



# Neuroscience of trading

**Tony Plummer**

# Our limitations



**On the voyage of science we are perpetually sighting great continents of ignorance that we did not even know were there.**

**Matt Ridley.**

**Science keeps showing us how little we know. *The Times*. 10th February 2014**

# Little known facts



## 1. Brain and body co-evolved

Brain is large because body is complex  
*And vice versa*

## 2. ‘Mind’ involves brain *and* body

Brain is only one part of information-processing system

## 3. Body’s priority is survival

Can’t distinguish between real & imagined threats

**Body is involved in your decision-making**

# Another little known fact



## 1. Learning occurs in three phases

New information → absorption → application

## 2. Absorption phase uses energy

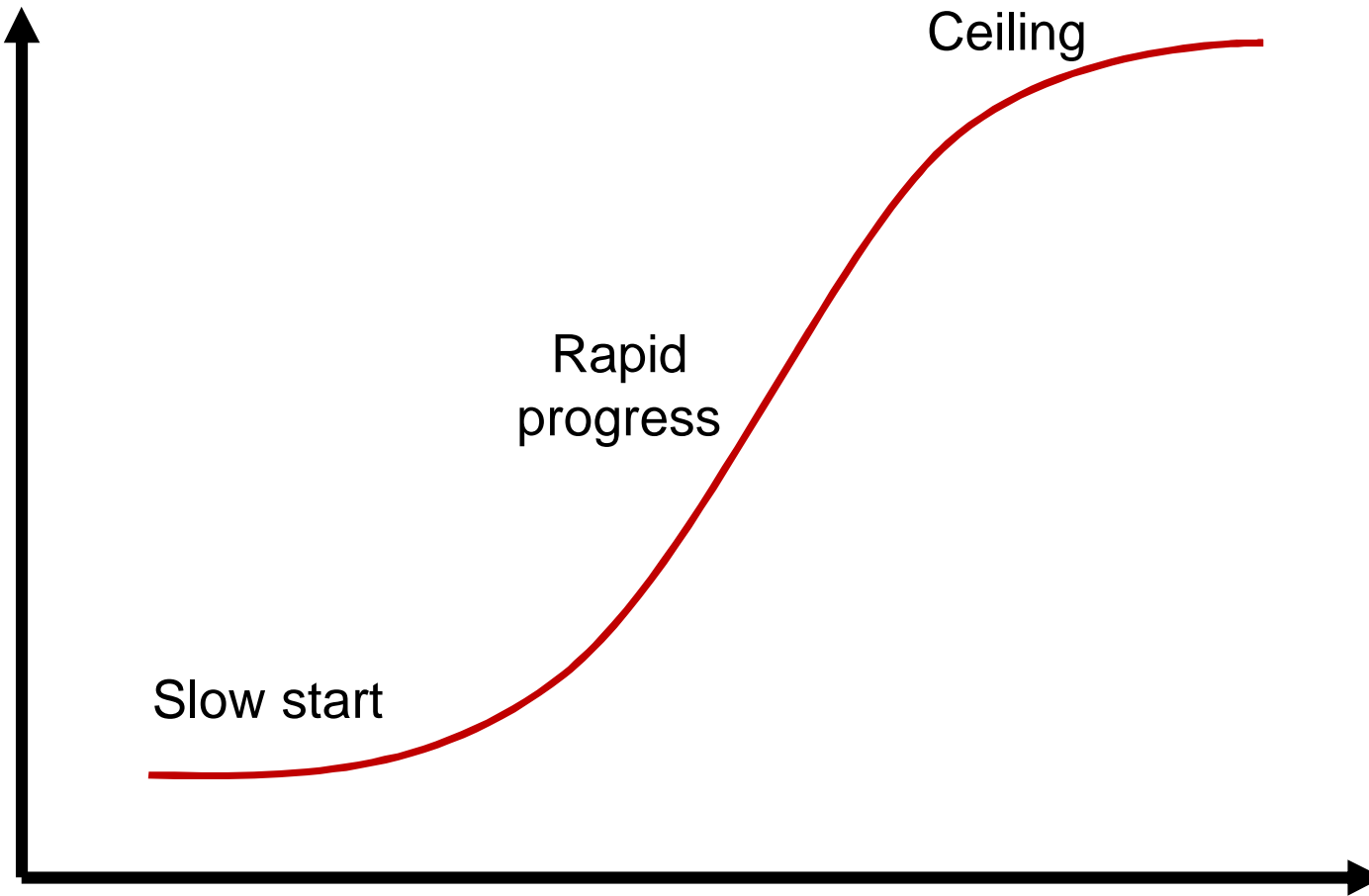
Information moved from long- to short-term memory (Donald Hebb)

## 3. Energy diverted from other activities

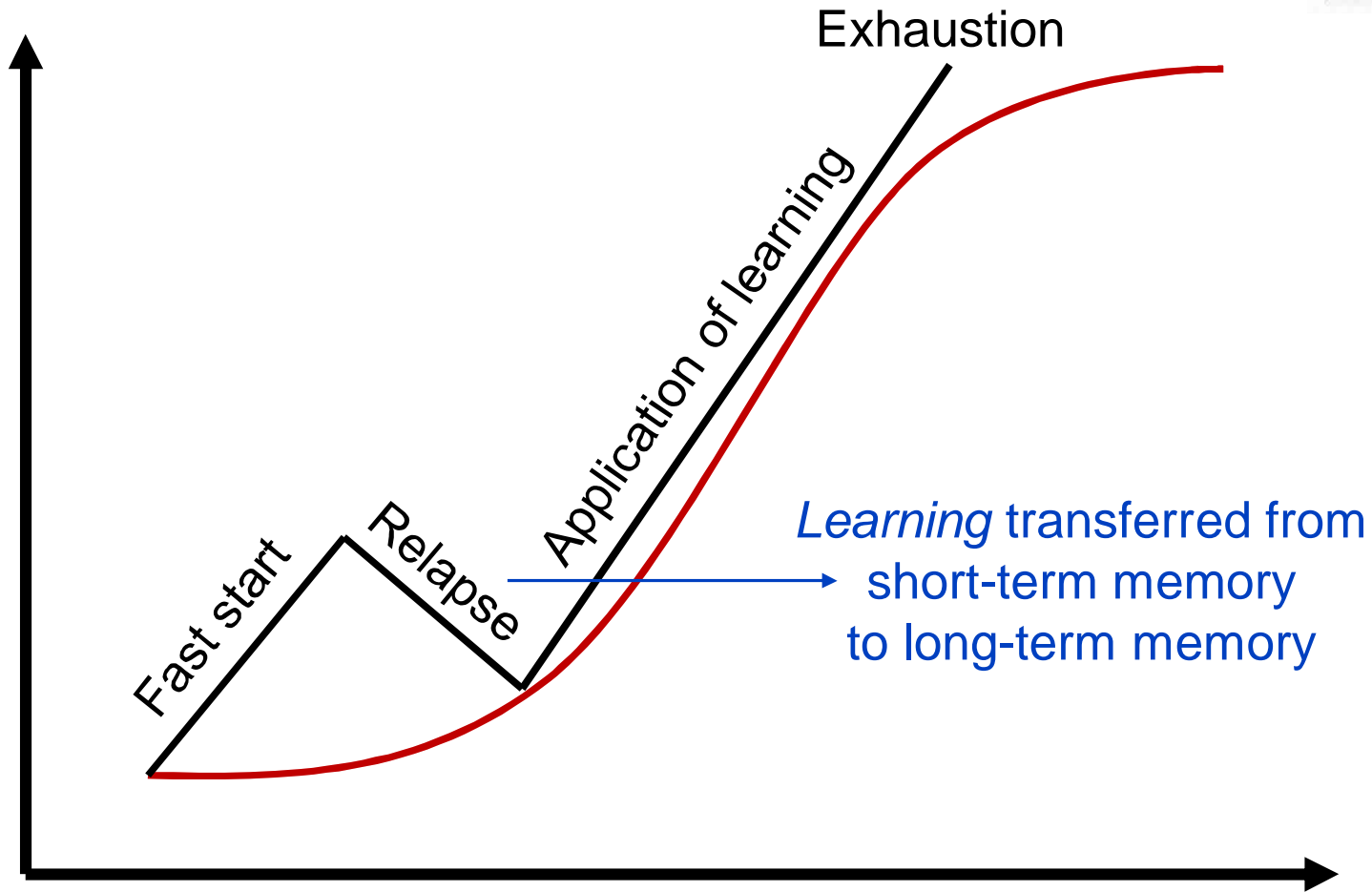
External rest / internal work

**NOT the 'S'-shaped learning curve**

# 'S'-shaped learning curve



# Mills-Hebb learning curve



Learning is a three-stage process (Henry Mills)

