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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/>. See also material at <https://archive.org/details/orsett-psych>.

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1. GENERAL COGNITIVE BIASES AND CLIMATE CHANGE SCEPTICISM

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1.1. PROBLEM-SOLVING AND COGNITIVE BIASES

The "what can we add here" heuristic is the tendency to solve problems by adding something rather than subtracting (Meyvis and Yoon 2021).

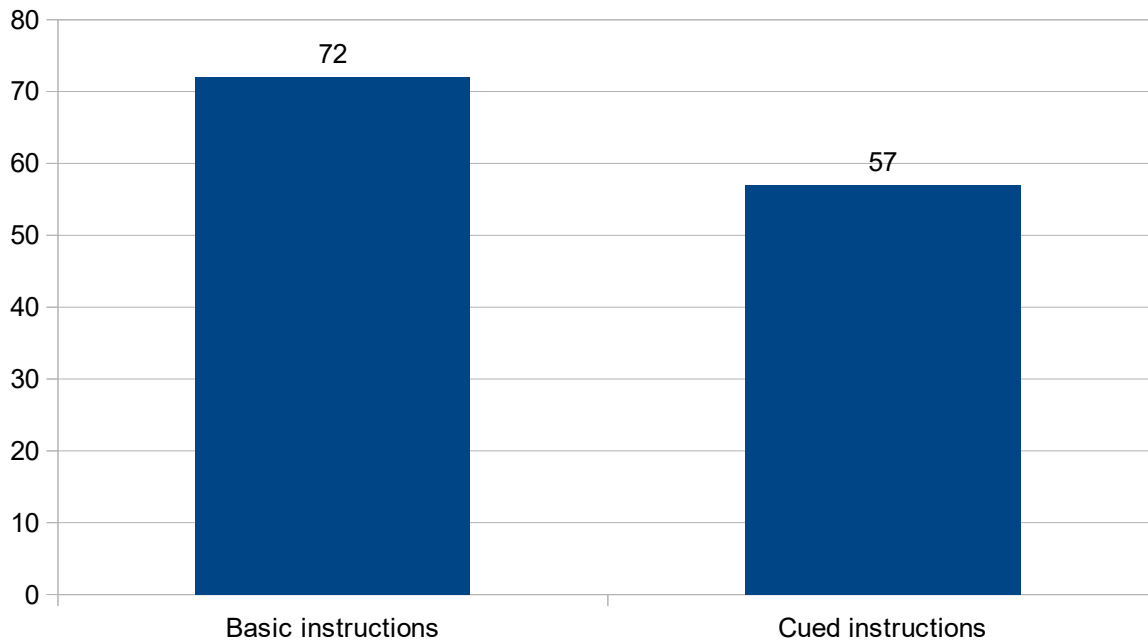
Adams et al (2021) explained that "[W]hen a transformed state has fewer components to the original (for example, a revision with fewer words or a process with fewer obstacles), we describe it as a subtractive transformation; when a transformed state has more components than the original, we describe it as an additive transformation" (p258).

Adams et al (2021) performed a number of studies to show the preference for addition over subtraction. For example, in Experiment 1, participants were presented with a large model of a house that was unstable, and in order to stabilise it participants could add or remove bricks. The majority of participants chose to add bricks despite a cost for each brick as opposed to no cost to removing bricks.

In another experiment, participants were shown a picture of a miniature golf hole, and asked to improve it. They could add a feature or remove something. The majority of participants chose to add a feature, unless they were cued to the possibility of subtraction (eg: instructions that mentioned both adding and subtracting features) (figure 1.1).

Meyvis and Yoon (2021) explained that "[A] proposal to get rid of something might feel less creative than would coming up with something new to add" (p189), and so consequently individuals assumed that they are expected to add rather than subtract.

A variety of other experiments by Adams et al (2021) confirmed the tendency towards additive transformations unless cued to consider subtractive transformations as a possible solution.



(Data from Adams et al 2021 table 1 p259 Experiments 2 and 3)

Figure 1.1 - Percentage of participants choosing to add a feature to the miniature golf hole.

1.1.1.1. Decision-Making By Experts

Kahneman and Sibony (2021) described a cognitive bias related to the difference in judgments between individuals (called "noise"). Noise is "variability in judgments that should be identical" (Kahneman and Sibony 2021 p44).

Two experts looking at the same case may vary by 50% of the mean - that is, for example, three and a half years between two judges in sentencing for a crime that has an average of seven years (Kahneman and Sibony 2021).

Noise comes in three ways (Kahneman and Sibony 2021):

i) "Level noise" - "different individuals have different average levels in their judgment" (Kahneman and Sibony 2021 p43).

ii) "Occasion noise" - differences related to the time of the decision (eg: being in a bad mood after a poor night's sleep).

iii) "Pattern noise" - fundamental differences between decision-makers.

1.1.2. Differences in Cognitive Ability

Usher et al (2021) recruited six hundred individuals who self-identified as aerospace engineers and 148 as neurosurgeons via social media to compare the cognitive skills of the two groups (and the general public). The study was advertised by the Society of British Neurological Surgeons, the Canadian Neurological Sciences Federation, the UK Space Agency, the Royal Astronomical Society, and the European Space Agency in mid-2021. Participants completed twelve tasks, which included word memory, digit span, delayed recall of words, emotional discrimination, and problem-solving tasks. These tasks has been used in the "Great British Intelligence Test" (GBIT) (organised by the BBC ¹), which was completed by 250 000 members of the British population. Usher et al (2021) emphasised that the "battery of tests should not be considered an IQ test in the classic sense, but instead is intended to differentiate the aspects of cognitive ability more finely" (p2).

Complete data were available for 329 engineers and 72 neurosurgeons, who were predominately male (approximately 70%). No difference was found between the two groups on a number of the tasks (eg: memory), but where there were significant differences, neurosurgeons were higher scorers on semantic problem-solving (eg: rare word definition), and engineers on mental manipulation and attention. Compared to the GBIT scores, the researchers noted two significant differences only - "problem solving speed was quicker for neurosurgeons than for the general population... and memory recall speed was slower for neurosurgeons than for the general population" (p3).

1.1.3. Overconfidence

Overconfidence is where individuals believe that they can achieve a goal that is objectively beyond them, like landing a plane without flight experience.

Overconfidence can take different forms, like "overclaiming" (claim to know terms that do not exist), the "Dunning Kruger effect" (poor performers overestimate their abilities more than skilled performers), and "above average" effects (believing oneself to be above average compared to others) (Jordan et al 2022).

At the same time, overconfidence as part of

¹ Details at <https://www.bbc.co.uk/programmes/articles/5NG89VsBmQ9Z490v7WzP01T/great-british-intelligence-test-the-results>.

