More Fun Than Fun: An Ode To Grandmothers and Their Grandmotherly Wisdom

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A woman with her grandchildren, in Bhutan. Photo: Asian Development Bank/Flickr, CC BY NC ND 2.0.

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This article is part of the 'More Fun Than Fun' column by Prof Raghavendra Gadagkar. He will explore interesting research papers or books and, while placing them in context, make them accessible to a wide readership.

The American primatologist Sarah Blaffer Hrdy came to India in the 1970s in quest of an evolutionary explanation for the tendency of male Hanuman langurs to snatch helpless infants from their mothers and bite them to death. Recalling her observations of these cruel acts in the forests of Mount Abu in Rajasthan, she wrote in her second book *The Woman That Never Evolved* (1981):

> "… two older females, Sol and Pawless, charged the male to wrest the infant from him. Before they succeeded the infant was bitten in the skull and received a gash on his thigh and lower abdomen so deep that the intestines could be seen within. This is the only time in my career as a field primatologist that I have ever cried while making observations."

In a more recent book, *Mothers and Others* (2009), she wrote:

> "I was a young woman myself, 26 years old and still childless when I watched, astounded, as again and again this worn-toothed old female [Sol] fought with a male twice her weight and armed with dagger-sharp canine teeth… It was her extraordinary selflessness that first inspired my interest in the evolutionary importance of old females."

She went on to add wryly,

> "Biologists and anthropologists alike—who in the early years were mostly male—had long taken for granted that the function of women was to bear and rear a man's children. From this perspective, women past childbearing age were deemed irrelevant and of no theoretical interest… [old women] were depicted as objects of ridicule—'old hags' whose behavior was obviously not worth studying."

As a man, I cannot read any of these passages without some measure of embarrassment (on behalf of males, *both langur and human!*). It is a common myth that scientists are (or should be) cold and objective truth-seeking machines, never letting their persona and their emotions sway their judgement. Unfortunately, this is and will always be far from reality. Therefore, I agree with the historian of science Naomi Oreskes – that one way to mitigate inevitable personal biases of individual scientists is for scientific communities to become inclusive and encompass geographical, national, racial and gender diversity.

The author photographed these Hanuman langurs in Mount Abu, Rajasthan, some 45 years after Sarah Blaffer Hrdy conducted her pioneering study. Photo: Raghavendra Gadagkar

Inspired by Sarah Hrdy's observations and writings, I wish to make this essay an ode to grandmothers. Human females are unique among all primate species in surviving for two to four decades past their reproductive life span. This human female menopause is an evolutionary puzzle. Why should natural selection favour individuals to stop reproducing long before they die or – put another way – to live long after ceasing to bear offspring?

In the past, this was often dismissed as an aberration of modern societies with advanced healthcare and medical technologies. We now know that this is not true. We also know that, although human females might stop reproducing a bit early for their lifespans, compared to elephants and blue whales for example, what is truly unique about human females is that they live long after they cease to reproduce.

Kristen Hawkes, an anthropologist at the University of Utah, wrote that menopause "is not new and it is not due to support for the elderly. Rather, grannies have a lot to offer their grandchildren". This grandmother hypothesis proposes natural selection favours post-reproductive life-spans because grandmothers contribute significantly to the survival of their grandchildren, and thus gain indirect fitness through kin selection.

Although this idea was met with scepticism at first, and is still shrouded in controversy, it is also steadily gaining in credibility, even as the hypothesis itself has been evolving.

One of the first problems with the grandmother hypothesis stemmed from the belief that in human societies, it is always the females who emigrate to breed in other families, so they might seldom have access to their mothers' other matrilineal kin to help with rearing children. But careful new research both with great apes and humans has altered this view.

Hawkes, the anthropologist, her colleague J.F. O'Connell, an archaeologist, also from the University of Utah, and N.G. Blurton Jones, an ethologist at the University of California, Los Angeles, lived among the Hadza hunter-gatherers in Tanzania, and carefully counted and weighed every food item that every man, woman and child contributed to the family's diet. They documented that while the 'hunter' men brought back nothing on most days, the 'gathering' women usually met the nutritional needs of the whole family. Even more remarkably, they found that the hardest working members of the family were the great-aunts and grandmothers of the hungry children.

Mirkka Lahdenperä of the University of Turku in Finland and her colleagues from the UK and Canada analysed multigenerational records from 18th and 19th century pre-modern populations in Finland and Canada, and found a strong relationship between women's lost-reproductive life-spans and the number of surviving grandchildren. More tellingly, they showed that grandmothers begin to show higher mortality at about the time they have no more grandchildren to care for.

The grandmother hypothesis has also found support in mathematical models, which compute the effects of grandmotherly hard work on natural selection for post-reproductive life spans by counting copies of the genes of grandmothers passed on to new generations. A particularly interesting kind of model sets up competitions between different 'agents' in the computer, with different strategies of investment and reproduction, to see who wins.