# Daniel Kahneman's Prospect Theory



## 1. Endowment effect

Owning something increases its value to you

## 2. Loss aversion

Losses have a greater psychological impact than gains

## 3. Reference point

Subjective *earlier* state used to evaluate gains and losses

**Traders cut profits and run losses**

# What's going on?



## 1. Prospect Theory identifies subjective biases

Contradicts 'rational' (left-brain) behaviour

## 2. Sense of self comes not just from body

Includes 'internal objects' signifying attachments

## 3. Need to protect 'self' creates anxiety

Financial losses affect bottom line *and* sense of self

**Actual and *potential* losses create anxiety**



# Financial market losses

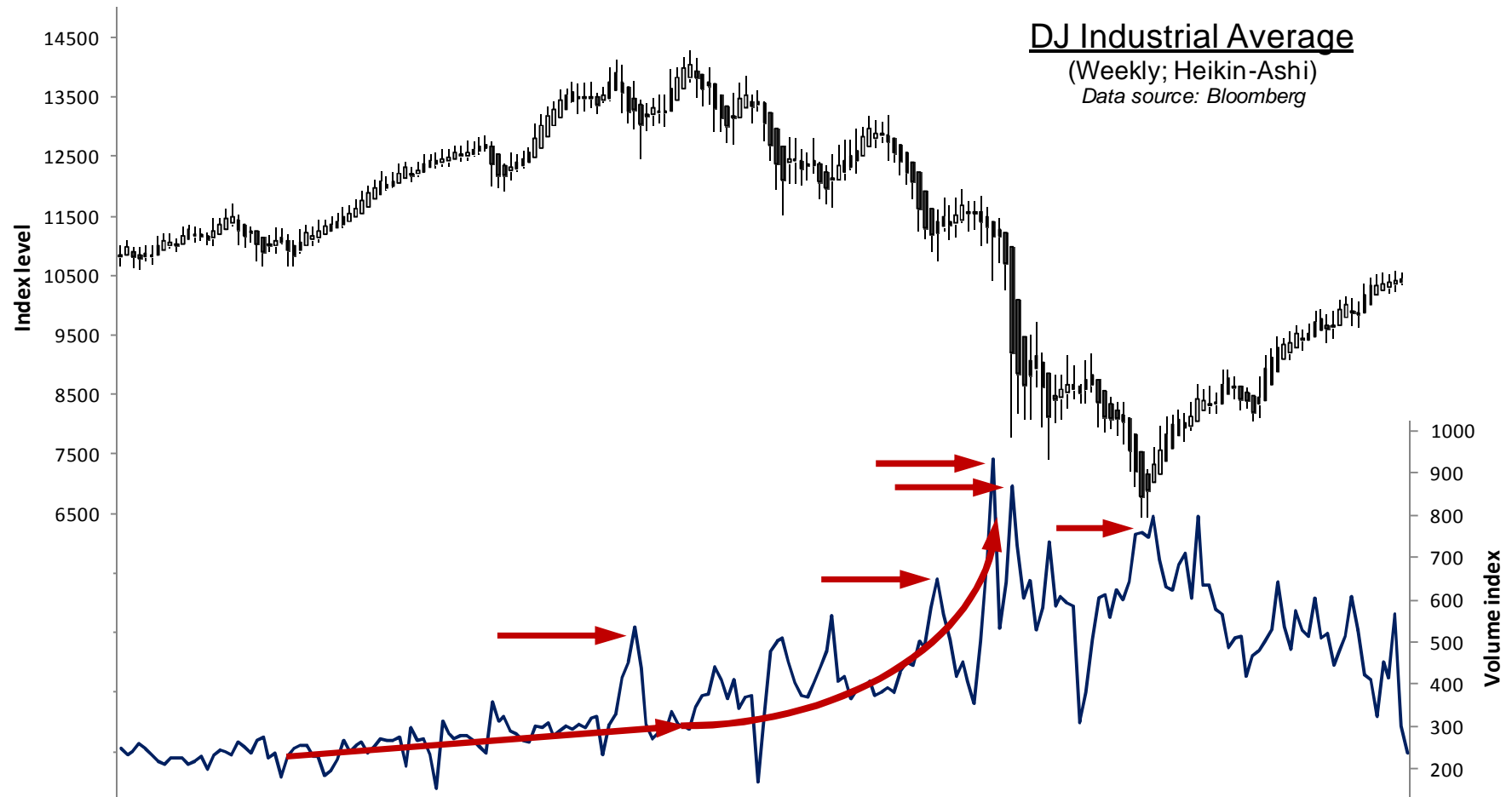


1. *Possibility* of increased loss  
outweighs  
*probability* of increased loss

2. Have to reduce possibility to zero

No comparable mechanism for profits

# The DJIA, 2007-09



Volumes rise as bear evolves

# Fear & anxiety



1. Imagined threats same as actual threats

Brain cannot tell the difference

