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Environment Topics

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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/ and http://kmbpsychology.jottit.com.

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1. SOME EXAMPLES OF THE HUMAN ENVIRONMENT'S EFFECT ON LIFE

1.1. FRAGRANCED CONSUMER PRODUCTS

Fragrant smells in the environment from air fresheners and cleaning products, for instance, could have negative health consequences.

Up to on-third of individuals reported health problems after exposure to fragranced consumer products. Of one thousand individuals in the USA, problems included migraines (10% of respondents), skin reactions, and respiratory difficulties, like asthma (8% of respondents) (Caress and Steinemann 2009).

But these are self-reports. In a controlled experiment, Jaen and Dalton (2014) found that expectations were important. Half of a small group of individuals with moderate asthma were led to believe that a rose scent would exacerbate their condition. These individuals did report more symptoms than a control group who just smelled the scent, but there were physiological changes also. The negative expectation of the scent stressed the individuals and this produced the negative asthma symptoms (Pain 2017).

The general concern with fragrance chemicals is the ozone in the air mixing with them, and the resultant chemicals are seen as the mechanism for health problems. For example, a UK study found limonene, which gives a citrus scent, in a number of homes, and when this reacts with ozone, formaldehyde (which is an irritant, and carcinogenic at high levels) is created (Pain 2017).

High concentrations of fragrance chemicals present in the air could trigger reactions in the nose, throat, and airways through chemesthesis (the chemical sensitivity of the skin). There will be some individuals who are more sensitive to such chemicals, as in the extreme case of multiple chemical sensitivity (MCS). A controversial condition where individuals are so

sensitive to smells that isolation is the only solution (Pain 2017).

1.2. CITIES AND ANIMALS IN THE SKY

The height of cities has consequences for aerial creatures. In an attempt to increase awareness of the aerial ecosystem [1], Davy et al (2017) outlined layers of the aerial habitat (similar to the layers of the marine habitat) or troposphere (0-15 km up):

i) Basoaerial (0-1 km up) - risk from tall buildings.

ii) Mesoaerial (1-8 km up): risk from light pollution and aircraft.

iii) Epiaerial (8-13 km up) - risk from light pollution and cruising aircraft (table 1.1).

It has been estimated that between 300 to 900 million birds a year are killed by building collisions in the USA, and thousands and thousands by wind turbines and civilian aircraft, while 100 million birds die annually from crashing into windows (Ogden 2017). But such figures are of limited use as there are no definitive numbers on the total population of the skies (Ogden 2017).

LAYER OF SKY	ANIMALS
Basoaerial	Noctule bat, Eastern amberwing dragonfly, Red bat, Diamondback moth, Black-sided pygmy grasshopper
Mesoaerial	Hoary bat, Mexican free-tailed bat, migrating passerines, Bald eagle, Bewick's swan, Desmoiselle crane
Epiaerial	Bar-headed goose

(Source: Ogden 2017 figure p40, after Davey et al 2017)

Table 1.1 - Animals at risk at different levels of the sky.

1.3. AIR POLLUTION

Worldwide, one in nine early deaths is related to air pollution, according to the World Health Organisation

[1] "Aeroconservatism" (Davey et al 2017).

(Fleming 2017).

It is often reported that air pollution is getting worse. For example, average concentrations of PM 2.5 particulates [2] worldwide increased by over 10% between 1990 and 2015, but this average was a product of large increases in countries like India and China, and falls in the developed world. Air pollution in the rich countries has improved drastically since the 1950s (Fleming 2017).

The figure of 40 000 deaths a year in the UK from air pollution is often quoted. This number is a combination of estimates and research by the Royal College of Physicians on nitrogen dioxide (NO^2) levels and PM 2.5s, the Department for the Environment, Food and Rural Affairs, and the Committee on the Medical Effects of Air Pollutants (table 1.2) (Editorial 2017).

But "it doesn't mean that 40 000 people die every year as a direct consequence of breathing dirty air. it is an aggregate of the life-shortening effects on the UK population. A more accurate way of putting it is that air pollution reduces a large number of people's life expectancies by a few months, and worsens quality of life for many more" (Editorial 2017 p5).

ORGANISATION	ESTIMATE
Committee on the Medical Effects of Air Pollutants (2010)	29 000 deaths attributable to PM <2.5
UK government	44 750 - 52 500 deaths from PM 2.5 and NO^2
Royal College of Physicians, and Royal College of Paediatrics and Child Health	30 000 - 50 000 deaths from PM 2.5 and NO^2

(Source: Fleming 2017)

Table 1.2 - Estimates of annual deaths attributable to air pollution in the UK.

Miller et al (2017) were able to show how particulates accumulated in the human body by using gold nanoparticles. These were detected in the blood and urine within fifteen minutes of the first 24 hours after exposure, and then still present three months after exposure. The fourteen healthy male young adult volunteers inhaled the gold nanoparticles over a two-hour period.

[2] Dust or droplets 2.5 micrometres across, which can penetrate deep into the lungs. Increases in PM 2.5 exposure are associated with increased heart attacks and lung cancer, for example, across a population (Fleming 2017).

Twelve volunteer patients due to undergo the removal of hardened arteries were exposed to inhaled gold nanoparticles, and gold was present in the removed tissue. This showed that "inhaled nanoparticles translocate from the lung into the circulation in man, where they accumulate at sites of vascular inflammation. Particle translocation was size dependent, with greater translocation and accumulation of smaller nanoparticles. These observations suggest a direct role of particle size for inhaled nanoparticles in the pathogenesis of cardiovascular disease and provide a mechanism whereby exposure to combustion-derived nanoparticles and manufactured nanoparticles may promote atherosclerosis and trigger acute cardiovascular events" (Miller et al 2017 pp4545-4546).

1.3.1. Foetal Development

Air pollution can impact the development of the foetus. For example, most studies have found associations between traffic density and risk of pre-eclampsia and intra-uterine growth restriction (eg: Brauer et al 2008). But some studies (eg: Van den Hooven et al 2009) did not find such associations (Wesselink et al 2017).

Wesselink et al (2017) put this difference down to exposure assessment methods, like the use of air quality monitoring networks, which "can only be used in areas in which sufficient monitoring data are available" (p2). These researchers preferred road proximity and traffic density measures for their study.

Wesselink et al (2017) analysed data from the Cape Cod Family Health Study in Massachusetts, USA, which included women who gave birth in eight local towns between 1969 and 1983. For this research, 3309 pregnancies were included in the retrospective study. Around 8% of these were classed as problems in pregnancy (eg: pre-eclampsia). Distance of residence of the women during pregnancy to major roads were calculated, and categorised as four groups (varying from <50 m to ≥200 m).

There was no significant association between problems in pregnancy and traffic exposure, but the risk of stillbirth "may be higher among women who live close to major roadways or who have a higher density of major roadways around their home" (Wesselink et al 2017 p9).

Details about the pregnancies were self-reported by the women, "allowing for the possibility of misclassification" (Wesselink et al 2017). The measures of traffic exposure used did not take account of weather, for example, and the researchers were "unable to measure the exposure at different time periods throughout the pregnancy and were unable to capture seasonal or annual changes in traffic" (Wesselink et al 2017 p10).

The study also had a risk of selection bias as early pregnancy losses (ie: before 27 weeks gestational age) were excluded from analysis, and "there is some evidence that air pollution is associated with an increased risk of early pregnancy loss" (Wesselink et al 2017 p11).

1.4. URBAN LIFE

In 1800 about 3% of the world's population lived in urban areas compared to 50% in 2008, or more dramatically, Shenzhen (China) had a population of 30 000 in 1979 and ten million today (Galea 2017).

"From public hygiene, to the living and working conditions of urban residents, to exposure to infectious diseases and dirty air, cities exert a profound influence on all aspects of our health" (Galea 2017 p20). For example, there is a one-third greater risk of mood disorders and one-fifth greater of anxiety disorders in urban than rural areas (Peen et al 2010).

But within the urban area, distribution of resources and stressors is not even - ie: "income inequality, particularly pronounced in cities, is a key driver of mental health problems for many low-resource households" (Galea 2017 p21).

The daily activity of people varies over the 24-hour period, but the pattern is different in urban areas with artificial lighting today to rural areas today or to the world in the past.

Monsivais et al (2017) used mobile phone usage to map the patterns of daily activity in an unnamed area of Southern Europe, which included thirty-six cities, in 2007. Data from one million users were analysed.

The number of calls in a day peaked around noon and around 8 pm, giving a bimodal pattern, with lows at 4 pm and 4 am.

The mean time of the first call and the last call of the day were influenced by the sun. So, despite artificial lighting, the "findings suggest that the length and timings of the human daily rhythms, still have a sensitive dependence on the seasonal changes of the sunlight" (Monsivais et al 2017).

1.4.1. Depression

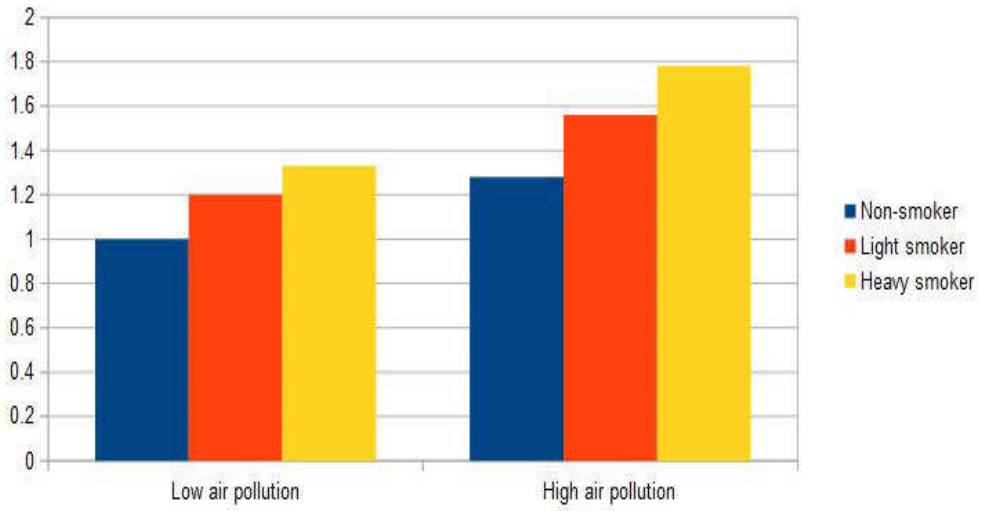
Exposure to air pollution has been linked to depression (eg: Kim et al 2016; study in South Korea), as well as tobacco smoking to depression, both in combination and separately (eg: Boden et al 2010).

In a study using data from six low- and middle-income countries, Lin et al (2017) found that "exposure to ambient PM 2.5 may increase the risk of depression,

and smoking may enhance this effect" (p157). The six countries were China, Ghana, India, Mexico, Russia, and South Africa, and the participants were part of the World Health Organisation Study on global AGEing and adult health (SAGE) (Kowal et al 2012). Face-to-face surveys were carried out between 2007 and 2010 with 41 785 individuals.

Depression was categorised based on self-reported symptoms, diagnostic criteria, and use of depression-related healthcare services in the past one year. Smoking status was defined as never/ever, occasional or daily, for less or more than fifteen years, and less or more than eight cigarettes per day. Air pollution (PM 2.5 concentration) was calculated for an area from satellite information and local detectors. Relevant control variables included social-economic status, alcohol consumption, body mass index, and physical exercise.

Overall, 8% of the participants were classed as depressed, and this group were significantly more likely to be older than non-depressed participants, to be exposed to higher air pollution, to be female, unmarried, less educated, and living in rural areas, and to be smokers, smoking more frequently and more cigarettes per day. After statistical analysis, including controlling other variables, individuals exposed to high levels of air pollution who were heavy smokers were 1.8 times more likely to be depressed than non-smoking individuals exposed to low air pollution, for example (figure 1.1).



(Data from Lin et al 2017 table 4 p160)

Figure 1.1 - Odds ratio of depression.

Lin et al (2017) reflected on the explanation of the findings. Though the mechanisms for the association

between PM 2.5 and depression are unknown, one possibility is that particulates stimulate the immune system "leading to inflammation and oxidative stress in the nervous system; these inflammatory factors have been closely related to the development of some depressive disorders... It is also thought that smoking may decrease the clearance and increase the deposition and retention of fine particles and thus enhance the health effects" (Lin et al 2017 p161).

This study had a large diverse sample, and "high-quality survey data were secured through tremendous efforts regarding homogenising the study design, with standardised data collection, and training and certifying data collectors" (Lin et al 2017 p160). However, the researchers recognised the following limitations:

- A cross-sectional study (which does not allow establishing of causality).
- Three year average air pollution concentrations were calculated from satellite data. "These measurements were more likely to reflect the background air pollution levels and may not reflect direct levels of individual exposure" (Lin et al 2017 p161).
- Some data were missing for over one-tenth of the sample.
- Individuals with severe depression may be more likely to refuse to participate.
- Information not collected for some relevant variables (eg: history of depression).
- No data collected on other aspects of air pollution (eg: ozone).

