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Old and Young

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An independent academic psychologist, based in England, who has written extensively on different areas of psychology with an emphasis on the critical stance towards traditional ideas.

A complete listing of his writings at <http://psychologywritings.synthasite.com/>.

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# **1. DEMENTIA**

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## **1.1. A NATURAL OUTCOME OF AGEING?**

The belief that dementia is a natural outcome of ageing (senility) is held by many people, whereas the disease model is more appropriate (Fletcher 2020).

Certainty on the part of scientists, dementia-related third sector organisations, and government institutions fits well with awareness programmes (eg: September is global Alzheimer's awareness month) (Fletcher 2020)<sup>1</sup>. "A substantial proportion of the dementia awareness agenda is dedicated to dispelling lay beliefs regarding senility and promoting the idea that dementia is caused by specific diseases" (Fletcher 2020 p708).

Minority ethnic groups have been viewed as having poor dementia awareness by studies. For example, Ayalon and Arean (2004) presented false statements like "Alzheimer's disease is a normal process of ageing, like greying of hair and wrinkles" to older adults in four different ethnic groups in the USA. Over three-quarters of Latinos and Asian-Americans agreed with these statements. "That senility statements with binary answers are used as an indication of dementia awareness is highly problematic, both given the nature of some of the statements and the nature of claims relating to senility more generally" (Fletcher 2020 p713).

Fletcher (2020) commented on such studies generally: "Almost all of this research concludes that the levels of awareness within the respective group are problematically poor, both objectively (though it is unclear how this is evaluated) and when compared with the general population or majority ethnic group. This is typically considered to be problematic because poor awareness prevents service access... The papers typically conclude with an appeal for the development of educational initiatives to increase awareness in the specific community of interest. As such, the literature offers a homogenous portrayal of

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<sup>1</sup> The science can sometimes be less certain. "At a foundational level, the relationship between dementia and ageing remains poorly understood and the molecular evidence does not yet provide a firm foundation for absolute aetiological claims" (Fletcher 2020 p714).

dementia awareness among minority ethnic groups and its implications. Such homogeneity is striking given that the research encompasses a diverse array of communities around the world, raising questions regarding the assumptions that are implicated in evaluating awareness" (pp709 and 712).

Fletcher (2020) criticised these studies as "questionable assumptions are wielded as certainties to position minority ethnic groups as unaware" (p712). Then "this purported poor awareness is used to justify the proposed governance of minority ethnic minority conduct through interventions explicitly seeking to re-educate and hence improve them. Overall, a post-colonial psychiatric interpretation reveals that the political assertions of ethnicity-focused dementia awareness research can be understood as the neuromolecular governance of life via a racialised deficit-model of science communication" (Fletcher 2020 p712) <sup>2</sup>.

## 1.2. DATA SOURCES

Individuals with dementia are often treated differently in terms of medications. For example, a Danish national study (Kristensen et al 2018) found that dementia sufferers had greater polypharmacy (ie: five or more medications) than non-dementia individuals, and this was increasing from 47% of individuals in 2000 to 69% in 2011 (Ilomaki et al 2020). On the other hand, individuals with dementia are less likely to be prescribed oral anti-coagulants (eg: after stroke), according to a meta-analysis (Fanning et al 2019). Part of the reason for these differences may be lack of data for research.

Ilomaki et al (2020) emphasised the importance of "routinely collected administrative data, implementation of electronic medical records (EMRs) and investment in clinical quality registries provide new opportunities to investigate medication safety and effectiveness" (p164), especially for individuals with dementia (table 1.1).

Overall, these data offer access to large samples and extended follow-ups, but there are the limitations of "the lack of random assignment to treatment groups leading to possible biases and confounding (eg: confounding by indication, channelling bias) that need to be addressed in the study design and analyses" (Ilomaki et al 2020 p164).

1. Clinical registries - routine data collected in clinical practice, and participants may either opt-in or

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<sup>2</sup> "As Rose (2019) notes of the neuropsychiatric enterprise more broadly, the 'expansion' of dementia entails the governance of certain populations, particularly regarding prescriptions of awareness-raising initiatives" (Fletcher 2020 p715).

opt-out from their data's use by researchers.

Example - Swedish Dementia Registry (SveDem): established in 2007 with collected data from memory clinics (Ilomaki et al 2020).

"Although clinical registries are usually more representative of routine clinical practice than prospective clinical trials, the representativeness of registries is dependent on the sample of clinicians who report data and how people with dementia are enrolled" (Ilomaki et al 2020 p166).

2. Routinely collected administrative data - eg: hospital admission and discharge data; health insurance claims data; pharmacy dispensing data.

Example - National Health Insurance Research Database (NHIRD): began in Taiwan in 1996 and covers 99% of the population (Ilomaki et al 2020).

3. Electronic medical records - primary care data. "Although often reliant on the quality of documentation by clinicians, these data may provide better diagnostic validity than administrative data because data collection is for clinical rather than financial purposes" (Ilomaki et al 2020 p167).

Example - The Health Improvement Network (THIN) database in the UK (Ilomaki et al 2020).

Criteria:	Clinical Registries	Administrative Data	EMRs
Coverage		Good	Poor
Data latency		Poor	Good
Medications	Good	Good	
Follow-up	Poor	Good	Poor
Diagnosis		Poor	
Clinical information	Good	Poor	Good

(Coverage = amount of population covered; Data latency = how up-to-date the data; Medications = details of prescribed or dispensed medications; Follow-up = extend of patient follow-up; Diagnosis = details and validity of diagnosis; Clinical information = medical details) (Not all criteria are relevant to each source).

