

Does quality matter? 'Rational' agent behavior in the 21st century

Keynote address, COMPLEX2012

Santa Fe, NM, December 2012

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The 'null model' of agent behaviour in the social sciences

- The 'rational' agent of economics – pervades many social sciences
- Agents choose independently
- An agent has fixed tastes and preferences
- Gathers information (complete/incomplete) on the alternatives
- Makes the optimal choice given his/her preferences
- Not just a micro model, it is the foundation of macro-economic models
- 'Representative agent' – Dynamic Stochastic General Equilibrium models (DSGE)
- “Nearly every central bank either has one, or wants to have one”, Oliver Blanchard, Chief Economist at the IMF, *'The State of Macro'*, August 2008
- “The state if macro is good” – August 2008!





Decision fatigue

3500

Laptop SKUs



3000

ED TV SKUs



450

Compact Camera SKUs



300

Plasma TV SKUs



120

Tablet SKUs



35

DSLR SKUs



The empirical background

- Consumers now face a stupendous proliferation of choice – over 10 billion – billion! – choices are available in New York City alone
- Many of these products are complex, hard to evaluate
- Pricing is becoming much more sophisticated, changing very rapidly
- In 1900, most of the world's population lived in villages. Now, over half live in cities
- The internet is transforming the world like the printing press did in the 15th century
- We are **far** more aware than ever before of the behaviour/opinions/choices of others
- The preferences of agents are in general **not** fixed, they evolve in many ways.
- Specifically, they can be altered *directly* by the behaviour of other agents
- 'Copying'

'Satisficing'

- Herbert Simon, 'A Behavioral Model of Rational Choice', *Quarterly Journal of Economics*, 1955
- Economists have neutralised this concept
- An agent searches amongst N alternatives and selects the n th ($n < N$) when a 'satisfactory' choice is encountered. The cost of further searching and acquiring and processing information outweighs the additional benefits from finding the 'optimal' choice
- NO!
- Simon argued that many situations were so complex that the optimal choice may not be discoverable, even *ex post*
- Similarly, when there is a proliferation of choice amongst hard-to-distinguish alternatives, economists argue that 'copying' may be rational
- But models with copying give quite different outcomes

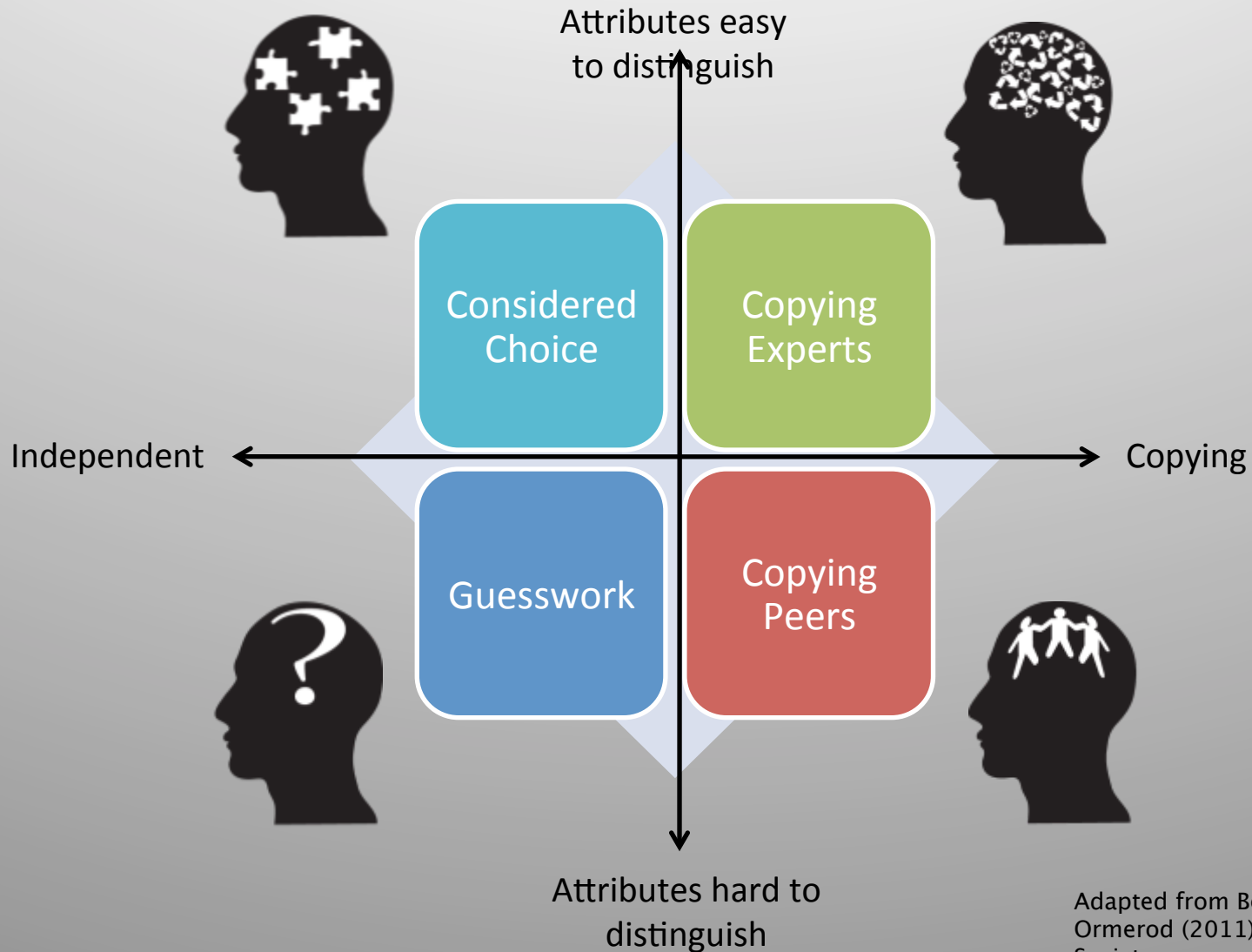
Why Copy?