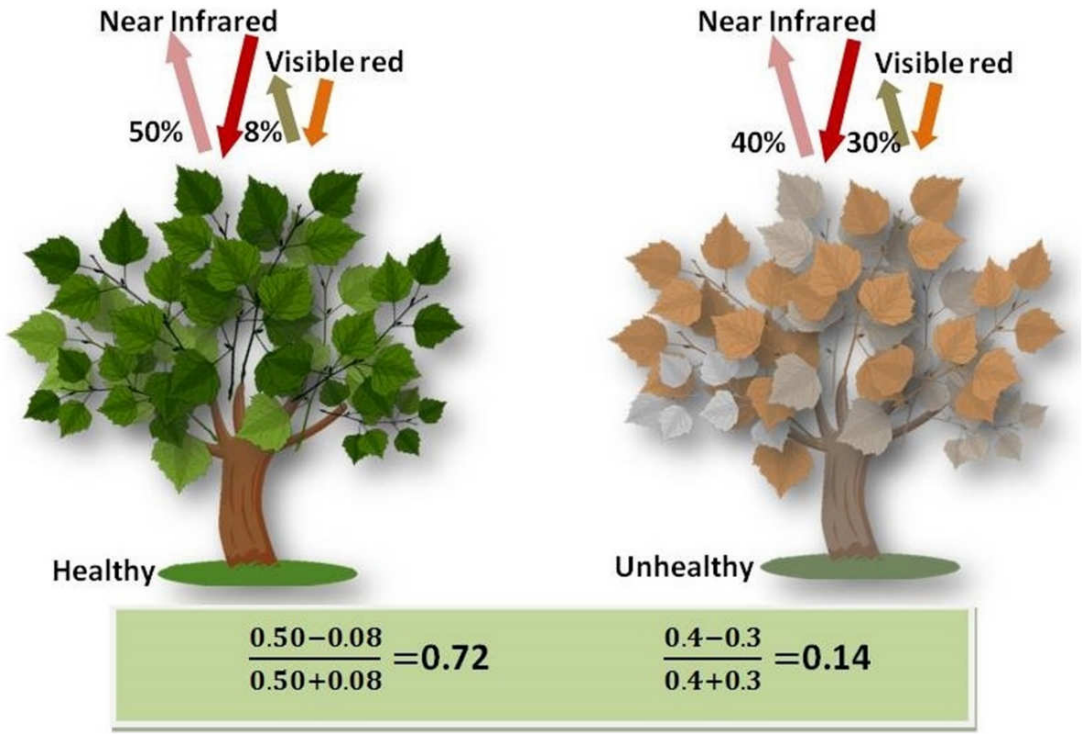
1.4.2. Greenness and Cognitive Development

Green spaces can be beneficial for children's cognitive development, through mitigating traffic-related air pollution and noise, or through encouraging physical activity (Dadvand et al 2015).

In a study in Barcelona, Spain, Dadvand et al (2015) concentrated on working memory and attentiveness in over 2500 7-10 year-olds. Exposure to green space was based on satellite data and observation of school localities. Over a 12-month period, improvements in working memory and attentiveness were significantly greater in areas with high surrounding greenness. The difference between children in the areas of highest and lowest greenness was

improvements equivalent to 5-6% more in working memory, and a 1% reduction in inattentiveness. Less traffic-related air pollution was key.

Wu et al (2014) reported better student performance at schools with high surrounding greenness in a US study. They used the Normalised Difference Vegetation Index (NDVI), which is "the ratio of absorbed visible light and reflected near-infra-red to the total amount of visible and near-infra-red radiation striking a surface" (Wu et al 2014) (figure 1.2). A high NDVI score is taken as a sign of "greenness". It can be calculated from satellite images.

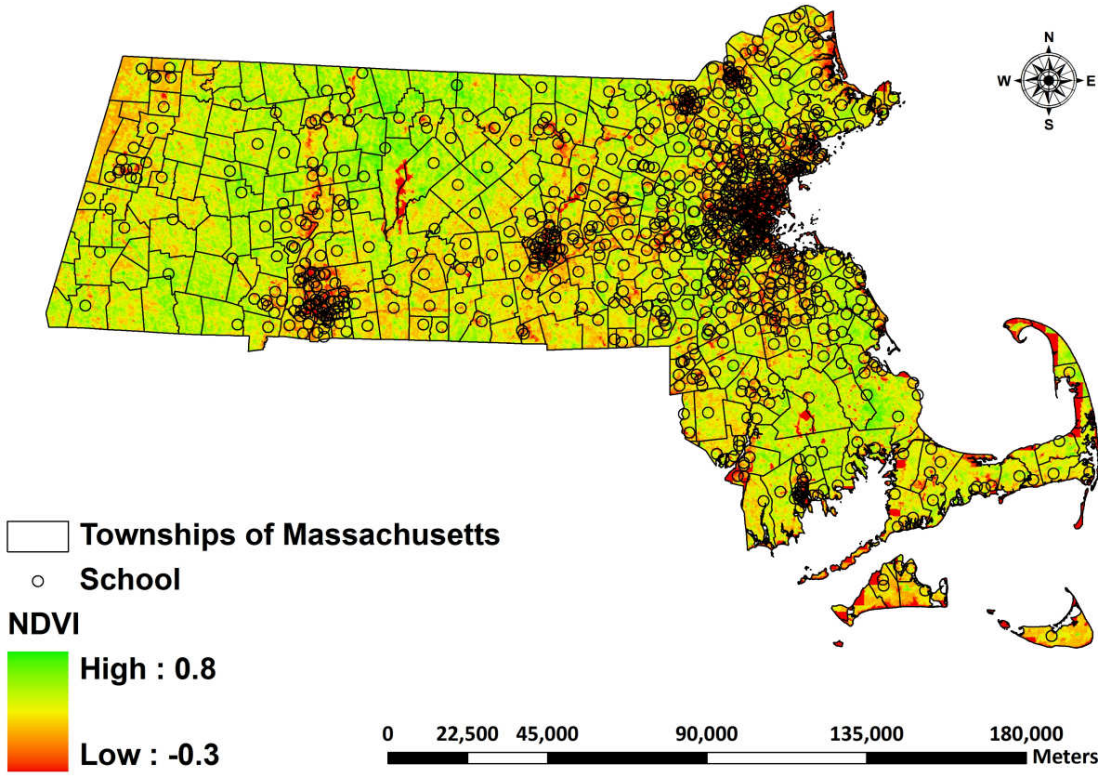


(Source: Wu et al 2014 figure 1)

Figure 1.2 - Example of high and low NDVI scores.

Wu et al (2014) calculated the NDVI around schools in Massachusetts (figure 1.3), and collected data on pupil performance in English and Mathematics. Pupils at schools with more greenness showed significantly better performance (even after adjustment for income levels, gender, and levels of urbanisation).

The data on performance were averages for the school, not individual pupils, and there was no information on "indoor greenness".



(Source: Wu et al 2014 figure 3)

Figure 1.3 - NDVI scores in 2012.

1.4.3. Artificial Light at Night

Animal-assisted pollination is used by the vast majority of wild plants. The decline in pollinating insects has been linked to human actions like habitat changes and intensive agriculture, the use of pesticides, the spread of pathogens and invasive alien species, as well as climate change (Knop et al 2017). Knop et al (2017) added artificial light at night to the list.

These researchers performed an experiment using meadows in Switzerland in 2014-15. Street lamps were set up in half of fourteen sites, and data were collected on plant-insect interactions in all meadows. There were significantly fewer visits to plants by insects in illuminated meadows (62% less), and this resulted in a 13% reduction in fruit at these sites.

1.5. DRONE NOISE

There is a growth in small unmanned aerial systems (sUAS) (colloquially called "drones") in recent years, and Christian and Cabell (2017) reported work studying the psychoacoustic effects (ie: the rating of annoyance of the sound). Thirty-eight participants listened to 103

different drone and vehicle sounds at a NASA research centre in the USA, and rated each one on an eleven-point scale of annoyingness. Final analysis was made on 46 sUAS sounds and twenty road vehicle noises (as controls). Though the two types of sounds were of equal volume, the sUAS sounds were perceived as more annoying. "This result casts doubt on the idea that sUAS operators can expect their operations to be greeted with minimal noise-based opposition as long as the sound of their systems are 'no louder than' conventional package delivery systems" (Christian and Cabell 2017 p20).

The participants did not know that there were listening to sUAS sounds as the recordings were presented as "the future of transportation", so it was unclear why the drone sounds were so annoying. "One reason for the difference might relate to how slowly most commercially available drones move. A drone takes a lot longer to pass by than a car travelling down a residential street, and a common complaint was how the drone sounds seemed to loiter" (Wilkins 2017 p7).

1.6. CHANGING ATTITUDES

Beliefs regarding human-caused climate change (CC) are linked to political ideology, particularly in the USA (eg: political conservatives and low support for action with negative economic consequences to combat CC) (Baldwin and Lammars 2016). For example, Gromet et al (2013) found that political conservatives were less likely to buy an energy-efficient product if the advertisement for it mentioned CC.

Baldwin and Lammars (2016) showed how messages about CC can be linked to key values for political conservatives in six online studies. The authors stated: "... conservatives tend to evaluate the present relative to the way things were in the past... more strongly endorse tradition and conformity and prefer the certainty of the past to the uncertainty of tomorrow" (Baldwin and Lammars 2016 p14953). But statements about action on CC, for example, by the United Nations are future-focused.

Study 1 - Participants read a message about CC either future-focused (eg: "looking forward to our nation's future...") or past-focused (eg: looking back to our nation's past..."). The message was attributed to a conservative or a liberal. Self-reported political conservatives responded more positively to the past-focused version. There was no difference for political liberals.

Study 2 - This was the same as Study 1, but the messages were attributed to a political moderate. The

same results as above were found.

Study 3 - This study used photographs showing the effects of CC that were presented as past- or future-focused. Significantly less favourable attitudes were expressed by conservatives in the future-focused condition.

Study 4 - Participants were presented with the websites of two real environmental charities that were rated as either past-focused in its tone or future-focused, and asked which one they would give an allocated $2 to. "Conservatives donated more to the past-focused charity than the future-focused charity, while this is not the case for liberals" (Baldwin and Lammars 2016 p14955).

Study 5 - As Study 4, but participants only saw one website. "When comparing donations among conservatives and liberals separately, we found that conservatives gave more to past-focused charity than to the future-focused charity" (Baldwin and Lammars 2016 p14956).

Study 6 - This study used two specially created environmental charity websites with the focus either "restoring the planet to its original state" (past-focused) or "creating a new earth for the future" (future-focused). Participants were asked to donate their allocated 50 cents to one charity. The conservatives gave an average of 30 cents to the past-focused charity and 20 cents to the future-focused charity, and liberals the opposite. These are both significant differences in allocation.

Looking at all the studies, Baldwin and Lammars (2016) calculated that the past-focused message increased the pro-environmental attitudes of conservatives to equal the attitude of liberals. "Past comparisons largely bridged the political divide in addressing global warming and climate change observed in the future-focused and control conditions" (Baldwin and Lammars 2016 p14956).

These studies, however, were with small samples of online volunteers at the "Amazon Mechanical Turk" website, which recruits individuals for paying tasks.

This research fits with other studies (both generally in psychology and specific to CC) that show that reframing messages can change attitudes. For example, CC presented with terms like "contamination" and "purity" produced more pro-environmental attitudes among conservatives than with terms like "harm" and "care" (Feinberg and Willer 2013).

1.7. CHANGING BEHAVIOUR

Anomaly (2014) described children as a "public good". "A good is any product that can be used to satisfy a desire. Goods are public if they are non-rival and non-excludable, meaning that, once produced, everyone can enjoy them in equal amounts, regardless of whether they paid for their production" (Anomaly 2014 p173). Put simply, having children is a benefit in the future, both in terms of conserving desirable traits like intelligence and kindness, and in terms of workers to provide funding for welfare programmes (Anomaly 2014).

So, "reproduction is a social category... because the collective upshot of our individual choices shapes the gene pool for all future generations, and because traits that are heritable will impact people who share a common environment. The environment includes not only the air we breathe and the land we live on, but the culture and political institutions we share, the technology that is created and transmitted through exchange, and the kinds of people who populate our planet" (Anomaly 2014 p177).

However, Buchanan et al (2000) observed that "significant portions of the costs of having children are externalised in virtually all societies – that is, borne by others besides the parents (or children). The more this happens, the greater a claim these others might make to have some say in, or control of, the costs imposed on them" (quoted in Anomaly 2014).

Population growth is a key driver of increasing greenhouse gases (GHG) emissions, and in the USA and Europe it is "a nearly 1:1 correlation" (Hickey et al 2016).

Consequently, Hickey et al (2016) argued that the threats produced by climate change make "population engineering" justifiable - ie: "the intentional manipulation of the size and structure of human populations" (p845). Such an argument goes against "procreative liberty", adults' moral right to procreative freedom enshrined by the United Nations in the Proclamation of Tehran in 1968 - "Parents have a basic human right to determine freely and responsibly the number and spacing of their children" (quoted in Hickey et al 2016) [3].