(Based on Ilomaki et al 2020 figure 1 p165)

Table 1.1 - Three sources of data compared on six criteria.

### **1.3. RISK FACTORS**

The "2017 Lancet Commission on dementia prevention, intervention and care" (Livingston et al 2017) found nine modifiable risk factors for dementia from their literature review:

- Less education
- Hypertension
- Hearing impairment
- Smoking
- Obesity
- Depression
- Physical inactivity
- Diabetes
- Low social contact

The "2020 Lancet Commission on dementia prevention, intervention and care" (Livingston et al 2020) added three more risk factors:

i) Excessive alcohol consumption - eg: shown in French longitudinal study (Schwarzinger et al 2018).

ii) Traumatic brain injury - eg: shown in Danish (Fann et al 2018) and Sweden (Nordstrom and Nordstrom 2018) cohorts .

iii) Air pollution - Comparing the highest and lowest quartiles of air pollution, there was an increased relative risk of dementia of about 10% (Livingston et al 2020) (appendix !A).

With statistical modelling, it was calculated that the twelve risk factors together accounted for around 40% of worldwide dementia cases. Livingston et al (2020) stated: "It is never too early and never too late in the life course for dementia prevention. Early-life (younger than 45 years) risks, such as less education, affect cognitive reserve; mid-life (45-65 years), and later-life (older than 65 years) risk factors influence reserve and triggering of neuropathological developments. Culture, poverty, and inequality are key drivers of the need for change. Individuals who are most deprived need these changes the most and will derive the highest benefit" (p413).

### **1.4. APPENDIX 1A - INDOOR CARBON DIOXIDE AND COGNITION**

Increased carbon dioxide (CO<sub>2</sub>) as a result of anthropogenic climate change will have an impact on human health. CO<sub>2</sub> concentration was estimated at 280 parts per

million (ppm) in the early 19th century and measured at 411 ppm in 2019 (Karnauskas et al 2020).

Karnauskas et al (2020) reflected on indoor CO2 levels, which will rise with CO2 concentration in the urban environment. Increased CO2 concentration has been studied previously in situation like submarines, finding impacts on cognition, while recent research on ventilation levels in school and office buildings have confirmed these studies (Karnauskas et al 2020).

For example, Allen et al (2016) compared three levels of CO2 concentration (550, 945 and 1400 ppm) over six hours in a building. A significant decline in cognitive abilities was found - "on the order of tens of percent decrease in performance per 400 ppm CO2 increase (equivalent to a doubling of present-day outdoor CO2 concentration)" (Karnauskas et al 2020 p2).

"Note that CO2 concentrations in buildings are a result of the combination of CO2 infiltrating from outdoors inside, or brought in with the ventilation system outside air, and the CO2 generated by the building occupants. Typical indoor concentrations are similar to outdoor levels if the occupancy is sparse and could be much higher if the building has high occupancy and poor outdoor air supply" (Karnauskas et al 2020 p3).

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## **2. FREE BUS TRAVEL**

- 2.1. For older adults
- 2.2. For young people
- 2.3. Appendix 2A - Andrews et al (2012)
- 2.4. Appendix 2B - Global cholesterol
- 2.5. References

### **2.1. FOR OLDER ADULTS**

"Social" treatments for mental health problems include changing social factors that are causing or contributing to the problems. For example, loneliness and social isolation are linked to depression, particularly in older adults. A "social" treatment would be to promote social interaction and inclusion. In the case of older adults, this may be achieved by increased access and use of public transport <sup>3</sup>.

For example, in England, free bus travel for over 60s was introduced in 2006. Qualitative research has found that this policy was linked to improved quality of life and increased social engagement (eg: Andrews et al 2012; appendix 2A).

Reinhard et al (2018) found a reduction in depressive symptoms and feelings of loneliness in a quantitative study using data from the English Longitudinal Study of Ageing (ELSA). ELSA involves a representative cohort of around 18500 participants aged fifty years and above, who have been surveyed at different times since 2002 (up to 2014 in this study).

Public transport use was classified as "yes" or "no" based on a single question (eg: "How often do you use public transport?"). Social engagement was also a binary variable, but the measurement of depression and loneliness used psychometric tests (eg: Centre for Epidemiologic Studies Depression Scale; CES-D; Radloff 1977) (table 2.1). Analysis controlled for age, mobility problems, and car ownership, for example.

Reinhard et al (2018) ended: "This study suggests that an age-friendly public transportation policy, the free bus pass, positively impacted the mental health of older adults. Concerns have been raised about the high costs of the free bus scheme, which amount to approximately 1 billion pounds per year. These concerns, however, overlook potential savings from reduced depressive symptoms as the annual cost of diagnosed

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<sup>3</sup> Older adults are at a higher risk of becoming "transport captives" (Hine and Mitchell 2001) - ie: a gap between "desired mobility and actual mobility levels" (Andrews et al 2012 p3).

- I talked less than usual.
- I felt lonely.
- I could not get "going".
- I had trouble keeping my mind on what I was doing.

Each item scored for the past week:

- Rarely or none of the time (less than 1 day)
- Some or a little of the time (1-2 days)
- Occasionally or a moderate amount of time (3-4 days)
- Most or all of the time (5-7 days)

(Source: Radloff 1977 table 1 p387)

Table 2.1 - Example of items from CES-D Scale.

depression in England has been estimated at 7.5 billion pounds. Increased transport use was also associated with increased social engagement, particularly volunteering. This suggests that the free bus pass may also bring wider societal benefits. Failure to consider these unanticipated mental health and social benefits of the free bus pass policy may lead to an overestimation of the cost and underappreciation of the value of the policy" (p367).