- Asch (1953 and 1955): *conformity* [Moscovici in 1970s]
- the behavior of an agent tends to become more similar to that of the group of which he or she is a member
- either because the agent believes the group to have better information than he or she does, or from a desire to conform to group norms
- *Peer acceptance*: 'it is ok to..... be obese, binge drink'
- Fowler and Christakis, 'The spread of obesity in a large social network' , *New England Journal of Medicine* , 2007
- Ormerod and Wiltshire, 'Binge drinking in the UK: a social network phenomenon' , *Mind and Society* , 2009

Copying/Social Learning

- ‘Social learning (learning through observation or interaction with other individuals) is widespread in nature and is central to the remarkable success of humans’; Rendell et al. ‘Insights from the Social Learning Strategies Tournament’, *Science*, 9 April 2010
- Anomalous size of human brain compared to other mammals maybe because of the evolutionary effectiveness of social learning - Dunbar

A heuristic classifier of 'rationality'



Adapted from Bentley, O'Brien Ormerod (2011) Mind and Society

Two key empirical features of social network processes

- Non-Gaussian distribution at a point in time
- Turnover in rankings within the distribution over time

Social and economic outcomes are typically highly non-Gaussian

- downloads on YouTube
- film producers' earnings
- city sizes
- the size of price changes in financial assets
- crowds at soccer matches
- firm sizes
- the size and length of economic recessions
- unemployment rates by county in America
- deaths in wars
- the number of churches per county in William the Conqueror's *Domesday Book* survey of England in the late 11th century





Keynes *QJE* 1937

- ‘We have, as a rule, only the vaguest idea of any but the most direct consequences of our acts’
- ‘How do we manage in such circumstances to behave in a manner which saves our faces as rational economic men?’
 1. ‘we assume the present is a much more serviceable guide to the future than a candid examination of past experience would show it to have been hitherto’
 2. ‘we assume that the existing state of opinion is based on a correct summing up of future prospects, so we can accept it as such unless something new and relevant comes into the picture’
 3. ‘We endeavour to fall back on the judgement of the rest of the world... **The psychology of a society of individuals each of whom is endeavouring to copy the others** leads to what may be called a conventional judgement

Well-known examples of copying models

- Much of the agent based/network literature which focuses on the spread of ideas/behaviour, essentially involves 'binary choice with externalities' (Schelling 1973, Watts 2002)
- Heterogeneous agents are connected on a network and can be in one of two states of the world
- Agents switch depending upon their individual threshold (propensity to switch) and the states of the world of their neighbours
- The process of preferential attachment (Yule 1925, Simon *Biometrika*, 1955, Barabasi and Albert 1999) involves agents choosing amongst a fixed number (which may be large) of alternatives
- Agents choose probabilistically in proportion to the number of times each alternative has already been chosen by other agents
- These models typically give highly non-Gaussian outcomes of popularity

