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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.

CONTENTS

1. ADULT SEX RATIOS

1.1. ADULT SEX RATIO AND ANIMALS

The adult sex ratio (ASR) is "the proportion of males in the adult population" (Schacht et al 2017 p1) [1].

Kappeler (2017) summarised the key insights from research:

i) There is a wide variation in ASR between species - eg: among wild populations of 183 bird species, two-thirds had a highly biased ASR (Donald 2007).

ii) There can be variations in ASR within a species over time and space - eg: the ASR changed dramatically over five years in a studied population of brush-tailed bettong (or woylie) (Bettongia penicillata) (figure 1.1) (Wayne et al 2015).

iii) Sex ratio at birth can be quite different from ASR.

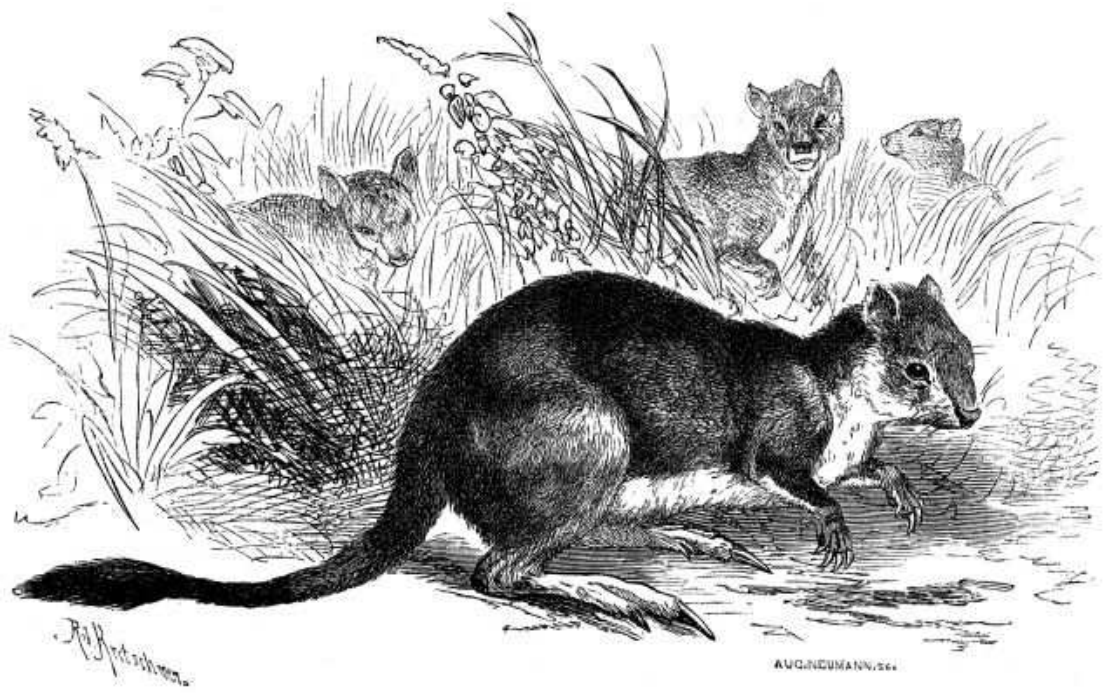
Variations in ASR influence mating systems [2] and parental care in bird species, for example (Liker et al 2013), as well as human behaviour [3]. In the former case, Mayr (1939) argued that monogamy was more common in species with a male-biased ASR (ie: more males than females), and polygyny was more common with a female-biased ASR (ie: more females than males). Many shorebirds are an example of the former with male parental care (and even sex-role reversal - eg: jacunas), as well as investing in mate-guarding (Schacht et al 2017).

Using data from 188 bird species, Korndeur et al (2017) showed that a male-biased ASR was related to co-operative breeding (where a non-breeding individual ("helper") provides additional care for the offspring of

[1] This is calculated as the number of males divided by the number of males and females, and it gives a number between 0 (only females in the population) and 1 (only males in the population). "This measure of the ASR is easy to interpret for two reasons. First, it does not invoke individuals of one sex as fractions of individuals of the other sex, so it is more in accordance with the nature of individuals as discrete units. Second, it results in values between 0 and 1 that reflect the relative abundances of males and females in the adult population" (Ancona et al 2017 p4).

[2] For example, the ASR of the American alligator, which has low female fertility, is 0.2 (ie: one male to five females) (Epstein 2012).

[3] At the extreme, strongly biased ASRs could lead to extinction (Ancona et al 2017).



(Source: Brehms Thierleben. Allgemeine Kunde des Thierreichs, Dritter Band, Erste Abtheilung: Säugethiere, Zweiter Band: Raubthiere, Kerfjäger, Nager, Zahnarme, Beutel- und Gabelthiere, Zweite umgearbeitete und vermehrte Auflage, Kolorirte Ausgabe, Leipzig: Verlag des Bibliographischen Instituts, 1883; in public domain)

Figure 1.1 - 19th century rawing of bettong.

a breeding pair) [4]. This non-breeding individual is a subordinate, like the offspring from a previous breeding season.

Helpers are often males, and the "ASR co-operation hypothesis" assumes that the cost of dispersal for the helper is high (ie: to move away and find their own breeding opportunities), and/or it is young females who usually disperse (Korndeur et al 2017). In Korndeur et al's (2017) analysis, female-biased dispersal was more common in co-operative breeding species than non-co-operative ones.