[3] Sen (1994) described two responses to the "population problem" generally - "collaboration" ("individual choice and a collaborative solution") or "override" ("legal or economic coercion"). These views have their origins in the late 18th century writings of French mathematician Condorcet emphasising reasoned action ("collaboration" view), and Thomas Malthus ("override" view) (Sen 1994). The collaboration view can be seen in Kerala state, India where the birth rate has fallen in the second half of the 20th century due to economic and social progress. China's one-child policy is an example of "override", and "its fertility rate seems to have fallen much less sharply than those of Kerala" (Sen 1994).

Concentrating on genetics, and with provisos, Buchanan et al (2000) stated: "we do not reject the thesis that stewardship of the gene pool in the interests of future generations is an appropriate role for the state" (quoted in Anomaly 2014). This may vary as "the state could perform the benign role of increasing informed consumer choice through education and subsidies for genetic research, the more extensive role of providing financial assistance to those who wouldn't otherwise be able to afford genetic screening or genetic engineering, or more intrusive measures such as reproductive licensing with compulsory sterilisation for the unlicensed" (Anomaly 2014 pp181-182) [4].

Hickey et al (2016) outlined four types of "interventions" to effectively reduce human fertility rates:

i) "Clearly non-coercive choice-enhancing interventions" - Policies to encourage the preference for less children (eg: changing cultural norms and individual beliefs via rational mass media campaigns).

ii) "Possibly coercive preference-adjusting interventions" - Similar policies as above but more psychological manipulation - eg: power of celebrity endorsement; use of emotional appeal (ie: "beyond rational persuasion").

Hickey et al (2016) pointed out that these interventions "don't have to be covert or present false information, and as such it seems less likely that their influence would rise to the level of objectionable manipulation, which often requires deceit and trickery" (p860).

iii) "Possibly coercive incentivising interventions" - Policies that directly alter the costs and benefits associated with reproductive choices - eg: higher hospital delivery fees for second child onwards, and removal of maternity leave after third child (both used in Singapore in the 1970s; Hickey et al 2016).

iv) "Clearly coercive interventions" - eg: enforced sterilisation.

LaFolette (1980) proposed theoretically for the

[4] Archard and Benatar (2010) proposed the "principle of the least restrictive alternative". They stated: "The extent to which we should interfere with reproductive freedom is a product not merely of the severity of harm that will be prevented. Where reproductive harm can be avoided equally well and efficiently by more than one kind of interference with reproductive harm, it is obviously preferable to choose the lesser interference. Thus, if we could prevent reproductive harm equally well either by physically restraining somebody or by incentivising her… the latter would be better" (quoted in Anomaly 2014).

licensing of prospective parents as "a way to prevent extremely irresponsible and abusive parents from having children. The rationale is that abused and neglected children are harmed by their parents, and significantly more likely to harm other people because of their abuse" (Anomaly 2014 p183). There are practical problems with licensing, including how to punish violators (eg: sterilisation). Anomaly (2014) commented: "Even if a licensing system were reasonably accurate, carried out fairly, and only used to prevent extremely irresponsible people from reproducing, the most serious problem with using sterilisation as a penalty for socially harmful reproductive behaviour is that most bad parenting and reproductive choices pose only a risk of harm. Thus, we would be preventing probabilistic rather than actual harms" (p184).

Anomaly (2014) observed that the "history of eugenics warns us that we should be wary of using coercive state intervention to achieve collective goals" (p187). But, as an alternative, he continued: "enabling future people to understand and use biomedical technology to enhance their children has the potential to harmonise private choice and collective welfare in a way that minimises unnecessary intrusion" (Anomaly 2014 p187).

Hickey et al (2016) preferred incentivised interventions under the slogan of "carrots for the poor, sticks for the rich" - ie: positive incentives to reduce fertility among the poorer individuals and countries, and negative incentives for richer individuals and countries. On a positive note, the authors concluded that "it will be easier for individuals to cut their GHG output by reducing their fertility than by reducing their personal consumption" (p860).

Coercive interventions are sometimes proposed to deal with potential disability. Mitchell and Snyder (2003) described "eugenic logic" as viewing disability as "the master trope of human disqualification", while Garland-Thomson (2011) argued that "disability is perhaps the essential characteristic of being human" (counter-eugenic logic) (both quoted in Garland-Thomson 2012).

Garland-Thomson (2012) summarised eugenic logic, thus: "Because disability is understood to disqualify us from access to the benefits and status of the properly human, it is a place that we do not go willingly or welcome into a life, perhaps especially in our contemporary time and place. The birth of a disabled child or the onset of disability is seen as a catastrophe or a failing. This is reasonable because being disabled reduces our social capital by shifting us into an unappealing and unexpected position... called 'the sick role', a place on the far edge of the circle of human

commonality where one is exempt from normal social roles and obliged to fight hard to re-enter society by getting well soon" (p340).

Garland-Thomson (2012) then set about providing the case for "conserving disability" - ie: "the cultural and material contributions disability offers to the world" (p341) (eg: "disability generates circuits of meaning-making in the world"; p344). For example, Scully (2008) talked of "thinking through the variant body" which gives disabled bodies "ways of knowing shaped by embodiment that are distinctive from the ways of knowing that a non-disabled body develops as it interacts with a world built to accommodate it" (Garland-Thomson 2012 p346).

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2. ENVIRONMENT AND ANIMALS

2.1. EXTREME CLIMATE EVENTS

Extreme climate events (ECEs) are increasing in frequency, intensity and duration with climate change (van de Pol et al 2017) [5]. How will these events have a biological influence? van de Pol et al (2017) outlined some of the issues in answering this question.

1. Defining ECEs - There is no "universally accepted definition" (van de Pol et al 2017). Definitions include:

- "the occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable (typically 5% or 10%" (IPCC 2012).

- "climatic extremes that have a strong abruptness (ie: biological magnitude over biological duration" (Jentsch et al 2007).

- "climate causes the cumulative resources available to an individual to be exceeded by the sum of its energetic costs. This allostatic overload triggers the emergency life-history stage that temporarily allows the individual to cease regular activities in an attempt to survive the extreme conditions" (Wingfield et al 2017).

- "climatic conditions that cause the (biological) response to be in the eg 5% of most extreme values of the (biological) response variable" (van de Pol et al 2017 p3).

Definitions also vary on the inclusion of impact (ie: climatological (eg: IPCC 2012) or impact-related (eg: Jentsch et al 2007)), the type of impact, and the

[5] For example, drought recovery time (ie: the time to return to the pre-drought state) is largest in the tropics and high northern latitudes, and there is the potential for permanent damage to an ecosystem (eg: desertification). Key is the frequency of droughts which is expected to increase with climate change (Schwalm et al 2017).

nature of the "event" (van de Pol et al 2017).

2. Detection of ECEs - In order to establish the biological impact, it is necessary to identify the ECE.

"A mechanistic understanding of the relationship between climate and the biological response (eg: via models, or knowledge about how climate impacts the biological response over the full range of climate values, not only at the extremes) is extremely valuable as it not only increases the power to correctly attribute responses, but may even allow for reliably predicting biological impacts when few climate extremes are observed" (van de Pol et al 2017 p5).

It is also important to control for other variables (eg: habitat destruction), and to see the interaction of ECE and other factors. For example, the autumn moth (Epirrita autumnata) produces more eggs in "exceptionally warm" winters in sub-Arctic habitats, and their caterpillars ferociously eat birch tree leaves, which would produce defoliation and turn forests into open heathland over the long-term (van de Pol et al 2017).

Table 2.1 lists 3 specific examples of studies of ECEs and birds [6] [7].

STUDY	FINDING
Bailey et al (2017)	Shorebirds not nesting on higher ground despite increased frequency of extreme tidal floods
Pardo et al (2017)	Positive effect on population growth rate of black-browed albatrosses (Thalassarche melanophris) with increases in mean sea surface temperature
Palmer et al (2017)	Two species of wren showed declining population despite favourable climate changes for them, which suggested "other factors outweighed or prevented individual level impacts of ECE from cascading onto population demography" (van de Pol et al 2017 p10)

Table 2.1 - Three examples of studies of ECEs and birds.

Extreme weather events can influence natural selection. This was first observed in 1898 by comparing house sparrows that survived a severe snowstorm to those that did not (Campbell-Staton et al 2017).

More recently, Campbell-Staton et al (2017) investigated the changes in the green anole lizard after

[6] Voelkl and Fritz (2017) reported that around one-fifth of all bird species are long-distance migrants, travelling hundreds and thousands of miles (eg: Arctic tern - Arctic to Antarctic).

[7] The International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/) keeps a record internationally.

an extremely cold winter in south-eastern USA in 2013-14. The cold influenced natural selection by killing the less cold-hardy individuals, and thus leaving the more cold tolerant. Key is the fact that cold tolerance is heritable in this animal.

"Gene expression in southern survivors shifted toward patterns characteristic of northern populations. Comparing samples before and after the extreme winter, fourteen genomic regions were differentiated in the surviving southern population..." (Campbell-Staton et al 2017 p495).

2.2. ANTHROPOGENIC NOISE

Anthropogenic noise is that caused by humans. "The exact mechanisms by which noise disrupts animals and their environments are still debated, but recent work links noise exposure with alterations in vocalisation, vigilance, foraging, and parental behaviour" (Kleist et al 2018 pE648).

Glucocorticoids (GCs) are secreted by the adrenal gland in response to a stressor, and they can be measured in the blood. However, prolonged and chronic stress can produce decreased levels of GCs as a coping mechanism (Kleist et al 2018).

Kleist et al (2018) investigated GC levels and anthropogenic noise effects among birds breeding in San Juan Basin, New Mexico, USA. Two hundred and forty nest boxes were placed in twelve different areas based on the level of noise. Three species of birds were the inhabitants - ash-throated flycatcher, western bluebird, and mountain bluebird. This was a field experiment.

A negative correlation was found between GC and noise level in adults and nestlings. This confirmed findings with adult female European starlings (Cyr and Romero 2007), and white-crowned sparrow chicks (Crino et al 2013), for example.

The anthropogenic noise itself could be a stressor or "acoustic masking" can be the indirect mechanism. This is where the noise pollution reduces the animal's ability to detect normal calls. "For example, the presence of birdsong and chatter is thought to signal the absence of nearby predators. Thus hearing birdsong could be used as a safety signal in birds, and continual masking could chronically impair risk perception, leading to environmental uncertainty and activation of the stress response" (Kleist et al 2018 ppE650-651).

Hatching success was also found to be reduced in the western bluebird with increased noise. This may because this bird is noise tolerant while the other two species are not. Being noise tolerant puts the western bluebird in an equal-preference ecological trap (Robertson and

Hutto 2006). "An equal-preference trap occurs when a species shows equal preference for low- and high-quality habitats but incurs a reproductive cost in low-quality habitats" (Kleist et al 2018 pE652). It could be that higher noise leads to increased distraction and vigilance by the females, which "could contribute to reduced hatching by a trade-off with incubation time leading to fluctuations of nest temperature and reduced time at optimum temperature" (Kleist et al 2018 pE652). Alternatively, noise leads to "a breakdown in courtship and copulation, or males, in contrast to females, might sort themselves by quality with noise, potentially leading to low-virility males in loud areas" (Kleist et al 2018 pE652).

The researchers noted that "conditions at our sites are not unusually loud compared with anthropogenic noise found in many areas across the United States, or globally" (Kleist et al 2018 pE654).

2.3. OCEAN ACIDIFICATION

Smell (appendix 2A) is an important sense for fish, and ocean acidification as a result of increased carbon dioxide in the atmosphere is changing the ocean's chemistry and consequently affecting fish (Dixson 2017) [8].

Dixson et al (2010) worked with orange clownfish (Amphiprion percula), whose larvae swim towards the injected scent of a friendly fish and away from that of a predator (eg: rock cod and dottyback) in a normal laboratory seawater tank. But when the seawater tank was made acidic (based on predictions for the levels in the oceans by 2100) the young fish showed no difference between the two smells.

Eggs were laid and reared in normal or acidic seawater, and then the larvae were tested with a choice of water flumes containing olfactory cues:

- Condition 1 - empty seawater vs empty seawater
- Condition 2 - predator 1 vs empty seawater
- Condition 3 - predator 2 vs empty seawater
- Condition 4 - non-predator 1 (eg: sturgeonfish) vs empty seawater
- Condition 5 - non-predator 2 vs empty seawater

[8] "Since the Industrial Revolution, approximately 142 billion tonnes of anthropogenic CO2 has been absorbed by the oceans, resulting in ocean acidification at a rate far faster than any time in the last 650 000 years, and causing the average pH of the ocean to drop by 0.1 units. If global emissions continue on the current trajectory, atmospheric CO2, currently at 390 ppm [parts per million], is predicted to reach 730–1020 ppm by 2100, causing a further drop in ocean pH of 0.3–0.4 units" (Simpson et al 2011 p917).

- Condition 6 - predator 1 vs non-predator 1; predator 2 vs non-predator 2.

Larvae raised in normal seawater showed the following behaviours:

- Condition 1 - no preference
- Conditions 2 and 3 - 90% preferred empty seawater
- Condition 6 - 88% preferred non-predator

"Larvae reared in acidified water always chose the stream of water containing an olfactory cue over untreated water, regardless of the source of the odour" (Dixson et al 2010 p71). Thus, all larvae preferred the predator in Conditions 2 and 3, and they showed no preference in Condition 6.