2. Fear & anxiety have a physical dimension

Flight/flight/freeze

3. Amygdala(e)

Overrides rational thought

Need to understand role of amygdala

# Human brain



## 1. Brain stem

Reptilian ancestry

## 2. Limbic system

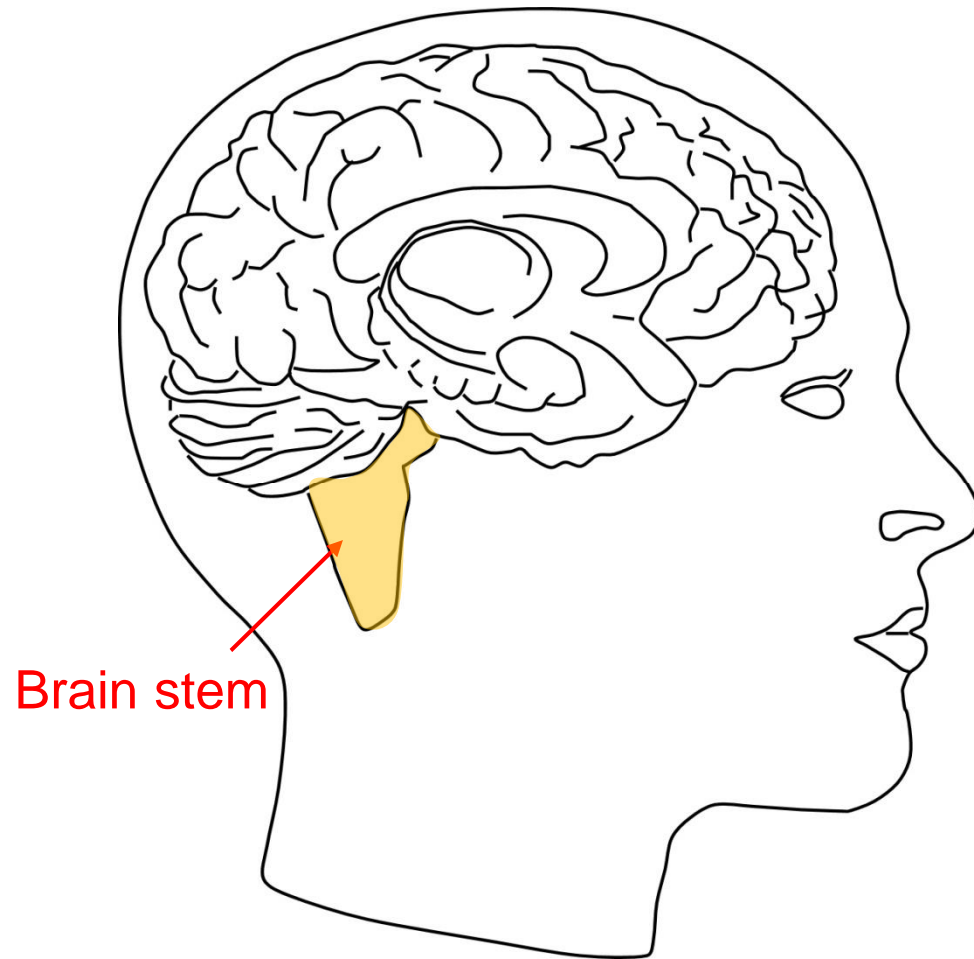
Mammalian ancestry

## 3. Neo-cortex

Distinctively human

**‘Triune’ brain (Paul Maclean)**

# The triune brain: brain stem



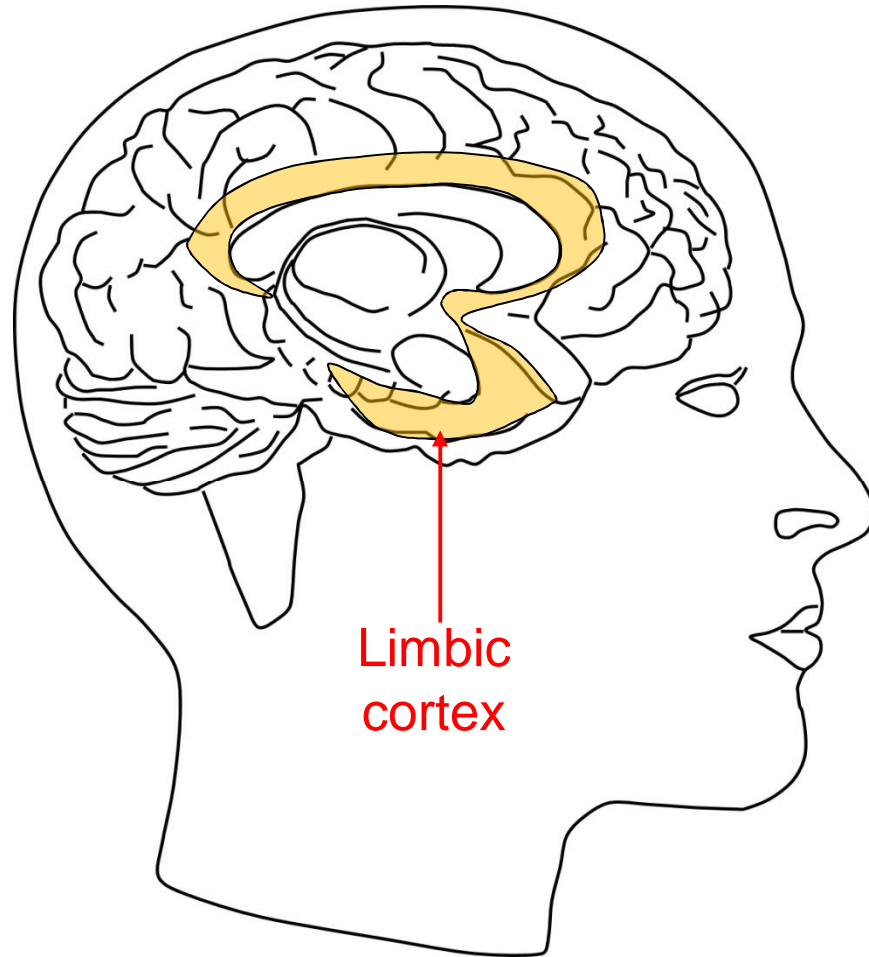
Reptilian ancestry

Instinctive behaviour

Biological drives

Compulsive behaviour

# The triune brain: limbic system



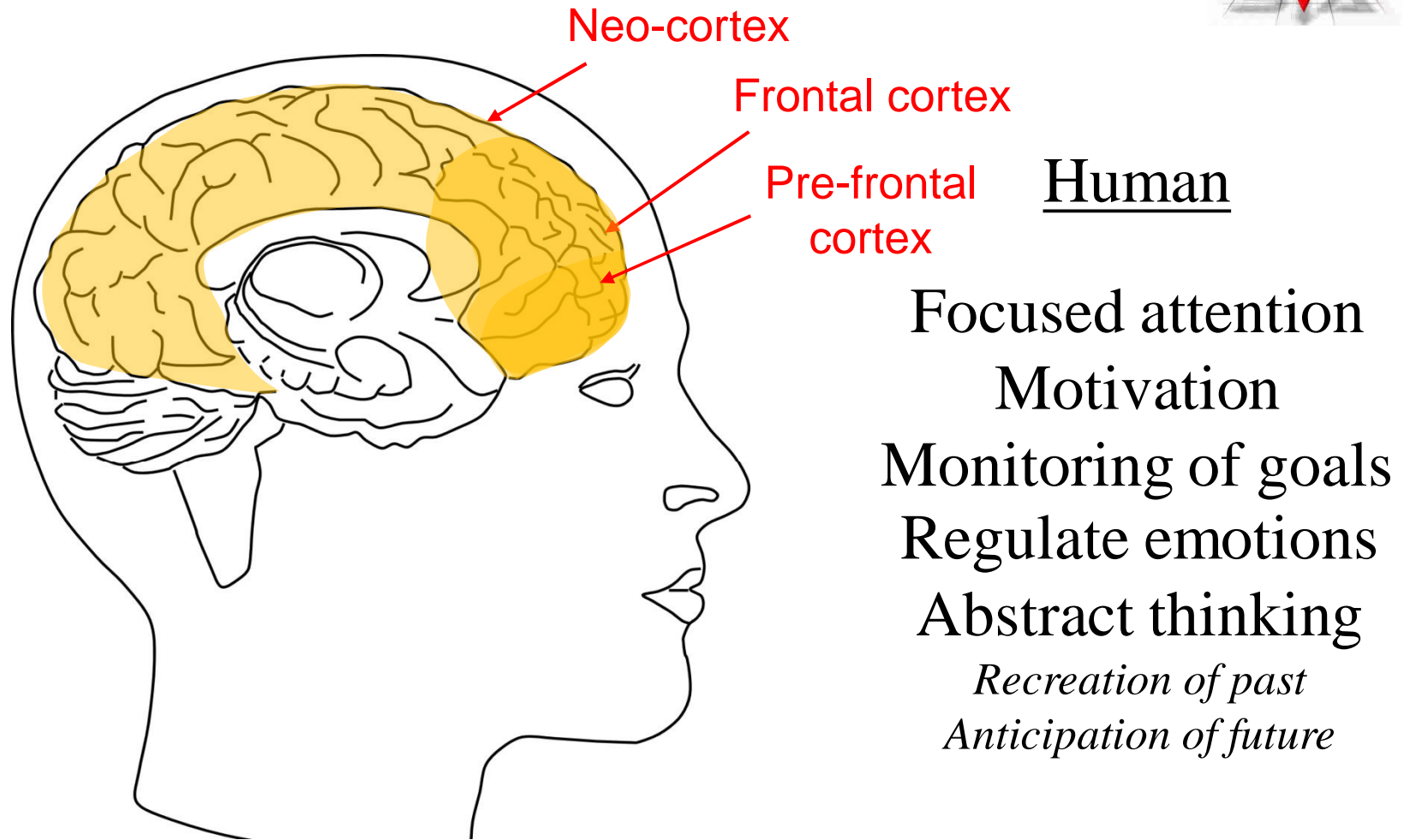
Mammalian ancestry

Emotions

Long-term memory

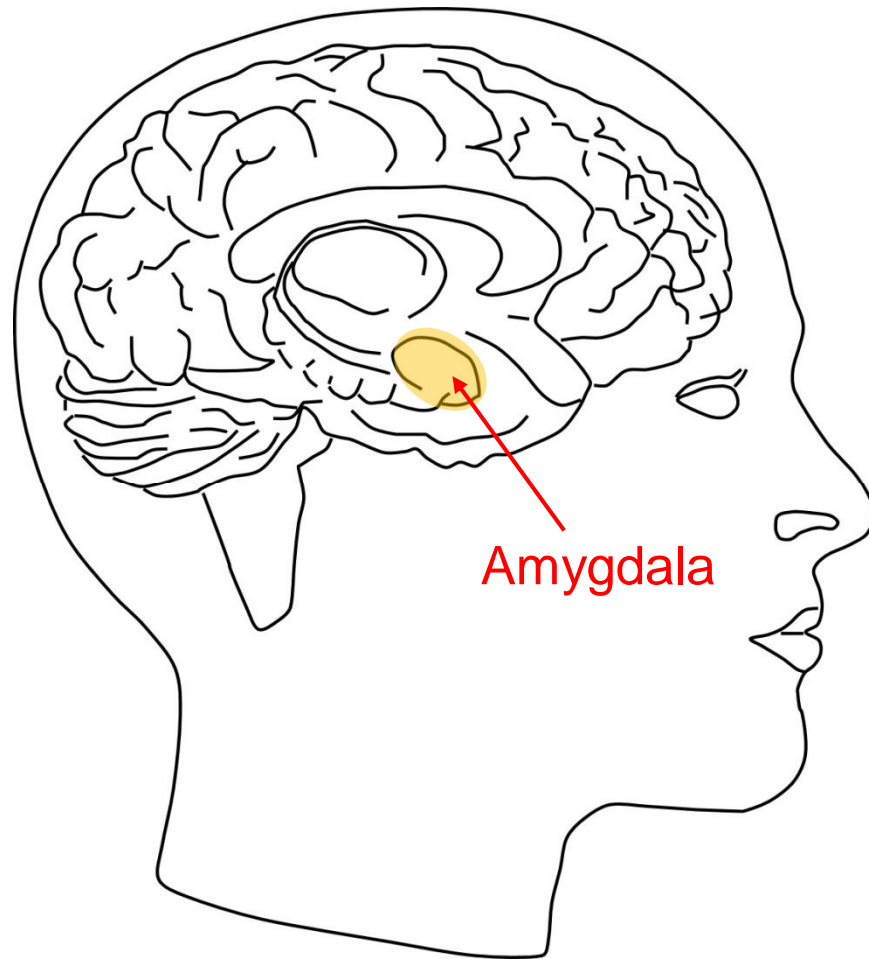
Group behaviour

# The triune brain: neo-cortex



Suppress neo-cortex → brain stem & limbic system

# The amygdala



Deals with change

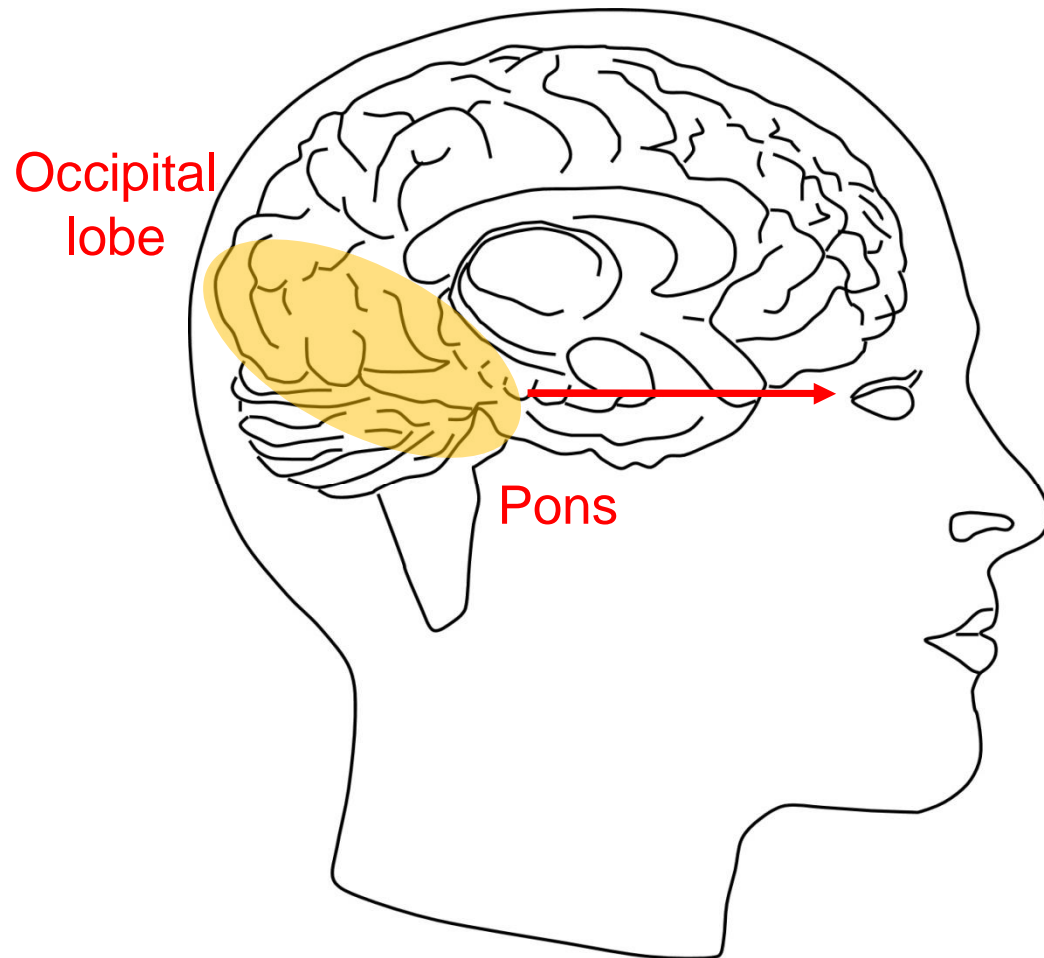
Stores memories of  
emotional events

Matches patterns

Triggers learnt reactions

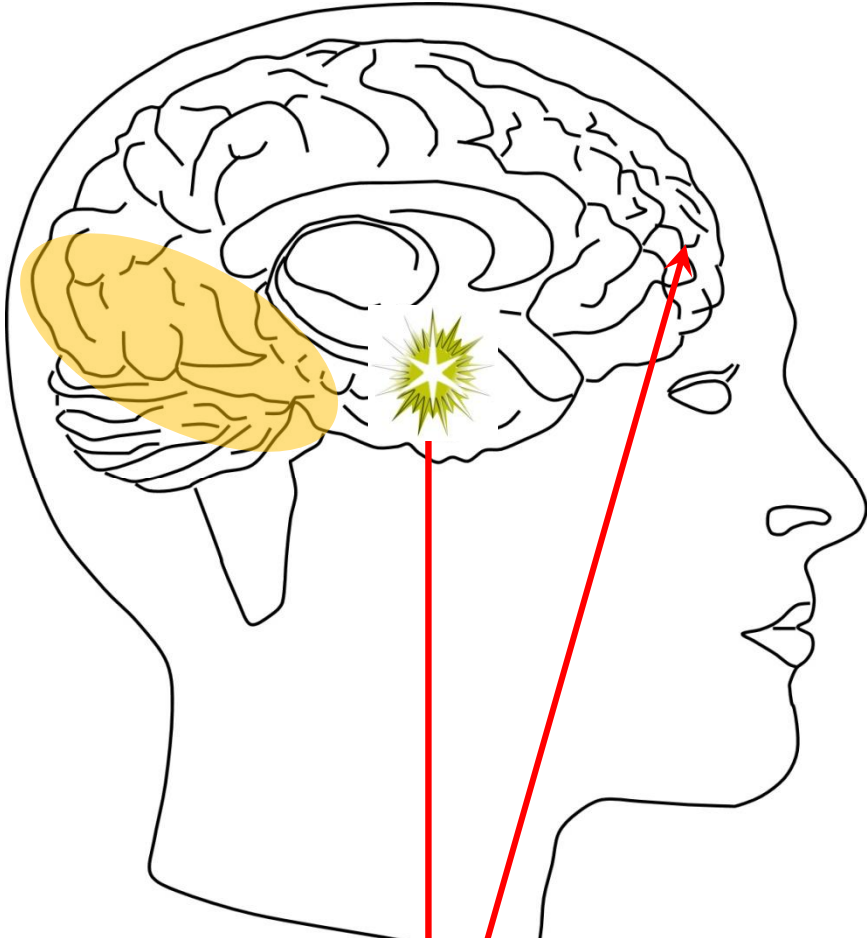


# Surprise!



- Electrical 'spike'
- Activates visual system
- Focuses attention
- **Orientation response**