Schacht et al (2017) pointed out that "there is a general expectation across literatures that a relative abundance of males will elevate levels of conflict (particularly between males over partners), reduce pair-bond stability and decrease paternal investment" (p2) [5].

[4] Korndeur et al (2017) admitted: "Male-biased ASR can either be a cause or a consequence ofsex-biased helping, but regardless of the causal relationship, it is clear that a male-biased ASR is associated with a male bias in helping behaviour" (p5).

[5] Where there are more men, it is argued that there will "a growing class of unattached bachelor males", and unmarried men are more likely to engage in criminal behaviour than married ones (Schacht et al 2016).

But the researchers continued that evidence challenges this idea. Jones and Ferguson (2006), for instance, showed more family instability and men involved in concurrent relationships in late 20th century Colombia when there were more women than men (appendix 1A).

Introducing a series of articles on ASR, Schacht et al (2017) noted three problems with research into ASRs:

i) Studies are correlational;

ii) A limited number of species are studied (among fishes, reptiles, birds and mammals);

iii) Cross-sectional data are common (ie: no exploration of long-term trends).

The "ratio of the number of males and females competing for breeding opportunities at the same time" is the operational sex ratio (OSR) [6], and it determines intra-sexual conflict (Clutton-Brock 2017) [7]. The OSR and ASR can vary within a breeding season as, for example, males die from injuries after fighting or exhaustion, and juvenile males disperse.

But there are difficulties with measuring OSR. "For example, in polygynous species, what categories of males should be included? All adults that are not currently involved in parental care? Only those that have established breeding territories or dominance over other group members? Only those that breed successfully?" (Clutton-Brock 2017 p3).

Clutton-Brock and Parker (eg: 1995) the idea of "Time Out" to cover "the relative length of time for which one breeding attempt prevents individuals of each sex from competing for further breeding attempts" (Clutton-Brock 2017 p3). So, average "Time Out" in the two sexes gives an index of OSR [8].

This does not, however, include an "estimate of the potential fitness gains that males and females can achieve by winning reproductive contests" (the potential reproductive rate - PRR) (Clutton-Brock 2017).

He continued later: "Comparisons of estimates of maximum PRR by males and females show that males have

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[6] It is assumed that sex ratios at birth are equal (standard sex allocation theory; eg: West 2009), but subsequently they become biased for different reasons (eg: one sex is more prone to infant mortality). Thus the sex ratio at maturation (MSR) is more relevant for some (Jennions and Fromhage 2017).

[7] Jennions and Fromhage (2017) stated: "Theoretical models suggest that biased sex ratios drive the evolution of sex roles" (p1). Sex roles include differences in aggression, willingness to mate and parenting, and the ability to search for mates.

[8] But "'time out' after mating might depend on whether a mating is with a male's social partner or an extra-pair female: males rarely care for their offspring from extra-pair matings" (Jennions and Fromhage 2017 p3).

higher PRRs than females in species where they can care for multiple broods of eggs at the same time and compete more strongly for breeding opportunities (as in a number of fish and amphibians), while females compete more strongly and have higher PRRs than males in oviparous species where males care for a single clutch at a time, as in some mouth-brooding fish and a number of wading birds. Most species falling in the first category are ectotherms while most of those falling in the second category are homeotherms or mouth-brooding fish where neither parent can care for multiple clutches simultaneously and clutch size is relatively small" (Clutton-Brock 2017 p3).

Ancona et al (2017) discussed practical problems with measuring ASR, including:

i) Some species do not have visible genitalia to aid observers, which means DNA-based sexing.

ii) One sex may be more conspicuous or easily detectable (eg: male songbirds).

iii) One sex is less dispersed (eg: congregate at one site - female northern elephant seals).

iv) Other behavioural differences - male mirid bugs more attracted to light traps than females.

v) The sampling method used - eg: fiddler crab males are more likely to be captured foraging and females within burrows.

vi) Uncertainty of indirect methods - eg: Severinghaus and Maguire (1955) estimated "the juvenile sex ratio from hunter kills of deer as the proportion of yearling to adult males divided by the proportion of yearling to adult females" (Ancona et al 2017). But it depends on "differing assumptions about demographic rates for the juvenile age class: juvenile survival is equal for males and females, juvenile survival differs between sexes, juvenile sex ratios do not differ from unity and juvenile sex ratios are unequal" (Ancona et al 2017 p8).

1.2. APPENDIX 1A - HUMAN POPULATIONS [9]

ASRs vary around the world from over four men to one woman in Qatar (which has more men moving there to work)

[9] Guttentag and Secord (1983) is seen as the seminal work on ASR and human behaviour (Pollet et al 2017).

to 0.79 men to one women in Djibouti (where men have left to work elsewhere) (Epstein 2012).

Barber (eg: 2004) has outlined many affects of human biased ASRs, including when they are more men, women are more curvaceous in body shape, and men have more facial hair, while women are slimmer in body shape when men are scarce (Epstein 2012).

Uecker and Regnerus (2010) looked at the ASR on campuses, and found that where there were more women to men, females dated less and were less likely to have a college boyfriend (Epstein 2012).

ASR has been linked to both positive and negative relationships with, for example, crime. Hudson and Den Boer (2002) described a positive relationship based on case studies in Asia (ie: more men, more crime), while Antonaccio and Tittle (2007) reported a negative correlation using a sample of 100 countries and homicide, but Nivette's (2011) meta-analysis found no relationship.