Simpson et al (2011) continued this research. Young clown fish typically avoid the swimming around the coral reef during the day based on the noise level, and move around at night when quieter. When daytime reef sounds were played through a speaker at one end of the tank, the fish moved to the other end. But when the acidity in the seawater was increased, the fish now moved towards the speaker more often.

Larvae from a single clutch of eggs were hatched and reared in one of four different tanks - current seawater acidity (CO^2 at 390 parts per million), 600 ppm, 700 ppm, or 900 ppm. An acoustic choice chamber was used for testing. This was a tank with two compartments, each containing a speaker, which played either reef sounds or silence. The amount of time spent in each compartment over two minutes was recorded. Larvae from normal seawater spent three-quarters of the time in the silent chamber (ie: fled the reef sounds as expected), while the larvae from the three acidic conditions showed no avoidance. In fact, the highest acidity seawater larvae preferred the sounds.

Dixson et al (2015) performed similar experiments with 24 smooth dogfish (small shark) caught off the coast of New England. One-third were placed in a normal seawater tank (controls), one-third in a mildly acidic seawater tank (to mimic the oceans predicted in 2050), and the remainder in seawater to mimic acidity in 2100 (ie: highly acidic). The smell of squid (prey) was infused at one end of the tank. Sharks in the control and mildly acidic tanks moved towards the smell as expected, but the other group avoided the smell. "It is surprising to see a predator lose interest in, and even avoid the smell of, its food... Given the importance of sharks as top predators to ecosystems and their known vulnerability to environmental changes, ocean acidification could be a major threat to these animals and the ecosystems where

they live" (Dixson 2017 p38).

Munday et al (2013) reported similar findings with juvenile damselfish in the wild. Individuals were caught and kept in high acidity seawater for four days. When tested in the tank, the fish moved towards predator smells. Then the fish were returned to their reef habitat off Australia, and were found to be more likely to be eaten by predators. The acidic seawater had made the fish more bold/risk-taking which led to their predation. It appears that the acidification interferes with brain chemistry (Dixson 2017) [9].

2.4. HUMAN-POLAR BEAR INTERACTIONS

Human-polar bear (HPB) interactions have become more common since the 16th century with increasing maritime exploration, and the first recorded death (involving European explorers) was 1595. Indigenous people in the Arctic had interacted before that, but there are no written records (Wilder et al 2017).

HPB interactions are changing today because "polar bears now face a new and unprecedented threat due to the effects of climate change on their sea ice habitat" (Wilder et al 2017 p538). Hunting opportunities have been reduced by longer ice-free periods, and there have been reports of infanticide, cannibalism and starvation in some polar bear sub-populations (Wilder et al 2017).

"Increased frequency of hungry bears on land due to retreating sea ice, coupled with expanding human activity in the polar bear range, is expected to result in a greater risk of human-polar bear interaction and conflict" (Wilder et al 2017 p538).

Wilder et al (2017) analysed data from the Polar Bear-Human Information Management System (PBHIMS), which records HPB interactions in Arctic Canada, Greenland, Norway, USA, and Russia [10]. There were 73 confirmed polar bear attacks on humans during the period 1870 to 2014, in which twenty people died. Male bears were the main culprit.

Where the data were more accurate (since 1960), there were 47 attacks between 1960 and 2009, but 15 in 2010-14. These figures compare with 42 serious or fatal human injuries from black and grizzly bears between 1960

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[9] More generally, surveying the data on 63 fished populations around the world, Barnett et al (2017) found that "age truncation" was rife (ie: a shortest of older fishes). The researchers stated: "The implications of truncated age structure with few old individuals are obvious: fish traits often vary with age, and thus phenotypic and life-history diversity will decline when age structure is truncated" (Barnett et al 2017 p2846). Put simply, greater instability in many marine communities.

[10] Data come from government agencies, news reports, and ships' logs, for example.

and 1998 in Alberta, Canada (Herrero and Higgins 2003), and sixty-three fatal attacks by black bears in North America in the 20th century (Herrero et al 2011). Most of these attacks were defensive by females with young.

Wilder et al (2017) concluded: "Although the risk of a polar bear attacking a person remains low, it does exist, particularly when bears are nutritionally stressed and in poor body condition, which was characteristic of bears involved in the majority of attacks we analysed" (p542).

2.5. APPENDIX 2A - SMELL

Floating plastic debris at sea is ingested by many organisms, including seabirds like albatrosses, petrels and shearwaters. Savoca et al (2016) showed that the debris produces a smell that is similar to olfactory cues used by these birds when hunting prey. The smell of dimethyl sulfride is produced by zooplankton and this triggers the foraging activity of organisms, but this smell is mimicked by rotting plastics.

2.5.1. Marine Litter

"Marine litter", defined by the United Nations as "any persistent, manufactured or processed solid material discarded, disposed of, abandoned or lost in the marine and coastal environment" (quoted in Watts et al 2017), is "one of the most indiscriminate and pervasive pollution issues facing our seas and oceans today" (Watts et al 2017 p416).

Marine litter that comes ashore is "beach litter", along with land-based sources (eg: recreational activities on the beach). The amount of beach litter in the UK is reported to have risen by one-fifth in the decade since 1994 (Watts et al 2017).

Watts et al (2017) analysed the data for one area of south-west England (ie: nine beaches on the north Cornish coast) between 2005 and 2011. There were nearly 250 000 litter items removed in that period, with plastics dominating (90%).

The researchers noted that "the majority of this litter comprised small, fragmented, plastic pieces less than 50 cm in length, much of which had been subject to significant weathering. This weathering suggests that these items have been in the environment and/or at sea for a long period prior to being collected as part of these beach cleans. These weathered plastic pieces are therefore impossible to link to their original source due to their fragmented nature, but have clearly been present in the environment for an extended period of time prior to being removed and recorded for this study" (Watts et

al 2017 pp419-420). Only one-fifth of litter was directly attributable to beach users.

Between monthly cleans the litter was "restocked" throughout the year. Watts et al (2017) concluded that the "constant input of fragmented (aged) litter on to our study beaches each month means that floating plastic debris is accumulating off the coast of North Cornwall and being driven on to these coasts throughout the year" (p423).

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3. EXERCISE, DIET, AND HEALTH IN THE MODERN ENVIRONMENT

3.1. LONG-DISTANCE TRAVEL

Time changes through long-haul travel affect physical performance. Controlled laboratory experiments suggest that it is easier to delay than advance the body's circadian rhythms, so jetlag symptoms will be worse with travelling east (moving found in time) than west (moving back in time). These symptoms include a misalignment of body temperature and melatonin with external cues, and negative consequences will continue until the internal body clock and the external cues are aligned (Fowler et al 2017) [11] [12].

Controlled studies of real-life travel have found changes in grip strength, and reduced counter-movement jump performance after trans-meridian travel (Fowler et al 2017).

Recently, Fowler et al (2017) investigated physical performance after east and west travel with ten healthy male students at an Australian university. Performance data were collected prior to travel (BASE), after travel from Australia to Qatar (WEST) [13], and following return from Qatar to Australia (EAST) [14]. The performance test include a 20-metre sprint (timed), and a counter-movement jump (eg: height jumped).

The travel west had little effect on performance (and sleep and fatigue), but the travel east significantly reduced performance for two days following it compared to BASE and WEST measures.

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[11] Long-distance air travel also places demands on the body in terms of, for example, uncomfortable seating, noise levels, and dehydration (Fowler et al 2017).

[12] Generally, physical performance has a circadian late afternoon peak and a morning nadir (Fowler et al 2017).

[13] This involved 21 hours of travel, and crossing eight time zones.

[14] The participants stayed ten days in Qatar.

3.2. SNACKING

The positive health benefits of regular exercise can be counteracted by post-exercise unhealthy snacking or excessive food consumption. Dimmock et al (2015) proposed that exercise motivation can influence the post-exercise eating behaviour - ie: "post-exercise eating behaviour may be influenced by the extent to which exercise is experienced as autonomous (ie: characterised by a sense of value, alignment with one's identity, and/or enjoyment) or controlled (ie: characterised by feelings of internal or external pressures)" (Beer et al 2017 p2110).

Dimmock et al (2015) described three processes involved in autonomy and self-control:

i) Facilitation of conscious reflective licensing - "Licensing represents the belief that unhealthy behaviours (eg: unhealthy food choices) are justified after engagement in a healthy behaviour (eg: exercise)" (Beer et al 2017 p2116). An individual has licence to do something "bad" (eg: "go wild") after the self-control of a "good" behaviour.

ii) Non-conscious impulsive processes - The "exertion of self-control (which is considered a limited resource) results in a subsequent state of 'ego-depletion', which consequently reduces the ability to further override natural or habitual responses (such as consuming pleasurable but unhealthy food)" (Beer et al 2017 p2116). The exertion of self-control, particularly on an undesirable or tiring task, leaves the individual unable to "resist temptation".

iii) Physiological responses - "For instance, there is some evidence to suggest that engaging in tasks requiring self-control (eg: exercising under controlling conditions) may result in lower levels of blood glucose, which in turn may have implications for appetite" (Beer et al 2017 p2116).

Fenzl et al (2014) reported that individuals who self-imposed physical activity (ie: controlled motivation) consumed post-exercise food more than individuals who had autonomous motivation for exercise (ie: performed physical activity when they wanted), while Werle et al (2011) found that participants were more likely to want snacks after reading about "tiring" than "fun" physical activity. It seems that lack of perceived control and choice for exercise is associated with greater post-exercise food choice and unhealthier food.

Beer et al (2017) confirmed this idea in an experiment. Fifty-eight healthy Australian adults were randomised to a choice or no choice exercise condition

(independent variable). The former condition offered the participants the choice of exercise mode (bike or treadmill), intensity level, duration and time of day, and music playing. The no choice condition had these parameters imposed after stating their preferences. After the exercise the participants completed questionnaires while food was freely available. The amount eaten and type of food were recorded (dependent variable).

Significantly more food was eaten (mean: 2456 vs 1668 kJ), and more unhealthy food was chosen (mean: 1412 vs 790 kJ) by the no choice condition participants.

This study had the strength of being a controlled experiment, but it "did not extend past the immediate post-exercise meal", nor was it "clear whether a specific aspect of choice relating to the exercise bout (ie: duration, mode, intensity) had the most impact on subsequent food intake" (Beer et al 2017 p2117).

3.3. PHYSICAL ACTIVITY

Levels of physical activity (PA) "vary widely between countries", and this statement is based on self-reports (with attendant biases) or wearable sensors (with limited samples) (Althoff et al 2017).

Althoff et al (2017) overcame these weaknesses of other methods by using smartphone app data from over 71 000 anonymised users (ie: 68 million days of minute-by-minute step recordings) from 111 countries. The overall average was around 5000 steps per day.

Looking at specific countries, Japan had high PA (over 5800 steps average), while Saudi Arabia was the opposite (average 3103 steps per day). Furthermore, the latter had large variance - ie: a great variety within the country [15]. There was a significant correlation between PA and obesity prevalence.

Analysing the data from 69 US cities, the walkability of the city (ie: features that encourage walking, like pavements or parks) was associated with the level of PA. High walkability cities had more daily steps for all body sizes, as well as disproportionately more for women.

3.3.1. Perceived Physical Activity

Physical activity/inactivity is related to health, but so is the individual's perceptions about their level of physical activity (Zahrt and Crum 2017).

Crum and Langer (2007), for example, found that

[15] In countries with high PA inequality, females are disproportionately less active than males.

hotel cleaners perceived themselves as physically inactive as they did not recognise the activity in their work as "good exercise". The researchers provided a twenty-minute talk explaining the benefits of the cleaning-related exercise, and the cleaners subsequently showed physiological health improvements (compared to the control group who did not receive the talk).

Zahrt and Crum (2017) offered three potential mechanisms to explain these findings:

i) Perceptions affect motivation - The cleaners who perceived themselves as active became more active (eg: making beds more energetically).

ii) Perceptions affect emotions - Messages about the negative health consequences of physical inactivity can produce negative emotions and demotive as the cleaners (prior to the researcher's talk) struggled to find time to exercise outside work.

iii) Perceptions affect physiology - As in the placebo and nocebo effects, how individuals perceive a medicine can produce physical changes.

Crum and Langer (2007) was a short-term study with a small sample. Zahrt and Crum (2017) looked for longer term benefits using data from the National Health Interview Survey (NHIS), and the National Health and Nutrition Examination Survey (NHANES) in the USA. These are nationally representative regular surveys that include questions about "how much exercise individuals perceive themselves to be getting as compared with other people their age" (p1018). The response options were: "a lot more active", "a little more active", "about as active", "a little less active", and "a lot less active". Actual activity was also self-rated as "very active", "moderately active", or "inactive". Data covering 21 years and over 60 000 adults were analysed.

It was found that "less active individuals perceived themselves to be, as compared with other people their age, the more likely they were to die in the follow-up period. Most notably, individuals who perceived themselves as less active than other people their age had an up to 71% higher mortality risk than those who perceived themselves as more active. More important, this result held when controlling for actual amounts of activity (assessed through comprehensive self-report questionnaires and objective accelerometer data), socio-demographic variables, health status, and other health behaviours" (Zahrt and Crum 2017 p1021).