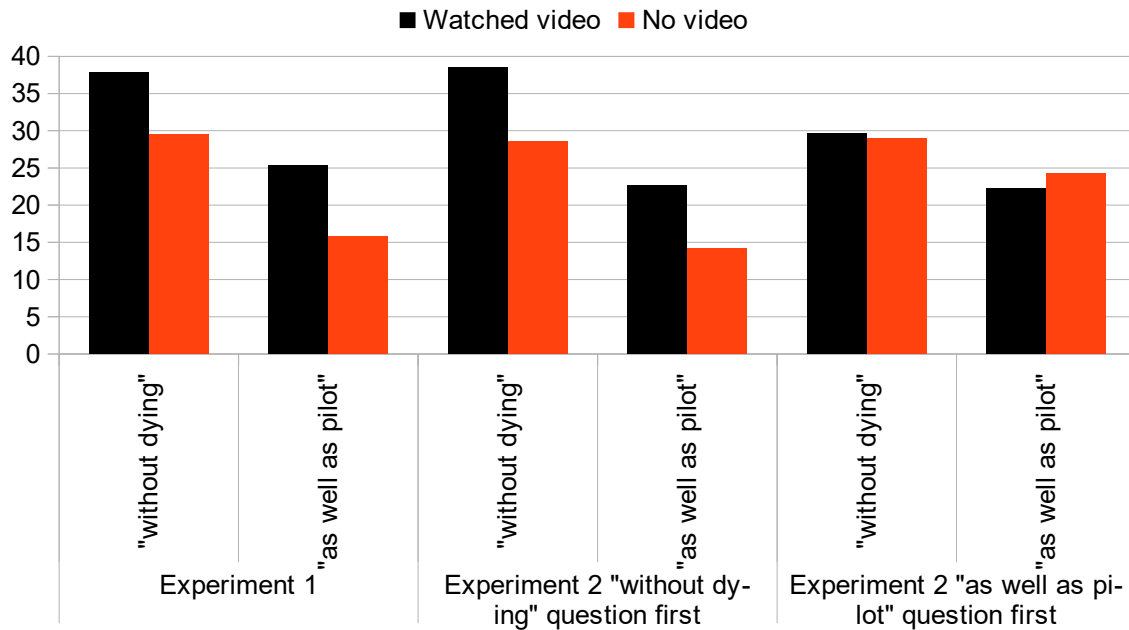
"positive illusions" can be beneficial. "For example, when people are overconfident in their abilities to do something, it can bias them to focus on the expected benefits rather than the costs. This focus on benefits might in turn drive people to pursue more difficult goals, to put in more effort and persistence to accomplish those goals, and sometimes even to accomplish them" (Jordan et al 2022 p2).

In terms of the mechanisms of overconfidence, one explanation is that "people treat their feelings as information when making judgements about what they know, like, believe and understand. The idea is that when we process information, we are influenced by how easy or difficult it feels to do it" (Jordan et al 2022 p2). Song and Schwarz (2008), for example, found that individuals reported new recipes as easier to perform after receiving information in an easy-to-read font than in a difficult-to-read font.

Experiments tend to use simple abilities, but Jordan et al (2022) wanted to study overconfidence with highly specialised skills, and so used landing a plane. Two experiments were performed.

Experiment 1 involved 198 participants recruited via Amazon Mechanical Turk, who watched a video or not (by random allocation). The short video involved a pilot landing a plane, but it did not teach the skills involved. Then this scenario was presented: "Imagine you are on a small commuter plane. Due to an emergency, the pilot is incapacitated and you are the only person left to land the plane" (p4). This was followed by a series of questions, like "How confident are you that you would be able to land the plane without dying?" and "How confident are you that you would be able to successfully land the plane as well as a pilot could?" (scored out of 100). The group who had watched the video was significantly more confident than the control group. So, "watching one short non-instructional video of a pilot landing a plane inflated people's confidence in their own ability to land the plane – a specialised task requiring a great deal of expertise" (Jordan et al 2022 p6).

Experiment 2 recruited another 632 online participants for a replication, which counterbalanced the order of the confidence questions. The same overconfidence was found after watching the video, but asking the "without dying" question first did have an effect (figure 1.2). Jordan et al (2022) explained this finding with "an anchoring-and-adjustment account in which the order of items affects people's evaluations of their performance on those items. That is, our findings



(Data from Jordan et al 2022 table 1)

Figure 1.2 - Mean confidence ratings (out of 100).

from Experiment 2 support the possibility that the question people encountered first anchored their response to the second. In other words, when people first face the lower standard 'without dying' question, they might be lulled into a more heuristic type of processing, essentially 'nodding along' with the scenario, and tending to rely on recent feelings of easy processing that the added semantic context of the video provided. Then, to the extent people have difficulty sufficiently adjusting away from their overconfidence, when they face the higher standard question – comparing themselves with a pilot – they report more confidence than people who did not watch the video. But what happens to people who encounter the questions in the opposite order? When they are asked to compare their ability with that of a pilot, the obvious high standard should make it difficult to nod along; when they are then asked about their ability in the lesser standard, they too adjust away from their low confidence – but never get to the point where they nod along. These are speculative mechanisms, and although they fit with the literature, more research is needed" (pp11-12).

In both experiments men were more confident than women.

The researchers proposed that the video was easy to watch and so participants felt that landing a plane was easy and thus became overconfident (Jordan et al 2022).

1.2. CLIMATE CHANGE SCEPTICISM

There is a "non-negligent segment" of the lay population (ie: non-scientists) that does not acknowledge a human influence on climate change (Tremoliere and Djeriouat 2021). These have been called "climate change sceptics".

Tremoliere and Djeriouat (2021) reported three studies to investigate if there were cognitive differences between such individuals and the majority of the population.

Study 1

This study investigated "analytic cognitive style" - ie: the willingness and ability to undertake "deliberative thinking" ("Type 2 thinking") as opposed to fast, intuitive decision-making ("Type 1 thinking"). A sample of 373 US participants were recruited online.

A number of questionnaires were completed including the Cognitive Reflection Test (CRT) (to measure analytic thinking), and those covering scientific literacy, belief in science, and climate change scepticism (table 1.1).

Low analytic cognitive style (CRT score) and low belief in science score predicted high climate change scepticism. "People more intuitive seem more likely to endorse scepticism despite scientific evidence and consensus as compared to people more analytic" (Tremoliere and Djeriouat 2021 p3).

Study 2

This study tested knowledge (general and climate change specific) and the "illusion of knowledge" (or "confidence bias"). The participants were 386 US adults recruited online.

As Study 1, the CRT, and the measures of cognitive ability, and climate change scepticism were the same, while three new questionnaires were included:

- Rational Experiential Inventory - Another measure of Type 1 and 2 thinking (eg: "I prefer to do something

MEASURE	EXAMPLE
CRT	"In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?". Incorrect answer: 24 days (Type 1 thinking). Correct answer: 47 days (Type 2 thinking).
Thinking disposition	"People should revise their beliefs in response to new information or evidence".
Cognitive ability	"Imagine that we rolled a fair, six-sided die 1000 times. Out of 1000 rolls, how many times do you think the die would come up even (2, 4 or 6)?".
Belief in science	"Science is the most efficient means of attaining truth".
Science literacy	"Electrons are smaller than atoms".
Climate change scepticism	"The evidence for climate change is unreliable".

Table 1.1 - Example of questions in Study 1.

that challenges my thinking abilities rather than something that requires little thought"; "I believe in trusting my hunches").

- Climate change knowledge and confidence - eg: "At the same quantity, CO2 is more harmful to the climate than methane"; "The global CO2 concentration in the atmosphere has increased during the past 250 years". Participants rated their confidence (out of 100) to each answer.
- General knowledge and confidence - eg: "What artistic movement does Anacreontics belong to?" [Answer options: Rococo (correct), Romanticism or Realism]. Confidence levels were also rated.

Analytic cognitive style predicted climate change scepticism as in Study 1, as did climate change knowledge - ie: "people with greater knowledge about climate change were less sceptical about climate change" (Tremoliere and Djeriouat 2021 p5). Overconfidence was not significant after controlling for other variables.

Study 3

This was a replication of Study 2 with 272 more participants, and an added question about political orientation (liberal-conservative on a ten-point scale).

Analytic cognitive style, climate change knowledge, and overconfidence (this time) all significantly predicted climate change scepticism, but being politically conservative was the greatest predictor.

Altogether, climate change scepticism was a combination of intuitive thinking (Type 1 - non-analytic), limited factual knowledge about climate change (but overconfidence about that knowledge), and a conservative political orientation (at least in this US study).

The participants were volunteers on the Amazon Mechanical Turk platform.