Pollet et al (2017) noted problems with pooling data, particularly from different countries. For instance, a statistical relationship at the individual level (eg: "more men, more violence"; Hudson and Den Boer 2002) can be reversed by pooling the data for a population level analysis (eg: negative relationship between violence and ASR at US county level; Schacht et al 2016 [10]).

So, "much evidence shows that one should not generalise from the individual to aggregate level and that the relationship could be different at different levels of analysis" (Pollet et al 2017 p3).

Pollet et al (2017) analysed 110 variables in US society to show the problems with aggregate level data (eg: country or state level) and ASRs. They found 39 statistically significant correlations, but many of them were meaningless - eg: chocolate consumption in 2004 was higher in states with male-biased ASRs; at a national level more men correlates with longer travel time to work.

Findings could also differ depending on the operationalisation of ASR (ie: the age range used) - 15-64 years old is common (but also 15-45 and 15-49 years are used) (Pollet et al 2017).

Schacht and Smith (2017) assessed the effect of ASRs using data from nineteenth century North America, and found that female scarcity led to "greater male pair-bond commitment and lesser male mating effort" (p1).

[10] "Counties with fewer men than women have higher rates of homicide and aggravated assault. These results are in line with mating market predictions, supporting the claim that when males are relatively rare they are more likely to engage in direct, violent competition" (Schacht et al 2016 p493).

This conclusion was an attempt to resolve theoretical disagreements about the consequences of male-biased ASR. The parental investment theory (Trivers 1972) predicted less commitment to marriage by both sexes, and greater male-male competition, while the mating market theory (Becker 1981) [11], using the principles of supply and demand to explain mating, predicted the opposite (Schacht and Singer 2017).

Schacht and Singer (2017) used data for the period 1880 to 1900 from the Utah Population Database for that State, and for between 100-200 districts. The analysis supported the market mating theory.

Uggla and Mace (2017) used data from the Northern Ireland Longitudinal Study, which covers just under a third of the country's population, for the period 2001 to 2011 to see if ASR influenced mating and parental behaviours [12]. The focus was upon individuals aged 16-39 years old ("roughly reproductive age"), and analysis was done at the ward level (an administrative area of around 3000 individuals). The wards were divided into quartiles based on ASR [13].

Women were more likely to be co-habiting in wards with a male-biased ASR than in a female-biased area, while there was no difference for men. Separation was greater for both sexes in female-biased areas (figure 1.2).

Education was an interacting variable: "In female-biased areas women with low education are less likely to be in a stable pair-bond than highly educated women, but in male-biased areas women with the lowest education are as likely to be in a stable pair-bond as their most highly educated peers" (Uggla and Mace 2017 p1).

Socio-economic status was also relevant, but for men only: "Men belonging to several of the lower social classes, but not all, were somewhat more likely to live

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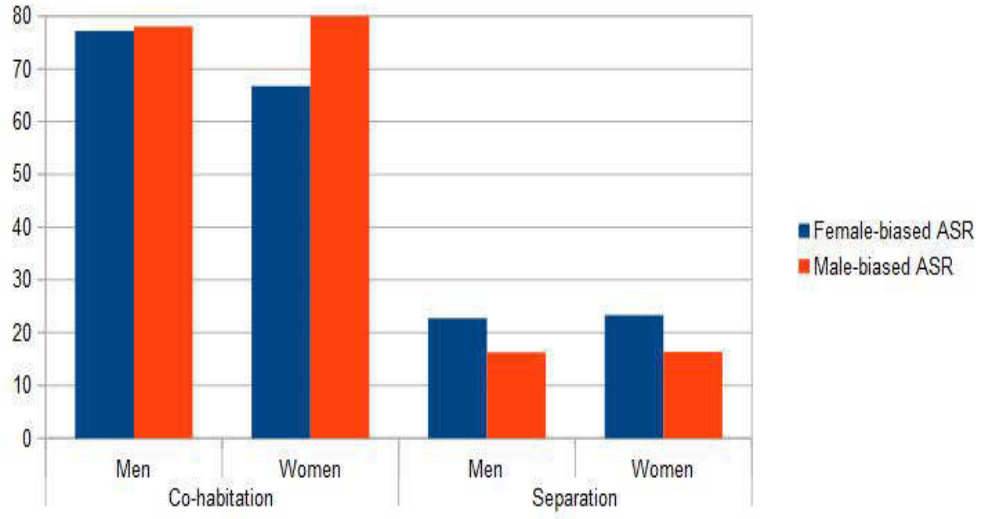
[11] "Specifically, a population of men and women can be thought of as a mating market, which operates by the principle of supply and demand. The rarer sex has more bargaining power in the marketplace and can leverage their scarcity to realise their preferred mating strategy. The more-common sex must cater to the preferences of the rarer sex in order to acquire a mate. For example, when women are abundant, men are expected to invest more in short-term mating effort and to behave more promiscuously, while offering little parental investment. However, when women are in short supply, men's mating orientation will turn to behaviour necessary to secure long-term relationship commitment from a relatively rare partner" (Schacht et al 2016 p491).

[12] "Theoretically, the reasoning is that when one sex is scarcer, it will be driving 'the demand' for certain traits... For example, if there is an oversupply of men, a market logic would suggest that women would desire higher status in potential marriage partners. Conversely, following Guttentag & Secord (1983), a low sex ratio, ie: relatively more women, would lead to a decline in marital stability, such as higher divorce rates and greater non-marital fertility" (Pollet et al 2017 p3).