Cultural evolution (1)

- Cultural evolutionary theory retains preferential attachment as the basis for individual decisions amongst alternatives
- But it allows agents to innovate and select something which no agent has previously done before (Shennan and Wilkinson 2001, Lieberman et al. 2005, Bentley and Shennan 2007)
- Agents select amongst existing alternatives using preferential attachment with probability $(1 - \mu)$ and make an entirely new choice (or choose at random) with probability μ
- There is a substantial amount of evidence from a variety of contexts that μ is small, not greater than 0.1 (for example, Eerkens 2000, Larsen 1961, Rogers 1962)
- In the basic version of the model, the attributes of the various choices do not matter – agents are ‘neutral’ between them

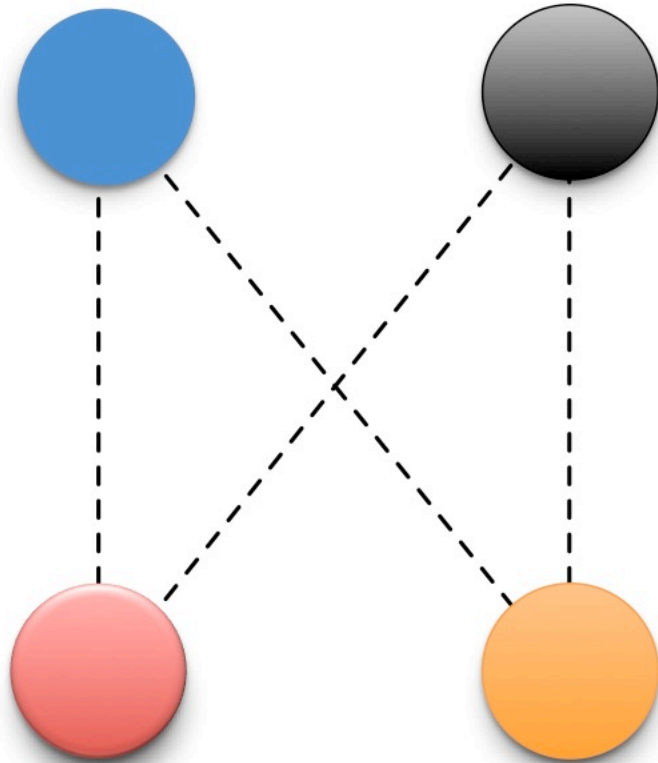
Cultural evolution (2)

- The model is known for $m = 1$ and for $m = \text{'all'}$, where m is the number of previous steps back an agents looks at i.e. how many previous decisions of other agents?
- m can be allowed to take any value between 1 and all
- Turnover in rankings is a natural feature of this model
- As μ increases, the outcome becomes more egalitarian
- As m increase, the outcome becomes more egalitarian

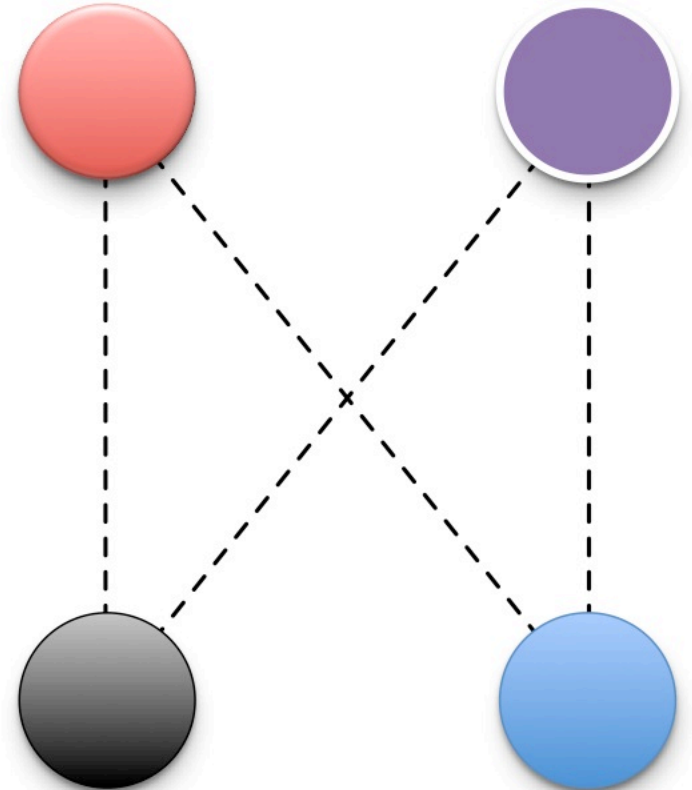
Neutral copying with **multiple** choice