# Surprise!



Amygdala alarm



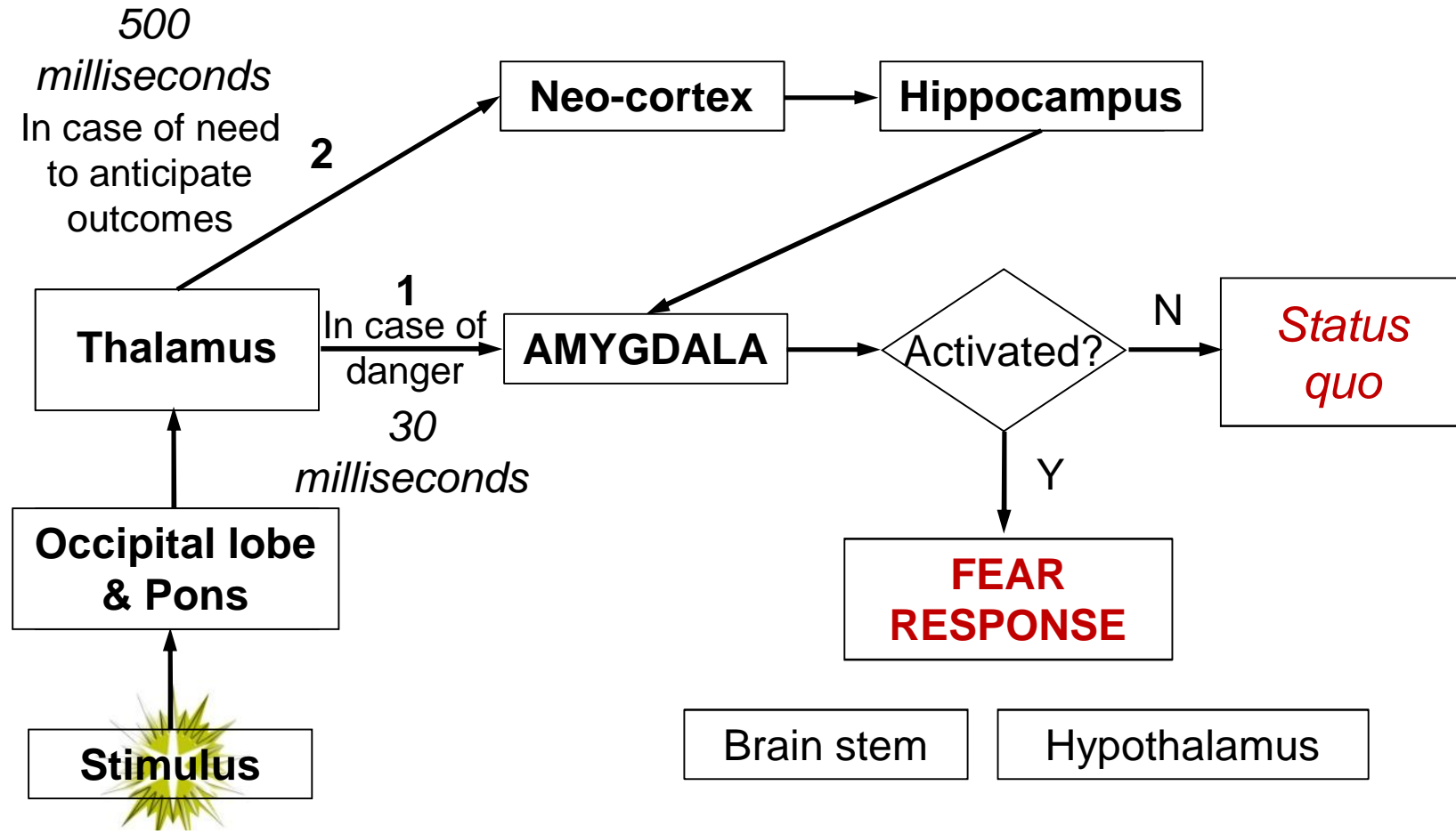
Physical readiness for  
fight or flight  
or  
freeze



Conscious awareness

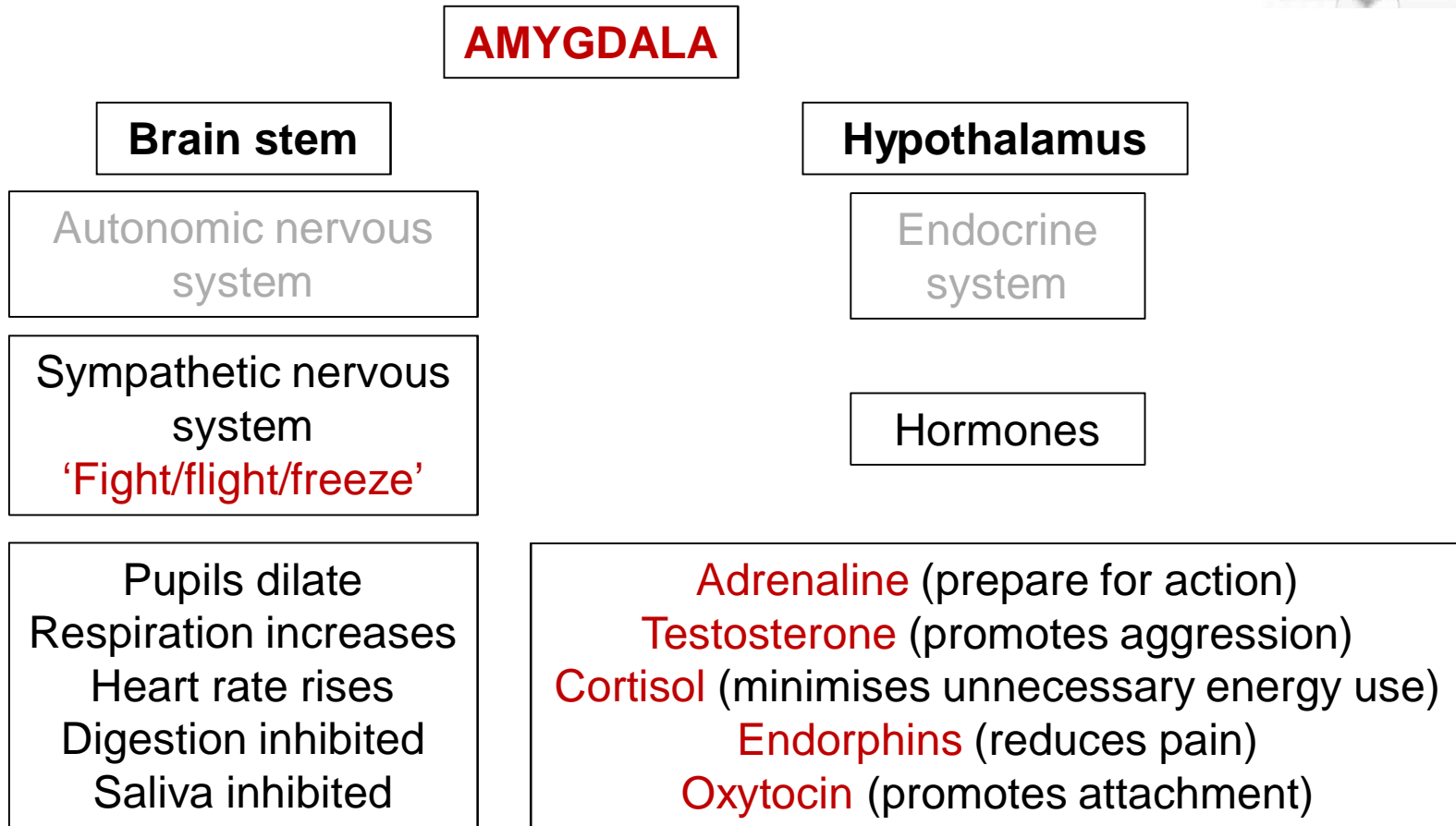
**Rational thought is short-circuited**

# Thinking slow and acting fast



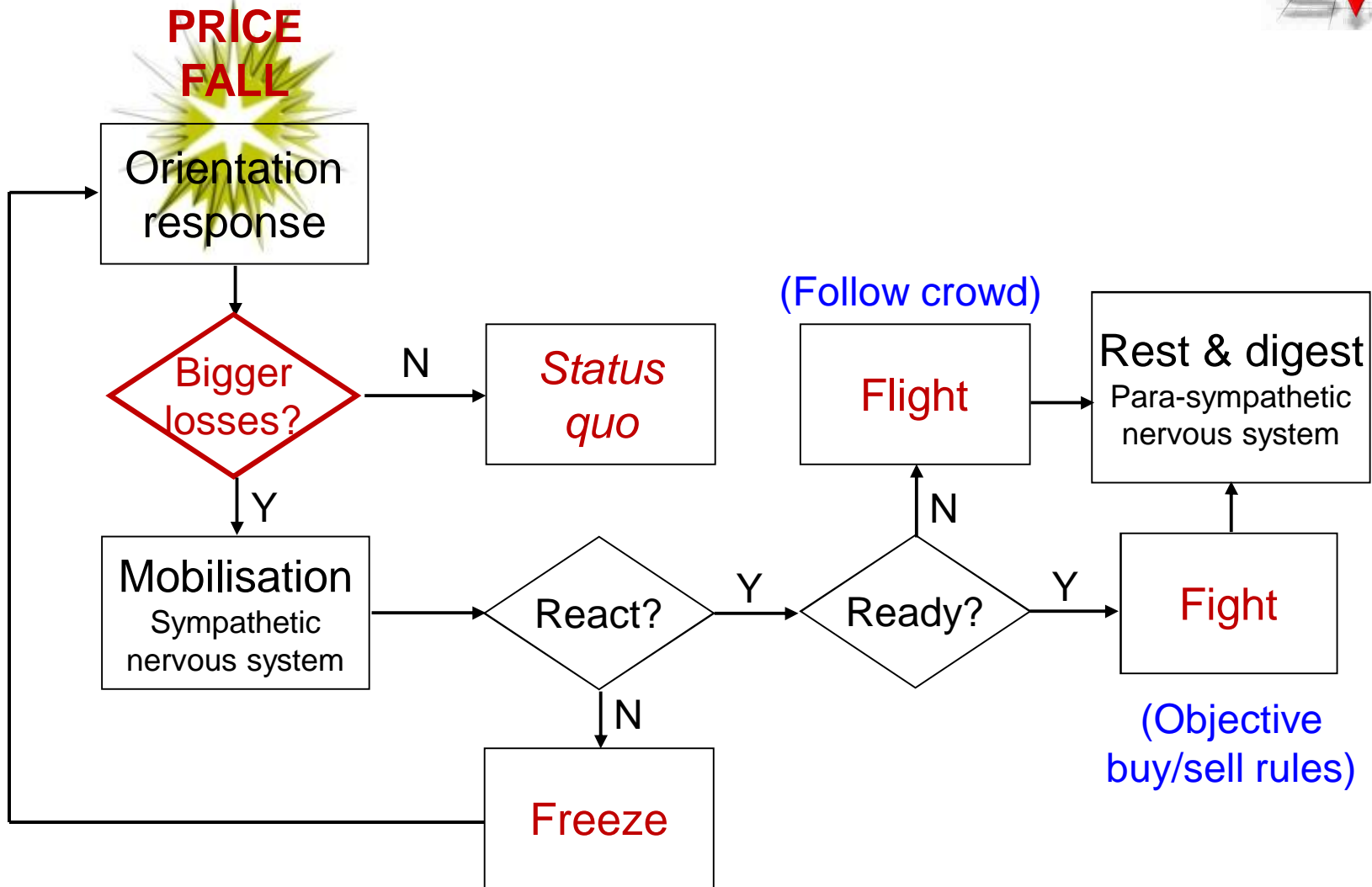
**Amygdala over-rides rational behaviour**

