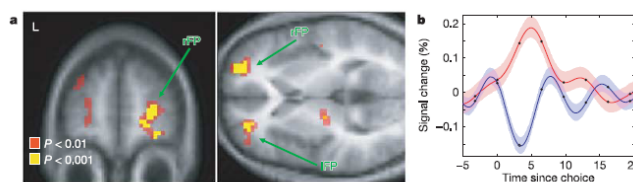


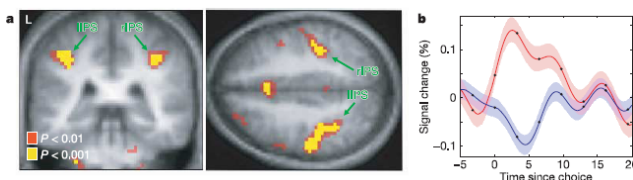
## A view from behavioral economics and neuroscience

- Cooperation needs commitment PLUS discrimination
- Brain tissue is expensive, so our ancestors needed economical ways of encoding such behavior, either in cognitive short-cuts (for cheater detection) or in emotions (for commitment)
- Natural selection has repeatedly recruited existing neural machinery (eg homeostatic mechanisms) for strategic purposes (see Churchland: *Brain Trust*, Princeton 2011)
- Neuroscientific evidence is accumulating that commitment is linked with reward circuits in the brain

## Anatomical separation of exploratory and exploitative decisions in the brain (Source: Dow et.al., Nature, June 15 2006)



**Figure 3 | Exploration-related activity in frontopolar cortex.** a, Regions of left and right frontopolar cortex (lFP, rFP) showing significantly increased activation on exploratory compared with exploitative trials. Activation maps (yellow,  $P < 0.01$ ; red,  $P < 0.001$ ) are superimposed on a subject-averaged structural scan. The coordinates of activated areas are  $[-27, 48, 4, \text{peak } z = 3.49]$  for lFP and  $[27, 57, 6, \text{peak } z = 4.13]$  for rFP. b, rFP BOLD time courses averaged over 1,515 exploratory (red line) and 2,646 exploitative (blue line) decisions. Black dots indicate the sampling frequency (although, because sample alignment varied from trial to trial, time courses were upsampled). Coloured fringes show error bars (representing s.e.m.).



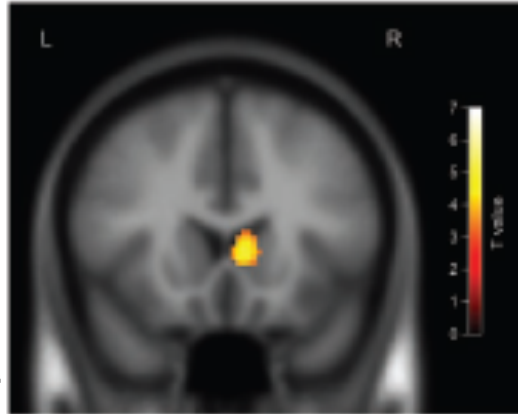
**Figure 4 | Exploration-related activity in intraparietal sulcus.** a, Regions of left and right intraparietal sulcus (lIPS and rIPS) showing significantly increased activation on exploratory compared with exploitative trials. Activation maps (yellow,  $P < 0.01$ ; red,  $P < 0.001$ ) are superimposed on a subject-averaged structural scan. The coordinates of the activated areas are  $[-29, -33, 45, \text{peak } z = 4.39]$  for lIPS and  $[39, -36, 42, \text{peak } z = 4.16]$  for rIPS. b, lIPS BOLD time courses averaged over 1,515 exploratory (red line) and 2,646 exploitative (blue line) decisions. Black dots indicate the sampling frequency (although, because sample alignment varied from trial to trial, time courses were upsampled). Coloured fringes show error bars (representing s.e.m.).

## The neural basis of altruistic punishment

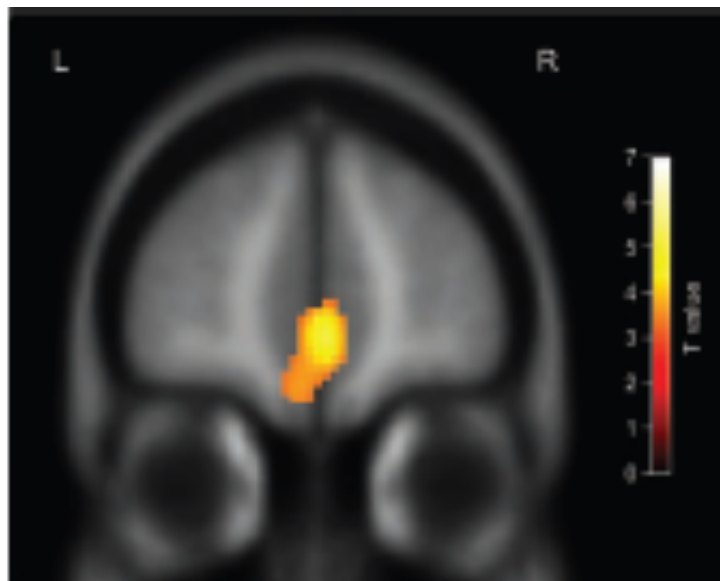
(Source: de Quervain et.al., *Science*, August 27 2004)

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Activation in the caudate nucleus when subjects feel a strong desire to punish others for unfair behavior (compared to control when no such unfair behavior has taken place):

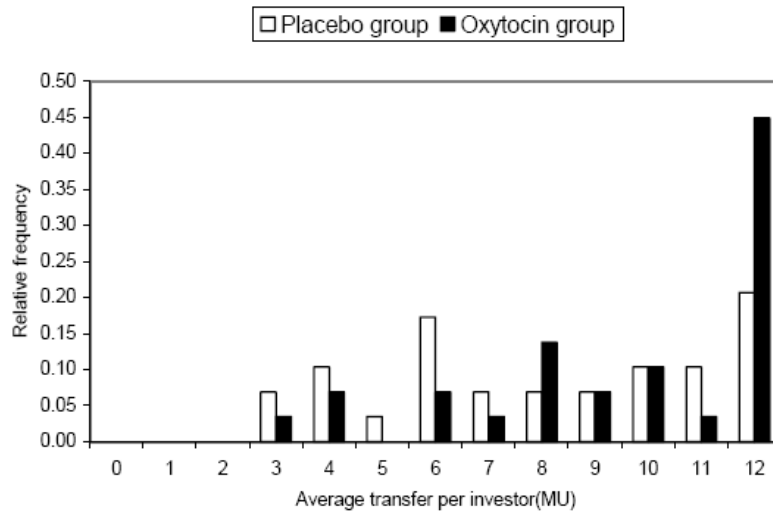


Activation in the prefrontal cortex when subjects know that punishing others will be personally costly to them (compared to control when desire to punish is present but punishment is not costly):

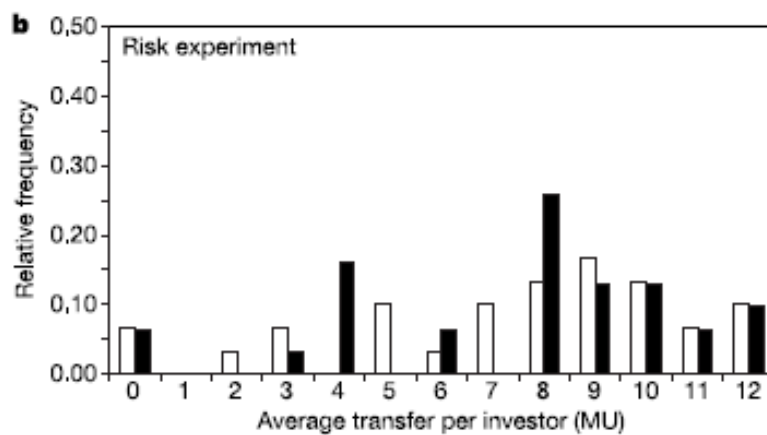


# Oxytocin increases trust in humans

(Source: Kosfeld et al., *Nature*, June 2 2006)



...and it's not about greater willingness to take risks:  
compare the same game played against a machine...



