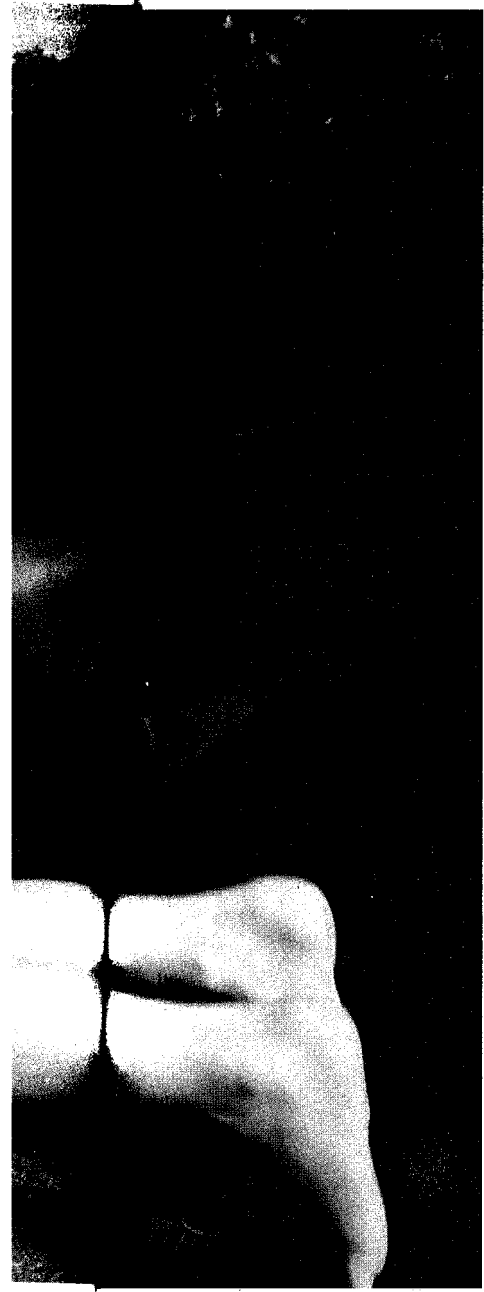




BERTRAND MELNIER/TENDANCEFLOUE

Population paradox

Given a choice, many humans decide to have few children or none at all. Why? And how will this affect the future of our species, wonders Mairi Macleod



OVERPOPULATION is, arguably, the greatest challenge facing humanity. It took until 1800 for our numbers to reach 1 billion. Now the human population exceeds 7 billion and is set to reach 10 billion by 2085. Although problematic, it is also a testament to our success as a species. In a world in which people are increasingly well fed, healthy and safe, a population explosion is only to be expected. In fact, the surprising thing about human numbers is that they are not growing faster. Far from increasing rapidly as you might expect under such good conditions, human fertility rates are plummeting all over the planet. The question is, why?

An obvious answer is that access to contraception gives us control over our reproductive fate, allowing us to limit the number of children we have. But why we choose to do this is a puzzle for evolutionary biologists. After all, you are only alive to read this because you are descended from a long line of ancestors who were good at reproducing. When times were hard and resources scarce, they were the ones who successfully managed to pass their genes down to the next generation.

Today, survival is much easier for many of us, so why aren't we taking the biological advantage and having lots of babies? Indeed, why do people in the richest parts of the world tend to have fewer children? And, given that some people do still choose to have large families, what will be the repercussions for the future of our species?

In traditional and developing societies, reproductive rates rise with increasing wealth, but this pattern is reversed in richer, industrial nations – a phenomenon known as the demographic transition. In the European Union, for example, the average number of children per woman now stands at about 1.6, well below the 2.1 needed to maintain the population. The demographic transition has puzzled biologists for decades, as it seems to go totally against evolutionary principles.

On the face of it, our tendency to have fewer children as we amass more wealth looks maladaptive – an evolutionary wrong turn. But it may not be so. Low fertility could actually be evolutionarily advantageous in the long run if, by investing heavily in fewer children, parents ultimately increase the number of descendants they have, ensuring the survival of their lineage.

The first hard evidence that there might be something in this idea came in 2008, when David Lawson and Ruth Mace of University College London published findings from a study of 14,000 children in the UK. They found that children in larger families suffer in terms of reduced investment of parental time and money, and this has negative consequences for their educational and physical development. Meanwhile, those with fewer siblings did better in school assessments and were even likely to be taller than children from bigger families (*The International Journal of Epidemiology*, vol 37, p 1408).