Reinhard et al (2019) developed the work by investigating the impact of free bus passes on cognitive function. Data from the ELSA were again analysed. Cognitive function was measured by a series of tests including the recall of ten common nouns immediately or after a short delay, and the ability to name as many animals as possible in one minute.

Users and non-users of public transport varied at baseline with the former more likely to be female and healthy. "For all domains of cognitive function, average scores declined among both transport users and non-users as age increased. However, the average score for transport users was higher than the score for non-users at all ages" (Reinhard et al 2019 p1776).

Reinhard et al (2019) were cautious about this finding: "While this might suggest that public transport use is associated with better cognitive function, it could also reflect confounding or reverse causality" (p1776) (eg: cognitive function determines transport use). Further statistical analysis was performed.

After controlling for potential confounders, it was found that "increased public transport use due to the free bus pass is associated with improved cognitive function, particularly memory scores" (Reinhard et al 2019 p1779).

The researchers explained the results as public transport use being stimulating in three ways:

i) Physically - Physical activity is known from other research to protect "cognitive health by reducing

cardiovascular and cerebro-vascular risks and by upregulating molecules involved in healthy brain structure and function" (Reinhard et al 2019 p1779) (appendix 2B).

ii) Socially - As Reinhard et al (2018) showed, public transport use leads to greater social engagement, and this is "postulated to benefit cognitive health by increasing use of cognitive faculties in social interactions, reducing stress, and promoting mental and physical health" (Reinhard et al 2019 p1779).

iii) Intellectually - The "free bus pass might have increased participation in intellectually stimulating activities - for example, in cultural, educational, or civic settings, which might benefit cognitive health according to the 'use it or lose it' hypothesis" (Reinhard et al 2019 p1779).

Reinhard et al (2019) added: "The bus ride itself might serve as a cognitively stimulating environment or activity that directly benefits cognitive health" (p1780).

## **2.2. FOR YOUNG PEOPLE**

"Independent mobility" is seen as an issue with younger people as well. For example, the age at which British parents granted their children "licences" to undertake certain journeys, like travelling to school unaccompanied, has risen in recent years. "This decline in independent mobility has been linked to various negative outcomes including decreased physical activity..., reduced opportunities for social, emotional and cognitive development... and increased fear of the local environment" (Goodman et al 2014 p276).

The opportunities for independent mobility can be linked to Sen's (2002) "capabilities approach" to human development, which proposed that "what matters for human freedom is not what people actually do (their 'functionings') but rather the range of options open to them (their 'capabilities')" (Goodman et al 2014 p276). While Kaufmann et al (2004) referred to "potential mobility" or "motility" as "the capacity of entities (eg: goods, information or persons) to be mobile in social and geographic space" (quoted in Goodman et al 2014).

Goodman et al (2014) considered these issues with free bus travel for under 18s in London (introduced in 2005). Between February 2010 and August 2011, 118 12-18 year-old Londoners were interviewed alone or in small groups, or participated in focus groups.

The opportunity to travel independently did not mean alone, as "many young people valued being able to travel

with friends and were willing to use their travel choices as a means of demonstrating friendship" (Goodman et al 2014 p280).

The key themes from the research included:

a) Opportunities that would otherwise be limited by cost - The opportunity to travel for young people whose parents could not take and collect them in a car.

b) The acquisition of skills - eg: learning local geography. One fourteen year-old male said: "When I came to London I didn't yet have free bus travel [...] and] it actually limited me and didn't allow me to go places that I would actually go when I had the free bus travel. For example, when you go out because I can get lost easily, you know? If you have to pay for the bus it's going to limit you from getting back" (Interview 21; p282).

c) The freedom of "non-necessary" trips - eg: "Me and my friend tend to just get on the bus and go somewhere and then just get off and get the bus back. [...] We saw a park once on a bus we were like 'that's nice' and got off there for a while" (12 years old female; Interview 4; p283).

d) Independence from parents - eg: not having to ask for a "lift" or money for the bus. As one 18 year-old female said: "The good thing about free travel is that when you're old enough to be able to get places your own, your parents don't take you..." (Interview 12; p285).

e) Group-level benefits for all young people - eg: social inclusion. "Several participants explained that, regardless of how they travelled when they were alone, they took buses when out with friends so as not to exclude those who could not pay for transport: '[How I go] depends if I have friends with me, cos they don't like to go on the train, so if I have friends with me then we go on the bus cos they don't have to pay'" (Goodman et al 2014 p285).

f) Negative perceptions - eg: concern about being "tracked" and the electronic bus pass card used; confiscation of bus pass for "anti-social behaviours".

Goodman et al (2014) emphasised the capability to travel with free bus passes - ie: "during the teenage years, young people may have permission to travel by themselves in theory, but may not be able to do so in practice if they cannot afford to pay for travel and if their parents are unwilling or unable to give them money or a lift. Thus, making any specific trip may require not only parental permissions (mobility licences) and the confidence to act in general, but also financial access

to public transport and/or lower order parental permissions for that particular trip" (p288).

### **2.3. APPENDIX 2A - ANDREWS ET AL (2012)**

Andrews et al (2012) collected their qualitative data from 56 free bus pass owners in seven focus groups in south-west England.