## The key to our credibility?

---

- Emotions are not easy to manipulate...
  - In a word, they're *costly*
  - You can display them more easily when you have credible intentions (threats, promises)
  - An example: the smile
  - Fake smiles are easy to produce
  - Genuine smiles are harder...
- 





## An experimental test

---

- *Smiling is a Costly Signal of Cooperation Opportunities: Experimental Evidence from a Trust Game*
  - (co-authors: Samuele Centorrino, Elodie Djemai, Astrid Hopfensitz, Manfred Milinski)
  - The puzzle: smiles perceived as genuine use the *orbicularis oculi* as well as the zygomatic major
  - The *orbicularis oculi* is under very imperfect conscious control – why did natural selection hit on such an obviously flawed mechanism?
- 

## An experimental test

---

- We test the hypothesis that smiling convincingly is a *costly* signal of cooperation opportunities
  - 1) It is costly; people smile more convincingly when the stakes are higher
  - 2) It pays them to invest that cost, because it is effective at inducing others to cooperate with them
  - 3) It is an honest signal (rather than, say, a piece of psychological manipulation) because those who smile more convincingly are more rewarding cooperation partners
  - We do this by giving subjects the chance to make video clips as part of their participation in a trust game
-

## The experiment

---

- A trust game
- A video clip viewed before taking the trust decision
- A rating of the video clips by a sample of trusters
- What we find:
  - Subjects playing for higher stakes produce more convincing smiles
  - Subjects viewing more convincing smiles are more likely to trust the smilers
  - Those who successfully produce more convincing smiles are on average more profitable cooperation partners.

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45

## Summing up: the emotions

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- Homo sapiens is the animal above all others that has staked its existence on cooperation among unrelated individuals
- The emotions aren't incidental to this process – they're at the heart of it!
- They help us to commit to those we want to cooperate with
- And they do it more credibly than calculating rationality could ever do on its own

---

46

As so often, Adam Smith got there first:

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*The man who indulges us in this natural passion, who invites us into his heart, who, as it were, sets open the gates of his breast to us, seems to exercise a species of hospitality more delightful than any other. No man, who is in ordinary good temper, can fail of pleasing, if he has the courage to utter his real sentiments as he feels them, and because he feels them.*

*Adam Smith – The Theory of Moral Sentiments*

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47

Let's now see how market institutions strengthen our cognitive talents by aggregating information....

---

- The usual example is stock markets, which are thought of as ways to monitor the performance of managers
  - How can they do this?
  - It's a matter of aggregating the information that is available to all the market participants.
  - But how can they do that?
  - To get an idea of the answer let's look at some markets for very different kinds of stocks.....
-

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A look at some political markets:

[www.biz.uiowa.edu/iem](http://www.biz.uiowa.edu/iem)  
[www.intrade.com](http://www.intrade.com)

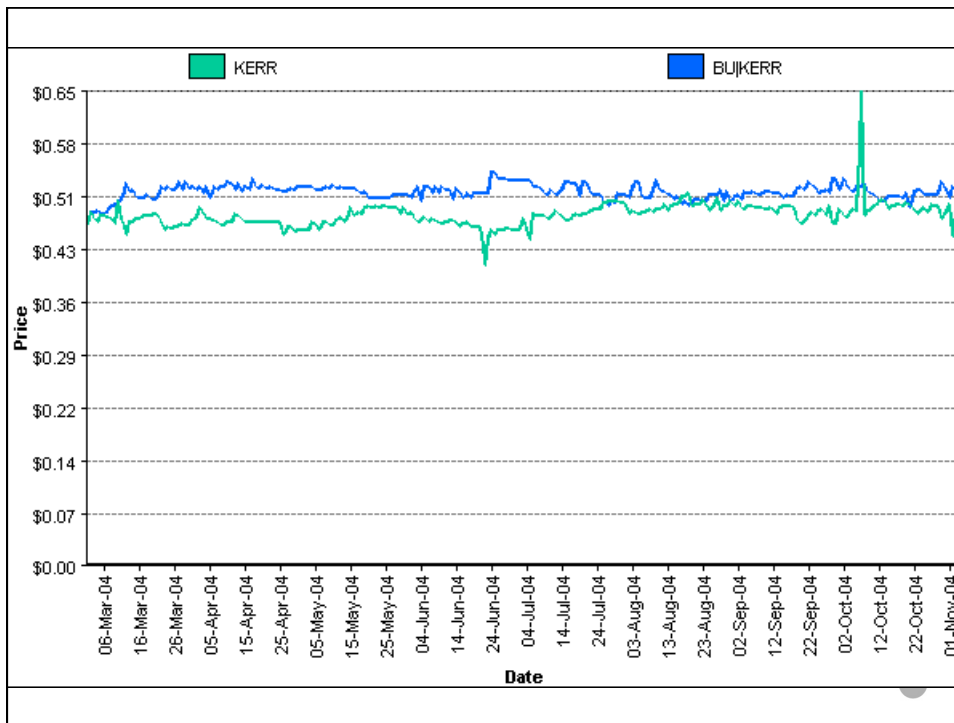
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A vote-share contract:

Pays \$0.01 for every percentage point of vote share  
gained by a candidate in an election

---

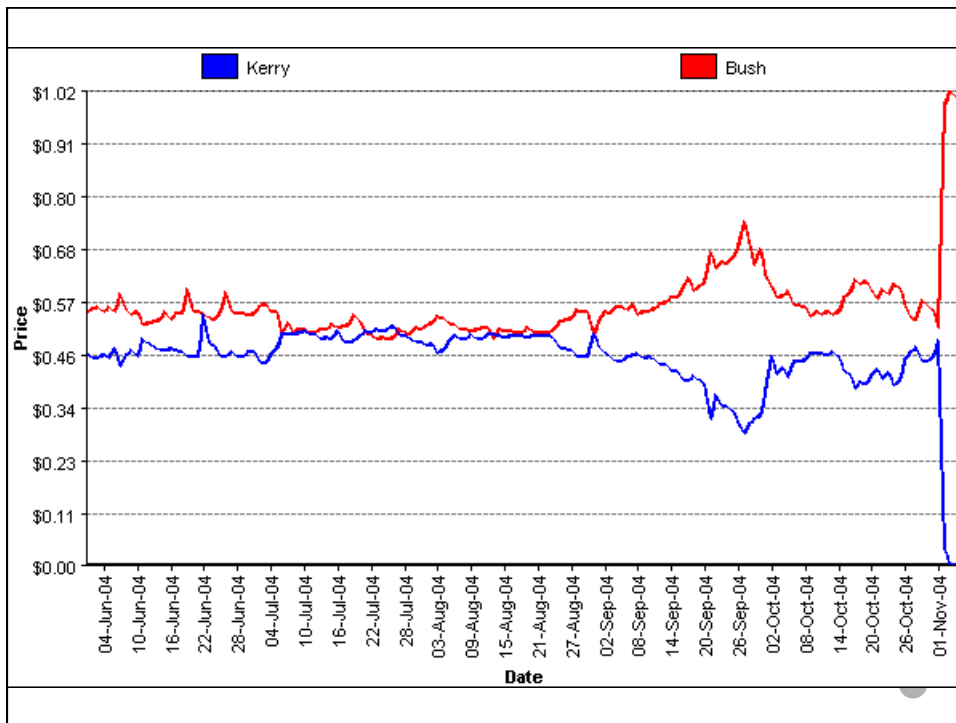



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### A "winner-takes-all" contract:

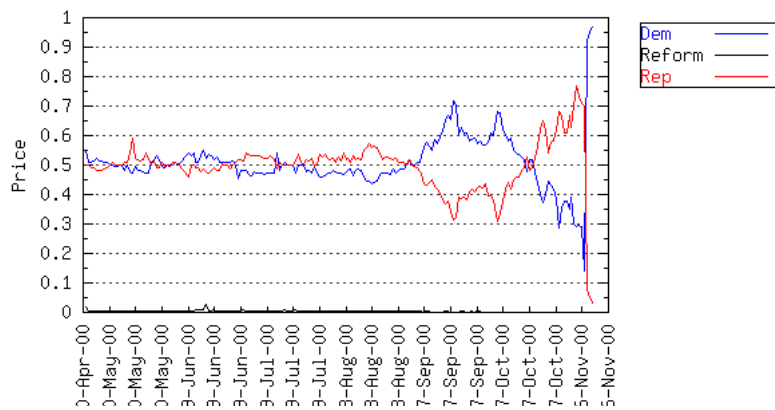
Pays \$1 if the candidate wins the election (defined as getting the highest number of vote cast), and nothing otherwise

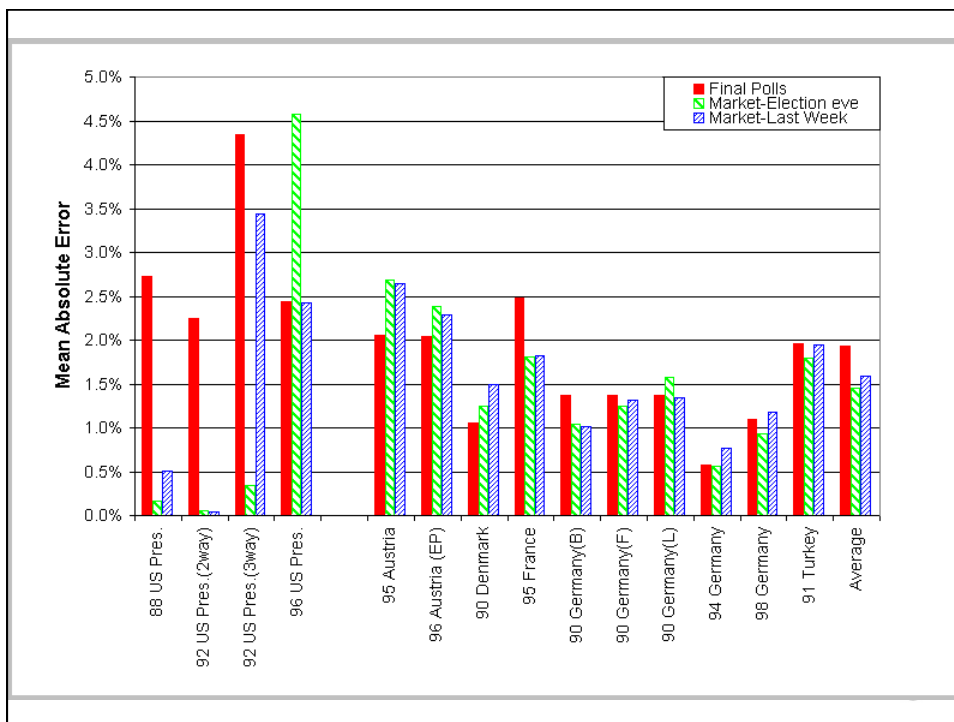
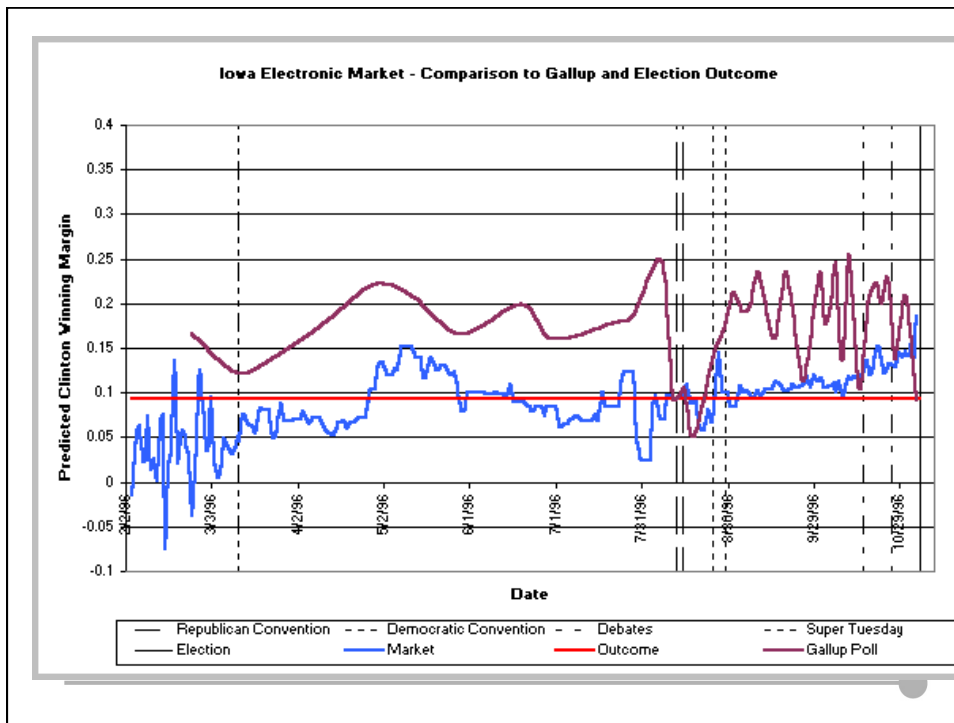
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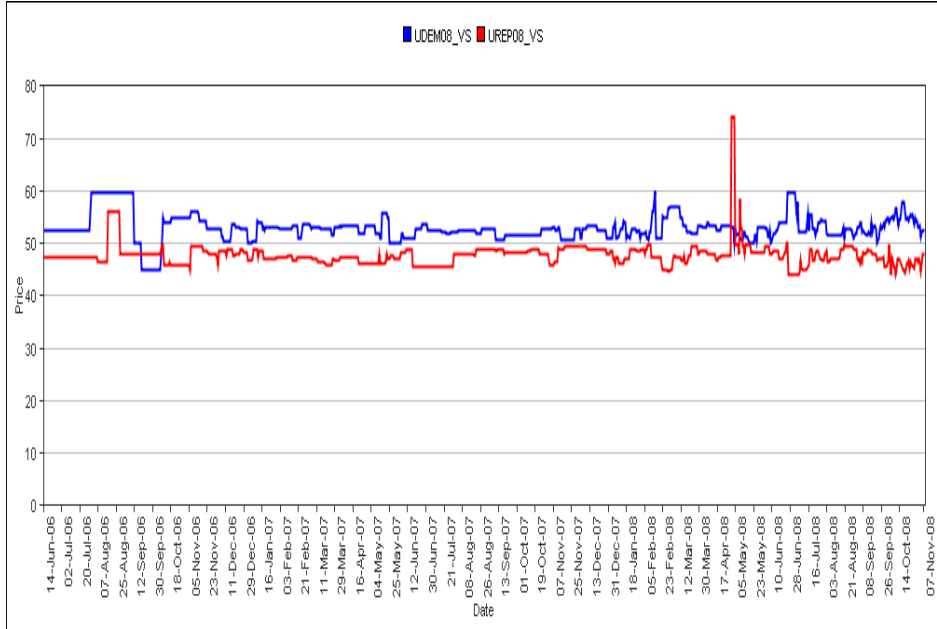
## Bush vs. Gore