The correlation between perceived and actual physical activity was quite low, such that one-fifth of inactive individuals perceived themselves as more active

than others and only one-third of active individuals as less active than others.

Zahrt and Crum (2017) ended their article thus: "To be clear, the finding that perceptions play a role in shaping health outcomes does not mean that behaviour is unimportant. Physical activity continues to be a crucial determinant of health... However, in the same way that medical researchers and doctors have grown to appreciate the power of perceptions in evaluating medical procedures and prescribing medications..., researchers and policymakers should appreciate the power of perceptions in evaluating the effects of health behaviours and promoting behaviour change. The determinants of health are manifold and cannot be reduced to any one factor — such as behaviour — however important it may be. It is time that we acknowledge, explore, and harness the powerful influence of perceptions in fostering public health, wellbeing, and longevity" (p1023).

3.4. CALORIC RESTRICTION

Caloric restriction (CR), without malnutrition [16], has been shown to extend the lifespan of various animals in the laboratory, and to delay age-related diseases. One possible explanation is that "CR induces a shift from carbohydrate to fat metabolism" (Roberts et al 2017 p539).

Low-carbohydrate diets (LCDs) also cause this shift. The ketogenic diet (KD) is an extreme LCD, and, in studied mice [17], leads to increased levels of ketone bodies [18], "resembling key features of CR" (Roberts et al 2017).

However, Douris et al (2015) did not find a significant increase in longevity in mice fed a lifelong KD. Roberts et al (2017) were critical of the methodology in this study, particularly of the control mice used, which they rectified in their experiment.

At twelve months old, 130 male mice were placed on one of three diets for the rest of their lives:

- Control - 65% of total calories from carbohydrate, 18% protein and 17% fat.

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[16] Being underweight has consequences, like early menopause (appendix 3A).

[17] Kalbassi et al (2017) placed knockout mice with the Nlgn3" gene turned off (as a model of autism) with other mice, and the sociability deficits of the knockouts were transmitted to the controls. The other mice showed problems with social and courtship behaviours, compared to when housed separately from the knockout mice. This raises concerns about "misinterpretation of experimental results" (Research Highlights 2017).

[18] These are produced by the liver from fatty acids during periods of low food intake. The KD forces the body to burn fats rather than carbohydrates for energy.

- LCD - 70% fat, 20% protein and 10% carbohydrate.
- KD - 89% fat, 10% protein and <1% carbohydrate.

Daily food intake was controlled, whereas Douris et al (2015) allowed ad libitum consumption (ie: as much as mice wanted).

The KD group showed significantly longer median and maximum lifespans than the control group, but not the LCD group (figure 3.1).

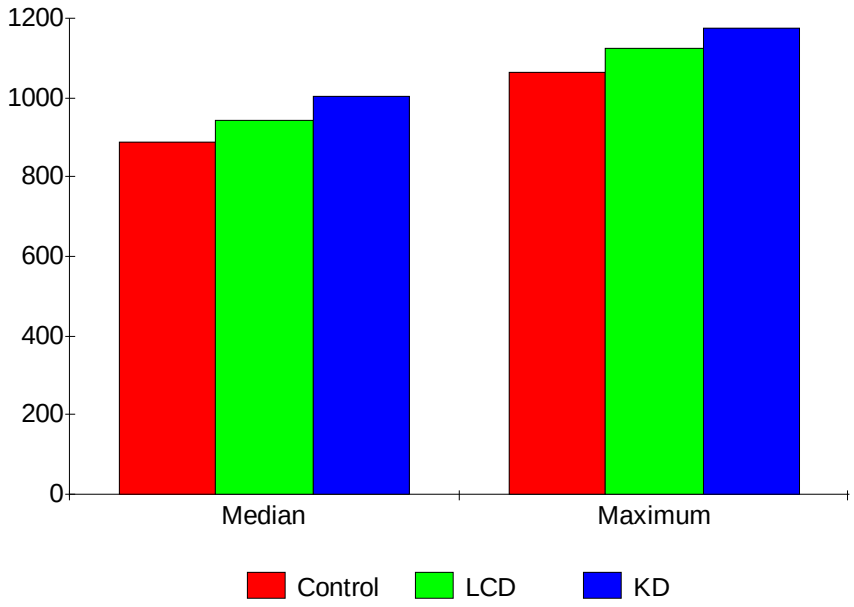

Figure 3.1 - Median and maximum lifespans (in days).

The KD group also maintained health in old age - eg: preserved memory, strength, and endurance at 26 months old. The memory was tested with recall of a novel object one day later. In the novel object recognition test, a mouse is presented with two objects (one known and one novel). If they recall the known object, they will spend more time exploring the novel object, but if the mouse does not recall the known object, both objects will be explored equally.

Roberts et al (2017) noted overall: "Level of energy intake and prevention of weight gain may be particularly important for positive lifespan effects with a KD, and the results of the present study suggest that longevity is increased when a feeding strategy is followed that mitigates weight gain in adult mice" (p543).

3.5. WHAT TO EAT

Roberts and Das (2017) argued that exercise is less important in weight loss than what the individual eats

and how much [19] [20] [21].

Food is not pure protein, carbohydrate and fat, and the body (through digestion) extracts different amounts. For example, whole grains, oats and high-fibre cereals are digested less efficiently, and Roberts and Das (2017) reported a difference of 1000 calories a day less for individuals eating this diet compared to a low-fibre diet.

Batra et al (2013) assigned 133 volunteers to one of two groups for weight loss over six months. The intervention group were told to eat foods high in protein and fibre and low in glycaemic index (GI) (ie: no sudden spike in blood sugar levels - better at suppressing hunger), like fish, beans, apples, and vegetables. The other group were a control, and ate any food they wanted. The intervention group lost more weight than the control, and reported less feelings of hunger.

Ludwig et al (1999) had found similar results in a study with a dozen obese boys who ate different breakfasts. Those on the low GI meal ate an average of 764 calories in the rest of the day compared to 1385 calories after a high GI breakfast.

Lustig et al (2012) noted the health risks of "added sugar" in the diet (ie: "any sweetener containing the molecule fructose that is added to food in processing").

These authors argued for regulation using Babor et al's (2003) four criteria for alcohol control:

- Unavoidability - easily available in a way that early humans did not face.
- Toxicity - eg: association with metabolic syndrome.
- Potential for abuse.
- Negative impact on society.

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[19] Pontzer (2017a) observed that "humans tend to burn the same number of calories regardless of how physically active they are. Yet we have evolved to burn considerably more calories than our primate cousins do" (p24). Among individuals using a lot of energy, the body appears to reduce the calories spent on "housekeeping work" (eg: slower tissue repair) (Pontzer 2017a). Humans burn more calories than chimpanzees and bonobos, say (eg: 400 calories per day) to meet the demands of larger brains (Pontzer 2017a).

[20] An average healthy male in the USA needs 2500 calories per day and a female 2000 calories (Roberts and Das 2017). This is similar to more active groups - eg: Hazda hunter-gatherers in Tanzania: 2649 calories for men and 1877 for women (Pontzer 2017b).

[21] In a survey in the UK (Royal Society for Public Health 2014), 9% of respondents said they would take diet and exercise advice from an overweight GP, 17% from an obese or overweight healthcare professional, or 5% from an overweight fitness instructor compared to 59%, 41%, and over 50% respectively from healthy weight individuals. Three-quarters of respondents expected public health workers to have a healthy weight, and to be non-smokers, while half of such workers felt under pressure to be role models for healthy lifestyles.

3.6. EATING SPEED

Weight gain is influenced by the amount eaten and the frequency of eating (fairly obviously), but also by eating speed.

Hurst and Fukado (2018) investigated changing eating speed (as well as other lifestyle habits) with obese individuals with type 2 diabetes in Japan. Data were available for nearly 60 000 adults between 2008 and 2013. Eating speed was categorised as fast, normal or slow based on self-reports at baseline and five years later [22].

Compared to the fast-eating group, slow-eaters were significantly less likely to be overweight and obese (22% of group vs 45%). In terms of changing speed of eating, eating slower (along with not snacking after dinner, not eating dinner within two hours before sleeping, and infrequent alcohol consumption) was associated with weight loss over the study period. Normal and slow eaters, but not fast eaters, showed a reduction in waist circumference [23].

Hurst and Fukuda (2018) offered this explanation for the findings: "fast eaters may continue to eat until they feel full despite having already consumed an adequate amount of calories, and the combined effect of eating quickly and overeating may contribute to weight gain. In contrast, eating slowly may help to increase feelings of satiety before an excessive amount of food is ingested" (p6).

This study used longitudinal panel data, which meant the same individuals were questioned a number of times. But the participants were volunteers for health check-ups by health insurance companies. "As a result, the data may not have included a large proportion of the insurance enrollees' dependents. In particular, there was a relatively small proportion of older adults in our study population. The results may therefore lack generalisability to other sub-populations" (Hurst and Fukuda 2018 p6). No information was collected on physical activity.

3.7. ALCOHOL

The UK Biobank prospective cohort study began with over half a million middle aged adults between 2006 and 2010 (Sudlow et al 2015). Approximately 20 000 of the participants were assessed five years later.

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[22] Sasaki et al (2003) found that self-reports by Japanese women of eating speed correlated with their friends' reports.

[23] A reduction of eating speed to stop weight gain has been reported in a study of Japanese schoolgirls (Ochial et al 2014), for instance, and among obese adolescents over 12-18 months using a feedback device (Mandometer) (Ford et al 2010).

Piumatti et al (2018) used this study to investigate the relationship between alcohol consumption and cognitive decline. Alcohol consumption was self-reported as frequency, type, and volume. Cognitive performance was measured by a reaction time test where participants were show two cards simultaneously on a computer screen, and had to press a button if the cards were the same.

The relationship between cognitive performance and alcohol consumption was found to be curvilinear - ie: cognitive performance improved with alcohol consumption up to 10 g/day, and then deteriorated for consumption of greater than 10 g/day. This detrimental effect was more pronounced with age.

This "J-shaped" or "U-shaped" relationship between alcohol consumption and cognitive decline has been found in previous studies (eg: Rodgers et al 2005), but it is controversial, and other studies have not found it (eg: Yeung et al 2012 in China). Much of the controversy concerns what is a protective amount of alcohol daily (eg: 40 g/day for women and 80 g/day for men; Zuccala et al 2001).

Piumatti et al's (2018) study has three main limitations:

i) A self-reported measure of alcohol consumed. Heavy drinkers may be more likely to under-report their consumption.

ii) A very limited test of reaction time as the indicator of cognitive decline.

iii) The risk of selection bias in the form of "bright boozers", "those with high alcohol intake and high cognitive performance, [who] may be over represented at recruitment and follow-up, thus deflating estimates of harm at high levels of consumption" (Piumatti et al 2018 p6).

3.7. EPIDEMIOLOGIC TRANSITION

In 1900 in the West most individuals died of infectious diseases, but a century later the leading cause is non-communicable diseases. This change has been part of the four stages of the epidemiologic transition (Omran 1971; Olshansky and Ault 1986).

Stage 1 - Pestilence and famine kept life expectancy around thirty years for most of human history.

Stage 2 - Increased food and improved public health as a result of industrialisation and urbanisation over the 19th century increased life expectancy.

Stage 3 - Increased mortality in the first half of the 20th century from "human-made" diseases (eg: smoking) and degenerative diseases.

Stage 4 - The second half of the 20th century saw improvements in stage 3 diseases with, for example, smoking cessation programmes, and the developments in modern technology.

Graziano (2010) added a fifth phase in the 21st century of "the age of obesity and inactivity".

3.8. APPENDIX 3A - UNDERWEIGHT AND EARLY MENOPAUSE

Early menopause is before 45 years old, and "though genetic factors partially account for increased risk of early menopause, modifiable lifestyle, reproductive and environmental risk factors may also play a role" (Szegda et al 2017 p2533). Body weight, or more particularly, body fat, is one of these modifiable factors - underweight in the teenage years (based mostly on cross-sectional studies) (Szegda et al 2017).

In terms of the longitudinal studies, Szegda et al (2017) analysed data from the Nurses Health Study 2 (NHS2), which began in 1989 with 116 430 registered nurses aged 25 to 42 years old in eleven US states. Data were collected every two years.

Menopause was defined as twelve months of amenorrhea, and 2804 women had experienced natural menopause (ie: not by hysterectomy) by age 45 in the study. This group was compared to 75 955 women with no menopause by age 45, where complete information was available. A body mass index (BMI) of less than 18.5 was classed as underweight, and greater than 30 as overweight. Relevant co-variates included smoking, use of oral contraceptive, and physical activity.

The risk of early menopause was significantly higher for underweight women at age 18 compared to health weight (BMI 18.5 - 22.4) (figure 3.2). Weight loss of greater than 20 lbs between 18 and 35 years of age was also an increased risk of early menopause.