Three types of benefit of the free bus pass were distinguished:

i) Cost gain - eg: A woman in her 70s said: "If I had to pay £4 a day I would not use it every day like I do" (p10).

ii) Facilitative gain (ie: increased options) - eg: "bus pass tourism" (trips that would not have been taken if no free travel).

iii) Avoidance gain - benefits from not doing certain things (eg: "not having to drive, especially in winter"; male in late 60s; p12).

A comment by a woman in her late 70s encapsulates all three benefits: "having the free bus pass has meant that I can save money and spend that on a coffee in town. I tend to walk in through the hills (well its downhill so it's easy) which means I don't have to pay for the inward journey. Then I get the bus back when it comes at 12 and it is free. [...] well the main thing is keeping fit and getting out [of] the house" (p13).

### **2.4. APPENDIX 2B - GLOBAL CHOLESTEROL**

High blood cholesterol is traditionally a problem of wealthy, Westernised countries, but NCD-RisC (2020) showed that the risk was moving to Asia and Oceania in an analysis of data from 1980 to 2018. Non-HDL (high-density lipoprotein) cholesterol is the risk factor for cardiovascular disease (NCD-RisC 2020).

Increasing obesity and high-fat diets have been the main causes in the West, but these are being countered with the replacement of saturated fats, and the widespread use of lipid-lowering medications (NCD-RisC 2020).

The researchers used data from 1127 population-based studies that measured blood lipids covering 200 countries (n = 102.6 million adults).

In 1980, mean total cholesterol was highest in north-west Europe and subsequently had declined, while increasing in east and south-east Asia, parts of sub-Saharan Africa, and Melanesia up to 2018. The "global

epicentre" of non-optimal cholesterol is now middle-income countries, though the high-income countries "would also benefit from further lowering non-HDL cholesterol" (NCD-RisC 2020 p77).

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### **3. AGEING AND LIFESPAN**

- 3.1. Evolution of ageing
- 3.2. Lifespan extension and ageing
  - 3.2.1. Blood ageing
- 3.3. References

#### **3.1. EVOLUTION OF AGEING**

Thompson et al (2020) noted the growth of a perspective that sees "ageing as a disease that can theoretically be cured, or at least delayed" (p2) (eg: Bulterijs et al 2015). But an evolutionary approach takes an opposite position, distinguishing "the process of ageing from the diseases that are affected by age" and accepting that "for most species, ageing is a natural and inevitable feature of life" (Thompson et al 2020 p2).

Thompson et al (2020) continued: "While evolutionary theorists have long argued that ageing evolved primarily because natural selection was unable to prevent it, there is increasing recognition that ageing and its mechanisms are in fact subject to natural selection, most notably through resource allocation decisions made earlier in life" (p2). Many physiological processes that are detrimental late in life are key to survival in earlier years (eg: inflammation). Add to this the fact that selective pressures occurred in an environment very different to the modern one. For example, the immune system evolved in a high-pathogen environment, and so "early and frequent exposure to infections, such as gastro-intestinal parasites, may promote healthy metabolism and immune regulation" (Thompson et al 2020 p2). In colloquial terms, a busy immune system is a happy one.

The evolutionary approach looks at human populations that live in environments more similar to our ancestors <sup>4</sup>, and at close non-human primate relatives. This latter group is important to study because laboratory experiments have tended to select non-human animals "for convenience, because they have short generation times and can be subjected to invasive manipulations that are not feasible in humans. Yet, ageing exhibits tremendous diversity across species, and conventional animal models have significant limitations in their applicability to humans" (Thompson et al 2020 p3). So, a "combination of a

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<sup>4</sup> Studies have found differences between humans today living in modern societies and those in traditional ones. "For example, Sayre et al.'s (2020) comparisons of foragers, pastoralists and industrialised populations suggest some universal features of ageing physical performance but also identify important variation that may be shaped by the different nature and age structure of workloads in the different settings" (Thompson et al 2020 p4).



long life and extensive parental investment has shaped primate life course strategies, potentially affecting not only how quickly we age but also how we age" (Thompson et al 2020 p3).

Comparative studies can compare "emergent" ageing processes, like frailty, or immunosenescence (changes in the immune system with age), in human and non-human primates, and distinguish shared and divergent ageing trajectories. For example, Ruff et al (2020) found that "while the bones of mountain gorillas exhibit several human-like signatures of ageing, they contrast with humans in that bone strength is preserved late into life" (Thompson et al 2020 p4). While Guevara et al (2020) reported that "the brains of chimpanzees recapitulate characteristics of ageing human brains, like neuronal loss in the hippocampus, but do not exhibit the human-specific pathologies linked to dementia and Alzheimer's disease" (Thompson et al 2020 p4).

### **3.2. LIFESPAN EXTENSION AND AGEING**

Different pharmaceutical, genetic, and dietary techniques have been tried to extend the lifespan of organism from yeast to mammals, and some have succeeded (eg: the immunosuppressant, rapamycin and mice). Others, however, like green tea extract or fish oil did not (Tyshovskiy et al 2019).

The work with mice and pharmaceutical techniques in the Interventions Testing Programme (ITP) (Miller et al 2007) are the best controlled experimental studies. They often find gender differences in lifespan increase (Tyshovskiy et al 2019).

#### **3.2.1. Blood Ageing**

Blood proteins show signs of biological age, based around three waves of changes at 34, 60, and 78 years old (Hamzelou 2019).

Lehallier et al (2019) looked for the regulators of ageing by analysing 2925 proteins in blood samples from 4331 healthy individuals aged 18-95 years (who were involved in the Interval and LonGenity cohorts) <sup>5</sup>.