# Fear response



**Body is involved in decision-making**

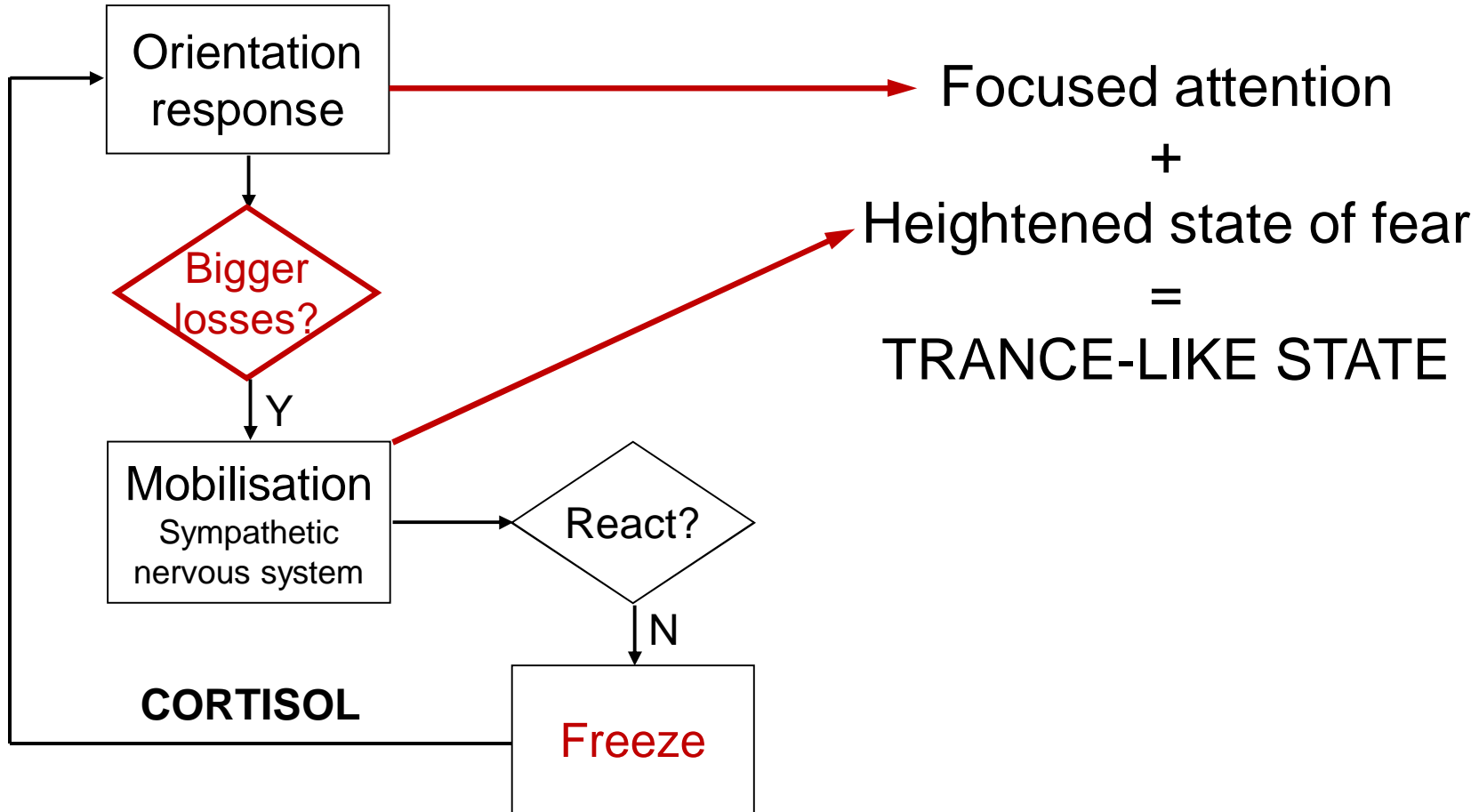
# Fight-Flight-Freeze





# Fight-Flight-Freeze

**PRICE  
FALL**



# The big freeze



## 1. Resist taking losses

Impact of every price change progressively magnified

## 2. Cortisol

Prepares body for *survival*

## 3. Trance-like state

Open to suggestion

**'Loser' effect**

# 'Loser' effect



## 1. Survival mode

Interruptions to: digestion, sleep, immune system, sex

## 2. Prolonged & severe stress

Blood pressure; raised cholesterol; high glucose  
Increased weight; heart attack; diabetes

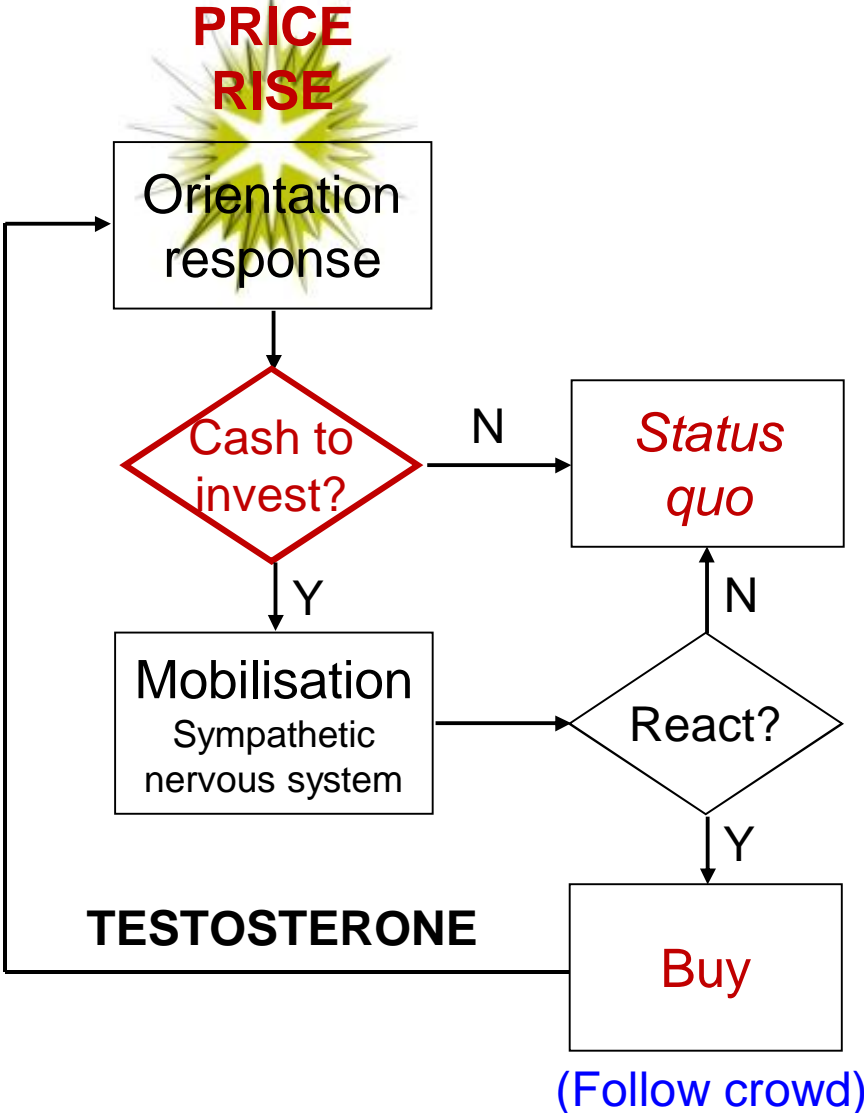
## 3. Widespread impact

Long-only funds cannot avoid bear  
Governments cannot stop it

**Cortisol dominates a bear (John Coates)**



# What about a bull trend?



What triggers a 'buy' reaction?

# Individual exuberance



## 1. Learnt beliefs about trend

After 38.2% retracement of previous trend

## 2. Testosterone

Slow-acting; improves performance

Feedback loop with prices

## 3. Dopamine

Pleasure and *anticipation* of pleasure

**‘Winner effect’**

# Winner effect



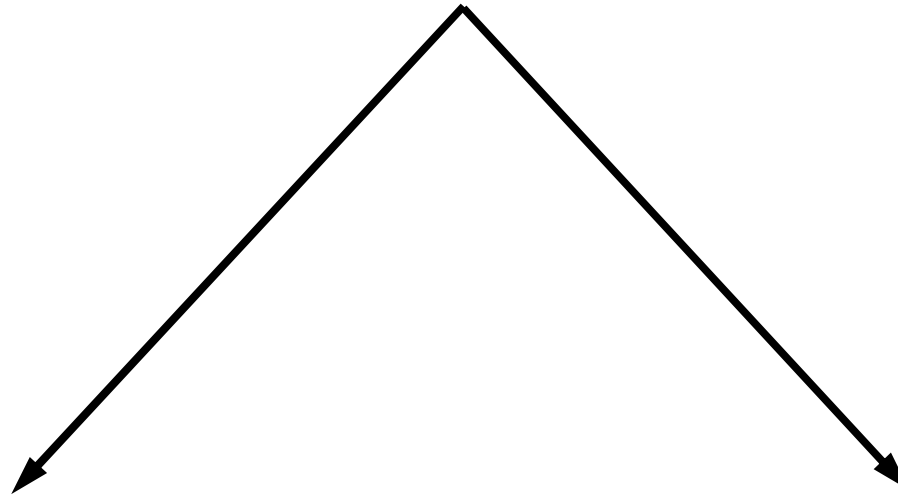
1. Testosterone for competition
  - 10 times more in men than women
  - Women less prone to 'winner effect'
2. Testosterone increases risk appetite
  - Stabilises attention
  - Increases reaction speed
3. Feedback loop with success

Testosterone dominates bull (John Coates)