Modified Wright-Fisher model yields:

(a) Popularity distributions (b) Lifespan distributions (c) Turnover among most popular



$t = 0$

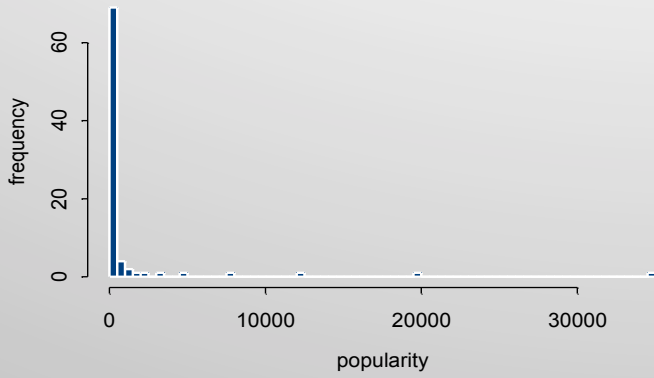


$t = 1$

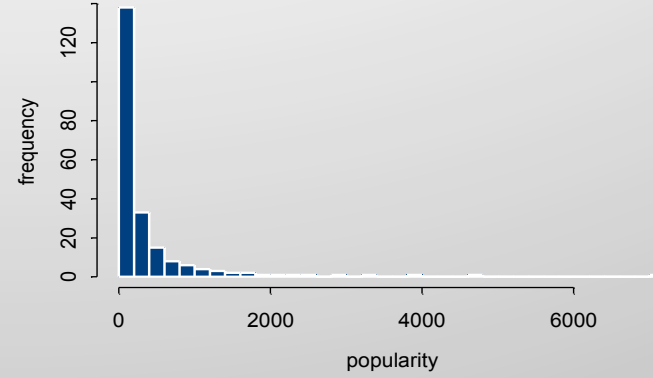
Kimura & Crow (1964) Genetics

Hahn and Bentley (2003) *Biology Letters*; Bentley, Hahn, Shennan (2004). *PRS B*; Bentley, Ormerod Batty (2010) *Evol. Biol. & Sociobiol.*; Ijiri & Simon (1964). *Am Econ Rev* 54: 77; Kimura & Crow (1964) *Genetics*; Yule (1924) *F.R.S. Phil.Trans.*; F (1995). *Am Antiq.*; Reali and Griffiths (2009) *PRS B*