A small number of proteins were key to ageing ("46-protein ageing signature" or "proteomic clock").

This opens the possibility both real and false of transfused young blood rejuvenating older individuals. In terms of reality, for example, surgically connecting the

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<sup>5</sup> The Interval cohort was set up in England with 3301 human plasma samples, while the LonGenity study began in 2008 with older adults of Ashkenazi Jewish descent in the USA.

circulatory systems of a young and an old mouse led to organ and tissue rejuvenation in the latter (eg: Conboy et al 2005).

Memory impairment in older mice has been reversed with a young blood transfusion (eg: Villeda et al 2014), and cognitive impairment can be induced in young mice infused with old blood (eg: Villeda et al 2011).

On the other hand, a clinic in California was changing \$8000 for transfusions of "young blood" to "reverse" Alzheimer's disease (unfounded claim) (Hamzelou 2019).

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## **4. PREGNANCY AND BIRTH**

- 4.1. Pre-conception care
- 4.2. Screening embryos
- 4.3. Cannabis use during pregnancy
- 4.4. Extremely pre-term births
- 4.5. References

### **4.1. PRE-CONCEPTION CARE**

The "Developmental Origins of Health and Disease" (DOHaD) theory (eg: Godfrey et al 2010) "postulates that environmental factors in critical windows of development shape health and developmental outcomes, possibly via epigenetic mechanisms" (Pentecost and Meloni 2020 p1) <sup>6</sup>. One application of this theory is to the "pre-conception period", and the idea of "pre-conception health" (Pentecost and Meloni 2020).

This period includes the "days to weeks" before conception, and the "longer periods of months or years to address pre-conception risk factors, such as diet and obesity" (Stephenson et al 2018 quoted in Pentecost and Meloni 2020).

Pentecost and Meloni (2020) noted that "frameworks of pre-conception care based on DOHaD expand the biomedicalisation of women's bodies; assume heteronormative definitions for sex, family, and care; exclude men from research and interventions; exhort women to engage in 'anticipatory motherhood' (Waggoner 2013...); and risk portraying motherhood as 'the default social and clinical strategy in women's health care' (Waggoner 2013)" (p2).

There is a problem inherent in the concept of the pre-conception period in that "a time period before conception can only be identified after a woman has become pregnant" (Stephenson et al 2018 quoted in Pentecost and Meloni 2020).

Pentecost and Meloni (2020) examined the "the DOHaD-inspired focus on pre-conception" in three ways:

1. A historical context - The idea that the mother's behaviour before conception could influence her offspring is not new. For example, "maternal impression" was a notion in early medicine, where the experience of witnessing a scary event, say, could impact the foetus (eg: being scared by a mouse could lead the child to have a birthmark shaped like a mouse) (Pentecost and Meloni 2020). Though today is an age of genomics, and a long way

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<sup>6</sup> The critical windows include pre-natal, pre-pubertal, and pubertal periods.

from such pre-gene understandings, the common thread is "developmental programming" (Pentecost and Meloni 2020).

2. The evidence for pre-conception interventions and care - Though there are many studies across the life course, there is less evidence on epigenetics and its impact in later life in humans, especially in terms of causality (Pentecost and Meloni 2020) <sup>7</sup>.

3. New norms - For example, "what happens to our understandings of health, the normal and the pathological, when an individual of reproductive potential is compelled to engage in behaviours thought to maintain the 'correct' environment in anticipation of conception?" (Pentecost and Meloni 2020 p8).

The "pre-conception population" has to be aware that "every action and lifestyle may have a direct impact on the integrity of the epigenome for present and future generations" (Pentecost and Meloni 2020 p9).

Pentecost and Meloni (2020) continued: "'pre-conception care' aligns with the contemporary trend toward a continuous analysis of the personal risks and benefits associated with different choices and environments, and predictive rather than reactive medicine based on gathering large amounts of data from patients, even when they are well... Pre-conception care, in the expanded public health perspective now advocated, directs populations to engage in the continuous management of potentially adverse or beneficial exposures" (p9).

What does the society with pre-conception care look like? Pentecost and Meloni (2020) answered: "At a population level, strategies include food fortification with folate, embedding pre-conception health in school curricula and in other policies related to maternal and child health, and broadly improving food environments... At the individual level, proposed strategies include 'normalising conversations about pregnancy intention' during clinic visits, providing online tools to promote behaviour change, and training health care workers about preconception care... This is more than detecting the presence of a faulty gene or highlighting risky alleles that may render the individual particularly susceptible to disease in a given environment. It is the emergence of a discourse of everyday self-regulation and anxious vigilance that resonates with contemporary neoliberal trends... as well as ancient modalities of

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<sup>7</sup> Bauer (2013) noted how life course theory and genomics presents "in/dividuals as data points moving from foetal development and early childhood to adult life", and creates "metabolic individuality": "a reassemblage of genetic disposition and exposure, including epigenetic transmissions of exposure to previous generations" (quoted in Pentecost and Meloni 2020).

ascetic control of the female body... While interventions may be wrapped up in a rhetoric of benign aspiration, effectiveness, and optimisation..., there is also potential for a deep personalisation and moralisation of what can be found in 'abnormal' epigenomic markers" (p9).

These authors ended with three implications of pre-conception care: "First, the further normalisation of individual responsibility of women for the health outcomes of their potential offspring. Second, the potential extension of this to cast both men and women from a potentially indefinite time in their lives as guardians of future generations' health. Third, the establishment of new and expanded metrics to measure the pre-conception health of populations with implications for the government of conduct and risk" (Pentecost and Meloni 2020 p10).

