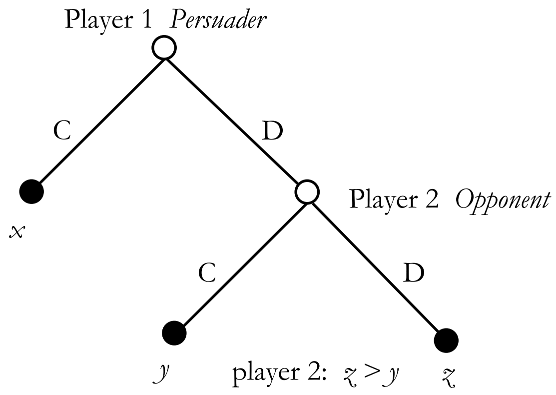


Figure 5   Strategy D: blockade

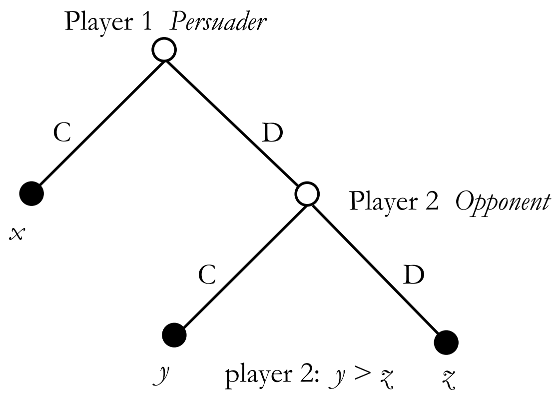


Figure 6   Soviets

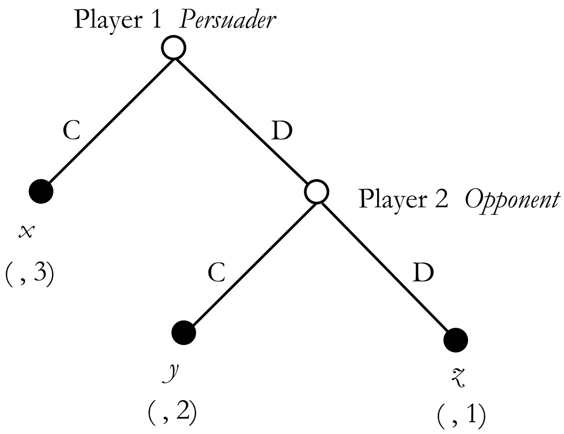


Figure 7   Hawks & Soviets

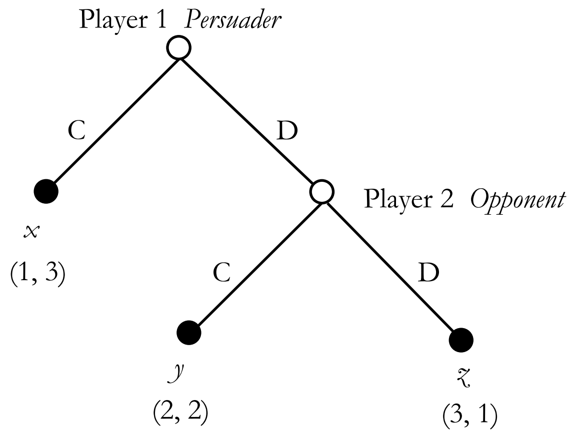
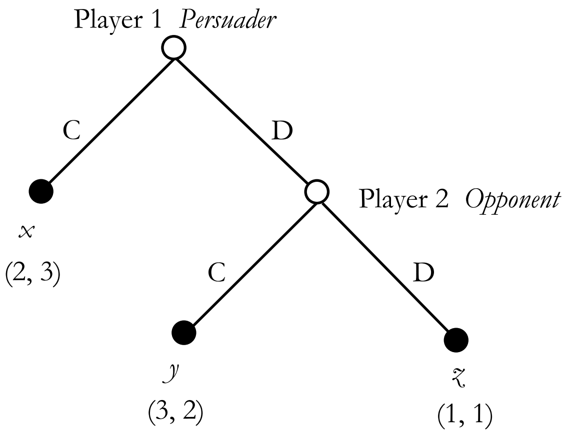


Figure 8   Doves & Soviets



From a formal point of view it does not matter whether the preferences of the US are $z > y > x$ (Figure 7) or $y > x > z$ (Figure 8). If the second player—for whatever reason—prefers outcome y to outcome z, then the outcome will be y in both cases.

The success (outcome y) or failure (outcome z) is a decision that depends only on the choice of the second player.