Quantity versus quality

So parents who choose to have fewer children may be investing more in those they have. But in evolutionary terms the key question remains: are the advantages of wealth and small family size carried through the generations to produce more descendants ultimately? Answering this would require data on education, wealth and reproduction spanning several generations. Remarkably, this information is available for a cohort of 14,000 Swedish women born in 19th-century Uppsala and their descendants to the present day. Lawson and colleagues have recently analysed that data set. So what does it tell us?

Mirroring the previous study, the descendants of women in the original cohort who had fewer children were more likely to go to university and earn more. However, these high-investment lineages were not more successful in the long run. Instead, ➤

"People who invest more highly in a smaller number of children do not have more descendants in the long run"



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Our evolved tendency to seek wealth and status makes having children more costly and unappealing

increasing wealth and decreasing fertility. "We know that trying to acquire status and wealth is a universal, clear, conscious strategy – everyone wants to be successful, and liked, and have resources." Throughout most of human existence, he says, a desire for sex has been enough to maximise our reproductive output, but in modern, skill-based, wage-labour economies, status-seeking is in conflict with having children. You might expect wealthy people to be able to afford more children, but if they feel they must provide their offspring with the trappings of status such as private schooling and good healthcare, then children become less affordable. Low fertility is a strategy the wealthy use to keep their advantage, says Lawson. As a result, status-seeking leaves us vulnerable to making

the mothers who originally had more children have more descendants today (*Proceedings of the Royal Society B*, vol 279, p 4342). "It's a very close relationship, suggesting there's no adaptive benefit to having fewer kids – no fitness benefit," says Lawson.

Bang goes the theory. But there may still be an evolutionary rationale underpinning the demographic transition.

Evolutionary anthropologist Sarah Hrdy, professor emerita at the University of California, Davis, points out that natural selection would not have favoured women who had the urge to produce lots of babies, simply because throughout most of our species' history, any woman fit enough to

ovulate would mate, get pregnant and bear a child. However, evolution would have favoured women who were most successful at competing for status, which would give them more resources, greater personal security and access to higher-quality mates. And that is what influences how we behave in affluent parts of the modern world. "If you're living in a society that values high status and income, and where your position and your local clout are determined by the kind of job you get, by the kind of education you get, then you are going to give priority to those things over having a baby," says Hrdy.

Lawson believes that an evolved tendency to seek status explains the link between

maladaptive reproductive decisions, ones that decrease our chances of passing on our genes.

It would appear, however, that some of us are less susceptible to this maladaptive force than others. Of course there are many factors influencing our individual reproductive decisions (see "Reasons to be childless", below), but one has particular significance from an evolutionary point of view. It seems that, to some extent, our baby-making urges are in our genes: a Danish study found that identical twins were more likely to bear the same number of children as each other than were non-identical twins. This congruence was even stronger in twin women reproducing in the mid-20th century, when contraceptives

REASONS TO BE CHILDLESS

Studies of twins indicate that an individual's motivation to reproduce is partly genetic. This heritable component is bound to be complex, but clues are starting to emerge. First, personality – which has a strong genetic component – was found to influence fecundity (see main story). Now, in research soon to be published, a team led by Melinda Mills at the University of Groningen in the Netherlands reports pinpointing several genes associated with the timing of first birth and number of children in both men and women.

Relatives have a vested genetic interest in our reproduction. To build up a picture of how family affects fertility patterns, Rebecca

Sear and Paul Mathews at the London School of Hygiene and Tropical Medicine analysed data from 1900 women in the UK. They found that women who are in closer contact with extended family are more likely to fall pregnant, even controlling for factors such as income, education, religion and ethnicity. "Kin are providing practical support such as childcare," says Sear. "It could also be because of things like emotional support and encouragement to have children."

High-earning career alpha-women tend to have very few children, at least in the UK and US. The work-family trade-off is very different for alpha women, says Alison Wolf at King's College

London, author of *The XX Factor* (Profile Books, 2013). "It's not just that you lose earnings while you stay at home. If you give up altogether, you drop out of sight, don't get promoted, don't stay up to date, and so will probably do less well in your later career. For women lower down the socio-economic spectrum, it's not such a dilemma," she says.

Overall there is not much link between socio-economic class and family size, but on closer inspection the picture is more complex. Daniel Nettle and Thomas Pollet at Newcastle University found that in the UK, lower-earning women tend to have more children than the average, but for men income is

positively correlated with fertility, with the poorest men likely to be childless. Men with few resources will have the toughest time attracting a partner with whom to have kids, says Nettle.