#### **4.2. SCREENING EMBRYOS**

Certain inherited conditions like cystic fibrosis have a single genetic mutation as their cause, and so screening of embryos via pre-implantation genetic testing (PGT) in IVF is justified for many people.

But many disorders are polygenic (ie: variations in many different genes), and the calculation of a "polygenic risk score" is difficult (Le Page 2019).

A company called "Genomic Prediction" in the USA has started offering PGT for polygenic conditions like heart disease. This has been criticised as placing "undue emphasis on genetics when it isn't the biggest factor... For instance, our risk of heart disease is typically determined by our diet, whether we smoke, how much exercise we take and so on" (Frances Flinter quoted in Le Page 2019).

However, a computer modelling study of polygenic screening (Karavani et al 2019) reported little benefit (eg: height could be increased by 3 cms or IQ by three points in embryo selection) (Le Page 2019).

#### **4.3. CANNABIS USE DURING PREGNANCY**

The constituents of cannabis (cannabinoids) can cross into the placenta from the mother and disrupt embryo development. Corsi et al (2020) used data from Ontario, Canada, to assess the long-term impact for individuals exposed to cannabis in the womb.

A birth cohort based on all registered births between 1st April 2007 and 31st March 2012 was studied (n = 689 071). The sample was 508 025 after exclusions (eg: death before eighteen months old). Maternal cannabis use

was self-reported in hospital for delivery <sup>8 9</sup>.

Overall, 3148 mothers admitted to cannabis use (recreational or medicinal) during pregnancy, and they were treated as a separate group (users) to compare to the rest of the cohort (non-users). A matched sub-sample was also created with 2364 users and 170 671 non-users as a way to control for confounders (eg: maternal age, education, and pre-existing medical conditions) <sup>10</sup>.

Diagnosis of autism spectrum disorder by eighteen months old was 1.5 times higher in the user than non-user group. While, at four years old, there were small (non-significant) increases in learning disabilities and attention-deficit hyperactivity disorder (ADHD) in the user group. In summary, "[A]mong pregnant women in Ontario, cannabis use was associated with an increased risk of neurodevelopmental disorders by age 10" (Corsi et al 2020 p1540) <sup>11</sup>.

Establishing causality was not possible. The researchers stated: "Associations between pre-natal cannabis exposure and potential neurodevelopmental outcomes in children may be complex and subject to confounding or mediation. Factors including individual genetic profile, pre-maturity, foetal and post-natal environment, dose and type of substance of exposure and environmental factors may be involved" (Corsi et al 2020 p1539).

#### **4.4. EXTREMELY PRE-TERM BIRTHS**

"Extremely premature (or pre-term)" (EP) is used to describe babies born less than 25-28 weeks in gestational age (GA) (Dance 2020).

The concern for such babies is the first few years, in terms of neurodevelopmental problems (by school age), say. "Although many extremely premature infants grow up to lead healthy lives, disability is still a major concern, particularly cognitive deficits and cerebral palsy" (Dance 2020 p21).

The EP population is quite large, and growing as new medical technology/techniques/treatment improve the

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<sup>8</sup> The researchers observed that "the prevalence of cannabis use was lower than reported elsewhere, although data were collected before recent increases in use. Cannabis users may be misclassified as non-users in the birth registry, probably due to under-reporting, which may arise from social stigma or fear of involvement of child protective services" (Corsi et al 2020 p1539).

<sup>9</sup> Data were not collected on the frequency and duration of use, nor during which part of the pregnancy. Information on pre-pregnancy use was also not recorded.

<sup>10</sup> Corsi et al (2020) admitted: "Despite employing a robust matching strategy to achieve balance in our cohort across critical potential confounders, residual confounding due to unmeasured confounders may remain" (p1540).

<sup>11</sup> Undiagnosed and misdiagnosed cases could not be distinguished with the official clinical records used.

survival of EP babies <sup>12</sup>, but health problems are appearing in adulthood (eg: cardiovascular disease risk) (Dance 2020).

Crump et al (2019) analysed Swedish data and found 5391 people born EP, of which 78% had at least one health condition that manifest in adolescence or early adulthood (eg: psychiatric disorders), compared to 37% of full-term births. Many of the EP children were born before key medical developments, like surfactant treatment (introduced in the 1990s) to help the delicate lungs from collapsing (Dance 2020).

A British study (O'Reilly et al 2020) has found similar results in that 60% of 19 year-olds born EP had at least one neuropsychological impairment. But Neil Marlow, who was one of the researchers here, said: "The truth is, if you survive at 22 weeks, the majority of survivors do not have a severe life-limiting disability" (quoted in Dance 2020).

In terms of physical health problems, Bolton et al (2012) reported chronic obstructive pulmonary disease (COPD)-like symptoms (eg: breathlessness). The lungs of EP children do not necessarily grow to full size. "Ventilators, high oxygen levels, inflammation and infection can further damage the immature lungs, leading to low lung function and long-term breathing problems" (Dance 2020 p23). Alterations in lung function can predict cardiovascular disease (Dance 2020).

On the positive side, clinical trials are showing that EP babies can be helped with associated complications (eg: ranibizumab and retina development problems) (Dance 2020).

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<sup>12</sup> In the UK today, for example, 35% of babies born alive and receiving care at 22 weeks GA survive, and 60% at 24 weeks GA (Dance 2020).