2000 U.S. Presidential Election Winner-Takes-All Market

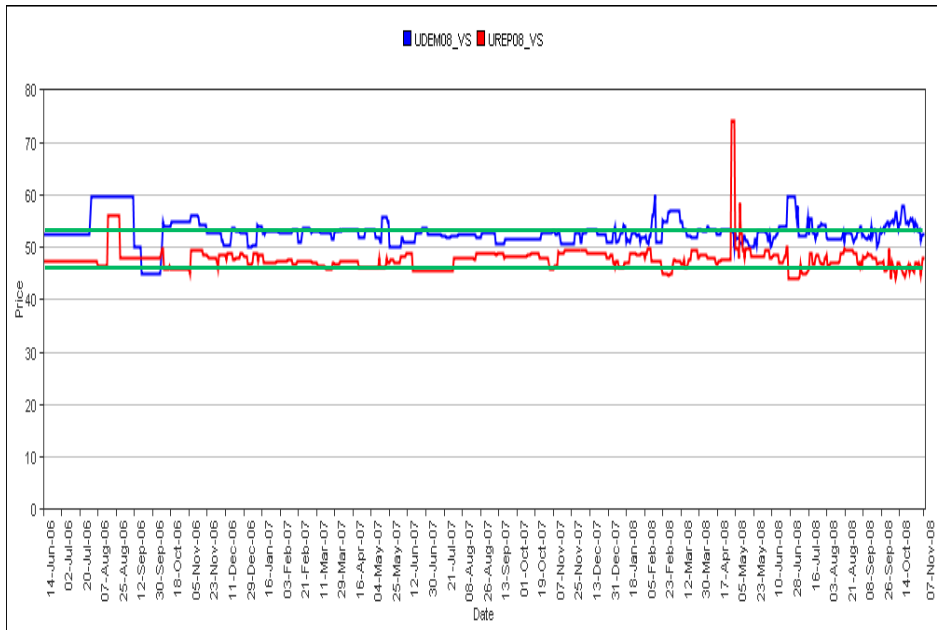




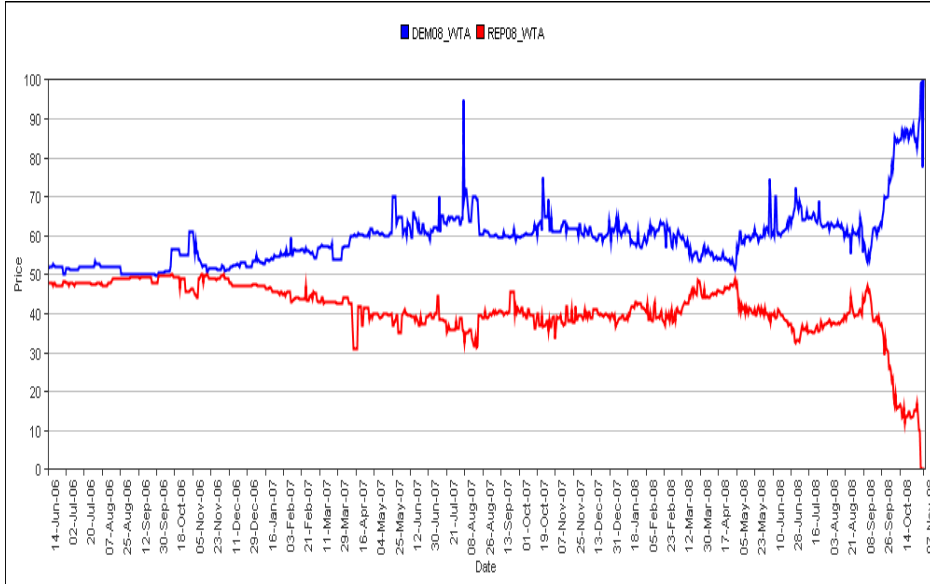
# What about 2008....?



# What about 2008....?

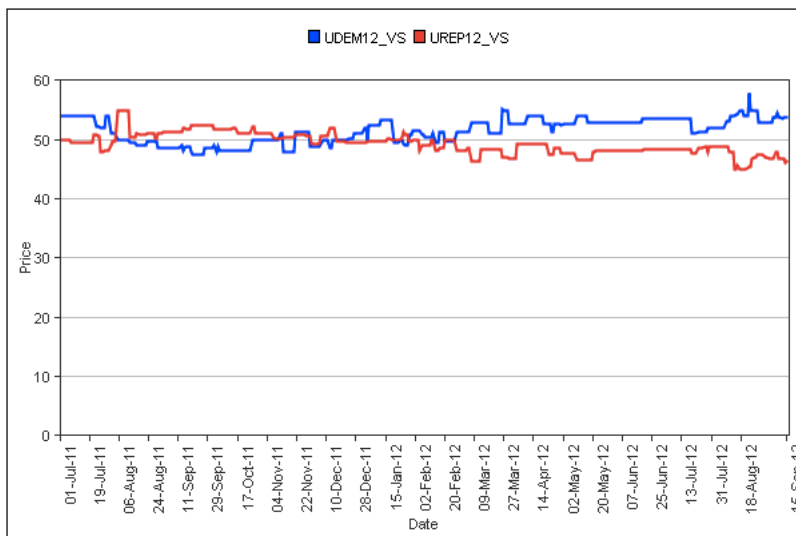


# What about 2008....?



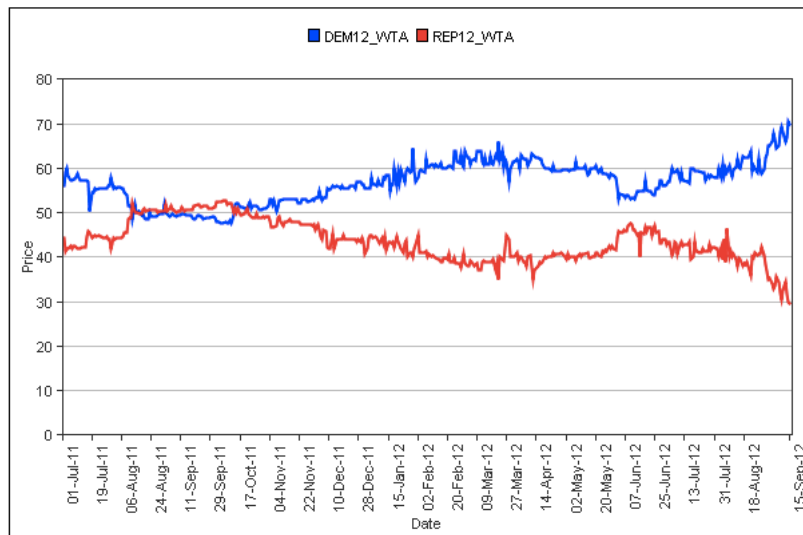
# Now what about 2012....?