[13] "Sex-biased migration patterns were the root cause of the variation in ASR in our population; women were more likely to migrate from areas that were scarcely populated and deprived" (Uggla and Mace 2017 p8).



(Data from Uggla and Mace 2017 table 2 p5)

Figure 1.2 - Percentage of sample in two quartile of wards.

with the mother of their child in a male-biased area than in a female-biased area. However, the parental investment of men with higher social class appeared not to be associated with the ASR" (Uggla and Mace 2017 p6).

Uggla and Mace (2017) concluded that their findings were "in line with theoretical models and some recent empirical evidence from non-human species that show that male-biased sex ratios are associated with greater pair-bond commitment. We show that there is heterogeneity in this effect and that the impact of mate scarcity varies with social status" (p9).

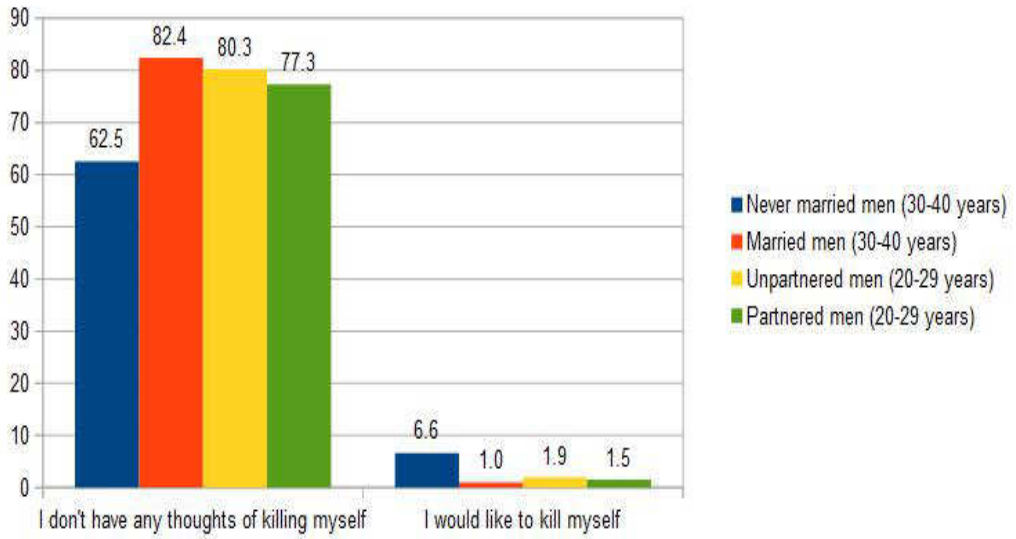
Concentrating on the African-American/non-Hispanic Black population in the USA, Puget (2017) highlighted the female-biased ASR "since at least 1850" (eg: 95 men to 100 women in 1920; 88 men to 100 women aged 15-49 years old in 2010). He explained this ASR as due to "high male incarceration and early mortality rates" (Pouget 2017). The upshot is men having concurrent relationships with women and more partners generally. However, Pouget (2017) admitted that online dating "may make the local less ASR less relevant for partner-seeking" (p7).

Rural China is an example of a situation of a male-biased sex ratio at birth, plus the out-migration of adult women further biases the ASR, "resulting in large numbers of men being unable to marry, in a culture where marriage and reproduction are an expectation" (Zhou and Hesketh 2017 p1).

Zhou and Hesketh (2017) analysed data for Guizhou Province in south-west China in 2015, where, in the 20-40 year-old age group, there were 118 (average) or 150 (maximum) men to 100 women. The researchers collected data in forty-eight villages for depression, self-esteem, and aggression among married/partnered and non-married/partnered 20-40 year-old males. A total of 2268 participants.

The mean depression score and the mean aggression score were significantly higher and the self-esteem score significantly lower among never married than married men. Thoughts of suicide were also higher in this group (figure 1.3). These differences increased with age, and with lower socio-economic status.

However, in terms of aggression, in the villages studied "levels of societal violence are very low", suggesting that the "aggression is largely internalised and may help to explain the higher levels of depression, low self-esteem and aggression scores" (Zhou and Hesketh 2017 p7).



(Data from Zhou and Hesketh 2017 table 3 p5)

Figure 1.3 - Percentage of respondents reporting suicidal thoughts and wishes.

Grosjean and Brooks (2017) focused on historical Australia, where convict transportation produced a heavy male-biased ASR. They observed that "it remains unclear whether these effects are transitory, lasting only until sex ratios return to normal, or are persistent. Some recent studies suggest that cultural changes concerning mating behaviour can persist for many generations after the circumstances that precipitated the change

returned to 'normal'" (Grosjean and Brooks 2017 p1). Grosjean and Brooks (2017) confirmed this persistence with their data.

In New South Wales and Tasmania in the mid-nineteenth century, for example, the average ASR was sixteen men to one woman among the convicts, who were freed after seven years of forced labour [14]. Areas of free migration had less extreme ASRs, but still male-biased. Data from recent marital satisfaction surveys were mapped onto areas of historical male-biased ASRs.

Overall, "present-day marital satisfaction and overall life satisfaction are higher in areas that were more male-biased in the past" (Grosjean and Brooks 2017 p6). Greater historical male-biased ASR was associated with greater current marital and life satisfaction.

