

# A Hawk-Dove Game









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# A motivating example: Hawk-Dove Game

- Consider the symmetric Hawk-Dove game.
  - Players: Two indistinguishable individuals
  - Strategies: They both must decide whether to share a resource or demand the resource for themselves.
  - Payoffs: If only one individual demands the resource [play Hawk], then he/she obtains that resource (of value  $V$ ).
  - If both demand the resource, they fight. Each wins with probability 0.5 (thus obtaining the resource). The loser pays a cost of  $D$  (due to injuries incurred). It is assumed that  $D > V$ .

## Hawk-Dove Model: Costs and Benefits of Fighting over Resources

Payoff* to...	...in fights against:	
	hawk 	dove 
hawk 	Hawk wins 50% of fights; is injured in 50% of fights.  Payoff: $(V-D)/2$	Hawk always wins; dove flees.  Payoff: $V$
dove 	Dove never wins; is never injured.  Payoff: $0$	Dove wins 50% of fights; is never injured; wastes time.  Payoff: $V/2 - T$

\* $V$  = fitness value of winning resources in fight

$D$  = fitness costs of injury

$T$  = fitness costs of wasting time

- Generalized Payoff Matrix with ( $T=0$ )

	Hawk	Dove
Hawk	$(V-D)/2, (V-D)/2$	$V, 0$
Dove	$0, V$	$V/2, V/2$

- Let us take  $D=10, V=6$

	Hawk	Dove
Hawk	$-2, -2$	$6, 0$
Dove	$0, 6$	$3, 3$

# Nash Equilibrium

	Hawk	Dove
Hawk	-2,-2	6,0
Dove	0,6	3,3

# Reinterpretation

	Hawk	Dove
Hawk	-2,-2	6,0
Dove	0,6	3,3

- Animal World
- The Hawk-Dove game explains why aggression is present within population of an animal, but is not always seen.
- Let us say that in a population fraction  $p$  are of hawk type and  $1-p$  are of dove type.
- On average, in an interaction, a hawk type makes=
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# Graph

- For Hawk type:  $6-8p$
- For Dove type:  $3(1-p)$