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## **5. MISCELLANEOUS**

- 5.1. Early cognition
  - 5.1.1. Early category formation
  - 5.1.2. Word boundaries
  - 5.1.3. Inflectional morphology
- 5.2. Education and inequality
- 5.3. Post-reproductive lifespan
- 5.4. References

### **5.1. EARLY COGNITION**

#### **5.1.1. Early Category Formation**

Quinn (2002) began: "Imagine a mental life in which each represented entity (ie: object, relation, event) was unrelated to every other stored entity, and an environmental experience in which each novel entity encountered was unrelated to all internally represented entities. Intellectual functioning and adaptive responding would be difficult, if even possible, under such conditions because both rely on the ability to relate familiar experiences to each other and to novel experiences. Cognitive scientists believe that our mental life as humans is coherent because of organising structures called category representations – mental representations for similar or like entities. Category representations are believed to underlie our ability to categorise, that is, to respond equivalently to discriminably different entities from a common class" (p66).

Children as young as 3-4 months old form mental categories (Quinn and Oates 2004). They have the ability to found general categories (eg: mammals vs furniture) and specifics (eg: cats vs dogs) (Quinn 2002). But how is this studied in these pre-verbal infants?

One method is called the "familiarisation/novelty preference" (F/NP) technique, and relies on the tendency of infants to prefer to look at novel things. Repeatedly showing the same picture will elicit less looking time as the infant habituates to it (known as "familiarisation"). Then the original picture is presented with a novel one, and the infant should look more at the latter (known as "novelty preference").

Applying this technique to researching categories, infants are shown four different pictures of the same category (eg: cats) for familiarisation. Then another picture of the category is presented with one of a new category (eg: a dog). "If infants look longer at the novel member of the novel category, this is a good indicator that they have formed a representation in their

memories of the familiar category - 'a category representation', but more attention to the novel category is assumed that "they are seeing the novel exemplar from the familiar category as 'just another one of those', whereas the response to the novel category exemplar is more like 'Aha! Here's a new sort of thing'" (Quinn and Oates 2004 p29).

A control group, who do not undergo familiarisation, needs to be shown the two pictures to check that infants do not have a natural preference for the novel picture (eg: because it more colourful) (Quinn and Oates 2004).

The understanding of categories has been studied extensively with cats and dogs. Spencer et al (1997), for example, familiarised infants to pictures of whole dogs and cats, and then presented hybrids (eg: cat head on dog body). "The infants' performance indicated that their category representations were based on the head region (and not the body region). These studies suggest that information from the head region provides infants with a sufficient (and possibly necessary) basis to form individuated category representations for cats and dogs" (Quinn 2002 p67).

The F/NP technique uses static photographs whereas children learn categories by seeing actual 3D things. "Real cats and dogs display different movement patterns and make different communicative sounds, and it is possible that such movement and sound information might also be diagnostic of category membership" (Quinn 2002 pp67-68).

Potential confounders to the use of the F/NP technique include the experimental task (eg: how many exemplars of a category shown during familiarisation), and the age of the child. "With increasing age, infants have more real-world experience, and are thus more likely to tap their own knowledge base when performing in laboratory experiments" (Quinn 2002 p68).

One response is to use exemplars that infants will not have seen in everyday life - eg: mammals such as hippopotamuses or elephants in contrast to furniture. "However, parents are known to read to infants from picture books that may depict exemplars of animals, and infants are likely to have at least some visual experience with generic furniture items such as chairs and tables. Moreover, even young infants may be able to recognise that unfamiliar mammals are more like familiar animals (eg: humans) than furniture items... Thus, even in an experiment that is designed as a study of category formation, young infants may recruit information from a pre-existing knowledge base that in part determines their preference behaviour" (Quinn 2002 p68).

### 5.1.2. Word Boundaries

As babies listen to a stream of speech, they come to recognise "word boundaries" through, say, "transitional probabilities". This is the idea that certain pairs of syllables are more likely to go together. For example, the phrase "pretty baby" contains four syllables: "pre", "ty", "bay", and "by". In English, "pre" and "ty" are more likely to go together than "pre" and "by", or "ty" and "bay" (Harris 2004).

Testing infants for "transitional probabilities" is difficult because of prior experience, unless an invented language is used, as with Johnson and Jusczyk (2001). These researchers invented twelve syllables that combined to make four words - "pakibu", "tibodu", "golatu", and "daropi". Eight month-olds were presented with a stream of these words for three minutes (familiarisation phase). Then the infants were played the words or new unheard combinations of the syllables, and the turning of the head towards the speaker was measured (novelty preference). The babies turned their heads longer to the novel words, which suggested that they could distinguish the previously heard words from unheard ones.

However, if stress was placed on the first syllable during familiarisation, then the infants turned their heads longer to the familiar words in the novelty-preference phase. This second part of Johnson and Jusczyk's (2001) study showed that "prosodic speech cues such as stress are more important than "transitional probabilities" in the detection of word boundaries" (Harris 2004 p72).

### 5.1.3. Inflectional Morphology

"Inflectional morphology" is the process of adding extra information to a word to change its meaning (eg: in English "ed" is added to a word for the past tense; "s" is added to signal plurals). But some words do not follow the regular rules, but are irregular (eg: "read" (present and past tense) or "deer" (single and plural)). The application of a regular rule to an irregular word is an "over-regularisation error" (eg: "sheeps") (Plunkett and Wood 2004).