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2. BIAS AND NON-SIGNIFICANT RESULTS

Bias and misconduct by researchers can undermine the trust in their work. "The person who publishes biased research may be regarded as negligent or incompetent, whereas the person who publishes fraudulent research may be viewed as morally corrupt" (Resnik 2015 p162).

In relation to bias, one of "the overarching goals of scientific research is to develop knowledge that is free from personal, financial, political, religious, or other biases. Scientific hypotheses and theories should be based on empirical evidence and sound argumentation, not on subjective opinions or beliefs, erroneous assumptions, careless mistakes, political ideologies, or religious dogma" (Resnik 2015 pp162-163).

Bias is controlled by methodological practices like randomisation of participants to different conditions in an experiment, and double-blinding, where the participant nor the researcher know who is in which condition. The peer review of work before publication is seen as a wider control of bias.

But there is "the tendency to publish positive results rather than negative ones. A positive result is evidence showing support for a particular hypothesis, while a negative (or null) result is evidence showing no support for the hypothesis... The underreporting of negative results can skew the publication record" (Resnik 2015 p163). Positive (and statistically significant) results are perceived as more interesting/exciting by journal editors (and readers), and so researchers may not even bother to submit negative findings for publication. In certain cases, as in drug trials, there can be consequences for such behaviour.

For example, the drug "Vioxx" was approved in the USA for treatment of arthritis and chronic pain in 1999, but data showing serious side effects was not published by the pharmaceutical company, Merck, that produced the drug. The drug was withdrawn in 2004 after an independent clinical trial showed the risks (Resnik 2015).

"Repression of negative results conflicts with the normative ideal of openness. Openness — the sharing of data, methods, materials, and tools — helps advance scientific knowledge by enabling scientists to build on each other's work, thereby saving time, effort, and resources. Openness is also crucial for the exchange of information and ideas that stimulates creativity, innovation, dialogue, criticism, and debate in science. Although some secrecy is justifiable in science for legitimate reasons, such as to protect preliminary work and the confidentiality of research participants or the peer review process, openness that leads to biased results or harms the public is not justifiable" (Resnik

2015 p164).

One response to such suppression of data is clinical trial registers which collect information when a trial begins [15]. However, this "does not eliminate the problem of data suppression, it makes investigators and clinicians aware of the studies that are being conducted and whom to contact if they want more information" (Resnik 2015 p165).

Another response to bias is the emergence of journals that focus specifically on publishing negative and non-significant findings. One such journal is the "Journal of Negative Results in Biomedicine" [16] [17].

Here are three recent examples of studies published in this journal.

1. Dalgaard et al (2017)

Background - Work-related stress can lead to "psychological complaints" (eg: poor mental health, sleep problems) and sick leave. Cognitive-behavioural therapy (CBT) has been used to reduce stress levels, and studies have reported the benefits (compared to other types of interventions). But many of these studies used volunteers, and/or individuals not on sick leave (Dalgaard et al 2017).

This study - A randomised controlled trial where 163 individuals attending occupational medicine departments in Denmark were randomised to an intervention group or one of two control groups. The intervention group received six one-hour sessions of CBT to help cope with stress. One control group (A) had received clinical assessment at the occupational medicine department, and the other control group (B) was waiting for this. Measures of psychological complaints were taken at baseline, and four and ten months later.

Findings - "There were no significant outcome differences between the intervention group and control group A (receiving assessment alone) at any time point" (p5). But, compared to control group B, the intervention group "exhibited significantly larger reductions in levels of perceived stress and memory complaints at both

[15] Eg: https://clinicaltrials.gov/.
[16] This ceased publication on 1st September 2017 (archive: https://jnrbm.biomedcentral.com/).
[17] There is also the "Journal of Negative and No Positive Results" (http://revistas.proeditio.com/jonnpr/index), and "The All Results Journals" for different sciences (http://arjournals.com/index.php/index/index).

4- and 10-month follow-up" (p6). However, the researchers emphasised that these differences "should most likely not be attributed to the intervention" (p8).

They explained the non-significant findings as due to "a high degree of natural recovery". "Since all patients in this study were on sick leave when included, they could rest and avoid excessive work demands; this should enhance a natural recovery process" (p9).

Dalgaard et al (2017) concluded: "CBT may be more effective in reducing symptoms in patients with more serious psychiatric conditions like depression or anxiety, and perhaps in less chronic conditions, where work-related stress has not yet necessitated sick leave" (p10).

2. Batty et al (2016)

Background - A twenty-year cohort study of two million British individuals (Qizilbash et al 2015) found that, contrary to established wisdom, being overweight or obese in middle age reduced the risk of dementia in older adulthood. But the "prolonged pre-clinical period of many dementias" could have confounded these findings. A longer study is needed.

This study - Batty et al (2016) analysed data from the Glasgow Alumni Study, which begin in 1947 with students at the University of Glasgow. Data on males attending the university between 1948 and 1968 were traced, and 9547 of them were linked to national mortality registers.

Findings - Of the sample, 2537 individuals had died, and 140 of them had "dementia" recorded on their death certificate. There was no association between being overweight as a student and future dementia-related death over a period of 50-60 years. The authors stated: "That we found no such link in a group of individuals who would have been free of the symptoms of dementia at weight measurement raises the possibility that the observation of an apparent protective effect of higher BMI [body mass index] against dementia is due to reverse causality. That is, the diminished self-care in people experiencing the early stages of dementia, as manifested by a poor diet, leads to weight loss and a spurious inverse BMI–dementia association" (Batty et al 2017 p3).