# Two lines of enquiry



## TECHNICAL ANALYSIS



### INDIVIDUAL INVESTOR

Can we avoid  
*stress and over-exuberance?*

### ANTICIPATING THE MARKET

How is individual experience  
related to *collective order?*

# Neutralising Prospect Theory



## 1. Endowment effect

Owning something increases its value to you

## 2. Loss aversion

Losses have a greater weighting than gains

## 3. Reference point

Need *earlier* state to evaluate gains and losses

Defining the problem reveals the solution

# Decisions that are right for you



## 1. WAIT before you change anything

Hope and despair trigger different reactions

## 2. Stress/exuberance is information

Physical reaction is *relevant*

## 3. Don't ignore intuition

Your body knows more than you think you know

**The mind depends on the body**

# Neuro-science of groups



1. We don't know everything  
(Certainty is not the same as perfect information!)

2. Rely on others for missing information  
Over-rides personal information

3. Awareness of others' behaviour  
Rational observation  
Non-rational sensing

**Basis of 'herding' or 'swarming'**

# Herding



## 1. Psychological

Brain wired for social co-operation/cohesion

Right brain/feelings

## 2. Imitation

Mirror neurons

Others' facial expressions, posture, tone of voice, movement, etc

## 3. Emotional contagion

Information influenced by feelings

Steroid hormones ensure that we all have the *same* feelings

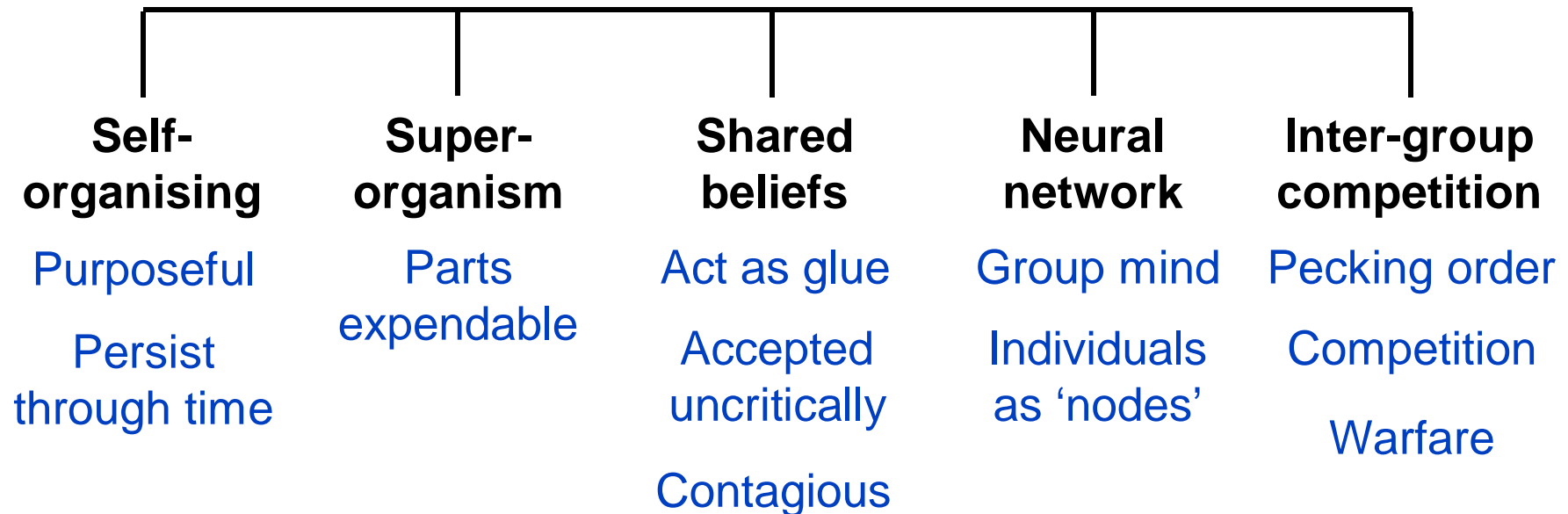
*Non-rational groups*



# Non-rational groups



## Five principles



Us vs Them

# Us vs Them



## 1. Group psychology controls:

Nation states

Armies

Religious sects

Political parties

Football crowds

Gangs

# Us vs Them



1. Group psychology controls:

**Stock markets**

Bulls vs bears

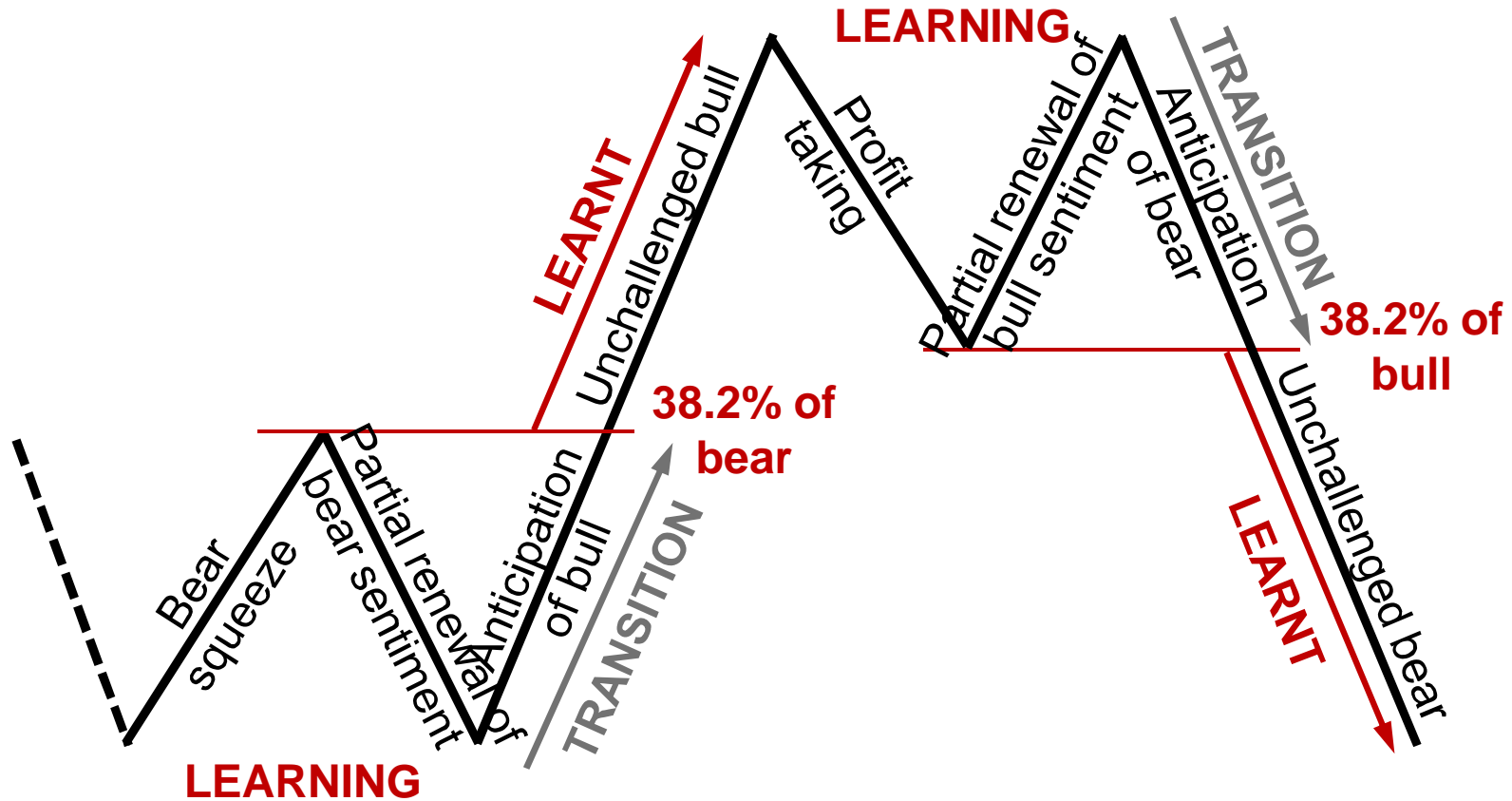
2. Groups will follow a leader

Reflects group beliefs

3. Price trends reflect stock market beliefs

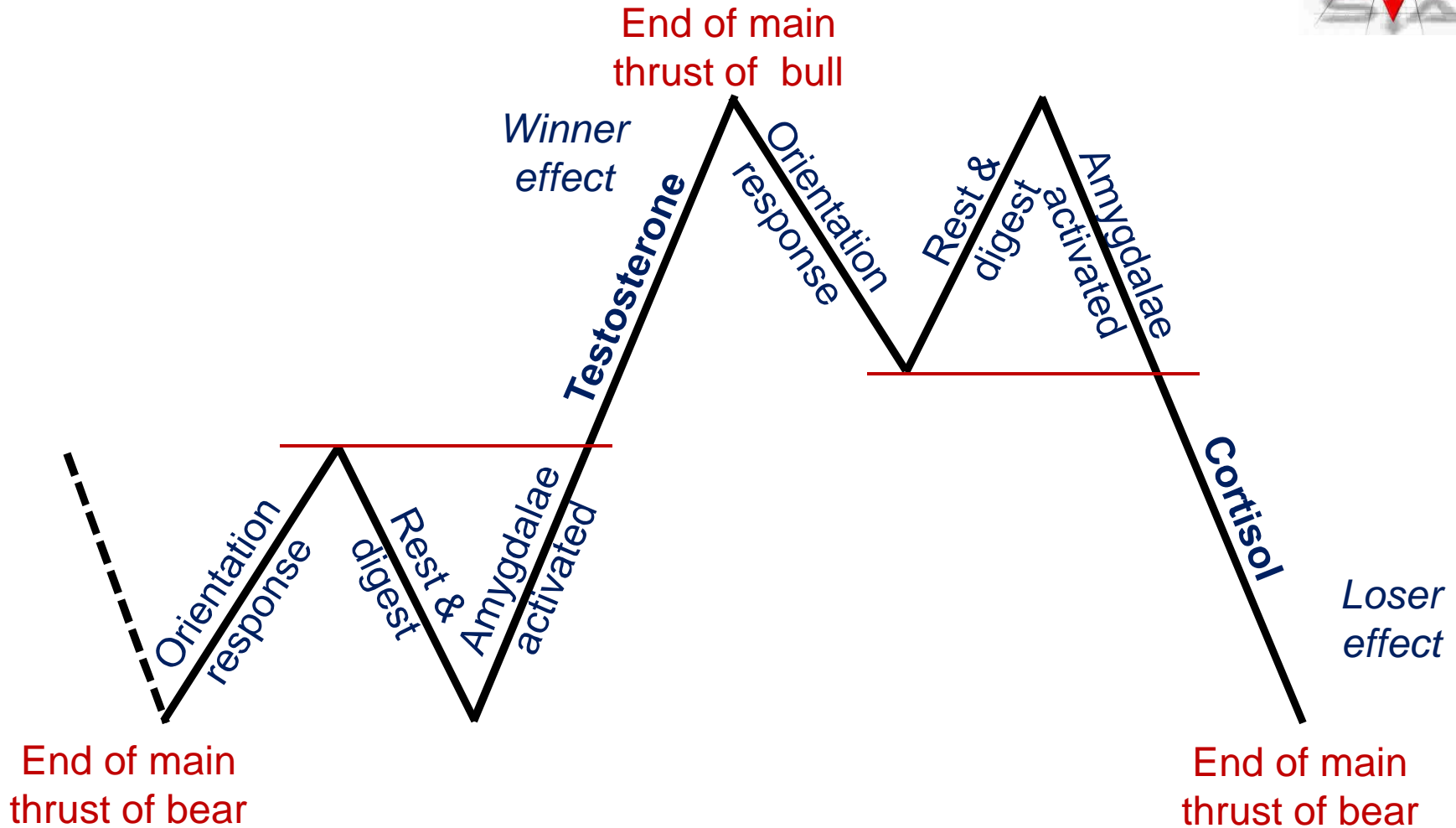
**Leadership provided by price movements**