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2. VIOLENCE AND THE YOUNG AS A PUBLIC HEALTH ISSUE

- 2.1. Introduction
- 2.2. Complex PTSD
- 2.3. Cost of PTSD
- 2.4. Family violence
- 2.5. Cyberbullying
- 2.6. Early detection of suicide attempts
- 2.7. Appendix 2A - Public health approach to
community gun violence
- 2.8. Appendix 2B - Suicides in Poland
- 2.9. References

2.1. INTRODUCTION

Violence against children and young people is a common problem around the world. For example, it is estimated that 170 million children under five years old live with a mother who is the victim of intimate partner violence, while over one-third of young teenagers have experienced bullying (Lam et al 2021).

Here are five studies from "Frontiers in Public Health" which addressed violence and young people as a public health issue, and varied in their approach and methodology (appendix 2A). Introducing the articles, Lam et al (2021) expressed the wish the "series of articles can draw attention to violence toward children and young people and call for further actions from governments all over the world to take effective measures to end current violence in all forms and to prevent further violence against the vulnerable population under their care" (p2).

2.2. COMPLEX PTSD

Herman (1992) introduced the idea of "complex post-traumatic stress disorder" (C-PTSD) as distinct from PTSD. C-PTSD, in addition to the symptoms of PTSD like hyper-vigilance and flashbacks, includes affective dysregulation, negative self-concept, and disturbances in interpersonal relationships" (Shin et al 2021). C-PTSD has been found to be associated with multiple types of childhood trauma (Shin et al 2021).

In terms of the distinction between PTSD and C-PTSD, Shin et al (2021) outlined four main studies which grouped individuals by symptoms and experiences (table

2.1).

STUDY	COUNTRY	DETAILS
Cloitre et al (2013)	USA	302 individuals seeking treatment for interpersonal trauma divided into three groups using latent profile analysis (LPA) based on trauma experiences - PTSD, C-PTSD, and low-symptoms. C-PTSD was associated with chronic trauma, and greater impairment.
Cloitre et al (2014)	USA	280 women with a history of childhood abuse divided into four groups using latent class analysis - PTSD, C-PTSD, low-symptoms, and borderline personality disorder.
Elklit et al (2014)	Denmark	607 bereaved parents, 449 rape victims, and 214 victims of physical assault divided into three groups using latent class analysis - PTSD, C-PTSD, and low-symptoms.
Perkonig et al (2016)	Germany	A community sample of adolescents and young adults with a psychiatric history classified into four groups based on interpersonal trauma - PTSD, C-PTSD, disturbance in self-organisation and low PTSD, and low-symptoms.

Table 2.1 - Four studies distinguishing C-PTSD from PTSD sufferers.

The specific characteristics of C-PTSD above PTSD will lead to predictable behaviours. Focusing on dysfunction in affective regulation, negative self-concept, and disturbance in interpersonal relationships, Shin et al (2021) "hypothesised the following: (1) adolescents with C-PTSD have deficits in emotional perception and cognitive functions, including executive function and attention; and (2) deficits in neurocognitive functions are associated with the severity of C-PTSD symptoms" (p2).

Data were collected from sixty-nine 13-24 year-olds in "state shelters" in South Korea, where individuals were attending for sixteen sessions of art therapy. These individuals had experienced parental abuse, and had a diagnosis of PTSD between 2017 and 2019. It was determined that 39 individuals had C-PTSD and thirty PTSD by the C-PTSD Interview (C-PTSD-I) (Ouimette et al 1996) (Korean version). This has 37 items covering seven domains - regulation of affective and impulse; alteration in attention or consciousness; alteration in self-conception; alteration in perception of the perpetrator; alteration in relationships with others; somatisation;

alteration in meaning system (Shin et al 2021).

The C-PTSD group had a higher rate of history of sexual assault than the PTSD group (72 vs 37%), and it had lasted longer (6.6 vs 2.7 years mean).

Three measures of outcome were used:

i) Emotional perception test - Between 2-8 faces were presented simultaneously on a computer screen, and the participants had to decide whether the same or different emotions were being expressed. There were pleasant, unpleasant or neutral facial expression used. Accuracy of response and reaction time were measured.

There was no difference in spread of answering between the two groups, but the C-PTSD group was significantly less accurate than the PTSD group.

ii) Mental rotation test - Two 3D shapes were presented on the screen side by side but at different angles, and the participants had to mentally rotate the shapes to say if they were the same or different. Accuracy and reaction time were scored.

The C-PTSD group was significantly less accurate, but there was no difference in reaction time between the groups.

iii) A version of the "Tower of London" test - This involved moving a number of coloured cards around the computer screen to produce a certain pattern. This assessed working memory for planning, and the time taken to solve and the number of moves made were measured.

There was no difference in time taken to solve, but the C-PTSD group made significantly more moves.

The findings supported Hypothesis 1.

Hypothesis 2 was also supported. Among the C-PTSD group, the higher the C-PTSD-I score (ie: more severe symptoms), the lower the accuracy in the emotional perception and mental rotation tests (ie: negative correlations), but the more taken moves in the third test (ie: a positive correlation). The C-PTSD score had no impact on the test scores in the PTSD group.

The sample was quite small, and the family environment of the participants was not investigated.

Shin et al (2021) concluded: "Because adolescents with C-PTSD showed more deficits in clinical symptoms and cognitive functions than those with PTSD, psychiatrists should pay careful attention toward neurocognitive function when assessing patients with C-PTSD. In addition, regulation of emotion and improving working memory could be crucial factors for treating C-PTSD"

(p7).

2.3. COST OF PTSD

Dams et al (2020) reported that PTSD after childhood abuse has negative consequences on life chances for adolescents and young adults. There are also monetary costs for society as well as the individual, which in US adults with PTSD has been estimated at \$3000 per year, for example, for psychiatric treatment (Dams et al 2020).

Dams et al (2020) analysed data on 87 14-21 year-olds attending therapists and outpatient psychiatric clinics in Germany between 2013 and 2015. All participants had a diagnosis of PTSD related to childhood sexual and/or physical abuse. Three outcome measures were taken:

i) Psychiatric health care costs (using 2014 German unit costs) - A mean figure of 5243 Euros for a six-month period was calculated. "Costs were mainly due to psychiatric hospitals, general hospitals and rehabilitation. As most of the participants had at least one psychiatric co-morbidity, inpatient costs may be due to these. In addition, high costs were due to the utilisation of child welfare institutions. Of all participants, 15% were living neither at home nor with relatives/friends" (Dams et al 2020 p5).

The calculation of costs made assumptions, and, for example, did not include costs related to transport and long-term nursing care. Dams et al (2020) explained that "costs were collected independent of seasons for 6 months prior to baseline, so that the influence of seasons on health care utilisation could not be determined. However, a seasonal influence on the results was not expected, because no seasonal clinical events are known for PTSD" (p6).

In terms of other studies, Shearer et al (2018) calculated health costs over an eleven-week period of £557 in the UK, while in Australia (Gospodarevskaya and Segal 2012), 2000 Australian dollars were estimated as the annual cost for cognitive-behavioural therapy.