Even something as simple as the local sex ratio may have an effect. A team led by Kristina Durante of the University of Texas, San Antonio, calculated the relative numbers of unmarried men and women of reproductive age for 50 US states. Looking at earnings, they found that women living in states with a low proportion of men tended to have highly paid jobs. Durante suggests that the unavailability of eligible partners encourages women to prioritise briefcase over babies.

were widely available, than in the late 1800s, suggesting that what is heritable is the motivation to have children (*Population and Development Review*, vol 25, p 253).

If some of us are beaver away at acquiring status at the expense of having kids, while others are breeding regardless of the financial and career consequences, that may have repercussions. "For the first time in human history, natural selection may be acting negatively on wealth accumulation and positively on dispositions for high fertility regardless of economic costs," says Lawson.

Parenting personality

So, were the tabloid-press scaremongers right all along? Do we face a gradual takeover of a poor underclass as the lineages of the high-flying elite grind to a standstill?

It seems unlikely. For a start, there is no reason to assume that the genes that motivate baby-making are linked with socio-economic class. Although the heritable component is little understood, new research by Anna Rotkirch at the Population Research Institute in Helsinki, Finland, and colleagues indicates that personality has a big impact on how likely we are to have babies, and also on whether or not our pregnancies are planned (*Journal of Research in Personality*, vol 47, p 296). "Extrovert men have more kids, as do more agreeable women," she says. "Conscientious women have fewer children because they do everything right and don't forget about contraception." Those who are 'open to experience' have fewer children, too, because they find many other exciting things to do. Such personality traits are known to be highly heritable, but they are not connected to a person's socio-economic class.

What's more, although Lawson's findings suggest that having a lot of children makes people poorer, being poor does not necessarily encourage people to have more children. In fact, his research reveals that in modern Western society there is little difference in the numbers of children born to rich and poor. Lawson says that in developed countries we are all on the same side of the demographic transition (see graph, right), and family size tends to be small for all income levels. Of the 7.7 million families with dependent children in the UK in 2012, for example, only one in seven had more than two children. In fact, statistics from many European countries show that childlessness is highest among the poorest citizens. This has increasingly been the case during the recent economic recession,



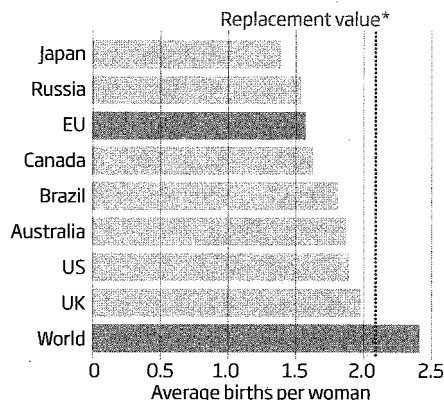
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says Rotkirch, and coincides with rising numbers of young adults having to stay in their parents' home because of a lack of employment opportunities.

So, poorer people may be no more likely to have large families than richer ones. But individual differences in how many children we choose to have could still have profound consequences for humanity. As increasing numbers of people in the West choose to forgo having children, future generations will tend to be the descendants of people with a propensity to procreate. As a result, the demographic transition might be reversed and fecundity increase again. Natural selection could quite rapidly favour heritable

An evolutionary conundrum

Given more resources, animals tend to produce more offspring, so why are human birth rates so low in the world's most affluent countries?



*Births per woman required to maintain a stable population

traits like personality and propensities for "baby longing", says Rotkirch.

But that is still very much in the realms of speculation, Rotkirch points out. "We should model the selection pressures and we should know the hormonal underpinnings and the genetic bases, but we don't." Hrdy is more cautious still. "Birth control hasn't been around long enough for natural selection to have had much sway," she says. "If you push this out long enough then it might, but I think we're talking about thousands of years."

As well as being slow, any evolutionary change will be influenced by cultural factors, says Daniel Nettle, a behavioural scientist at Newcastle University, UK. If society, through providing affordable, high-quality childcare and flexible working practices, makes it easier for people to combine kids and careers, then we would not need to choose between demanding jobs and the number of children we would like. "Women are very strategic in their response to changes in the labour market – in all kinds of things – and fertility goes up and down an enormous amount, even from year to year," he says.

Of course, if Lawson is correct, family size is not the only aspect of humanity that will evolve. "Status consciousness seems to be the defining feature of our modern world, but it seems likely that that could change," he says. It may take a long time, but it could have its benefits. Life would surely be more relaxed in a world in which people were less concerned about their place in the pecking order. ■

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