3. Cariaga-Martinez and Alelu-Paz (2016)

Background - In recent decades many studies have looked for genetic bases to mental disorders, and in the

last five years studies have focused on epigenetics [18] as the mechanism involved. Cariaga-Martinez and Alelu-Paz (2016) observed: "Although a non-negligible percentage of negative results is expectable to be found when using the inductive or deductive rationales, in our daily research work we are observing positive results in virtually all the published data when the epigenetic approach is applied to the psychiatry field" (p1).

This study - An analysis was made of the methodology used by 82 studies of epigenetics and schizophrenia or bipolar disorder for the period 2011-16.

Findings - Many studies "focused their efforts in finding new routes by analysing DNA methylation [19] in blood, saliva or other fluids in order to get putative biomarkers" (p2).

The authors made a number of comments:

i) "It is strongly recommended to understand that 'biomarker' is perhaps not the most adequate word when we study a highly dynamic process such as epigenetics" (p3).

ii) "Although it is tempting to find 'biomarkers' or 'biological signs' for clear diagnosis, we need to keep in mind all the limits of our techniques and approaches, with even more stringency when these approaches are borrowed from other scientific fields that, may not completely fit with ours" [psychiatry] (p3).

iii) General problems like few negative findings published, sample used, and the failure "to keep in mind that 'statistically significant' does not always mean 'biologically relevant'" (Cariaga-Martinez and Alelu-Paz 2016 p3).

Cariaga-Martinez and Alelu-Paz (2016) concluded: "Epigenetic approach, although tempting as a 'holy grail' for explaining what genetics was not able to do in mental disorders, might not be directly applied to psychiatry as if we were working with homogenous cell lines in immunology or with pure mice strains in cancer. Instead, we need to take a step back and to critically reason if our samples, statistical models, diagnose, clinical history of patients etc to really help us to contrast our hypotheses" (pp3-4).

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[18] "Epigenetics studies the heritable information that does not depend on the DNA sequence. In other words, it refers to the interplay between genes and environment that allows the existence of patterns of genetic expression and function, without changing the sequence itself" (Cariaga-Martinez and Alelu-Paz 2016 p2).

[19] DNA methylation is a process involved in epigenetics.

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3. WALKING WITH A MOBILE PHONE

The rise in mobile phone ownership (eg: 77% of the world's population) and use (eg: 897 million people sending emails from their phones) is a phenomena of the 21st century (Timmis et al 2017).

Around two-thirds of Americans admit to using their phone while "on the go", and sometimes there can be negative consequences to this behaviour. For example, in 2010 over 1500 US pedestrians used hospitals due to tripping, falling or walking into something while using the phone (Timmis et al 2017).

Phone use changes walking behaviour to be slower, altering direction more, deviating from a straight line, and with less awareness of the immediate environment than non-users (Timmis et al 2017).

Timmis et al (2017), in their research, were interested in changes in walking gait with mobile phone use. "Whilst walking and looking at the phone's screen, pedestrians will not be able to acquire concurrent visual information from the fovea (central part of the eye which provides the highest level of visual acuity) of the surrounding environment to guide locomotion: something which has been previously highlighted as important in safe walking... When walking and texting or reading a text, the fovea is fixated on the phone's screen. To acquire precise visual information from the environment, the eyes will need to re-fixate from the phone's screen to an area within the environment. If this re-fixation does not occur frequently enough or long enough to sufficiently acquire an updated visual representation of the environment, an increased risk of accidents are expected as potential hazards will not be seen or seen without allowing enough time to plan/initiate a suitable response (ie: walk round the hazard or step over the obstacle)" (Timmis et al 2017 p2).

In their experiment, 21 participants walked along a 5.6 m pathway with an obstacle and a surface height (figure 3.1) change while talking on their phone (talk condition), reading a text message (read condition), writing and sending a text message (write condition), or with no phone (table 3.1) (and in all cases wearing eye tracking glasses).

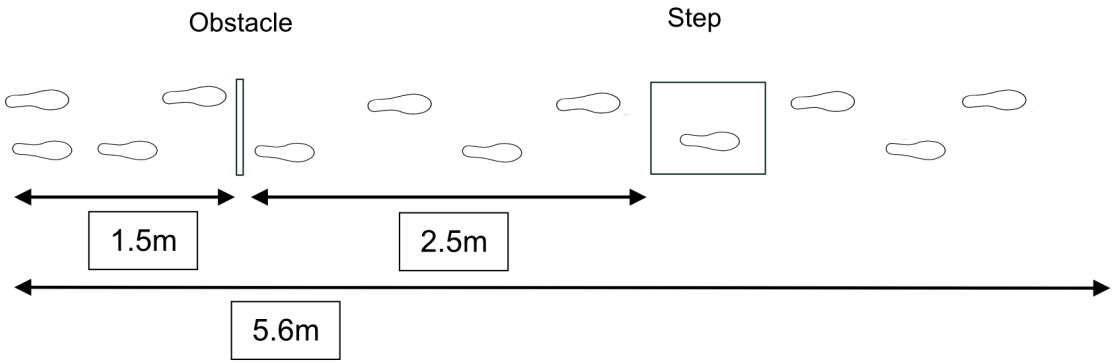
The participants took significantly longer to walk the set distance in the phone conditions compared to the no-phone condition (figure 3.2) [20], and they had less

[20] "Walking slower facilitates additional time to identify potential hazards and plan/initiate a suitable response (i.e: walk round the object or step over the obstacle) to minimise the risk of injury. However,

visual fixation time on the ground (figure 3.3). "Using a phone, compared to not using a phone, resulted in looking less frequently and for less time at the surface height change, and negotiating the surface height change in a manner consistent with adopting an increasingly cautious stepping strategy" (Timmis et al 2017 p13).