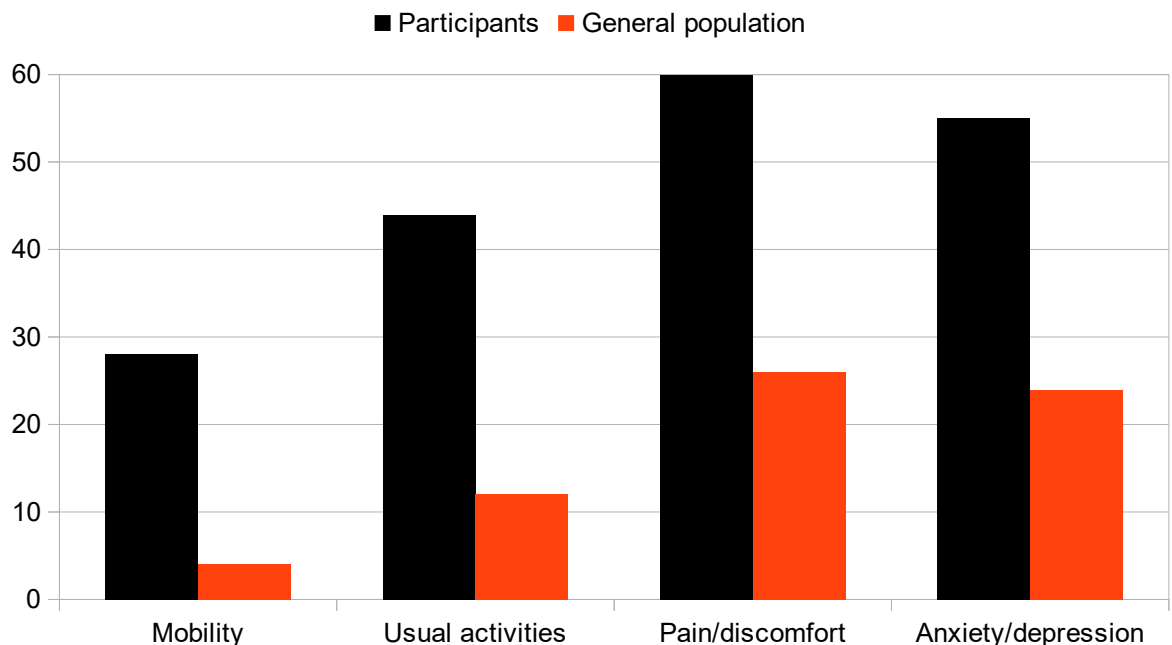
Dams et al (2020) wanted comparative data for adolescents and young adults in the general population in Germany, but found none published.

ii) Health-related quality of life (using EQ-5D-SL; GroupEuroQoL 1990) - Five dimensions (mobility, self-care, usual activities, pain/discomfort, and

anxiety/depression) were scored from 1 ("no problem") to 5 ("extreme problem").

The dimensions of pain/discomfort and anxiety/depression were most impaired. Around one-third of participants chose "severe problem" or "extreme problem" for the latter (compared to 2% in general population studies), and around half "moderate problem" to "extreme problem" for pain/discomfort (compared to around one-third of the general population). The other dimensions were slightly more negative than the general population (figure 2.1).

The overall mean score was 61 (out of 100), which is much less than 83.5 in a representative sample of 8-18 year-olds in Germany (Wille et al 2010). A higher score is a better health-related quality of life.



(Data from Dams et al 2020 table 4)

Figure 2.1 - Percentage of "slight problem" and "moderate problem" responses combined on selected domains of EQ-5D-SL by participants and a comparison general population in Germany.

iii) Education/training loss (eg: number of days absent) - An average of 27 days missed in the previous six months. Overall, 24 individuals had had to repeat a year in school, and twenty-five had failed school

graduation due to PTSD. In the general population, less than 2% of pupils repeat a year in Germany (Dams et al 2020).

Dams et al (2020) admitted that "almost half of the participants had not completed school yet. Therefore, results on educational interruption cannot be interpreted as long-term consequences of PTSD. In addition, further problems may arise in later working life (eg: when trying to find a job). Therefore, future research should consider long-term economic consequences of PTSD in adults after sexual and/or physical abuse" (p6).

Dams et al (2020) summed up: "Our analyses revealed a high burden of direct costs, reduced health-related quality of life and educational interruption among adolescents and young adults with PTSD" (p5).

2.4. FAMILY VIOLENCE

Family violence (FV) impacts children of all ages, but Addae and Tang (2021) concentrated on the experiences of adolescents.

FV covers (Addae and Tang 2021):

- Physical violence (ie: physical force intended to harm another).
- Psychological violence (eg: verbal comments with the intention of humiliating another).
- Sexual violence - "the imposition of sexual practice against the wishes of an individual or which results in their victimisation" (Addae and Tang 2021 p2).
- Exploitation (eg: use of the child in work that benefits others but harms the child in some way).
- Neglect (eg: lack of appropriate care).
- Exposure to intimate partner violence (IPV).

Poly-victimisation is common, and "can multiply the adverse effect on adolescents" (Addae and Tang 2021 p2).

Addae and Tang (2021) conducted focus groups with fifty-six adolescents from fourteen schools in seven regions of Ghana. A key issue of discussion was the

perception of the home as unsafe.

"Family violence emerged as the reason reported by adolescents for why they perceived their homes as unsafe. The common types of family violence perpetrated against adolescents were physical violence, psychological violence, exposure to IPV, neglect, exploitation, and sexual violence. The perpetrators include biological parents, step-parents, extended relatives, and guardians who are not blood-related to the adolescent. The violence could be severe, with extreme consequences such as permanent impairment and psychological trauma leading to suicide" (Addae and Tang 2021 p4).

Concentrating on each type of violence in more detail:

i) Physical violence - "Slapping, kicking, pushing, hitting with big sticks and hot firewood, and severe beating were reported. Belts, canes, and even cutlasses were used as tools for beating adolescents for perceived wrongdoings" (Addae and Tang 2021 p4).

For example, "Richie" said: "Let me say that in this part of our world beating is common. If you make a slight mistake, they will beat you severely. They can start with the cane and end with their hands. Sometimes, they will just take anything. They can even use burning firewood to beat you" (p4).

ii) Psychological violence - "Psychological abuse, either in the form of verbal abuse or intimidation, was reported to be a common experience by almost all the participants. Carers verbally abused the adolescents by yelling, insulting, and cursing them sometimes for no wrongdoing as reported by the participants" (Addae and Tang 2021 p6).

"May" described an example of the consequences of abuse: "My friend was banned by her mother to go out of the house to protect her from boys. Even if myself and her friends go to her house, the father will chase us out of the house saying friends are a bad influence to her. Although, she was given everything she needed, she was always bored and unhappy at home. One day, she told me that if her mother doesn't allow her to go out, she will poison herself. At that time, I took it as a joke. The last time I saw her alive was when I visited her, and she refused to talk to me. I had no idea that she had already planned to commit suicide on that same day. That day, she was alone at home and when the mother returned to the house, she had already poisoned herself and was found dead" (p6).

iii) Exposure to IPV - "Michael" summed up the situation thus: "Some fathers, like mine, always go out and drink alcohol. When they are drunk and come home, they will start beating their wives. How can I feel safe at home? Sometimes they will beat both the mother and the child. The child will get scared" (p6).

iv) Neglect - This was perceived as common, as "May" described: "Let me take our district for instance, most of the parents don't care about their kids. If you go out you will see the children roaming. If they are hungry, they eat anything they get. Some eat thrown away leftover food because the parents have not been providing for them" (p6).

v) Exploitation - This was more common where adolescents lived with non-biologically related adults, who "exploited adolescents by subjecting them to excessive work and household chores as though they were domestic workers. Consequently, these adolescents were usually tired and deprived of adequate sleep or happiness" (Addae and Tang 2021 p7).

vi) Sexual violence - eg: "Suzy" said: "I have a friend who lives with the stepfather. Because she is not the biological child, the man will be forcing her to have sex with him" (p7).

Addae and Tang (2021) drew out some key points about FV from the focus groups. First, the hidden or surreptitious nature of the violence (ie: within the home and away from outsiders to see). "Second, while some adolescents considered harsh parenting style and parents' mental health problem (eg: father's alcoholism) as the reasons behind the abuse they suffered, they often perceived family violence as a normal part of the culture and blamed themselves for inducing the violence" (Addae and Tang 2021 p8).