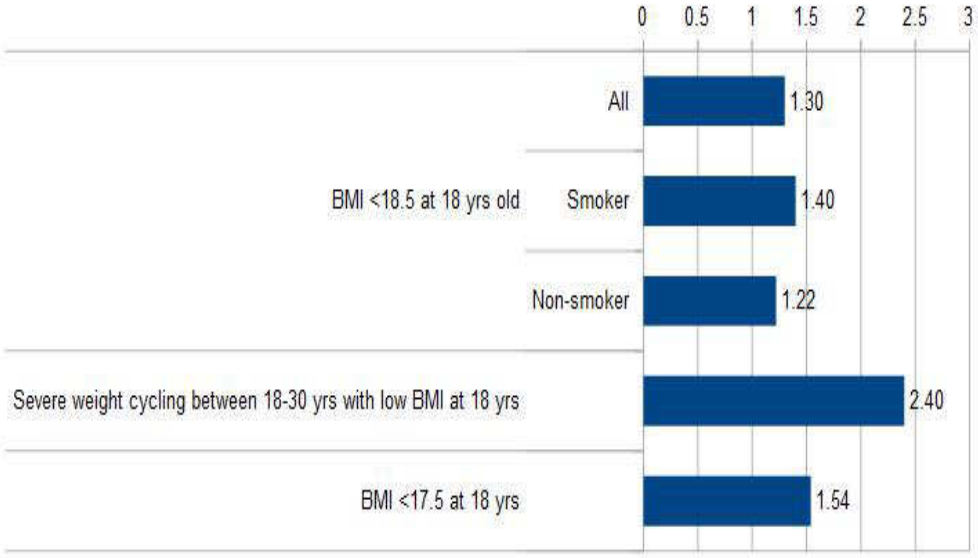

Figure 3.2 - Odds ratios of early menopause compared to healthy weight.

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4. RADIATION ANXIETY AND FUKUSHIMA

4.1. INTRODUCTION

Exposure to high-dose ionising radiation is rare, but protracted low-dose exposure through medical sources has increased in recent years (Leuraud et al 2015).

Establishing cancer risks of ionising radiation exposure originated with studies of survivors of the two atomic bombings in Japan in 1945 (eg: Folley et al 1952).

In terms of repeated low-dose exposure, data from the International Nuclear WORKers Study (INWORKS) have proved useful. This includes workers from France, the UK, and the USA monitored for up to sixty years after exposure.

Leuraud et al (2015) analysed the data on leukaemia, lymphona, and multiple myeloma mortalities. Underlying cause of death from over 60 000 workers was ascertained from death certificates, and data on radiation exposure from official records and red bone marrow post-mortem.

There were around 1600 deaths from the cancers of interest, and these were positively associated with cumulative small doses of ionising radiation. This challenged current "radiation protection systems [that] are based on a model derived from acute exposures, and assumes that the risk of leukaemia per unit dose progressively diminishes at lower doses and dose rates" (Leuraud et al 2015 pe280).

4.2. FUKUSHIMA

Not all individuals who experience a disaster suffer mental health problems later. Fernandez et al (2015), for example, identified four groups of factors associated with post-flooding mental health:

- Disaster-related (eg: level of exposure; financial losses).
- Coping (eg: positive behaviours).
- Health-related (eg: poor mental and physical health before the event).
- Personal (eg: gender; socio-economic status).

In the case of the Chernobyl nuclear power plant accident in 1986, poor long-term mental health was associated with exposure and proximity to the disaster, perception of radiation risk [24], being evacuated, and being female (Miura et al 2017). "However, no well-designed longitudinal studies were conducted in the first three years after the accident" (Miura et al 2017 p2).

More recently, the mental health effects of the Fukushima Daiichi nuclear disaster in March 2011 have been studied in detail [25]. Perception of radiation risk was found to be associated with psychological distress in the first set of data collected in the Fukushima Health Management Survey (FHMS) (Suzuki et al 2015).

The FHMS (Yasumura et al 2012) is a longitudinal study of adult residents of the evacuation zone [26] that surveyed individuals ten months after the event (January 2012), and one year after that (January 2013). Miura et al (2017) analysed data from over 36 000 respondents.

Three questions measured risk perception using a four-point scale (eg: "What is the likelihood of suffering immediate health damage (eg: dying within one month) as a result of your current level of radiation exposure?"), and psychological distress for the last month was scored 0-24 based on six questions.

The mean scores for psychological distress were 6.2 in 2012 and 5.7 in 2013. A score of thirteen was set as the cut-off point for psychological distress, and 14.3% and 11.7% respectively scored 13-24. Perception of radiation risk was positively associated with worsening mental health and negatively associated with recovery, especially for women. The authors stated: "Taken together, emotionality and coping strategies of women may account for our results of the association between perceived radiation risk regarding immediate effects and the worsened group among women. On the other hand, women might have more sensitive biological stress systems such as hypothalamic-pituitary-adrenal axis, which might have effects on the results" (Miura et al 2017 p9).

Pre-disaster mental health problems was also found to be relevant, though the study collected little data

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[24] Slovic (1987) described two psychological dimensions to risk perception:

- "Dread risk" (eg: radiation risk).
- "Unknown risk" (eg: health effects of exposure to radiation).

[25] Yamashita and Suzuki (2013) stated that "the doses to a vast majority of the population in Fukushima were not high enough to expect to see any increase in cancer and health effects in the future, however, public concerns about the long term health effects of radioactive environmental contamination have increased in Japan" (p128).

[26] The evacuation zone was divided into three categories (Oriu et al 2018):

- Difficult-to-return areas (radiation of ≥50 millisieverts per year).
- Residence restriction areas (20 to 50 mSv per year).
- Areas where evacuees can return (<20 mSv per year).

about the pre-disaster period. There was also limited information for the first ten months after the event, including who had received psychological interventions.

The response rate of the surveys was low with over 100 000 individuals not responding to the questionnaire. "Previous studies showed that the mental health status might have effects on response rate to survey, suggesting that non-response was associated with bad mental health status. There might be many residents who were in a bad condition and could not answer the survey" (Miura et al 2017 p10).

General levels of anxiety were increased after the disaster. For example, Nakayachi et al (2015) surveyed Japanese individuals nationwide about fifty-one hazards, and fear of nuclear accident was rated second in 2002 (compared to 19th in 2008).

Takebayashi et al (2017) performed a systematic review of studies about anxiety and Fukushima published after the event. Twenty-four relevant studies were found.

Risk perception and anxiety were found to be higher among certain groups generally - women, older adults, parents and grandparents, and lower educated individuals - and specifically among evacuees, those bereaved by the disaster, and individuals who had lost their homes and/or income.

Anxiety was higher for individuals who listened to rumours, and/or collected information from friends and the Internet, while individuals who trusted government sources were less anxious about radiation and health harms. Explanatory meetings or one-to-one medical consultations were beneficial in reducing radiation-related anxiety.

Anxiety was measured in over half of the studies by single-item Likert scales (Takebayashi et al 2017).

Murakami et al (2018b) investigated the risk perception through the "loss of happy life expectancy" (LHpLE) [27], where happy life expectancy is "the lifespan that people live with a subjective emotional feeling of well-being". Around 5000 Japanese residents completed an online questionnaire in September 2015.

Evacuees had a higher LHpLE, due to psychological distress, than other Japanese residents (ie: decline in emotional happiness, and perceived shortened life expectancy).

Some businesses were allowed to continue working in the residence restriction and return areas. Orui et al (2018) surveyed employees of two such manufacturing companies in late 2016 (n = 219), and compared them to a

[27] This is similar to other quality of life measures (appendix 4A).

similar business in a nearby non-evacuation area (n = 175).

The employees in the evacuation areas had significantly higher rates of perceived radiation risk than in the non-evacuation area (48% vs 26% rated high on four-point scale [28]). Deteriorating mental health was evident among 45% of employees in the evacuation areas and among 16% in the non-evacuation area. But employees in the evacuation areas did have to relocate where they lived.

The authors admitted that "control selection bias might exist in the present study; the control group may not be truly representative of the non-evacuation area. Even employees in the non-evacuation area might have been affected by the nuclear disaster, because their company was located close to an evacuation area. Moreover, approximately 10% of respondents in the non-evacuation area experienced separation from family members" (Orui et al 2018 p12). They continued: "Moreover, we obtained the data from only one company located in the non-evacuation area, which was imbalanced compared to the number of companies in the evacuation area. The reason for this was few companies co-operated as a control in this study" (Orui et al 2018 p12).

Other limitations included low response rate of employees in evacuation areas, risk of recall bias, and subjective measures of mental health.

Oe et al (2018) analysed data from the FHMS about children. Studies of children affected by the earthquake and tsunami that led to the Fukushima disaster showed differences in the children's improvement - for example, problems still 30 months after the event versus improvements by twenty months (Oe et al 2018).

Oe et al (2018) focused on over 8000 6-12 year-olds in the Fukushima prefecture at the time of the disaster. Parent-completed data from 2012, 2013 and 2014 were used [29].

Emotional symptoms showed a small decline over the study period based on four groupings - very severe (9% of sample), moderate (34%), low (46%), and minimal (11%). Peer relationship problems were stable over time based on three groupings - very severe (9%), moderate (69%), and low (22%).

Concentrating on the "very severe" group, emotional symptoms were significantly associated with being female, experiencing the tsunami and nuclear plant accident, long-distance evacuation, and little physical exercise. Peer relationship problems were significantly associated

[28] Example of question used: "What do you think the likelihood is of damage to your health (eg: cancer onset) in later life as a result of your current level of radiation exposure?".

[29] There was no comparison group from an unaffected area, and little pre-disaster information.

with being male, experiencing the accident, and little exercise [30].

Murakami et al (2018a) investigated the effect of "radiological counter-measures" (eg: explanatory meetings; thyroid examination; food inspection; individual radiation dose monitoring) on the subjective well-being with FHMS data from over 1000 individuals. The use of counter-measures was associated with higher subjective well-being scores, and less radiation anxiety in the main, except for explanatory meetings which increased sadness, worry, and radiation anxiety.

4.3. RADIATION ANXIETY

Radiation anxiety is "worry and anxiety about the possible adverse health effects of exposure to radiation" (Fukasawa et al 2017 p741).

Logically, radiation anxiety is related to high environmental levels of radiation contamination (eg: level of caesium-137 after the Chernobyl disaster and poor self-reported health 20 years later; Lehmann and Wadsworth 2011). On the other hand, Beehler et al (2008) found no relationship between the caesium-137 level here, and depression and anxiety twenty years later among Belarusians.

Studies show that other factors play a role in radiation anxiety, like gender and age (eg: Dohrenwend et al 1981; Three Mile Island).

In relation to Fukushima, Fukusawa et al (2017) looked at the link between environmental radiation exposure and radiation anxiety in a survey of over 1600 non-evacuees in early 2016. Radiation anxiety was measured of the seven-item Radiation Anxiety Scale. Each item (eg: "every time I feel ill, I am afraid this is caused by radiation exposure") was scored on a four-point Likert scale. As well as environmental radiation level (which was calculated at a municipality level), radiation anxiety was significantly associated with younger age, lower education, lower income, being married, having psychiatric problems, experiencing disaster-related damage, and family problems.

[30] Other studies have shown an inverse relationship between physical exercise and mental health (eg: Hallal et al 2015).

4.4. APPENDIX 4A - QUALITY OF LIFE MEASUREMENT

4.4.1. Health

Muldoon et al (1998) noted that "the personal burden of illness cannot be described fully by measures of disease status such as size of infarction, tumour load, and forced expiratory volume. Psychosocial factors such as pain, apprehension, restricted mobility and other functional impairments, difficulty fulfilling personal and family responsibilities, financial burden, and diminished cognition must also be encompassed" (p542).

The WHOQOL Group (1998) pointed out that "an ideal health assessment, therefore, would include a measure of the person's physical health, a measure of physical, social and psychological functioning, and a measure of quality of life" (p1569), and the latter will cover "physical, psychological, social and spiritual dimensions of life".

Defining quality of life (QOL) is not easy, but two kinds of information are identified - the functional status of the individual (objective functioning) and the individual's appraisal of their health (subjective well-being) [31].

Ferrans (eg: 1996) distinguished six ways of conceptualising QOL:

1. Normal life - QOL is assessed as a comparison between the functioning of the ill person and that of a healthy person of the same age. The closer to the normal, the better the individual's QOL.

Problem - Fails to address positive elements that contribute to QOL (Moons et al 2006).

2. Social utility - QOL is the ability to lead a "socially 'useful' life" (Moons et al 2006) (eg: employment status; social functioning).

Problem - Assumes that employment status, say, is indicator of QOL (when it is more likely a determinant) (Moons et al 2006).

3. Happiness/affect - Focused on the emotions - positive and negative - of the individual.

Problem - Emotions can "fluctuate significantly over

[31] "Many clinicians remain unsure of the relevance of measuring quality of life to their clinical practice. In health economics quality of life measures have become the standard means of assessing the results of health care interventions and, more controversially, the means of prioritising funding..." (Fitzpatrick et al 1992 p1074).

time and may change from day to day" (Moons et al 2006 p898).

4. Satisfaction with life - ie: "a patient's ability to have a life that fulfils his/her personal needs" (Moons et al 2006 p894).

Problem - Ultimately a subjective measure which goes beyond health-related issues (Moons et al 2006).