In terms of the different phone use conditions, "the greatest adaption in gait strategy was observed in the write compared to the read and talk conditions. In the write condition, when stepping up onto the surface height change, participants lifted their lead foot significantly higher over the edge of the surface height change and crossed with a slower lead and trail foot velocity compared to the read and talk conditions... Participants also reduced their stride length, walked slower (increased trial length) and demonstrated greater medial-lateral deviation. Adaptations in gait strategy was also observed in read compared to talk condition" (figure 3.4) (Timmis et al 2017 pp15-16).

Overall, the researchers concluded that "mobile phone users were able to adapt their visual search behaviour and gait to incorporate mobile phone use in a safe manner when negotiating floor based obstacles" (Timmis et al 2017 p1).



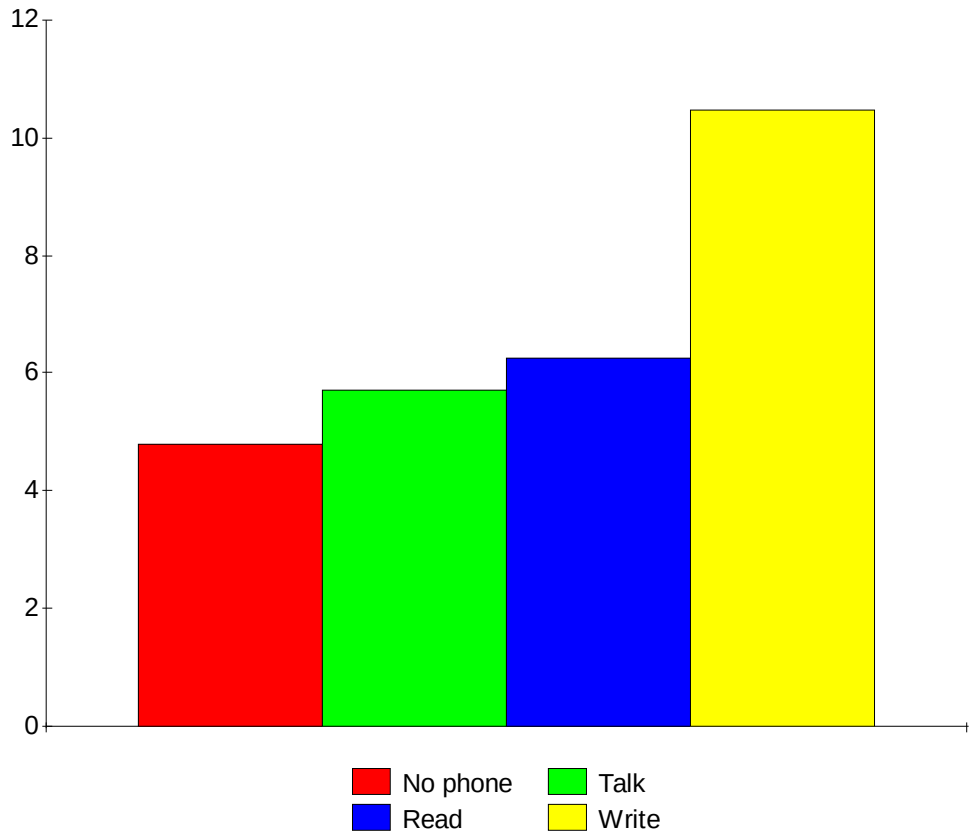
(Source: Timmis et al 2017 figure 1)

Figure 3.1 - Diagram of experimental set-up.

it is important to recognise that walking slower when engaged with the mobile phone may not necessarily reduce the risk of pedestrian injury if they fail to `see' the hazard in the first place, especially if the hazard suddenly appears in the environment (ie: pedestrian walks across the travel path)" (Timmis et al 2017 p14).