The cultural norm of corporal punishment was seen as legitimising FV. "The difference between 'reasonable and justifiable' corporal punishment and abuse is not well-defined, possibly allowing carers leeway to abuse adolescents who were even above 16 years..." (Addae and Tang 2021 p8).

Addae and Tang (2021) added the norms of a patriarchal culture (ie: fathers as "accepted" perpetrators), and superstitions that were used to justify abuse of individuals with mental health problems. Interventions to reduce FV could focus of these three

norms (Addae and Tang 2021).

"In general, carers demonstrate their superiority and control over the adolescents in an authoritarian manner, thereby, making the adolescents powerless" (Addae and Tang 2021 p1).

2.5. CYBERBULLYING

Bullying in cyberspace (ie: cyberbullying) is a new form of violence experienced by children and adolescents in the 21st century. It can be defined as "the intentional and repeated harm from one or more peers that occurs in cyberspace caused by the use of computers, smartphones and other devices" (Zhu et al 2021 p2).

Compared to victims of traditional bullying, online victims report greater levels of depression, anxiety, and loneliness (eg: Larranaga et al 2016). Figures on the prevalence of cyberbullying vary widely (Zhu et al 2021).

Zhu et al (2021) performed a systematic review of cyberbullying globally. Sixty-three relevant studies published in English between 2015 (when first studies appeared) and 2020 were found. Ten of the studies were rated as "high quality" in terms of methodology (eg: full reporting of method; double blinding) (table 2.2).

The prevalence of cyberbullying victimisation ranged from 14% to 57%, and being a perpetrator from 6% to 46%. Of the different types of cyberbullying behaviour, "verbal violence" (ie: "offensive responses, insults, mocking, threats, slander and harassment") was most common, compared to "group violence" (ie: "preventing others from joining certain groups or isolating others, forcing others to leave the group"), "visual violence" (ie: "the release and sharing of embarrassing photos and information without the owners' consent"), "impersonating and account forgery" (ie: "identity theft, stealing passwords, violating accounts and the creation of fake accounts to fraudulently present the behaviour of others"), and "other behaviours" ("disclosure of privacy, sexual harassment, and cyberstalking") (Zhu et al 2021 p3).

The risk factors for victimisation were being female, having mental health problems, spending more time on the Internet than peers, and "family dysfunction", while perpetrators were older teenagers, having experienced cyberbullying or traditional bullying themselves, and relationship difficulties.

In terms of protective factors, "high emotional intelligence, an ability for emotional self-control and

empathy, such as cognitive empathy ability, were associated with lower rates of cyberbullying" (Zhu et al 2021 p7), as well as close relationships with parent(s).

The prevalence of cyberbullying appeared to have increased over the five-year period of the studies. "The underlying reason for increases may be attributed to the rapid changing landscape of social media and, in recent years, the drastic increase in Internet penetration rates" (Zhu et al 2021 p8).

- Sample size varied from hundreds to tens of thousands, but national representative samples "scarce".
- Most studies from the USA (n = 14) and Spain (n = 12), followed by China (n = 6). Four of the high quality studies from non-high income countries.
- Use of self-reported measures, and instruments and scales used.
- Definitions and terminology of cyberbullying.
- Recall period (eg: last week vs lifetime).
- Sample demographics (eg: age, gender, ethnicity).
- Study of victims and/or perpetrators.
- Cross-sectional design and so unable to establish causality.
- Also "variations in economic development, cultural backgrounds, human values, internet penetration rates, and frequency of using social media may lead to different conclusions across countries" (Zhu et al 2021 p8).

Table 2.2 - Methodological issues of the studies included in the review by Zhu et al (2021).

2.6. EARLY DETECTION OF SUICIDE ATTEMPTS

The World Health Organisation estimates around 800 000 deaths per annum globally from suicide (Kim et al 2021). A previous suicide attempt is a high predictor of another attempt. Thus the need for early detection and management of high-risk individuals (appendix 2B).

A multi-disciplinary emergency consultation system (MECS) for suicide attempters with a drug overdose was set up in a hospital in South Korea. Focusing on cases between 2018 and 2019, Kim et al (2021) analysed the data for 251 patients referred to the MECS. Retrospectively, around half the participants were studied before contact

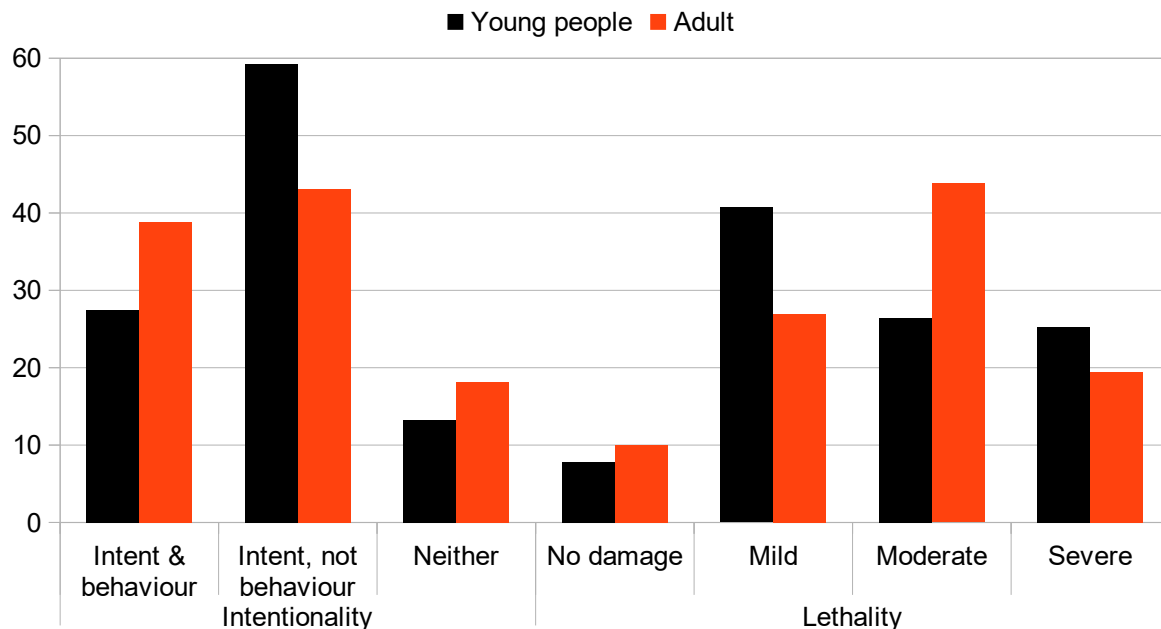
with the MECS, and half after contact. They were also divided into "young people" (13-24 year-olds) and "adults" (25 years and above).

There were significantly more females in the former group, and this group had more unplanned attempts than planned ones, as well as lower levels of suicide lethality and intentionality (table 2.3; figure 2.2) compared to the adults.

- Intentionality:
 - i) Intention and behaviour - "I really tried to die and I chose that method".
 - ii) Intention, but not behaviour - "I had a desire to die, but I knew it was not actually a way to die".
 - iii) No intention nor behaviour - "I was trying to get help, not really trying to die".

- Lethality:
 - a) No physical damage.
 - b) Mild physical damage.
 - c) Moderate damage requiring medical attention.
 - d) Severe damage requiring hospitalisation and/or intensive care.

Table 2.3 - Categories of suicide intentionality and lethality used by Kim et al (2021).



(Data from table 3 Kim et al 2021)

Figure 2.2 - Intentionality and lethality (%) in "young people" and "adult" groups.

Comparing the MECS groups, the intervention reduced the hospital costs (ie: less serious treatment needed), especially for young people, and "non-serious suicide attempters". Serious attempts were defined as intention and behaviour (intentionality), and moderate to severe damage (lethality).