5. Achievement of personal goals - QOL is "the discrepancy between an individual's actual status and what he/she desires or expects" (Moons et al 2006 p894) (known as "Calman's gap"; Calman 1984).

Problem - Individuals can adjust their expectations as a means of coping with disappointment and so QOL changes over time (Moons et al 2006).

6. Natural capacities - This is a more philosophical conceptualisation that concentrates on fundamental needs, like relief from pain or ability to interact with the environment (Moons et al 2006). The assessment is often made by others for the individual.

Problem - "Natural capacity relies mostly on the appraisals of health care professionals and lay caregivers, since natural capacity is paramount in patients who are unable to subjectively appraise their own quality of life" (Moons et al 2006 p898).

Moons et al (2006) summarised some of the general problems with QOL conceptualisations:

i) A fully healthy life is not necessarily identical to a high QOL.

ii) Objective and subjective measures do not necessarily tally - eg: the "disability paradox" (Albrecht and Devlieger 1999) where individuals report a high QOL "against all odds" (Moons et al 2006).

iii) Differences between indicators (eg: what is QOL?) and determinants (eg: what influences QOL?).

iv) QOL changes over time.

v) The tendency to concentrate on negative elements that reduce QOL rather than the positive ones that enhance it.

vi) A concept like health-related QOL assumes that a distinction can be made from overall QOL.

Rejecting single dimensional scales of QOL as condensing "a complex multi-dimensional concept into a single Procrustean dimension", The WHOQOL Group (1998) described the construction of the multi-dimensional World Health Organisation Quality of Life Assessment (WHOQOL).

Initially, focus groups (qualitative pilot study) elicited 1800 questions, which the experts reduced to 1000 by removing semantically equivalent questions (eg: "How much of the time are you tired?" and "How often are you tired?"). Further analysis reduced the questions to 236 for the pilot WHOQOL (quantitative pilot study). A five-point Likert scale was used as the response option.

The pilot questionnaire was administered to at least 300 individuals in each of fifteen countries. Subsequent item analysis reduced the questions to 100 for the final version (WHOQOL-100) (table 4.1).

- How satisfied are you with your health?
- How well do you sleep?
- How satisfied are you with the way your body looks?
- How worried do you feel?
- How satisfied are you with your capacity for work?

(Source: The WHOQOL Group (1998) table 4 pp1576-1578)

Table 4.1 - Examples of items from the WHOQOL-100.

Validity is a key issue with QOL measures - ie: that it measures what it claims to measure. Muldoon et al (1998) pointed out some of the problems:

Criterion validity - The correlation of the questionnaire with an objective indicator (criterion). But subjective well-being does not always correlate with objective functioning.

Convergent and discriminant construct validity - The correlation of the questionnaire with expected constructs (convergent) and not with others (discriminant). Measures of QOL correlate with measures of psychiatric symptoms like depression and anxiety, but should be unrelated to personality, say (discriminant). Yet certain personality characteristics, like neuroticism, do influence QOL scores (Muldoon et al 1998).

Fitzpatrick et al (1992) raised the issue of the QOL measure and sensitivity to change. Long questionnaires like the WHOQOL include many items that may not be relevant to a particular individual with a particular illness, while other measures may have ceiling or floor effects. "For patients with very poor quality of life who obtain minimum scores before treatment there may be no scope to register any further deterioration" (Fitzpatrick

et al 1992 p1076).

QOL measures may not include relevant elements, like the arthritis impact measurement scales which does not cover fatigue, "a dimension that patients report as one of the main distressing consequences of the disease" (Fitzpatrick et al 1992 p1076). This is the issue of the appropriateness of the measure.

4.4.2. Ageing Society

Goldman et al (2018) noted that policy responses to the ageing population in the USA have tended to neglect "changes in the structure and function of the family on intergenerational relations, rising tensions between age groups amidst a fight over entitlements, a widening gap among older persons between the 'haves and have-nots', threats to financial security, and opportunities for productivity in late life (work or volunteering), and human capital development (lifelong education, skills training). There is little acknowledgment of the substantial benefits of an aging society" (p435). This led to the "Research Network on an Ageing Society" to consider what characteristics identify a successfully ageing society.

Such societies are "cohesive, with minimal tension and competition between generations and major sex or racial sub-groups, productive with opportunities for effective engagement both within and outside the workforce, healthy, equitable, and secure. Importantly, all of these domains are mutable with effective public policies" (Goldman et al 2018 p435).

From these ideas came the "Ageing Society Index" to assess countries on five domains - well-being (eg: subjective measure of health), equity (eg: food security and poverty risk for older adults), cohesion (eg: intergenerational co-residence), productivity and engagement (eg: late-life workforce participation and volunteerism), and security (eg: feeling safe).

All scores are standardised between 0 (worst) to 100. Among European countries, Norway scored highest (65), the UK inbetween (52), and Hungary scored lowest (23) (with the USA 60).

Drawing from the high scoring countries, Goldman et al (2018) made the following five recommendations for a successfully ageing society:

- Invest in early childhood programmes as this leads to longer, better life.

- Encourage lifelong learning and training.

- Find ways to engage older adults in society (eg: incentives for employers).
- Increase training and recruitment for the eldercare workforce.
- Ensure financial security.

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5. SLUM TOURISM

Appendix 5A - Spiritual materialism
Appendix 5B - Dark tourism

Visitors to many cities in the developing world can take organised tours of slum areas [32], as in Dharavi, Mumbai. This is "slum tourism" [33],which Nisbett (2017) argued that "the tour operators and tourists jointly construct a view of poverty that is normalised, even romanticised. It is seen as neutral, natural and benign, rather than something deadly, which diminishes well-being and threatens life. Poverty is depoliticised. Visitors leave the slum feeling happy and satisfied to have witnessed the 'real' and 'authentic' India, but the potential for development is hindered as residents are left with little prospect of change" (p37).

"Reality Tours" is the main provider of commercial tours to this area, which began in 2006, with 15 000 visitors per year. Much of its profits are invested in programmes for the residents (eg: life skills classes for children) (Nisbett 2017). Slikkar (2014 quoted in Nisbett 2017) reported that only 12% of Dharavi residents surveyed were negative about slum tourism.

Nisbett (2017) undertook the tour, and also analysed 226 "TripAdvisor" website reviews of the tour. She distinguished two key themes from the reviews:

a) "Industry" - The residents were described as "hard-working" and "enterprising", for example. "There was a normative moral subtext of independence and self-sufficiency, with comments around the lack of 'hand-outs' and the 'contribution to society' made by the residents. The slum was seen as 'efficient', 'functional' and 'organised'. The majority of these comments did not mention or acknowledge the glaring poverty. For some, there was even a seeming refusal to accept that the slum was a place of deficiency and disadvantage..." (Nisbett 2017 p41).

b) Community - The residents were described as "happy", "proud", "friendly", and "welcoming", for instance. One reviewer even wrote: "Friendly children smiled... The dignity of the human experience shone brightly... neighbours watched out for each other... A

[32] A slum, according to the United Nations, is a place where the residents do not have any legal right to the area where they live (Nisbett 2017).
[33] "Slum tourism" started in Victorian London with tours of the East End by the upper and middle classes. Its current incarnation began in South Africa in 1991 (Nisbett 2017).

model for the world" (p41).

Nisbett (2017) commented: "When Asia's largest slum is endorsed as 'a model for the world', there is an ignorance of poverty. Residents were repeatedly seen to be 'living here quite happily', having an 'abundance of life', living in an 'absence of anger and bitterness', and demonstrating that 'your life circumstances don't define you'. This rejects the widely recognised notion that for the vast majority of people, where you are born and the circumstances into which you are born, tend to dictate your lot in life. Reviewers repeatedly asserted that they 'didn't see suffering', whilst residents were deemed to be 'high on life' and able to 'find happiness in the smallest things'. Aside from these comments being highly patronising, they overlook the endless drudgery of poverty, the sub-standard living conditions of the slum residents and the degraded environments..." (p42).

The depoliticisation of poverty evident in the tours, Nisbett (2017) argued, was a "defining practice of neoliberalism... By not discussing the factors that create and maintain slums, the site and its attendant poverty were detached from its origins. Instead, structural inequalities were rendered invisible" (p42). Seeing the residents as "hard-working" was even a "pro-neoliberal sub-text", which promotes success through one's own efforts, and clearly distinguishes between the "deserving" or "productive" poor [34], and the "undeserving" or "unproductive" poor.

Slum tourism can also be seen as a "product" to consume as the tourists purchase "spiritual materialism" (appendix 5A) (Williams 2014) (ie: a journey of "a self-empowered spiritual awakening" from seeing the "authentic"; Nisbett 2017) [35]. Roy (2010 quoted in Nisbett 2017) emphasised the colonialism of "white people discovering themselves in brown places".

APPENDIX 5A - SPIRITUAL MATERIALISM

Referring to Elizabeth Gilbert's (2006) memoir of self-discovery, "Eat, Pray, Love" (EPL), Williams (2014) saw it not as a "critical reflection on the self and society", but as "'spiritual' consumption". Williams (2014) continued: "In developing the groundbreaking marketing approach which connects the inspirational content of Gilbert's book with a variety of products, EPL marketers have indeed made consumption meaningful for many women" (pp615-616).

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[34] What Smith (1997) called "subjects of value".

[35] "Ultra-consumerism" means that everything is there to be consumed either literally in the case of products or experientially in the case of services and "experiences". Another example is the growth of "dark tourism" (appendix 5B).

Saunders and Barnes-Brown (2010) have talked of an "enlightenment industry" [36], while Fraser (2009) described neoliberalism as harnessing "the dream of women's emancipation" to "the engine of capitalist accumulation". "The female neoliberal spiritual subject is not only situated as a consumer who expresses her spirituality through spending, she is also encouraged to adopt a depoliticised outlook that ignores oppressive social realities in favour of a therapeutically tinged focus on herself. In effect, EPL marketing perpetuates neoliberalism in that it encourages women to view their happiness as their sole responsibility, thus ignoring the social realities, such as unpaid household labour and gendered expectations of child care, which may negatively impact their happiness. Furthermore, by coupling consumption and political disengagement with spirituality, EPL branding manages to convince women that the pursuit of spiritual enlightenment via consumption is akin to exercising empowerment, thus encouraging the neoliberal spiritual subject to see her power to buy 'spiritual' products as a sign of her essentially empowered state" (Williams 2014 p616).

Tourism is a key element of consumption here. But the travel experience is not to meet the locals, rather the consumption of the "local culture" is a "spiritual product" to aid the journey of enlightenment. Gilbert (2006) admitted: "It wasn't so much that I wanted to thoroughly explore the countries themselves... It was more that I wanted to thoroughly explore one aspect of myself... in a place that has traditionally done that one thing very well. I wanted to explore the art of pleasure in Italy, the art of devotion in India and, in Indonesia, the art of balancing the two" (quoted in Williams 2014).

APPENDIX 5B - DARK TOURISM

Foley and Lennon (1996) coined the phrase "dark tourism", and defined it as "the presentation and consumption (by visitors) of real and commodified death and disaster sites" (quoted in Stone and Sharpley 2008). It covers "death-related tourism" from graveyards to prisons to sites of atrocities and disasters.

Dann (1998 quoted in Stone and Sharpley 2008) suggested eight influences on the growth of "dark tourism" including "fear of phantoms" (ie: overcoming child-like fears), the search for novelty, and "dicing

[36] This industry, and thus empowerment, is only available to those with the power to buy it. Saunders and Barnes-Brown (2010) described EPL as "priv-lit", which is "literature or media whose expressed goal is one of spiritual, existential, or philosophical enlightenment contingent upon women's hard work, commitment, and patience, but whose actual barriers to entry are primarily financial" (quoted in Williams 2014).

with death" (journeys that heighten the sense of mortality).

Stone and Sharpley (2008) explained the rise of "dark tourism" as linked to the place of death in modern Western society ("death sequestration"; Mellor and Shilling 1993). These authors talked of an "apparent paradox": "On the one hand, absent death through privatisation of meaning, the medicalisation of dying and the professionalisation of the death process is evident yet, on the other hand, death is very much present within popular culture and, of course, very present since death is the single most common factor of life" (Stone and Sharpley 2008 p585). Simplistically, "dark tourism" is a way of making sense of death in society today.

Stone and Sharpley (2008) summed up:

> Firstly, dark tourism allows death to be brought back into the public realm and discourse, thus acting as a desequester that allows absent death to be made present. Secondly, the consumption of dark tourism may aid the social neutralisation of death for the individual, either implicitly or explicitly, thereby reducing the potential sense of dread that death inevitably brings and permitting a search for, and a purchase of, ontological security through a new social institution. Finally, this new social institution (dark tourism) facilitates the reconstruction of a meaning system for individuals in the face of reflexivity, desacralisation and institutional sequestration, thus creating an opportunity to confront and contemplate 'mortality moments' from a perceived safe distance and environment. This, in turn, allows for some immunity and reassurance from the actual death or macabre event which has been (reproduced through dark tourism) (p589).

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6. THE ANTHROPOCENE EPOCH

The "Anthropocene" is a term [37] used to describe the current epoch "characterised by human domination of the planetary system" (Malhi 2017) [38] [39].