The choice of a blockade is what Schelling calls a 'low-level intrusion' which gives the opponent time to think about how to react (Schelling 1966: 77). Thus, the revealed preference gives us information about the underlying preferences of some action.

Figure 9 The level of intrusion

strategy	strategy C		strategy D			
instrument			blockade			air strike
ordering	$x>y>z$	$x>z>y$	$y>x>z$	$y>z>x$	$z>y>x$	$z>x>y$
disposition	not aggressive		aggressive		most aggressive	

The method of lottery ticket

[1] $A = p * C + 1 - p * B$

This result would be consistent with the payoffs we have attached: 2 utilities to outcome A, 3 utilities to outcome C and 1 utility to outcome B:

[2] $2 = .5 * 3 + .5 * 1$

Figure 9 The lottery ticket method: *p* = ½

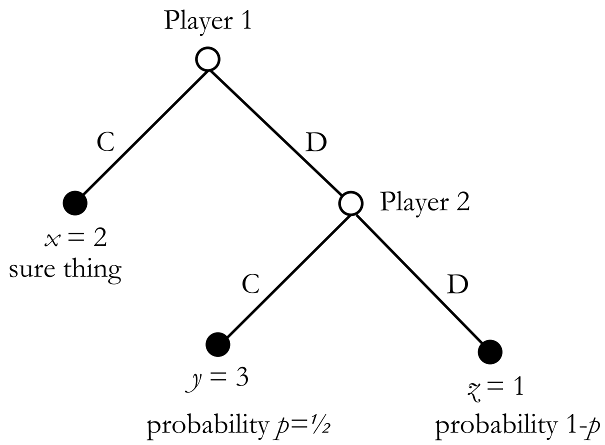
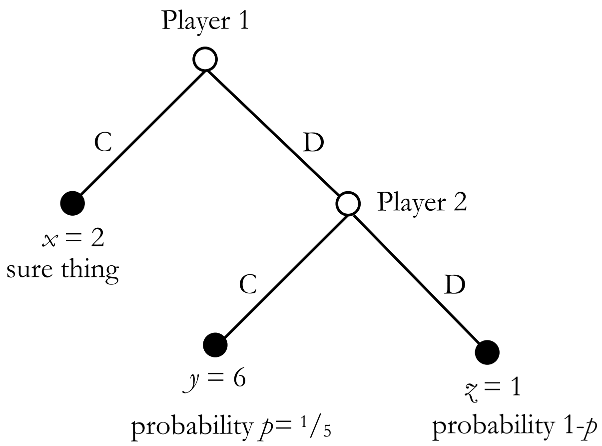


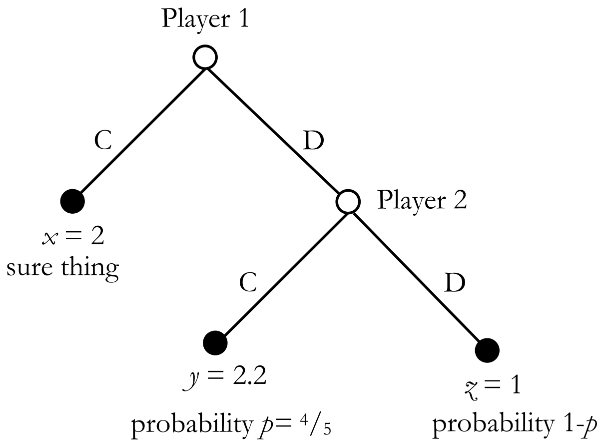
Figure 10 The lottery ticket method: $p = {}^{1}/_{5}$



Another individual can have a different personal standard, for example, with $p = {}^{1}/_{5}$. With the same equation, we can establish that the numerical values are $x = 3$, $y = 6$, and $z = 1$: Figure 10.

[3] $x = p * y + 1\text{-}p * z$

Figure 11 **The lottery ticket method: $p = {}^{4}/_{5}$**



[4] $x = p*y + 1\text{-}p * z$

A third individual could be indifferent when $p = 0.8$. His payoffs would be $x = 3$, $y = 2.2$ and $z = 1$:

Von Neumann and Morgenstern already established that it makes no sense to use the method of the lottery ticket if the sure thing outcome is the highest preferred or the lowest preferred alternative.

> 'We expect the individual under consideration to possess a clear intuition whether he prefers the event A to the 50-50 combination of B or C, or conversely. It is clear that if he prefers A to B and also to C, then he will prefer it to the above combination as well; similarly, if he prefers B as well as C to A, then he will prefer the combination too. But if he should prefer A to, say B, but at the same time C to A, then any assertion about his preference of A against the combination contains fundamentally new information' (Von Neumann and Morgenstern 2004: 18).