# Model of mass behaviour



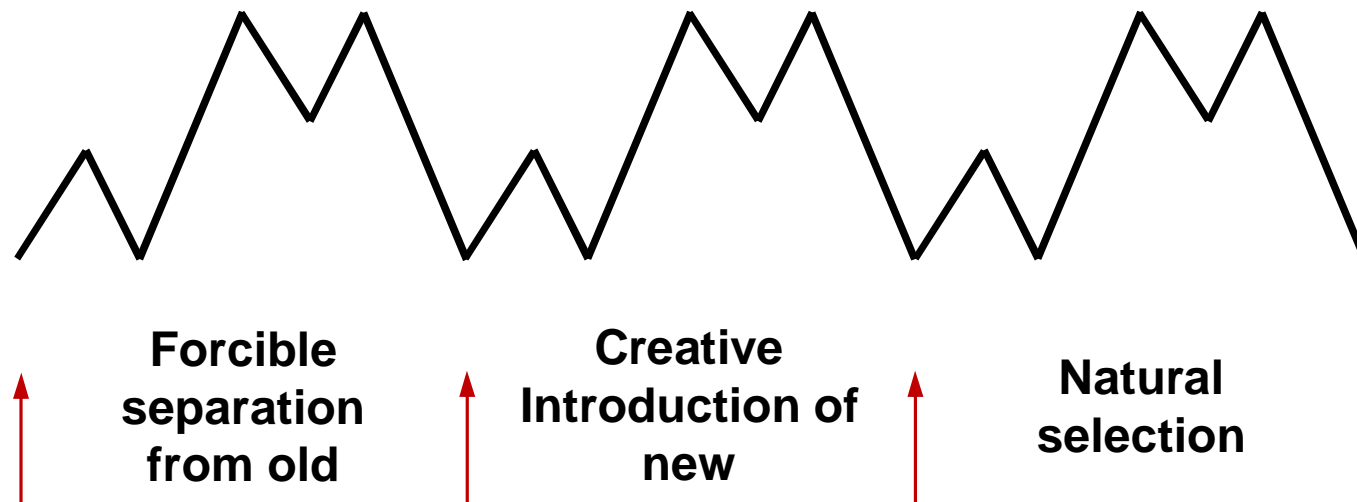
Learning occurs in three-waves

# Neuro-model of *mass mind*



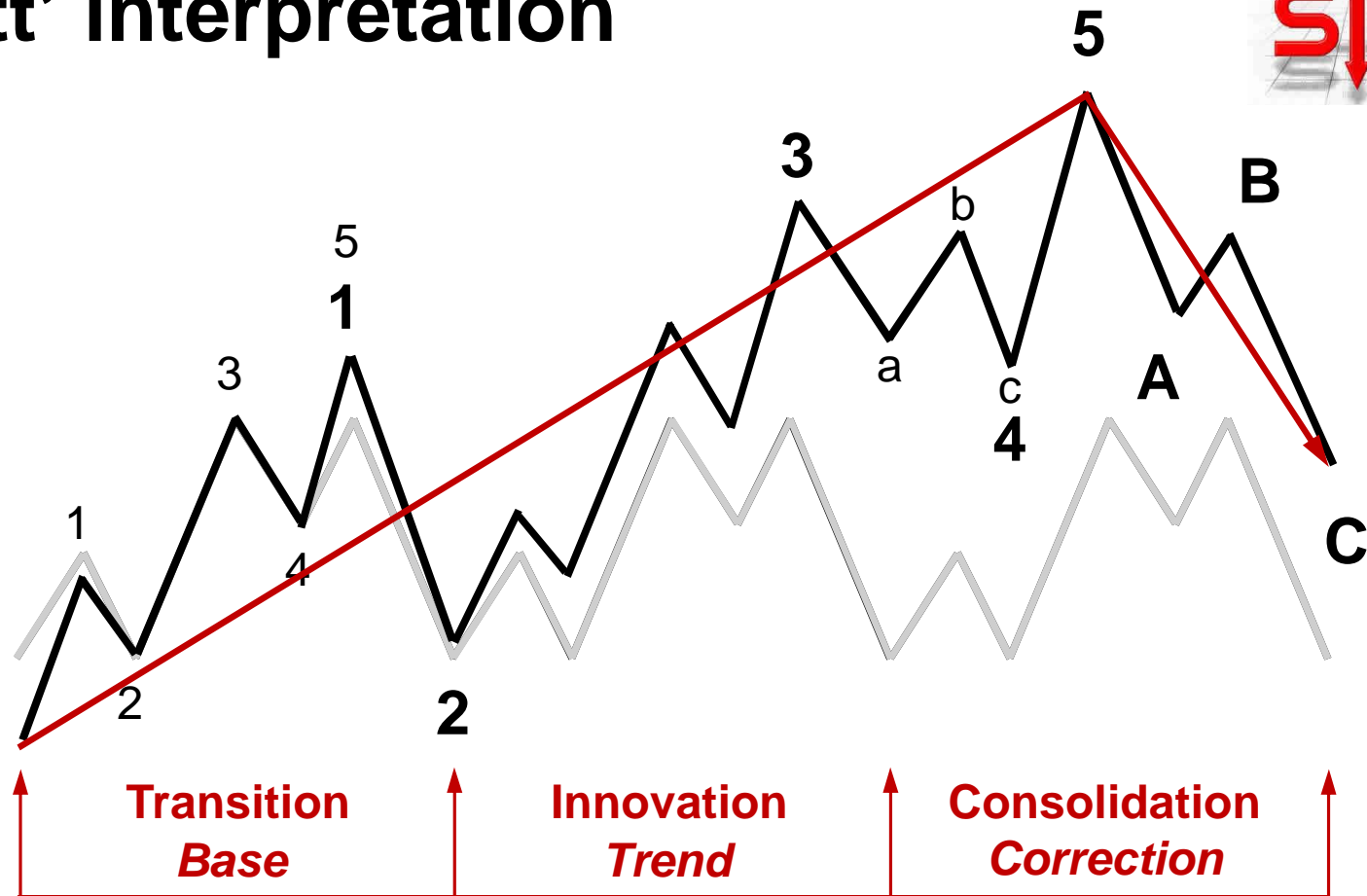
Actual pattern varies depending on bigger cycle

# The threefold sequence of change



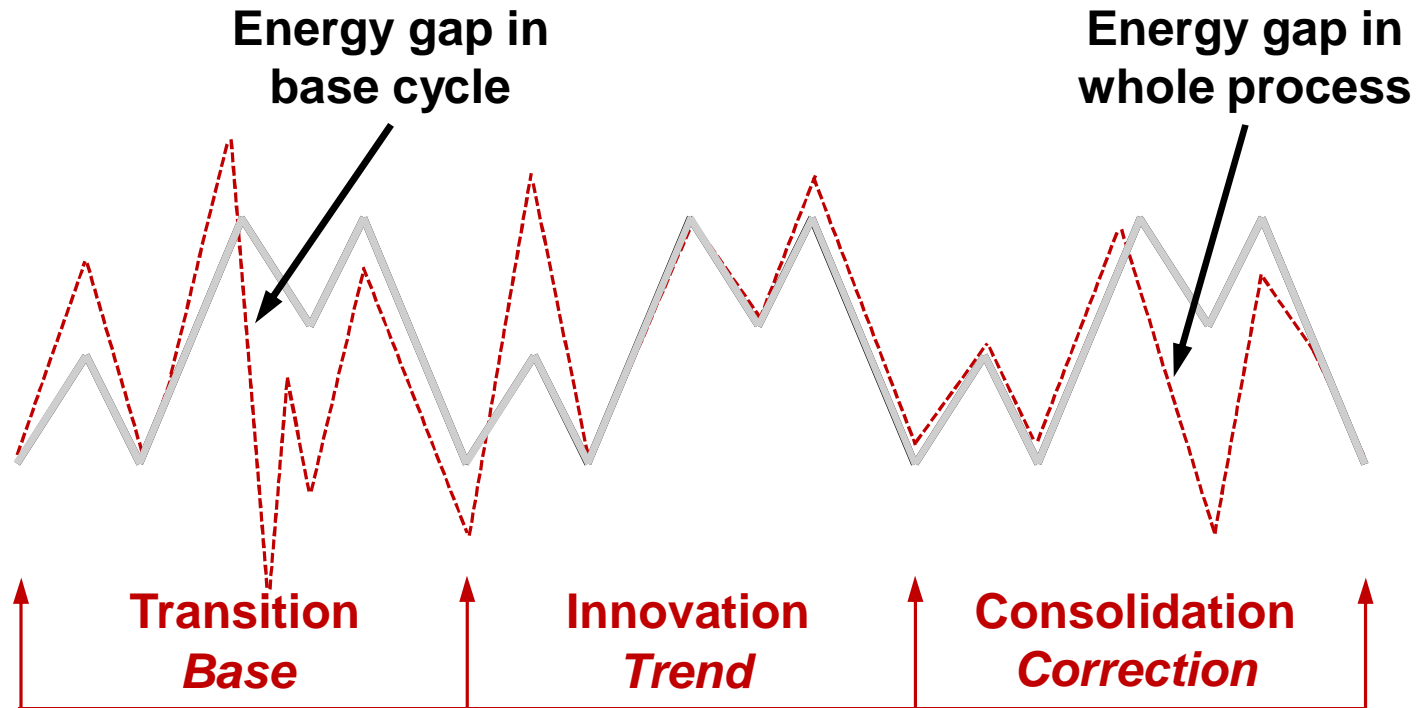
Elliott and Gann treated sequence differently