How do children learn the correct inflectional morphology? Two main approaches can be distinguished (Plunkett and Wood 2004):

i) Dual route theory (Pinker and Prince 1988) - Two cognitive systems are working in parallel: one that applies the regular rules, and a memory system for irregulars. Mistakes are made (eg: "readed") because the memory system failed to find a stored record, and the regular rule is the default position. On the other hand,

the default position is over-ridden when the memory system finds a record of "went" as the past tense of "go", say.

ii) Single route theory (Rumelhart and McClelland 1987) - A single memory system stores all the information about inflectional morphology. Mistakes are made because of memory errors (eg: increased vocabulary leads to increased competition for limited memory resources, which is overcome with the strengthening of memory traces with age).

A number of sources of evidence have been used to test these two theories including (Plunkett and Wood 2004):

a) Use of artificial language - Children are taught novel words like "wug", and are asked to provide the plural, for instance.

b) Use of native language - Children are presented with a story and gaps to fill in (eg: "The boy is walking. Yesterday he \_\_\_\_\_").

c) Cross-linguistic research (comparison of languages) - Languages have different regular rules and so the nature of over-regularisation errors can be compared.

d) Case studies of children with developmental disorders.

## **5.2. EDUCATION AND INEQUALITY**

More years of schooling are beneficial to individuals (eg: better health) and to societies (eg: greater economic growth)<sup>13</sup>. So educational inequality has clear implications, which is the reason that "inclusive and equitable quality education" was made one of the United Nations Sustainable Developmental Goals (SDGs) in 2015 (Grant 2020).

For example, with the sub-goal of universal primary schooling, half of young adults in the world had received at least six years of schooling in 1970 compared to 83% in 2018 (with projections of 90% by 2030) (Friedman et al 2020). Gaps in schooling for women mostly explained the nations not achieving this sub-goal (Friedman et al 2020).

However, there is less progress on the sub-goals of

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<sup>13</sup> "Ensuring equality in education will translate into positive effects in the equality of human productivity, health, and well-being" (Friedman et al 2020 p639).

universal secondary schooling (ie: twelve years of education), and tertiary education (ie: fifteen years of schooling). There are also gender gaps here as well as differences between regions of the world (Friedman et al 2020).

Friedman et al (2020) developed the "average interpersonal difference" (AID) to measure educational inequality. AID is the "average difference in educational attainment between any two individuals in a population in a given year" (Grant 2020 p591).

The AID shows an inverted U-shape as educational opportunities increase. The AID is low in societies where only a few individuals (eg: elites) receive education and the majority do not. As schooling widens, so the AID increases "because the population now contains many people who have no education and many who have several years of schooling . As school enrolment becomes universal and members of the population begin to achieve similarly high levels of education, the AID declines again" (Grant 2020 p592).

Universal schooling requires policies that include eliminating school fees, improving local access to schools, and providing food, stipends, and other resources to disadvantaged children (Friedman et al 2020)

<sup>14</sup>.

### **5.3. POST-REPRODUCTIVE LIFESPAN**

Extended post-reproduction lifespan is "a long-term puzzle in evolutionary biology" (Chapman et al 2019 p1). For males this is not an issue because they can reproduce as long as they can produce sperm, but it is the case for females.

Post-reproductive representation (PrR) is the term used, and it is defined (for a population) as "the proportion of total adult lifespan spent in a post-reproductive state" (Chapman et al 2019 p2). It has been calculated as 0.15 to 0.30 (ie: 15-30% of adult female years of life post-reproduction) for a few species, like killer whales, narwhals, and beluga whales (Chapman et al 2019). Ellis et al (2018) compared 52 mammal species, and found post-reproduction rare.

But data are often from specific individuals (who may not be representative of the whole population or species), and/or captive/semi-captive populations, and not necessarily fully being aged (Chapman et al 2019).

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<sup>14</sup> Piketty (2020) criticised the "meritocratic fairy tale" that wealth inequalities are due to differences in hard work. "But, of course, Western societies are not meritocratic. As Piketty demonstrates, discrimination is common - based on status, race, gender and religion" (Kvangraven 2020 pp582-583). Education is part of this situation.

Concentrating on Asian elephants (*Elephas maximus*), Chapman et al (2019) used detailed demographic records of 3802 females born after 1940 from timber camps in the Union of Myanmar (Burma). There was no reproductive management, interference with maternal care, or culling of calves.

The PrR was calculated as ranging from 0.15 to 0.21 (ie: 15-21% of life) <sup>15</sup>.

Chapman et al (2019) commented: "Whilst the current population of Asian elephants is not fully wild, the elephants have better survival and later reproduction than zoo elephants, and a comparable reproductive lifespan to wild elephants. This could, therefore, be considered broadly representative of the species" (p6).

The age of last calf was taken from individual logbooks of the timber company, and there was always an element of guesswork involved. Physiological measures of reproduction, like ovarian activity, would be ideal, but require "opportunistic sampling of dead individuals" (Chapman et al 2019 p7).

The researchers admitted: "At present, we cannot assess here whether cessation of reproduction is true physiological incapability of further reproduction or whether the lack of further reproduction is due to behaviour or declining body condition. The opportunity to reproduce may often be out of an individual's control, such as if dominant individuals suppress reproduction in subordinates" (Chapman et al 2019 p7).

One explanation put forward for long post-reproductive periods is "grandmothering". If a female's body condition affects fertility and/or mating opportunities are unavailable (eg: male preference for younger females), these "superseded" females can gain fitness by helping their daughter's offspring, say (Chapman et al 2019).

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