With the lottery tickets, we can measure the numerical values of the orderings $y > x > z$ and $z > x > y$, but not of the orderings $y > z > x$ and $z > y > x$.

Figure 12 $p = ½$

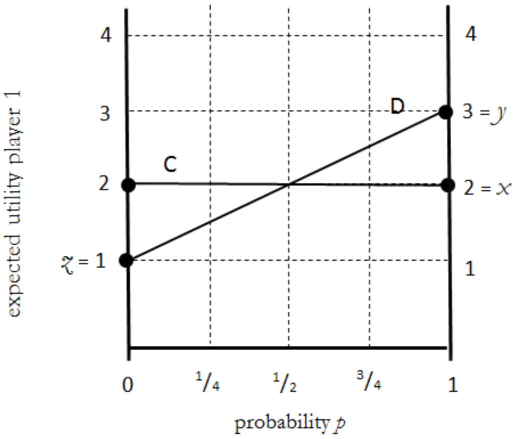


Figure 13 $p = {}^4/_5$

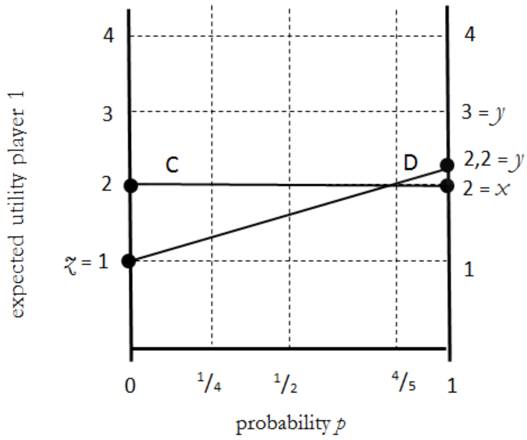
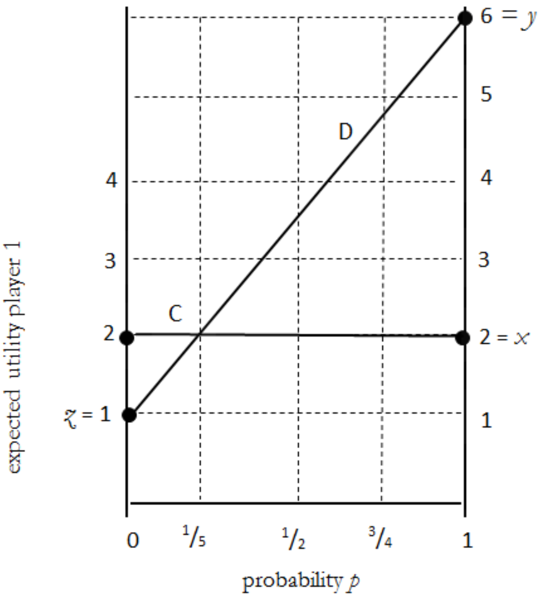


Figure 14 $p = {}^1/_5$



Hawks and Doves

British evolutionary biologist John Maynard Smith in his *Evolution and the Theory of Games* (1982). The names 'hawk' and 'dove' represent two different strategies in a model of conflict over resources. Strategy Hawk stands for fighting for resources, while strategy Dove is just posing a threatening stance without engaging in a fight.

Figure 15 Hawk versus Dove game

		player 2 Dove (C)	player 2 Hawk (D)
player 1	Dove (C)	(15, 15)	(0, 50)
	Hawk (D)	(50, 0)	(-25, -25)