The advantage of indirect fitness through grandchildren, especially when coupled with the increasing risk of childbearing in old ages, seems to provide support for this evolutionary explanation for human female menopause. Additional important factors that researchers are studying concern the contrasts between younger and older females in (1) access to resources, (2) kinship to each other's offspring and (3) risk of death during childbirth.

Jared Diamond is an American geographer, historian, anthropologist, ornithologist, evolutionary biologist and physiologist, a modern-day polymath and author of many famous books. Perhaps the most famous among them is *Guns, Germs, and Steel* (1997). In a charming essay entitled 'Unwritten Knowledge', Diamond has given a new twist to the grandmother hypothesis. Studying dozens of human societies in New Guinea, he concluded that "the knowledge of elders is passed by word of mouth in pre-literate societies". Diamond, therefore, hypothesises that the wisdom of grandmothers is the key selective force behind the evolution of the human female menopause.

Grandchildren, and indeed the whole community, gets much more from grandmothers than mere food: they get "culturally transmitted survival techniques." Grandfathers too may have wisdom but they don't usually have menopause because "men never die from childbirth and lactation".

All this seems quite reasonable for humans – but we now have to contend with a very curious fact. Female menopause is not restricted to humans. It has also been observed in four species of marine mammals: resident killer whales (*Orcinus orca*), short-finned pilot whales (*Globicephala macrorhynchus*), beluga whales (*Delphinapterus leucas*) and narwhal (*Monodon monoceros*) – a very curious fact indeed.

Undaunted, Diamond has boldly speculated that "similar considerations may have driven the evolution of menopause in killer whales and pilot whales", and cites an anecdote: "While watching individually recognised killer whales recently, I saw an 85-year-old, long post-menopausal, female still accompanied by her 55-year-old son".

I think most people will agree that Diamond's 'wisdom' hypothesis looks more far-fetched for whales than for humans. And that is why I was fascinated to read a paper entitled 'Ecological Knowledge, Leadership, and the Evolution of Menopause in Killer Whales'. Lauren Brent, Emma Foster and Michael Cant from the University of Exeter, Daniel Franks from the University of York and Kenneth Balcomb from the Centre for Whale Research in Washington have set out to test the bold hypothesis that whale grandmothers store and provide ecological information about the location and timing of resources.

Of the two species known to have menopause, they have studied killer whales, specifically the fish-eating resident killer whales, in the Pacific ocean. This is the only non-human species with which one could test Diamond's hypothesis because of the availability of long-term data on individually identified whales, since the 1970s.

Killer whales are not true whales; they are large dolphins that can grow up to 6-8 metres long and can weigh more than 6,000 kg. They apparently got their name because they kill whales and their present name 'killer whale' is derived from 'whale killer'. Resident killer whale males live up to 50 years or so and show no menopause. Females, on the other hand, breed until they are about 40 years of age only, but they survive as post-menopausal females into their 90s.

Killer whales near the San Juan Islands, Washington state, in 2011. Photo: Pacific Northwest National Laboratory/Flickr, CC BY NC SA 2.0

These whales are social foragers and feed almost exclusively on a single prey species, the so-called Chinook salmon (Oncorhynchus tshawytscha). Knowledge of when and where a large population of the migratory salmon are to be found, especially in times of abundance, is therefore critical for their survival.

Is it possible that old female resident killer whales have the required knowledge gained from their long experience, and that they use it to lead their groups to profitable locations? To answer this question, these researchers analysed 751 hours of video footage of the whales following migrating salmon and determined who led the whale groups.

The Centre for Whale Research makes such videos, and also has multigenerational demographic records of the whales since 1976. These records were used to determine which whales in the videos were related to which others. Using a sample of 58 females and 44 males, ranging in age from 0 to 91 years, they determined who led the foraging party and who followed.

They found that adult females were more likely to lead than adult males, and that post-reproductive females were more likely to lead compared to reproductively aged females. The propensity of post-reproductive females to act as leaders was especially pronounced in times of low salmon abundance.

From the followers' perspective, both males and females were more likely to follow post-reproductive females compared to reproductive females, and more so in the lean years. The authors concluded that

the wisdom of elders, especially their ecological knowledge, helped the group to survive and in turn led to selection for long lives even after it became too risky for the grandmothers to give birth to their own offspring.

We still have a long way to go in understanding and explaining the distribution of menopause across the animal kingdom, finding a satisfactory explanation for its evolution where it occurs, and its absence where it does not. But there is little doubt about the importance of grandmothers for the survival and well-being of long-lived social animals. We must therefore join Diamond and ask: How can we now restore social value to old people and cope with the tragedy of growing old in our literate societies?

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