The features of this epoch include (Malhi 2017):

i) The planetary scale of environmental changes from human activity.

ii) The multi-faceted nature of global change (ie: not just climate change, but also extinctions [40], for example).

iii) The two-way interaction between humans and "the rest of the natural world" (Malhi 2017).

iv) A "sense of a current or imminent fundamental shift in the functioning of our planet as a whole" (Malhi 2017 p79).

Williams et al (2015) included these features:

a) Homogenisation of flora and fauna by human activity.

b) Increased biological activity in biosphere (eg: burning fossil fuels).

c) Humans and domesticated species only have benefited from increased activity.

d) Human influence on evolution of other species.

e) The interaction of technology with the biosphere [41].

Crutzen (2002) originally argued that the Industrial Revolution in the mid-18th century would signal the beginning of the Anthropocene epoch, whereas Steffen et al (2007) placed the start post-World War II. On the other hand, others have argued that the Anthropocene

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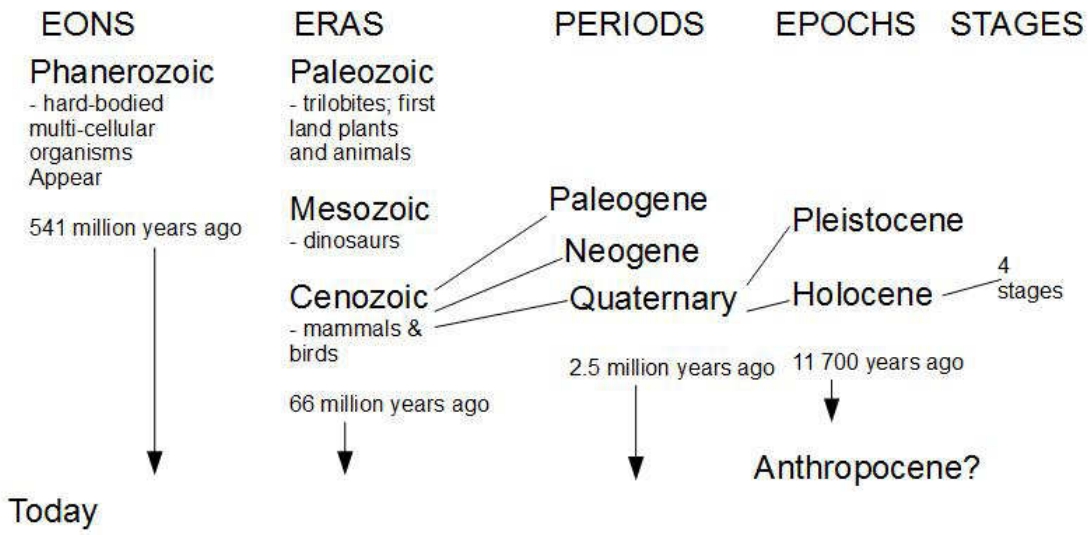
[37] This term was first used by Crutzen and Stoermer (2000), and developed by Crutzen (2002).

[38] In geological terms, this is the Phanerozoic Eon (started 541 million years ago), within that the Cenozoic era, and within that the Holocene epoch (11 700 years ago) to now (Malhi 2017) (figure 6.1).

[39] Officially, the International Commission on Stratigraphy (ICS), part of the International Union of Geological Sciences (IUGS), does the naming of time periods.

[40] Potentially the "Sixth Extinction" (Kolbert 2014).

[41] Chakrabarty (2009) observed that the "'Anthropocene spells the collapse of the Kantian distinction between natural history and human history' for we are now in the first geological epoch in which the force transforming the globe — human-initiated activity — is supposedly self-conscious about what it is doing, with profound implications for politics and the allocation of responsibility" (Lock 2017 p2).



(After figure 2 p83 Malhi 2017)

Figure 6.1 - Where Anthropocene fits in geological time.

should began when Homo erectus adopted fire (Malhi 2017).

In terms of critics of the term, Finney and Edwards (2016) argued that "the ICS is being asked to make a political statement, namely to raise awareness of contemporary human impacts on the Earth system, and thereby potentially encourage a planetary management mindset" (Malhi 2017 p87).

Writing from an anthropological point of view, Lock (2017) commented: "In sum, a new geological epoch exists because humans are making over nature writ large to such an extent that it is irreparably transformed. At the same time, molecular science has shown that the human genome does not determine who we are; on the contrary, the environment that we are constantly remaking is in the driver's seat, bringing about increased inequalities and, for many, intensified misery" (p3).

This fits with Lock's (1993) idea of "local biologies", which "refers to the manner in which biological and social processes are permanently entangled throughout life, ensuring a degree of biological difference among humans everywhere that typically has little or no significance but at times bears profoundly on well-being" (Lock 2017 p8). Lock and Nguyen (2010) added the concept of "biosocial differentiation" "to suggest the continual interactions of biological and social processes across time and space that sediment into local biologies, in effect precipitating artifacts — snapshots of ceaseless entangled change" (Lock 2017 p8).

Practically, the environment will have an affect upon individuals in creating "local biologies". Lock

(2017) gave the example of "local toxic biologies" with the use of "Agent Orange" in the Vietnam War (eg: higher rate of children and grandchildren born with severe physical disabilities in Vietnam). So, "environmental variables - dietary, toxic exposures, climate change, and so on - clearly bring about biological differences, following Darwinian logic" (Lock 2017 p11).

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7. CONCERNED BUT INACTIVE

7.1. INTRODUCTION

The research on pro-environmental behaviour distinguishes three broad categories of variables that influence it (Bleys et al 2018):

i) Socio-demographic factors - eg: women, older adults, and higher social status individuals perform more pro-environmental behaviours than men, younger individuals, and those from lower social classes.

ii) Personality traits - eg: internal locus of control, high altruism, and "openness to experience" linked to pro-environmental behaviours.

iii) Environmental attitudes and values - Self-reporting pro-environmental attitudes and behaviours go together, but "the correlation between concern and actual behaviour is not strong" (Bleys et al 2018).

Hines et al (1987) proposed knowledge of environmental problems as the key predictor of pro-environmental behaviour, but "abstract knowledge" (awareness of problems) less so than "concrete knowledge" (actions to take) (Bleys et al 2018).

7.2. LEARNED HELPLESSNESS

Landry et al (2018) observed the paradox that "many concerned individuals refrain from pro-environmental action. Indeed, evidence indicates that concern is only weakly related to pro-environmental behaviour..." (p18). For example, Inglehart (1995) found that over 95% of respondents in forty-three countries expressed concerns about the environment, but only two-thirds were willing to perform pro-environmental behaviour.

Corral-Verdugo (1997) referred to "dual realities" in reuse and recycling behaviour to highlight the difference between self-reported and actual behaviour. It has been "suggested that self-reports, instead of reflecting behaviour, are largely measures of individuals' perceptions of their behaviour or of their behavioural intentions... These self-reports might also

be related to individuals' self-identity. Individuals with a strong sense of environmental identity might present themselves in ways congruent with their self-identity... They might report to behave in an environmentally friendly way, but not act accordingly, due to... barriers such as time constraints or budget restrictions" (Bleys et al 2018 p192).

Landry et al (2018) found that learned helplessness (LH) explained this paradox (or a version of the attitude-behaviour inconsistency). LH is often seen as linked to self-efficacy (ie: perceived ability to perform a specific behaviour), but it is "conceptually and empirically distinct" (Landry et al 2018).

"Whereas self-efficacy relates only to beliefs about capabilities of performing specific behaviours in particular situations..., trait learned helplessness is a domain-free construct indexing a learnt disposition to behave helplessly" (Landry et al 2018 p19). Trait LH is the generalising of LH from a particular situation to novel scenarios, and is perceived as stable over time, and as "due to the individual rather than to external circumstances" (Landry et al 2018) [42].

Landry et al (2018) surveyed 437 Canadian undergraduates with measures including:

- LH - The Learned Helplessness Scale (LHS) (Quinless and McDermott-Nelson 1988) (eg: "I do not try new tasks if I have failed similar tasks in the past").
- Environmental concern - seven-point scale.
- Pro-environmental behaviour - twelve behaviours.

Environmental concern predicted pro-environmental behaviour, but only in individuals with low LHS scores (ie: low LH).

7.3. SPILLOVER EFFECT

In order to respond to the adverse impact of human behaviour on the planet, individuals need to change many of their behaviours. In terms of positive behaviour change, the concept of "spillover" (Thorgersen 1999) "suggests that practicing one environmental behaviour may speed-up, or catalyse, the adoption of additional environmental behaviours" (Kneebone et al 2018 p1).

Spillover has been explained by two psychological theories (Kneebone et al 2018):

[42] Thus, LH "entails cognitive attributions ranging on continua from specific to global, internal to external, and stable to instable..." (Landry et al 2018 p19).

a) Cognitive dissonance - A motivation to change inconsistent beliefs and behaviours.

b) Self-perception theory - Individuals learn about their attitudes from observing their behaviour.

So, applied to performing one pro-environmental behaviour, individuals feel motivated to change other negative environmental behaviours which are inconsistent with that (cognitive dissonance), or they observe their pro-environmental behaviour and perceive themselves as pro-environment individuals (self-perception theory).

Spillover can be effective for similar behaviours. Kneebone et al (2018) explored the perceived similarity of household water saving behaviours in Melbourne, Australia. Thirty-two participants were presented with 44 water saving behaviours (table 7.1) and individually sorted them into groups.

- Only wash full loads of clothes
- Install a low-flow showerhead
- Keep swimming pool covered when not in use
- Go meat-free one day a week
- Fix leaking taps
- Water the garden in the early morning or evening

Table 7.1 - Examples of water saving behaviours.

Three groupings or clusters emerged from the analysis:

1 - "indoor curtailment-type" - behaviours inside the house including flushing toilet less, and going meat-free one day per week.

2 - "outdoor garden and plant-related behaviours" - eg: water plants less.

3 - "efficiency and maintenance behaviours" - eg: repair leaks.

Together, these clusters produced two dimensions - "location" (indoor vs outdoor behaviours), and "behaviour type" (curtailment, efficiency or maintenance practices [43]). Kneebone et al (2018) noted: "Our findings suggest that outdoor water saving behaviours are not seen as

[43] Karlin et al (2014) distinguished the behaviour types as thus, in relation to energy saving: low frequency/high cost (efficiency), high frequency/low cost (curtailment), and low frequency/low cost (maintenance).

similar to indoor behaviours; campaigns focussing on outdoor water conservation may therefore preclude spillover to indoor water saving" (p8). Curtailment and efficiency behaviours were viewed differently, but there was an unclear division between efficiency and maintenance behaviours. Ease of performing the behaviour was also relevant.

7.4. CAR USE

Car use has been rising in this century, and is predicted to continue. "Car use reduces physical activity during commuting... while substantially increasing carbon dioxide and nitrogen oxide emissions compared to public transport use" (Chng et al 2018 p24). How to persuade drivers to use public transport, walk or cycle, particularly for commuting? Any intervention to do this must understand the reasons for car use.

Chng et al (2018) performed a literature review of the studies on the psychology of car use, and found thirty-two relevant studies from the period 1998 to 2015. Fifteen psychological theories were identified.

The researchers combined the theories in an integrative conceptual framework of antecedents of car use (the CAUSE framework). Car use decisions are based on three stages - cognitive and emotional antecedents (eg: goal intention), pre-action (eg: habits, "objective constraints"), and action. These stages are influenced by values (eg: altruistic), "environment concern", norms (eg: others' use of cars), and "frequency of past behaviour".

Chng et al (2018) gave an example of how to reduce car use: "in an environment where car ownership and usage are normative and seen as socially desirable with little awareness of its consequences, goal and behavioural intention to use cars are likely to be strong, so interventionists might consider discouraging action (rather than undermining motivation) by targeting the facilitating conditions of car use such as increasing taxation on car ownership and usage" (p30).

7.5. AWARENESS OF ENVIRONMENTAL IMPACT

Bleys et al (2018) observed that the limited number of studies performed "indicate that individuals who report to behave more pro-environmentally do not have a lower environmental impact as measured through the ecological or carbon footprint. This indicates that by focusing on the traditional measures of pro-environmental behaviour (eg: recycling, buying used goods) one might miss the behaviours that have the largest environmental impacts" (p188).

This is not helped by the tendency to use self-reported measures of pro-environmental behaviour, not

necessarily because individuals lie (which does happen), but there are memory failings, and "individuals being (partly) unaware of their environmental impact" (Bleys et al 2018).

Bleys et al (2018) concluded from their analysis of survey data from 1286 participants in Flanders, Belgium, that individuals were "ill-informed about the environmental impact of their behaviour". This was because "(a) respondents may overestimate the importance of some aspects of their behaviour, while other aspects are given too little attention, and (b) respondents may lack information about the relative magnitude of the contribution of each of the aspects to the totality of the environmental problem" (pp204-205).

Bleys et al (2018) gave this example where "people who use public transportation more often report themselves to be more environmentally sustainable. This might be due to the fact that they compare their situation with one in which they would use private transportation instead. However, the more environmentally sustainable situation would be to minimise one's transportation needs altogether, for example, by moving closer to one's workplace" (p204).

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