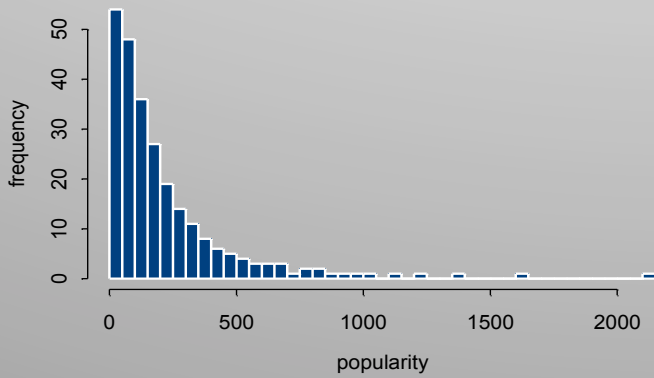
Very low innovation



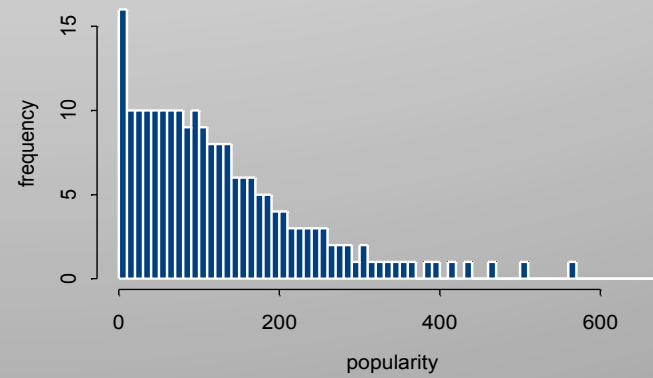
Moderate innovation



Faster innovation



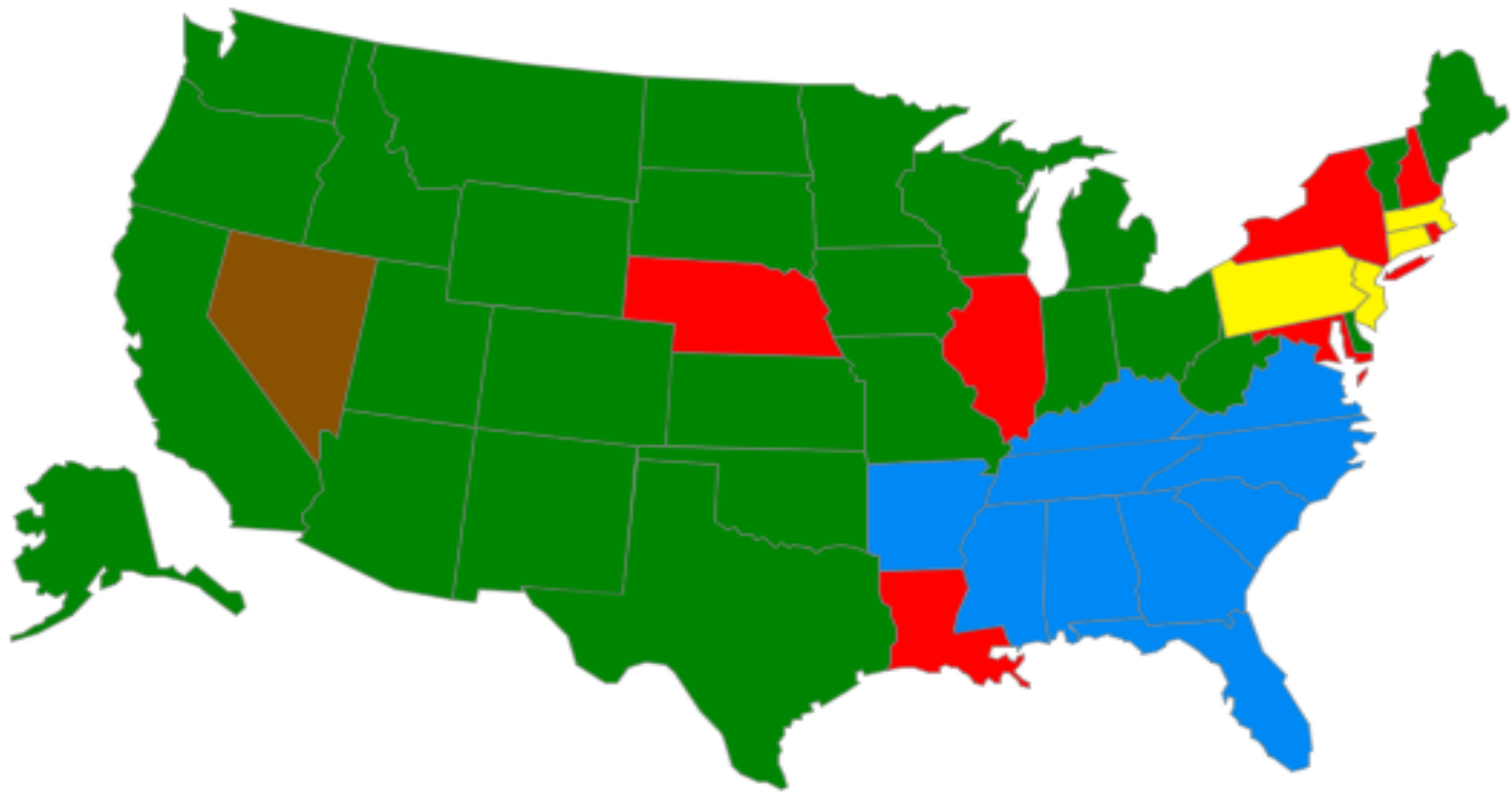
Rapid innovation



Baby names (1)