Pres12\_VS  
2012 US Presidential Election Vote Share Market



## Now what about 2012....?

Pres12\_WTA  
2012 US Presidential Election Winner Takes All Market



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Compare these prices with those on Intrade:

[www.intrade.com](http://www.intrade.com)

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# Now what about 2012....?

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








## Closing prices chart











2012.PRES.OBAMA  
Dec 06, 2010 - Sep 16, 2012



Some other Intrade markets:

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Hot Markets		Info on market details 	
Some of our most active and topical markets		View: Latest   Current Prices   Charts	
	<b>Barack Obama to be re-elected President in 2012</b> Event: 2012 Presidential Election Winner (Individual)	 	<b>67.9%</b> CHANCE <a href="#">Predict</a>
	<b>Mitt Romney to be elected President in 2012</b> Event: 2012 Presidential Election Winner (Individual)	 	<b>32.1%</b> CHANCE <a href="#">Predict</a>
	<b>Republican candidate to win</b> Event: Massachusetts (Scott Brown - R)	 	<b>41.5%</b> CHANCE <a href="#">Predict</a>
	<b>Democratic candidate to win</b> Event: Missouri (Claire McCaskill - D)	 	<b>61.6%</b> CHANCE <a href="#">Predict</a>
	<b>Bashar al-Assad to no longer be President of Syria before midnight ET 31 Dec 2012</b> Event: Bashar al-Assad (President of Syria)	 	<b>25.0%</b> CHANCE <a href="#">Predict</a>
	<b>Any country currently using the Euro to announce intention to drop it before midnight ET 31 Dec 2012</b> Event: Any Current User to Drop Euro as National Currency	 	<b>16.4%</b> CHANCE <a href="#">Predict</a>
	<b>The US Economy will go into Recession during 2013</b> Event: US Economy in Recession (*see contract rules for definiti...	 	<b>26.2%</b> CHANCE <a href="#">Predict</a>

Most Active in Foreign Affairs (10 Markets)		
	<b>USA and/or Israel to execute an overt Air Strike against Iran before midnight ET 31 Dec 2012</b> Event: US/Israeli Overt Air Strike against Iran	<b>27.5%</b> CHANCE <a href="#">Predict</a>
	<b>USA and/or Israel to execute an overt Air Strike against Iran before midnight ET 30 Sep 2012</b> Event: US/Israeli Overt Air Strike against Iran	<b>2.2%</b> CHANCE <a href="#">Predict</a>
	<b>Bashar al-Assad to no longer be President of Syria before midnight ET 31 Dec 2012</b> Event: Bashar al-Assad (President of Syria)	<b>25.0%</b> CHANCE <a href="#">Predict</a>
	<b>Bashar al-Assad to no longer be President of Syria before midnight ET 31 Dec 2013</b> Event: Bashar al-Assad (President of Syria)	<b>67.0%</b> CHANCE <a href="#">Predict</a>
	<b>USA and/or Israel to execute an overt Air Strike against Iran before midnight ET 30 Jun 2013</b> Event: US/Israeli Overt Air Strike against Iran	<b>44.9%</b> CHANCE <a href="#">Predict</a>
	<b>USA and/or Israel to execute an overt Air Strike against Iran before midnight ET 31 Dec 2013</b> Event: US/Israeli Overt Air Strike against Iran	<b>50.0%</b> CHANCE <a href="#">Predict</a>
	<b>Bashar al-Assad to no longer be President of Syria before midnight ET 30 Jun 2013</b> Event: Bashar al-Assad (President of Syria)	<b>60.1%</b> CHANCE <a href="#">Predict</a>
	<b>Hugo Chavez to no longer be the President of Venezuela before midnight ET 31 Dec 2012</b> Event: Hugo Chavez (President of Venezuela)	<b>11.0%</b> CHANCE <a href="#">Predict</a>
	<b>A successful WMD terrorist attack to occur anywhere in the world before midnight ET 31 Dec 2013</b> Event: Successful terrorist attack using WMD	<b>22.2%</b> CHANCE <a href="#">Predict</a>
	<b>Ayman al-Zawahiri to be captured or killed before midnight ET 31 Dec 2012</b> Event: Ayman al-Zawahiri	<b>11.0%</b> CHANCE <a href="#">Predict</a>

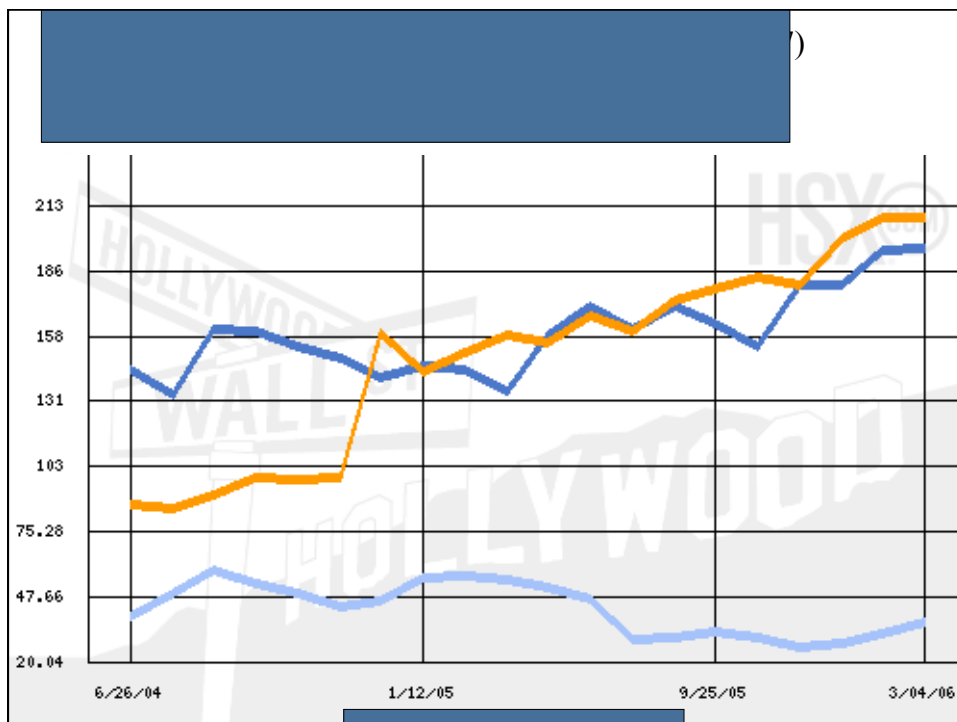
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A look at some other prediction markets:

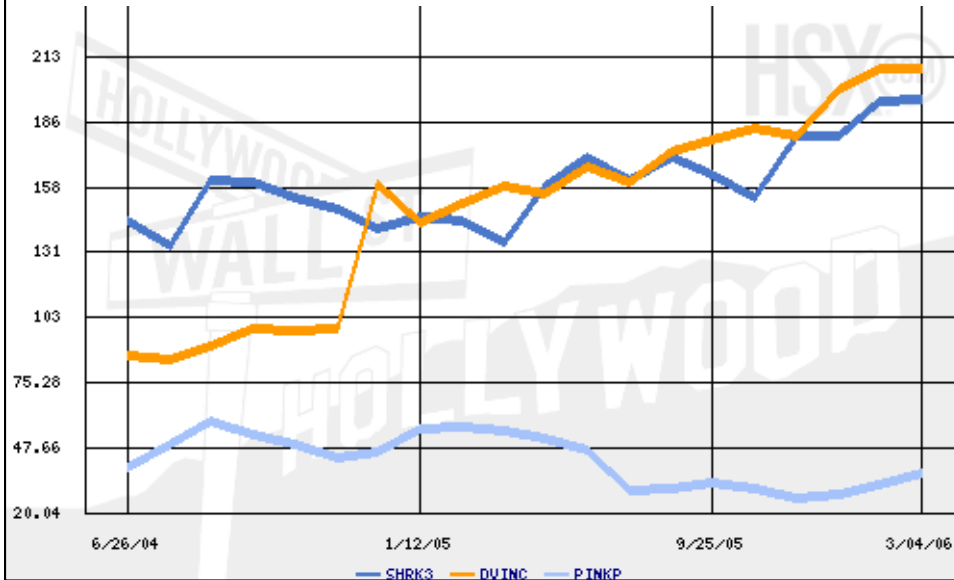
The Hollywood Stock Exchange

[www.hsx.com](http://www.hsx.com)

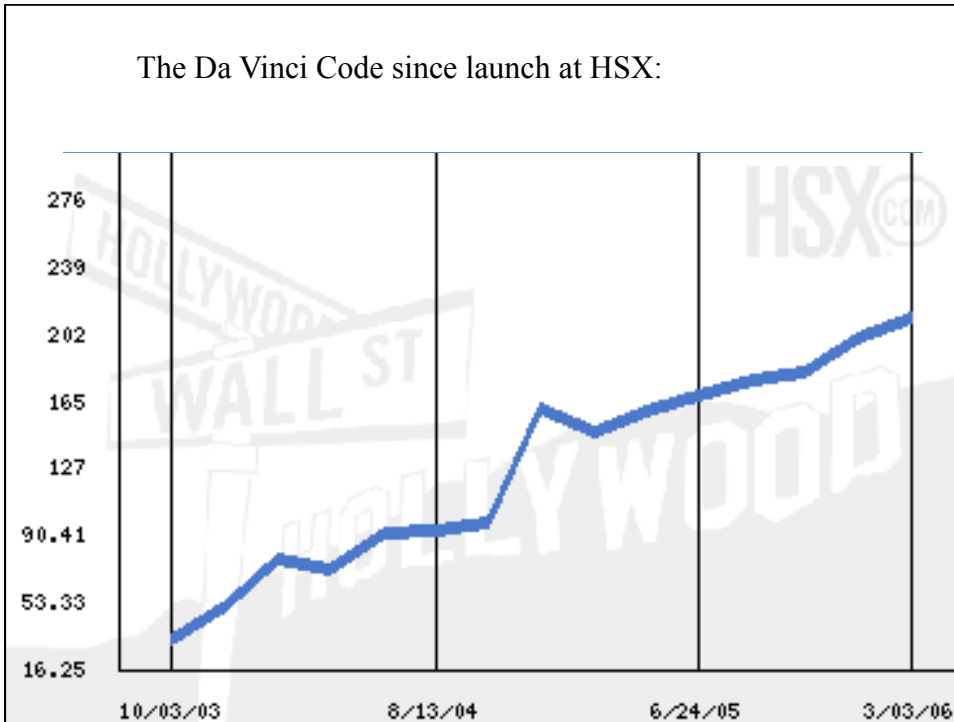
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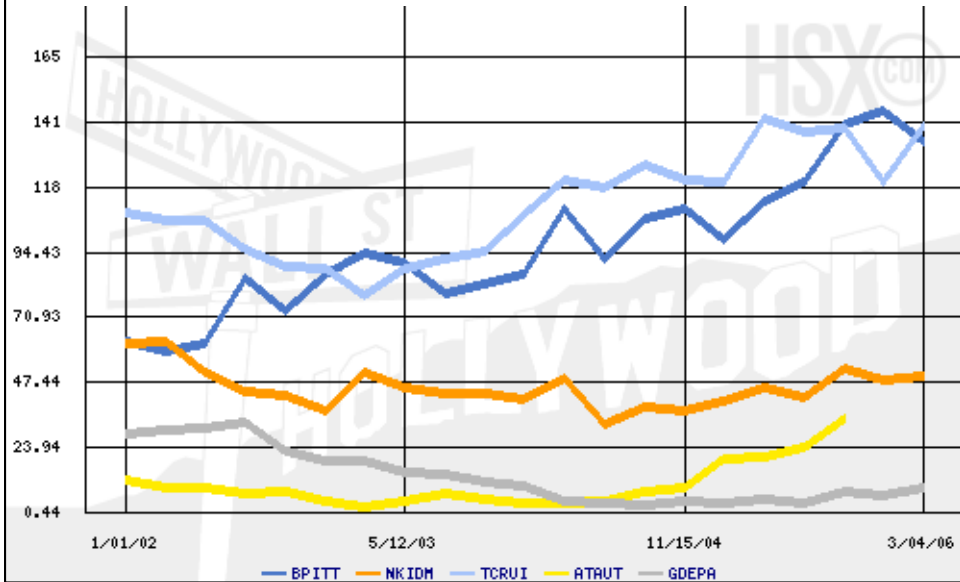
Movie prices at HSX for Shrek 3 (release date 05/18/2007)  
 Da Vinci code (release date 05/19/2006)  
 The Pink Panther (release date 01/20/2006)



The Da Vinci Code since launch at HSX:



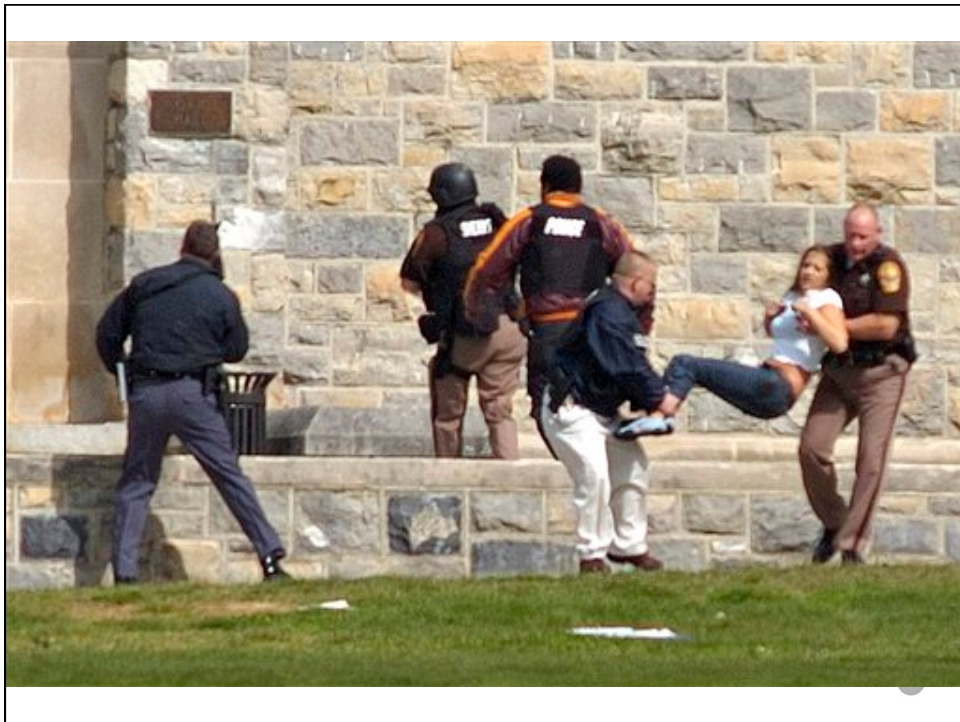
Star prices at HSX for Brad Pitt, Nicole Kidman, Tom Cruise  
Audrey Tautou, Gerard Depardieu