[6] $15 * (1-p) + 0 * p = 50 * (1-p) -25 + 50 * (p)$

$15 – 15p = 50 – 75p$

$60p = 35$

$p = {}^{7}/_{12}$ and thus $(1-p) = {}^{5}/_{12}$

[7] ${}^{5}/_{12} * 15 + {}^{7}/_{12} * 0 = 6{,}25$

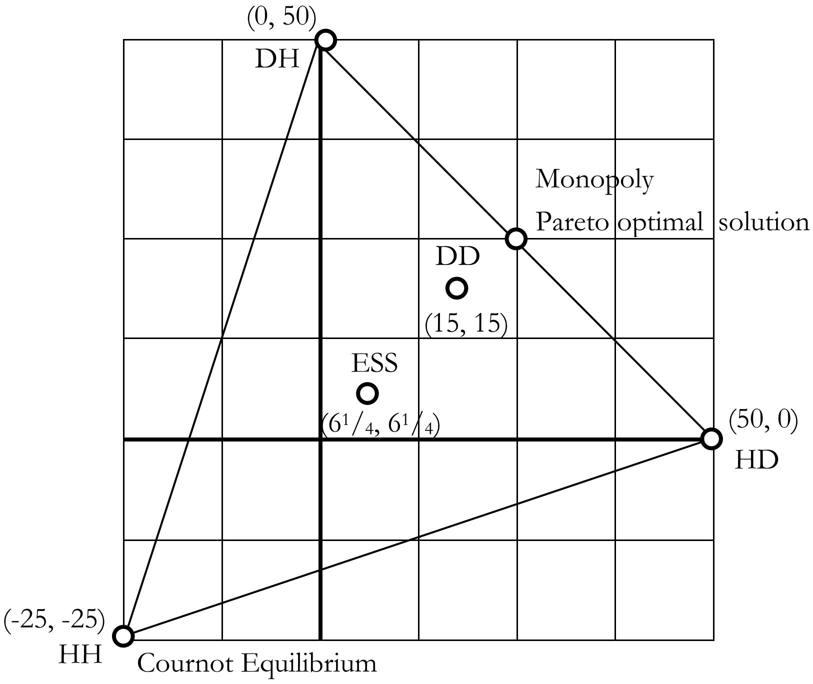
And the expected payoff for strategy Hawk is:

[8] ${}^{5}/_{12} * 50 + {}^{7}/_{12} * -25 = 6{,}25$

Figure 16 Mixed strategies of the Hawk versus Dove game

		player 2	
		Dove (C) * $^{5}/_{12}$	Hawk (D) * $^{7}/_{12}$
player 1	Dove (C) * $^{5}/_{12}$	(15, 15)	(0, 50)
	Hawk (D) * $^{7}/_{12}$	(50, 0)	(-25, -25)

Figure 17 Payoff polygon of the Hawk versus Dove Game



The evolutionary theory of conflict

The original evolutionary game is about animals contesting limited resources such as a favourable habitat. Maynard Smith describes two habitats, a favourable habitat in which an animal produces a relatively high number of offspring and a less favourable habitat in which an animal produces a low number of offspring on average.

The contest over the habitat has the value V, i.e. the gain in fitness due to a more favourable habitat. Fighting over the habitat can lead to injury and the cost of the injury is C, which stands for the loss in fitness.

The strategy in the games of evolutionary biology does not refer to two different animals, a dove and a hawk, but to two different kinds of behaviour of the same animal. Strategy Dove stands for Cooperate and Hawk for Defect.

If two hawks fight, then each hawk has a 50% chance to gain V or lose C, and the expected payoff is ½(V-C). A hawk will win value V in the confrontation with a dove, and the dove gets nothing.

Two doves will split the gain of sharing the favourable habitat V/2. Figure 18 illustrates the payoff matrix of the Hawk-Dove game that represents the fitness for the players (Maynard Smith 1982: 12).

If the value of the gain in fitness is high relative to the cost of being injured, say V = 6 and C =2, then the game becomes a Prisoner's Dilemma game (Dixit and Skeath 2004: 448)

Figure 18 Hawk versus Dove game

		player 2: Dove (C)	player 2: Hawk (D)
player 1	Dove (C)	V/2, V/2	0, V
	Hawk (D)	V, 0	½ (V-C), ½ (V-C)

Figure 19 Game with V = 6 and C = 2: Prisoner's Dilemma

		player 2: Dove (C)	player 2: Hawk (D)
player 1	Dove (C)	3, 3	0, 6
	Hawk (D)	6, 0	2, 2

Figure 20 Prisoner's Dilemma game

		player 2	
		Cooperate (C)	Defect (D)
player 1	Cooperate (C)	3, 3	1, 4
	Defect (D)	4, 1	2, 2

On the other hand, if the cost of being injured is high and the gain in fitness is low, say V = 2 and C = 4, then the game is a Chicken Game (Dixit and Skeath 2004: 448) with outcomes HD and DH as Nash equilibria.

Figure 21 Game with V = 2 and C = 4: Chicken Game

		player 2: Dove (C)	player 2: Hawk (D)
player 1	Dove (C)	1, 1	0, 2
	Hawk (D)	2, 0	-1, -1

Figure 22 Chicken Game

		player 2: swerve (C)	player 2: drive straight (D)
player 1	swerve (C)	(3, 3)	(2, 4)
	drive straight (D)	(4, 2)	(1, 1)

Figure 23 Payoff polygon of the Chicken Game