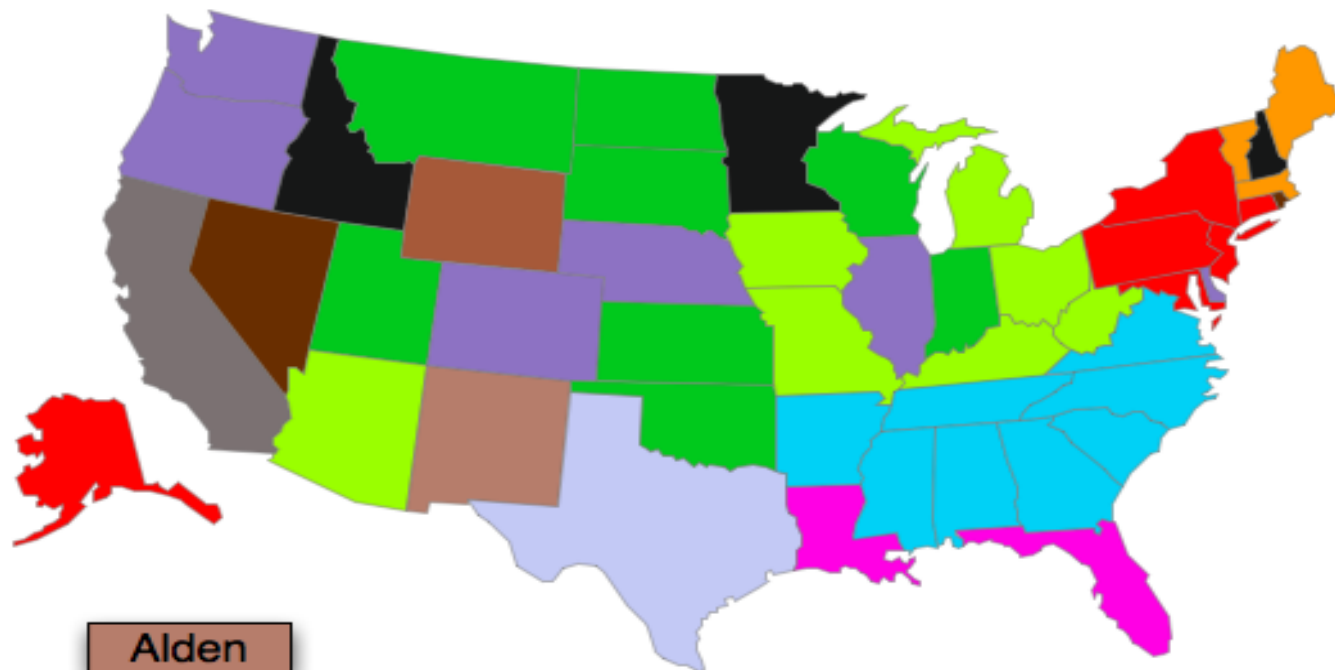
- Choices of first names reflect 3 general principles of collective behavior that apply to fashion/popular culture
- They involve a number of people carrying out the same or similar activity at the same time
- The behavior exhibited is transient or continually changing
- There is some kind of dependency amongst individuals, they are not acting independently
- 'the choice of a name 'connects us to society in a way that encapsulates the great contradiction in human social life: between the desire to fit in and the desire to be unique' Stephen Pinker