Now let's see how other institutions have worked by reinforcing our emotional talents

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## How far we' ve come: a historical perspective on risk in human societies

---

- The Forty-ninth World Health Assembly (1996, in Resolution WHA49.25), noted “with great concern the dramatic worldwide increase in the incidence of intentional injuries affecting people of all ages and both sexes, but especially women and children”
  - “The twentieth century will be remembered as a century marked by violence” - Nelson Mandela, preface to *World Report on Violence and Health*
- 

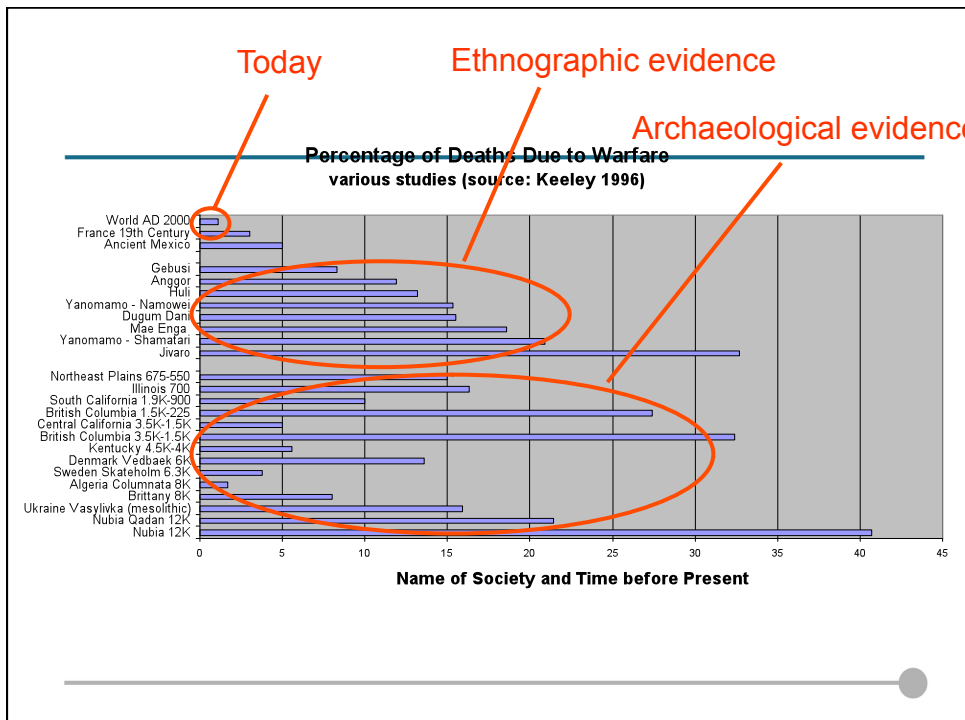
## ...provoking speculative explanations?

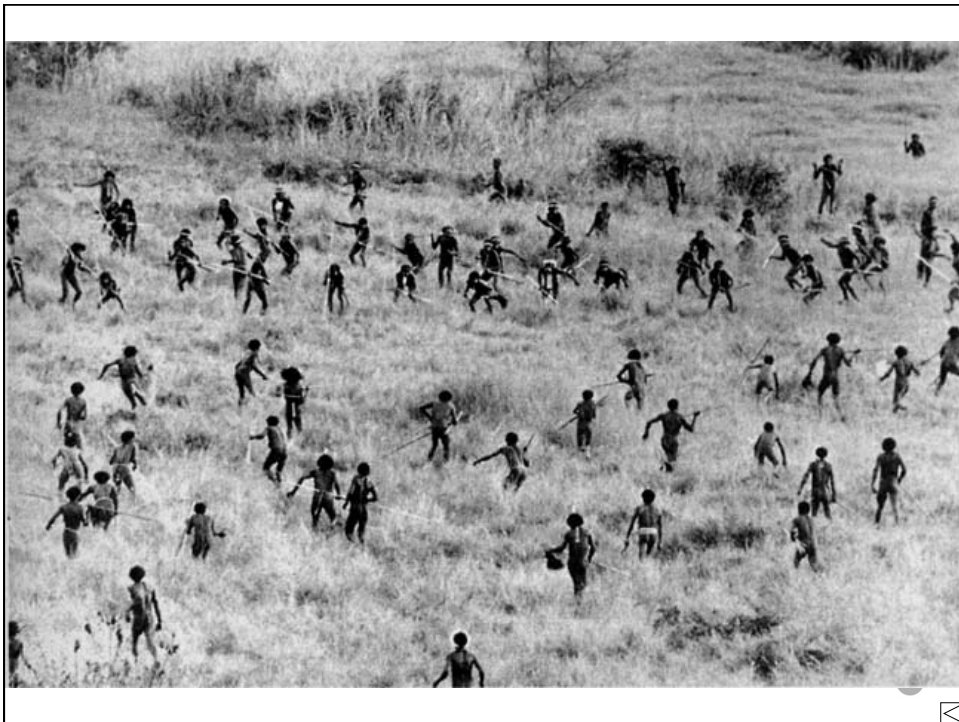
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- “On Sunday former House Speaker Newt Gingrich blamed 40 years of liberalism for an increasingly violent and vicious society.” – ABC News interview, April 23<sup>rd</sup> 2007
-

## A historical perspective on risk in human society

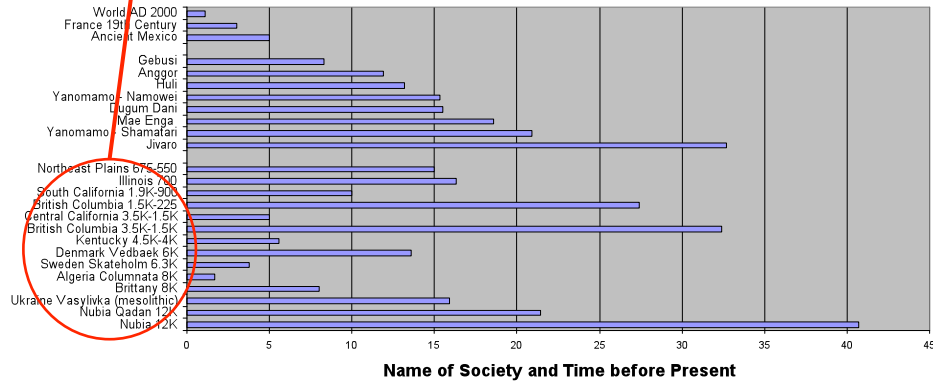
- There were 57.0 million deaths worldwide in 2002; of these 172,000 (0.3%) were in war and 559,000 (1.0%) in other forms of violence
- Compare this with 873,000 suicides (1.5%) and 1,192,000 (2.1%) in road accidents
- Even in Africa the rates were 0.8% war, 1.3% other violence, 0.3% suicide and 1.9% road accidents (compare 19.6% AIDS and 10.7% malaria)
- For the 20th century as a whole (including two world wars), war and violence caused around 3.7% of all deaths
- In hunter gatherer societies violence is estimated to have cause 14% of deaths – more than ten times today's rate!