Kim et al (2021) ended: "Fast and precise co-operation from the multi-disciplinary departments for patients who attempted suicide by drug overdose reduced unnecessary ICU [intensive care unit] treatment and costs, especially in young attempters and those with a lower level of intentionality and lethality" (p8).

The study was based on one hospital in one city, and the data were analysed in retrospect.

The patterns from the data fitted with previous research that suggested that "adults often attempt suicide because of psychiatric illnesses, but adolescents are often affected by emotional factors, such as anger, frustration, and rejection in interpersonal relationships. Adolescents tend to choose suicide as a means of expressing extreme pain because of emotional factors rather than attempting suicide because they really want to die" (Kim et al 2021 p6).

2.7. APPENDIX 2A - PUBLIC HEALTH APPROACH TO COMMUNITY GUN VIOLENCE

The data on gun violence in the USA are staggering - in 2019 firearms were used in over 14 000 homicides, and 280 000 non-fatal cases, according to official records (Webster 2022). The cost of gun violence annually, including medical treatment, disability, lost productivity, and criminal justice responses, was estimated at \$229 billion in 2017 (Webster 2022). Other impacts include drops in home values in areas of gun violence (Webster 2022).

A public health approach attempts to "create environments that are less conducive to violence or that facilitate social conditions that constrain violence" (Webster 2022 p38). For example, the wide availability of firearms and alcohol as the density of alcohol outlets is positively associated with violent crime, irrelevant of other characteristics of the neighbourhood (Webster 2022).

Abt (2019) argued that any approach to urban gun violence should be:

- Focused, as gun violence is concentrated among a
- Psychology Miscellany No. 170; August 2022; ISSN: 1754-2200; Kevin Brewer

very small percentage of the population and in certain areas.

- Balanced, with a variety of policies beyond enforcement (eg: social services).
- Fair, as "not only as a matter of justice, but research shows that compliance with laws and co-operation with law enforcement are highly dependent upon whether individuals view police and prosecutors as legitimate and fair" (Webster 2022 p40).

2.8. APPENDIX 2B - SUICIDES IN POLAND

Eastern Europe has seen a growth in suicides in the last half century (Gawlinski et al 2020). But the accuracy of the data is a problem.

Gawlinski et al (2020) concentrated on Poland using data collected by the Central Statistical Office (CSO), and the National Police Headquarters (NPH). The former source is based on death reports by medical practitioners, but that means the decision rests with those individuals to define the death. "For example, drownings are in most cases treated as unfortunate accidents, even if the circumstances of the case indicate that a suicide attempt may have occurred" (Gawlinski et al 2020 p223).

While "cases of suicide attempts undertaken in hospital wards, especially in psychiatric wards, are treated as a manifestation of the disease and as such are recorded in the history of the disease and are not separately recorded" (Gawlinski et al 2020 p223). Families may also want to hide the "real" cause of death.

The NPH data came from police records, which placed missing individuals and unidentified human dead bodies in separate categories to suicide, but some of which it can be assumed were suicides (Gawlinski et al 2020).

The upshot is that for the period of the study (1990-2018), there was a large difference in numbers from the two sources of data (eg: over two thousand difference in the worse year). The CSO data were favoured (Gawlinski et al 2020).

The 2018 rate of suicide attempts resulting in death was estimated at 13.6 per 100 000 population (compared to 9.2 in 2007 (lowest) and 16.2 in 2014 (highest)). The European Union average was 15.4 and 10.6 globally in 2016, and in neighbouring countries, the highest were Lithuania (31.9) and Russia (31.0) (Gawlinski et al

2020).

In terms of gender, there was around four times more male than female suicide deaths ², and men aged 45-54 years was the highest combined risk group. "Peak" times were the turn of winter and spring, and Mondays. Rural areas had a higher rate, and hanging was the most common method (three-quarters of deaths).

Gawlinski et al (2020) summed up: "A systematic increase in the number of suicide attempts has been observed in Poland, while the number of suicide deaths is gradually decreasing" (p232).

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² Gawlinski et al (2020) commented: "We tend to believe, however, that the number of suicides among women, as in other countries, may be underestimated, because they use methods referred to as 'soft', which contributes to a change in the categorisation of the case. It should be noted that 'soft' methods of committing suicide are those that are less likely to lead to death (for example, poisoning). The 'hard' methods include hanging, shooting with a firearm, or jumping from a height (they give a greater guarantee of effectiveness)" (p231).

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3. ASPECTS OF SPACE TRAVEL

- 3.1. Parabolic flight
- 3.2. Motion sickness
 - 3.2.1. Space motion sickness
- 3.3. NASA twin study
- 3.4. Hibernation and ageing
- 3.5. Appendix 3A - Physiological changes
- 3.6. References

3.1. PARABOLIC FLIGHT

Spaceflight produces physiological change in the human body, like bone loss, muscle atrophy, and fluid shifts (appendix 3A). Studies of space travellers show some adaptations, but not others (eg: space motion sickness) (Van Ombergen et al 2017).

Animal studies have found that the central nervous system can adapt to microgravity by neuroplasticity (eg: rats; Holstein et al 1999). This has also been seen in the very limited human studies. For example, a brain scan of a returning cosmonaut showed changes in function and connectivity in specific areas of the brain (Demertzi et al 2016).

"However, research on humans in space is expensive and subject to several logistic and payload restrictions. Hence, ground-based models have been developed, in which some aspects of spaceflight can be simulated" (Van Ombergen et al 2017 p2).

One such alternative is "parabolic flight" (PF), where acceleration of an aircraft upwards and then downwards can produce a brief period (around twenty seconds) of microgravity (ie: freefall; zero g). There is also a brief period of hypergravity (1.5 - 1.8 g). A PF lasting three hours can generate around thirty "zero g" periods. Van Ombergen et al (2017) studied 28 healthy volunteers in this situation.

Brain scans were performed approximately six hours pre- and post-flight. Changes in connectivity in the brain of the volunteers (compared to twelve controls) were detected, particularly in relation to the integration of visual, somatosensory (self-location in space) and vestibular (from the ears about balance) information (eg: right temporo-parietal junction).

Van Ombergen et al (2017) admitted: "However, it remains challenging whether the observed effects can be attributed to microgravity, hypergravity or to the general transitions of the gravitational force, which are

all induced during PF. With the current set-up, we are unable to make specific assumptions as to the origin of the effect. Our control group did not engage in an activity that could mimic the characteristics of the PF, ie: the alternation between the absence of gravity and the presence of hypergravity. Hence, we could not obtain a highly-controlled environment for the PF participants. Designs controlling for the effect of microgravity and the exposure to hypergravity, which is approximately twice the length of that spent in microgravity, might be able to disentangle between the effects of these two forces in the human brain" (p7).

The volunteers receive a scopolamine injection prior to PF to alleviate motion sickness, and this was also given to the controls. Other neuroimaging studies have shown an effect on brain connectivity from this muscarinic receptor antagonist (Van Ombergen et al 2017).

3.2. MOTION SICKNESS

Motion sickness occurs with many modes of transport (and with virtual reality technology), so it is a potential problem for space travellers.

The physiology of movement of the body and head leading to nausea is not fully understood. The vestibular system within the ear that detects motion is important. Though its overstimulation was an early theory, there are unanswered questions like sailors experiencing nausea after returning to land, or that car passengers suffer more than drivers (table 3.1) (Thomson 2020).

- The difference between driver and passenger in motion sickness susceptibility has been tested with the "yoked paradigm". Two individuals are seated side by side on a rotating device, and one of them controls the motion (active - to simulate driver) while the other is passive (to simulate the passenger). The passive participant is more likely to report motion sickness than the active one.
- But Lackner (2014) argued that such studies do not control for differences in attention. Where the passive participant mimics the joystick movements of the active participant (ie: to create equal attention with the active participant), there was no difference in motion sickness.