# 'Elliott' interpretation



Elliott's 5-3 pattern is sign of evolution

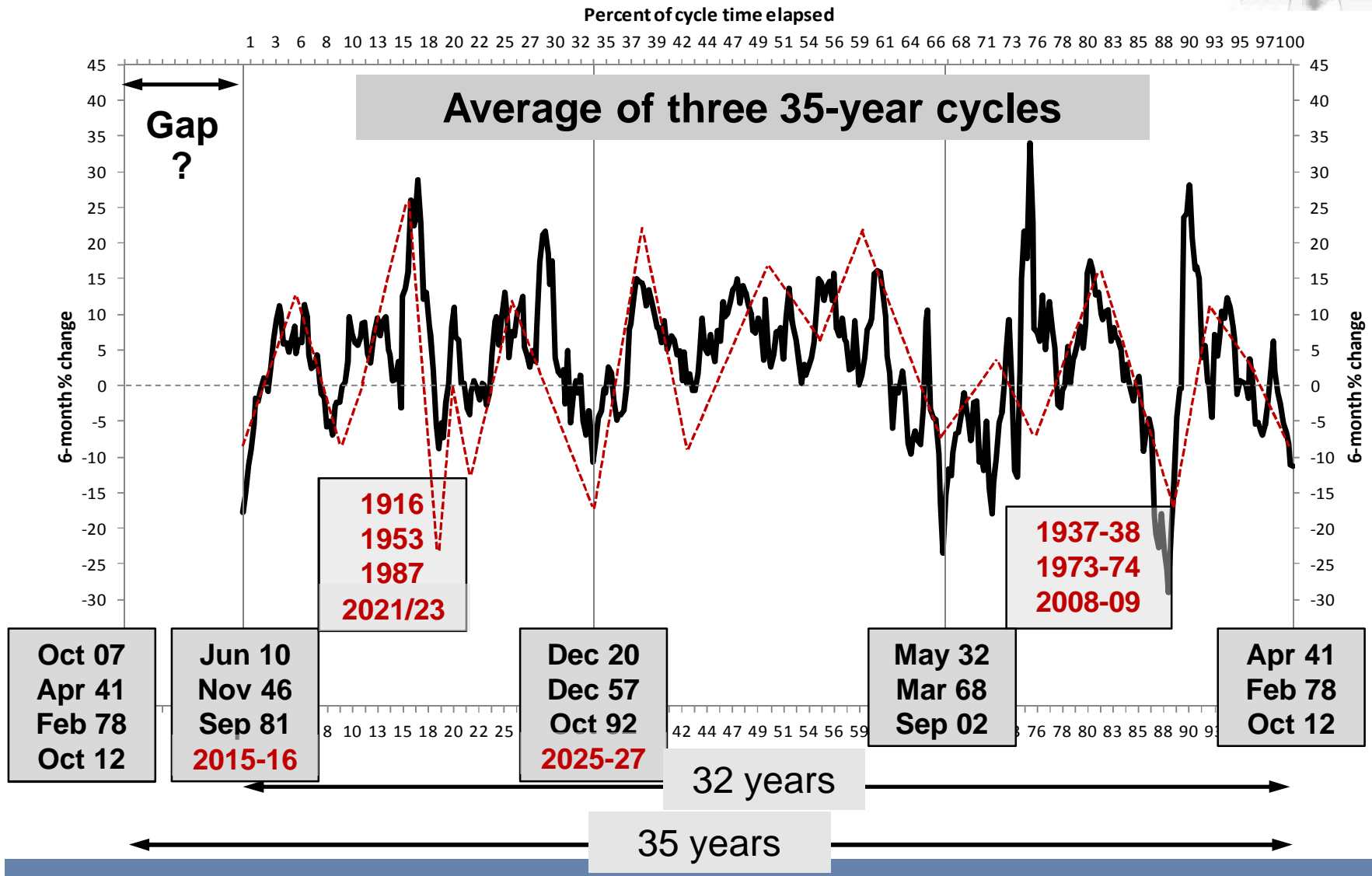
# Gann's interpretation



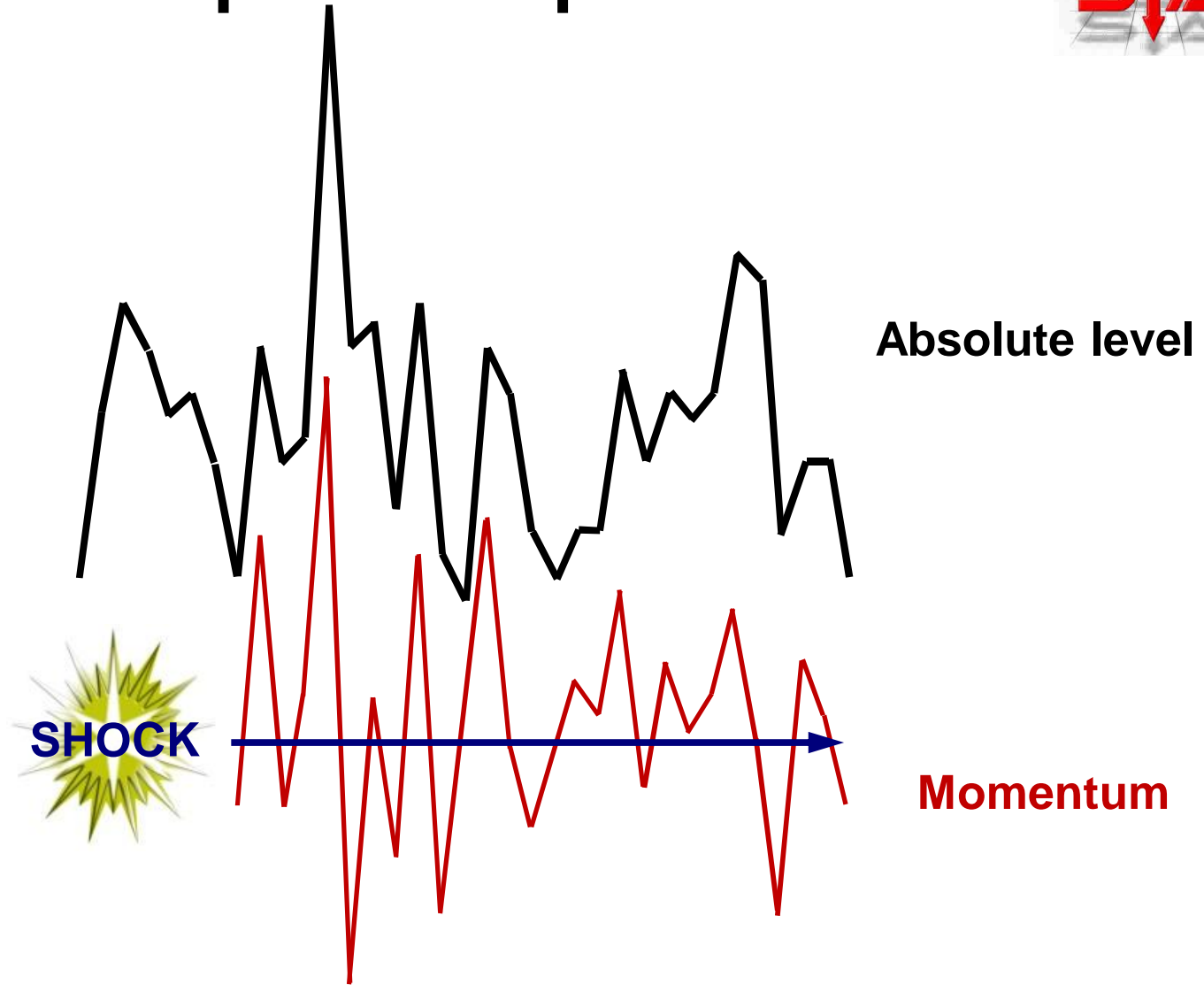
Each cycle has evolution-specific pattern



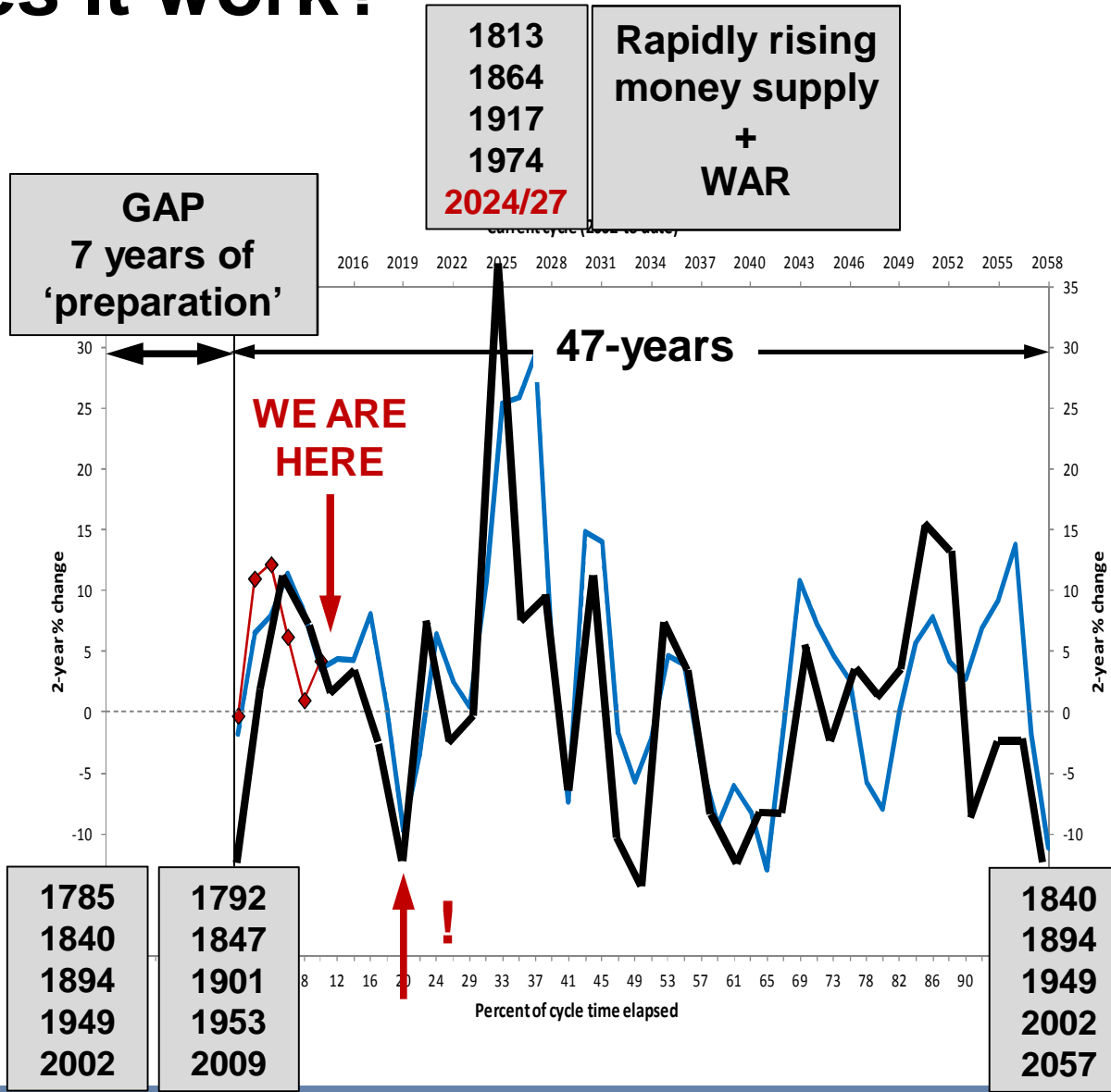
# Ordered behaviour in the DJIA



# Gann's mass pressure pattern



# Does it work?



# Implications of neural networks



## 1. Economy and markets are non-random

*'Randomness' is very short-term*

## 2. Driven by collective dynamics

*Physical effect of steroid hormones*

*Individual psychology interacts with group neural network*

## 3. Traders need to be *independent* of crowd

*Personalised approach*

*Aware of your limitations*

**Technical Analysis**

# Practical source reading



1. *Thinking Fast and Slow*

Daniel Kahneman

2. *The Hour Between Dog and Wolf*

John Coates

3. *Global Mind*

Howard Bloom

4. *The Law of Vibration*

Tony Plummer

Implications for your decision-making process