## Prehistoric societies based on archaeological records

**Percentage of Deaths Due to Warfare**  
various studies (source: Keeley 1996)



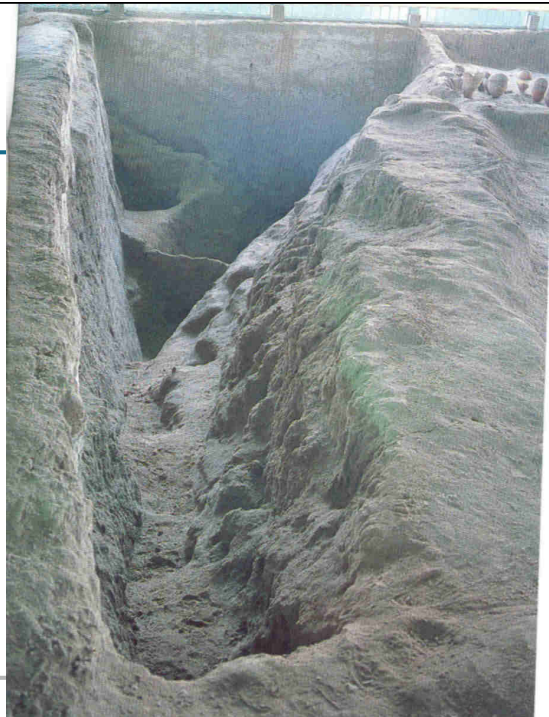
A COMPUTER-ASSISTED RECONSTRUCTION of a Neanderthal skull from St. Cesaire, France, shows that the young adult suffered a blow to the head, probably from a machetelike knife or sword, in an act of violence.

Date c.36,000 years BCE  
See Zollikofer et.al.(2002)



Cahokia point embedded in human sacrum  
Schild site, Illinois; date 600-900 AD

This ditch, at Banpo neolithic village, near Xian in central China, is 300 meters long, 5-6 meters deep and 6-8 meters wide at the top. Digging it required moving 10,000 cubic meters of earth – not a casual undertaking for people living on limited calorie supplies





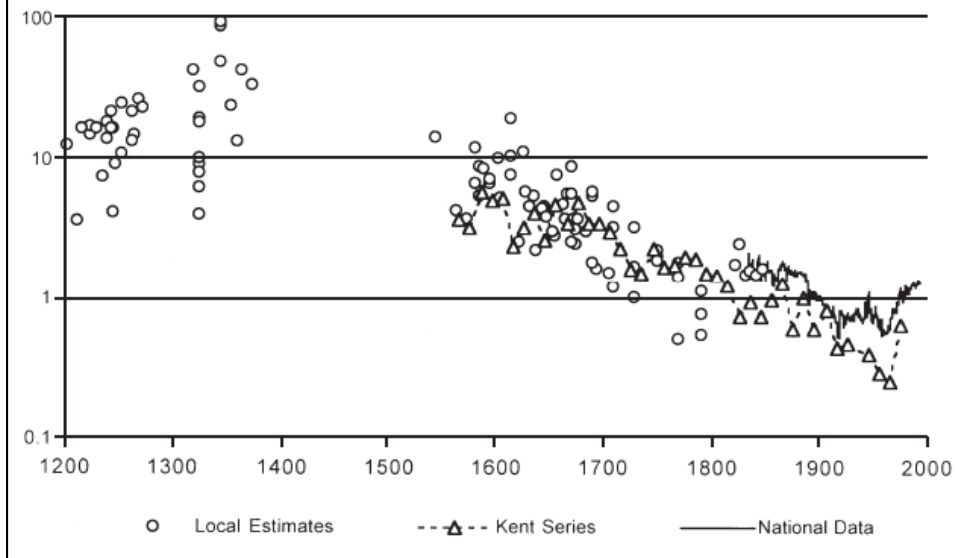
A model reconstruction of the ditch at Banpo,  
built c. 6000 years ago

## What do we know about the pattern of violence over the centuries?

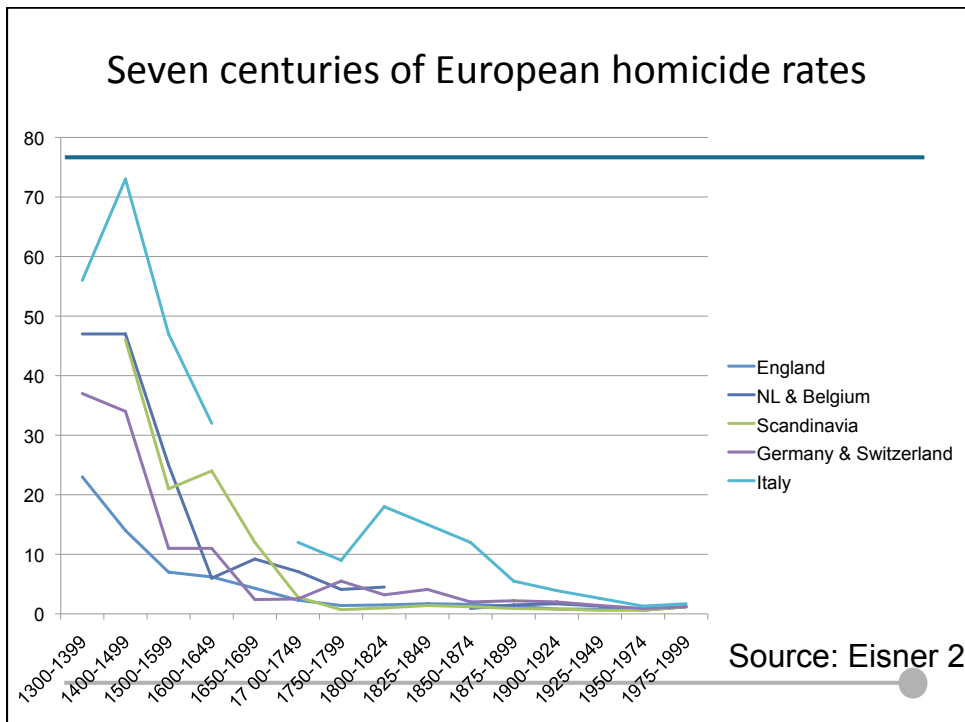
- In historical times the violence has declined gradually and relatively continuously since the middle ages – no earlier evidence available

## Eight centuries of English homicide rates

Source: Eisner 2001



## Seven centuries of European homicide rates



Source: Eisner 2

## What's the explanation? The accepted view

---

- Norbert Elias, *Über den Prozeß der Zivilisation* (1939) developed an answer which is broadly accepted by historians and social scientists today
  - The elements:
    - Growing influence of institutions (courts, armies, firms) on individual behaviour
    - Extension of ideals of behaviour (self-control, manners, prudence, etc) from higher to lower classes of society
- 

## What's the explanation? The accepted view

---

- Gradual replacement in the determination of behaviour of
    - honour by prudence
    - kinship by impartiality
    - emotion by reason
    - revenge by justice
  - Others (eg Azar Gat, *War in Human Civilization*, 2006) add the large benefits from peace in the post-Malthusian world
  - This view is not wrong – but it is incomplete!
-

## An alternative view from behavioral economics and neuroscience

---

- Reason has not *replaced* emotion but has *harnessed* it
  - Purely cognitive approaches to the enforcement of trust cannot work (the reliability of the reprisal mechanisms depends on emotional components)
  - In particular, trust is more effective in the presence of strong reciprocity
  - But effectively designed institutions can make a little reciprocity go a long way
-