(c) Boys 1960

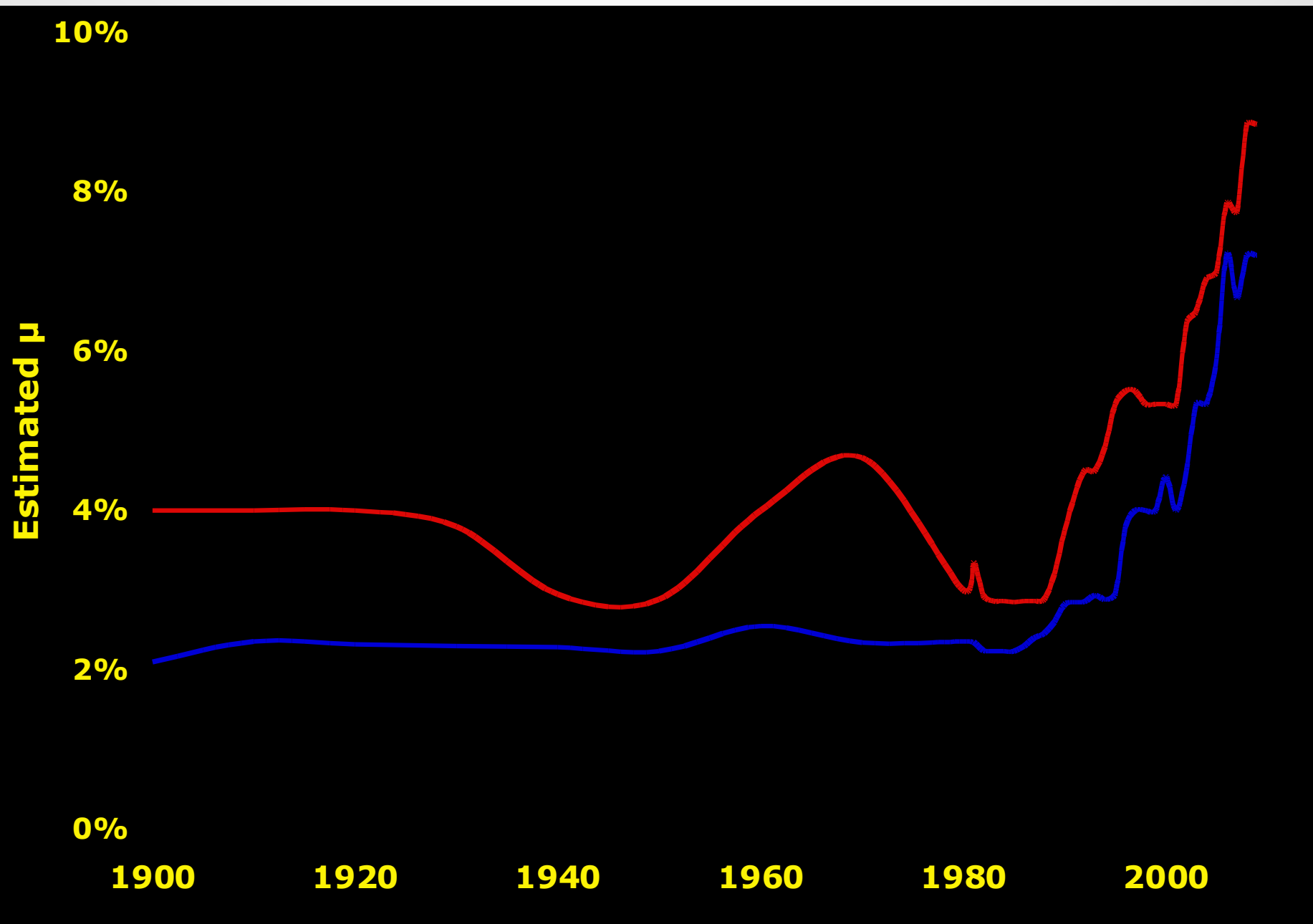


David	James	Michael	John	Robert
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(d) Boys 2009



Alden					
Ethan	Jacob	Alexander	Anthony	Daniel	Jayden
William	Michael	Logan	Noah	Jose	Wyatt



Other examples

- database of ceramic bowls from two successive phases of occupation of Bogazköy-Hattusa, capital of the Hittite empire and the largest Bronze Age settlement in Turkey in 14th century BC. The bowls differ in features such as size and the type of fabric used
- J Steele, C Gatz, A Kandler, *Journal of Archaeological Science* , 2010
- Three key features of linguistic evolution: i) power law at a point in time ii) inverse power law in word frequency versus replacement rate iii) S-curves for proportion of words in the top N replaced over time
- R Bentley and P Ormerod, *Proceedings of the Royal Society (B)*, 2011

Conclusion

- Markets in which copying is the principal driver of behaviour are characterised by strongly non-Gaussian outcomes
- They are also characterised by turnover in rankings
- Behavioral models which generate such features are candidates to be the 'null models' of rational behaviour in the 21st century
- Quality can still matter, but the greater the strength of the copying motive, the less it does
- “The problem nowadays is that anyone with a Twitter account and a blog is an 'expert'. Volume overtakes quality in many people's eyes.”
Contribution on the Rochdale AFC Fans' Forum to a debate about who was the club's greatest ever no. 9