Table 3.1 - The "yoked paradigm".

An alternative explanation is the conflict between

different kinds of sensory information. For example, sitting in a car, an individual is both stationary in terms of their body moving, and moving in terms of the car. But why do nausea levels vary, then, between experienced and novice sailors in the same situation (Thomson 2020)?

Another idea is that the conflict is between actual sensory signals and expectations (eg: Oman et al 1990). The idea is that "when you make a movement, your brain subtracts the actual sensory input from the expected pattern of neural activity, and what's left is a 'sensory-motor conflict signal'" (Thomson 2020 p49). Motion sickness occurs because this conflict is prolonged. Brooks and Cullen (2013), for instance, have found support for this idea with the existence of specific cells in the cerebellum that are activated when there is a mismatch between expected and actual head movement. Monkeys trained to move their heads in a particular way have a weight placed on the head which disrupts the movement and these cells are recorded firing (Thomson 2020).

A common laboratory method to study motion sickness is "to have subjects seated inside a large vertically striped drum. When the drum is rotated at constant velocity, it will soon be seen as being stationary and the subject will feel constant velocity self-rotation in the direction opposite that of the actual drum motion. Most subjects will develop symptoms of motion sickness within minutes" (Lackner 2014 p2503). But if the participant is walking forward on a rotating treadmill moving in the same direction and at the same speed as the drum, there is no motion sickness. Participants report feeling like they are doing voluntary movement. There is no sensory conflict and no sickness which supports the sensory conflict theory.

"However, if the direction of the rotating drum is reversed while the subject continues making forward stepping movements on the treadmill, he or she will soon experience backwards motion. Some subjects in this circumstance feel that they are voluntarily making backwards stepping movements, others feel a paradoxical sense that their forward steps push them backwards. Despite the profound sensory conflict, no sickness is experienced..." (Lackner 2014 p2504).

An evolutionary theory of motion sickness has linked the nausea and vomiting to these behaviours in response to poisoning. "The notion is that when a noxious substance is ingested (eg: rotting flesh) if nausea and

vomiting result, inactivity will be induced and symptoms will be attenuated because of reduced levels of toxins circulated in the blood stream. Decreased activity enhances the possibility of recovery" (Lackner 2014 p2501). Simplistically, the reaction to poisoning has generalised to motion in ways not experienced by early humans (eg: by car). Lackner (2014) was sceptical of this idea.

Individual differences in susceptibility to motion sickness may be linked to specific genes (related to the development of the eyes and the ears, and to glucose regulation) (Thomson 2020). Women are more prone to motion sickness than men as a generalisation (table 3.2).

- Gender differences in susceptibility.
- Sailors experiencing nausea after returning to land.
- Difference in experience between seasoned and novice sailors on same deck.
- Car passengers experience it more often than drivers.
- Motion sickness not usual when jumping around and dancing.

Table 3.2 - Issues for theories of motion sickness.

Lackner (2014) emphasised two key points:

a) Motion sickness is a complex syndrome.

b) Much motion sickness goes unrecognised - "Symptoms that are actually characteristic of motion sickness may be interpreted as due to fatigue or just boredom when in fact they are being elicited by exposure to motion" (Lackner 2014 p2494).

The early view was of two types of people - those who respond with "head symptoms" (eg: headaches and drowsiness), and "gut responders" (nausea and vomiting). "Now we know that an individual's response depends on the relative provocativeness of the stimulation, his or her relative susceptibility, and prior experience" (Lackner 2014 pp2494-2495).

"Decay of symptoms" varies between individuals (ie: the length of symptoms and after-effects). Lackner (2014) noted three relevant factors here - sensitivity to

stimulation, adaptation constant (rate of adaptation to stimulus), and time constant of decay of symptoms. For example, an individual with sensitivity, long decay, and low adaptation will become more sick as the journey progresses, while an individual with high sensitivity, short decay, and high adaptation will have mild sickness throughout (Lackner 2014).

3.2.1. Space Motion Sickness

"Space motion sickness" (SMS) was first reported as a problem in the early 1960s by the second manned Soviet space flight, and the general incidence is around three-quarters of first-time astronauts/cosmonauts (lessening in experienced space fliers) (Lackner and DiZio 2006). It occurs soon after weightlessness begins, and most astronauts have recovered by 72-96 hours later (Lackner and DiZio 2006).

Symptoms range from drowsiness to nausea and vomiting. Among the many symptoms is the "sopite syndrome", "which refers to the chronic drowsiness, fatigue, mood and personality changes, and lack of initiative associated with long-term exposure to mildly provocative stimulation" (Lackner and DiZio 2006 p377). These symptoms continue after the nausea abates (Lackner and DiZio 2006).

Motion sickness generally is diagnosed by criteria developed by Graybiel et al (1968) using seven categories (or "cardinal symptoms") (each scored as slight, moderate or severe) - vomiting or retching ("nausea syndrome"), skin flushing or pallor, cold sweating, increased salivation (but decreased salivary flow), headache, and dizziness (table 3.3).

Certain factors have been proposed to explain SMS including (Lackner and DiZio 2006):

i) "Fluid shift hypothesis" - Weightlessness means an absence of hydrostatic pressure in the body's circulatory system, and fluid behaves differently to on earth (eg: engorgement of the pulmonary circulation).

But fluid shifts occur on earth with changes in orientation (eg: standing and laying flat). The body evolved the ability to autoregulate small changes.

"Neither spaceflight nor ground-based studies provide support for fluid shifts being an important factor in space motion sickness" (Lackner and DiZio 2006

Category	Extreme (16 pts)	Major (8 pts)	Minor (4 pts)	Minimal (2 pts)	Basic (1 pt)
Nausea syndrome	vomiting or retching	severe	slight	mild discomfort	aware
Skin colour		severe pallor	moderate pallor	slight pallor	flushing
Cold sweating		severe	moderate	slight	
Increased salivation		severe	moderate	slight	
Drowsiness		severe	moderate	slight	
Pain					headache
Central nervous system					dizziness

(8-15 pts = severe; ≥ 16 = "frank sickness")

(Source: Lackner 2014 figure 1 p2494)

Table 3.3 - Diagnosing and scoring motion sickness.

p381). Also prolonged bed rest studies "which use recumbency to mimic weightlessness do not evoke the panoply of signs and symptoms characteristic of space motion sickness despite the rostral fluid shifts generated" (Lackner and DiZio 2006 p381).

ii) Head movements - Early space travellers reported that head movements elicited and exacerbated SMS, and subsequent studies found that pitch and roll head movements (when wearing accelerometers) were involved (Lackner and DiZio 2006).

"The question arises whether there is something special about head movements eliciting motion sickness in weightless conditions or whether head movements in any non-earth force background would elicit symptoms. In other words, is space motion sickness a unique diagnostic entity?" (Lackner and DiZio 2006 pp381-382). Studies in parabolic flights suggest that SMS is "not a unique diagnostic entity" (Lackner and DiZio 2006 p382).

iii) Vestibular asymmetries - The balance organs in the ears are usually synchronised in gravity, and become out of synchronisation in weightlessness. But immobilising the head has been found to reduce SMS, and this should not be the cause with vestibular asymmetries

(Lackner and DiZio 2006).

Not all astronauts experience SMS, and because of its impairing effect, there is interest in predicting who will suffer. Two main types of predictor have been used (Lackner and DiZio 2006):

a) Pre-flight motion sickness tests - Prior to travel to "Spacelab 1" (launched in 1983), four crew members were tested in four different situations to produce motion sickness (eg: wearing prism goggles to reverse the visual field) (eg: Oman 1987). Three of the four individuals experienced SMS during spaceflight, and the pre-flight tests did not predict susceptibility. For example, the astronaut showing the worst SMS symptoms in pre-flight tests was the person who did not vomit during spaceflight (Lackner and DiZio 2006).