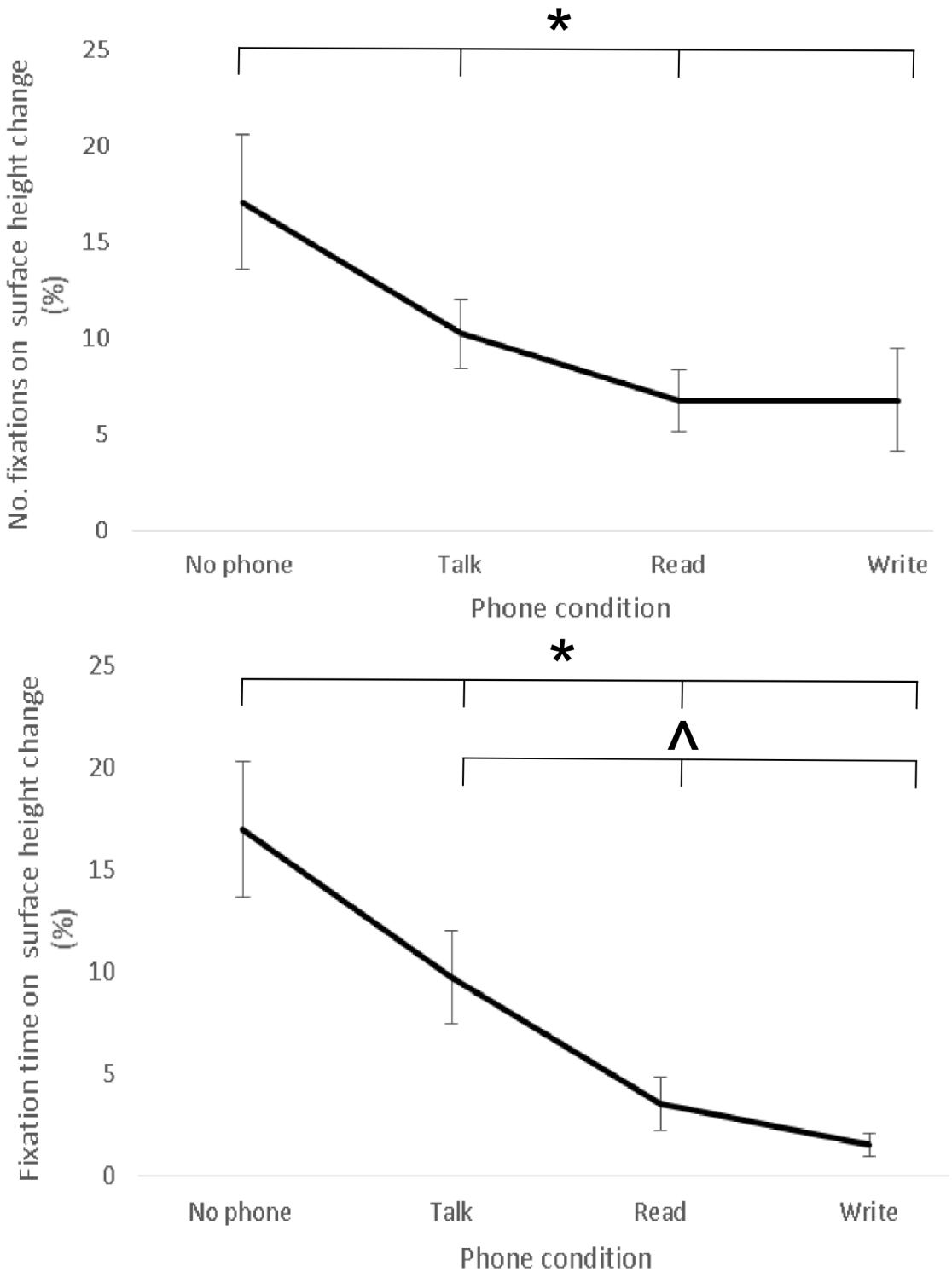
Condition	Details
No phone	Phone in pocket
Talking on phone	Answering simple questions like "Have you seen any good films lately?"
Read text message	Short text message (eg: "Shall we go for pizza?"
Write and send text message	Short text message (eg: "what shall we do today?")

Table 3.1 - Details of conditions.



(Data from Timmis et al 2017 table 1)

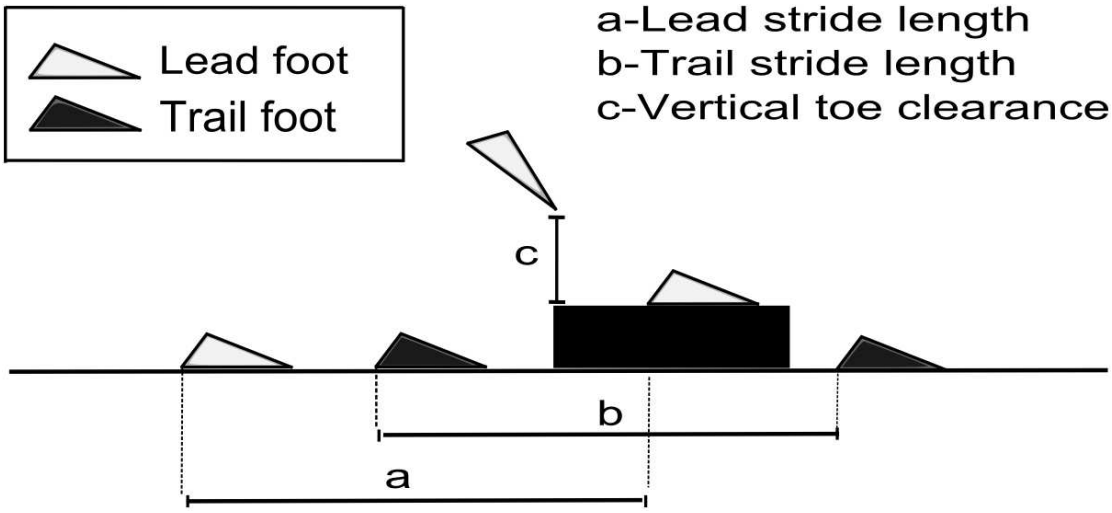
Figure 3.2 - Mean time to complete walk (seconds).



(* = no-phone significantly different to other conditions; ^ = talk condition significantly different to read and write conditions)

(Source: Timmis et al 2017 figure 3)

Figure 3.3 - Relative number (top figure) and length (bottom figure) of visual fixations on group at surface height change.



(Source: Timmis et al 2017 figure 2)

Figure 3.4 - Representation of foot placement with surface height change.

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