This was a small population and the tests were limited. More varied tests of motion sickness induction have been developed, but no patterns emerge (Lackner and DiZio 2006).

b) Susceptibility questionnaires - These require potential astronauts to report their past history of motion sickness, but little predictability found for SMS (Lackner and DiZio 2006).

Lackner and DiZio (2006) also observed that "when a motion sickness questionnaire is being used as a screening device, candidates are reluctant to reveal their full range of motion sickness experiences" (p393).

Questionnaires that try to identify psychological or personality characteristics "have little practical value for predicting susceptibility" (Lackner and DiZio 2006 p392).

Sleep deprivation has been found to increase motion sickness susceptibility (Lackner 2014).

Lackner and DiZio (2006) made this point: "It is important to recognise that a given sign or symptom of motion sickness may not have the same functional significance for different individuals. For example, some people when they experience nausea and vomiting are basically incapacitated and unable to perform essential activities, and it may take hours after removal from the provocative situation for them to recover. By contrast, and more rarely, some subjects may vomit after a minute or two of exposure to provocative stimulation, and then several minutes later may have recovered sufficiently to

continue exposure. Such individual differences in the relative significance of motion sickness have not been taken into account in the design and interpretation of questionnaires and predictive tests of motion sickness" (pp393-394).

3.3. NASA TWIN STUDY

Studying the impact of spaceflight on humans is limited to the 559 individuals who have done it between 1961 and 2019, of which eight have spent longer than 300 days in space (Garrett-Bakelman et al 2019). "The space environment is made harsh and challenging by multiple factors, including confinement, isolation, and exposure to environmental stressors such as microgravity, radiation, and noise" (Garrett-Bakelman et al 2019 p144).

Spaceflight durations of 1-4 months have been well studied in terms of the effects of weightlessness, say, on cardiovascular, musculo-skeletal and sensori-motor systems. For example, headward fluid shift, which "occurs immediately upon entry into weightlessness, resulting in a decrease in plasma and blood volume during the first few days of a mission that plateaus in the first 2 weeks of flight" (Garrett-Bakelman et al 2019 p1). There are also changes in oxygen consumption, and a loss of muscle mass meaning that regular vigorous exercise is required by astronauts in space (Garrett-Bakelman et al 2019).

The NASA Twins Study involved a pair of identical twins, where one of them ("TW") spent 340 days on the International Space Station (ISS) (and the other ("HR") remained on Earth).

Data were collected and compared for the genetically matched pair over 25 months (n = 317 samples including stool, urine, and blood). Garrett-Bakelman et al (2019) summarised the detailed findings as:

a) Little effect of spaceflight - eg: immune response to an influenza vaccine.

b) Changes that returned to pre-flight levels back on Earth - eg: gut microbiome composition (though changes probably related to diet as spaceflight itself); body weight (TW lost 7% during spaceflight).

c) Persistent changes continuing after six months on Earth - eg: DNA damage; attention problems.

d) The effect of the stress of returning to Earth - eg: immune function; cognitive performance.

Concentrating on cognitive performance overall, a computerised test battery ("Cognition") was repeatedly undertaken. TW's data were divided into pre-flight, early flight (1-6 months), late flight (7-12 months), and post-flight. Cognitive speed increased in the early flight period compared to pre-flight, and then remained similar in the late flight period. There was a decline in speed and accuracy post-flight which persisted six months. Garrett-Bakelman et al (2019) explained that "the cognitive performance effects of prolonging mission duration from 6 to 12months may be limited to a few domains. However, this extended mission duration may negatively affect cognitive performance post-flight, which could have implications for safe mission operations (eg: after a landing on Mars). Automation of post-flight operational procedures on future missions could help mitigate such risks. In addition to reexposure to Earth's gravity, the post-flight period can be demanding for astronauts owing to participation in research studies and media events. It is unclear how strongly each of the above factors contributed to the observed decline in the flight subject's cognitive performance post-flight" (p17).

3.4. HIBERNATION AND AGEING

Long-distance space travel will take a very long time and so finding a way to overcome ageing as well as the general boredom would be very helpful (eg: hibernation).

Turbill et al (2013) began: "Small hibernating mammals have longer maximum recorded lifespans than their similar-sized non-hibernating counterparts. This difference suggests that, because maximum lifespan is a good indicator of rates of ageing in survival, hibernators experience relatively slow rates of ageing" (p1). These researchers provided some evidence to support this observation.

Telomeres are repeated sections of DNA, which shorten with age due to accumulated oxidative damage. This process is believed to be involved in the physical decline associated with ageing. Telomere length has also been found to increase in small rodents (Turbill et al 2013).

Turbill et al (2013) investigated telomere length in

the hibernating edible dormouse (*Glis glis*) with DNA extracted from ear tissue punches taken pre-hibernation, post-hibernation, and after the active season. Telomere length did not change during hibernation (eight months of the year), but significantly declined during the active season for juveniles while increasing for adults.

Telomere length increase in adults during the active season could be associated with reproduction. Turbill et al (2013), however, were unsure about the relationship between telomeres, hibernation, and ageing in this species.

Hibernation involves long periods of torpor (where the metabolism is slowed) and short periods of arousal. The torpor-arousal cycle occurs many times during hibernation, and the processes controlling this cycle could suppress ageing ("hibernation-ageing hypothesis"; Pinho et al 2021).

Pinho et al's (2021) work with yellow-bellied marmots (*Marmota flaviventris*) over many years has shown that a key aspect of ageing slows down during hibernation - epigenetic changes in blood cells³. These animals hibernate for 7-8 months in a year.

Inducing such hibernation in humans would help in long-distance space travel. But would inducing hibernation in animals that do not usually hibernate extend lifespan (Sinisa Hrvatin in Le Page 2021).

Hrvatin et al (2020) reported the discovery of particular neurons in part of the hypothalamus that initiates torpor in mice ("torpor control centre"). Mice were kept in a cold environment and deprived of food in order to trigger torpor. Neurons in the torpor control centre changed in activity as the animal entered torpor, and "that this both contributes to and is necessary for the precipitous drop in core body temperature observed during natural torpor" (Hrvatin et al 2021). Chemical stimulation of this brain area produced features of torpor even in mice in warmer environments and not food-deprived.

3.5. APPENDIX 3A - PHYSIOLOGICAL CHANGES

Over half of astronauts from the ISS have altered visual acuity after a period of micro-gravity due to

³ A recently found way to measure physical ageing is "epigenetic clocks" (ECs) (based on DNA methylation). Put in simple language, the ageing of the DNA underpins physiological ageing. Hibernation stops ECs (Pinho et al 2021).

various physiological changes to the eyes (Mader et al 2011). NASA called this "spaceflight associated neuro-ocular syndrome", and the symptoms persist for years. (Kramer et al 2020).

One linked change is in intra-cranial pressure and brain volume. Kramer et al (2020) reported a longitudinal study of the brains of eleven astronauts. Magnetic resonance imaging (MRI) scans were taken before flight, and 1, 30, 90, 180 and 360 days post-flight. The period of spaceflight was around six months (mean 171 days).

The brains showed changes post-flight (compared to baseline) which persisted. For example, there was an increase in brain volume, and cerebrospinal fluid volume as well as changes to the pituitary gland. Many of "the changes are small in magnitude and remain within the range for healthy adults of similar age" (Kramer et al 2020 p644).

Note that only one participant was female, and the sample was volunteers from fifty-two eligible active ISS crew members.

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