# PSYCHOLOGY MISCELLANY

## No.149 - June 2021

Kevin Brewer

ISSN: 1754-2200

Orsett Psychological Services

orsettpsychologicalservices@phonecoop.coop

This document is produced under two principles:

1. All work is sourced to the original authors. The images are all available in the public domain (most from http://commons.wikimedia.org/wiki/Main_Page). You are free to use this document, but, please, quote the source (Kevin Brewer 2021) and do not claim it as you own work.



2. Details of the author are included so that the level of expertise of the writer can be assessed. This compares to documents which are not named and it is not possible to tell if the writer has any knowledge about their subject.

Kevin Brewer BSocSc, MSc

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/.

**CONTENTS**

# 1. SOCIAL MEDIA: THREE AREAS OF RESEARCH



## 1.1. DATING APPS

Smartphone dating apps, like "Tinder" or "Grindr", allow an individual to look for potential partners, and to "swipe right" if they like a photograph of a particular person (while "swiping left" for those they do not like). "Two individuals are matched and allowed to initiate communication on the app when they both swipe right on each other" (Potarca 2020 p1). There is the emphasis on visual content, and a wide range of possibilities. Critics have talked of "a 'dating apocalypse', turning individuals into 'sexual freelancers' , lowering the quality of connections, and even threatening the mere existence of long-term commitment" (Potarca 2020 p2). Other comments include "a brave new world of intimacy", a "deinstitutionalisation" of marriage, and a culture of "hooking up" (brief sexual encounters) (quoted in Potarca 2020).

The argument goes like this: first, "casual dating mindset promoted on apps encourages a superficial and consumerist approach to finding a match, inciting an objectification of partners and a focus on visual information only. Second, the card-game resemblance of the interface and its swipe-based logic create the setup of a game played at high speed, with a constant pursuit of the next best thing" (Potarca 2020 p3). This compares to dating websites which are "more restrictive and allow for less spontaneity of use, creating fewer incentives for short-term dating" (Potarca 2020 p3).

But research about relationships initiated via dating apps is limited (Potarca 2020).

Potarca (2020) attempted to rectify this problem with a large-scale Swiss study to investigate three questions:

i) Are individuals in relationships formed via dating apps less interested in long-term commitment?

ii) Are relationships formed this way rated less satisfying?

iii) Are relationships formed via dating apps more likely to be between individuals of wider diversity (eg: educational level; origin) (ie: more exogamy)?

Potarca's (2020) data came from the 2018 Family and Generations Survey, which representatively sampled over 35 000 adults aged 15 to 79 years old, and 3245 respondents had met their partner in the last ten years. Of these, 104 had used smartphone dating apps, 264 dating websites, and 125 other online services (eg: non-dating chat rooms) to meet their partner. The other respondents met their partners "through friends or acquaintances", or "at school, through studies, at work", for example.

The first research question was addressed by questions like, "Do you intend to marry your partner within the next two years?" (marriage intention), or "Do you intend to move in with your partner within the next two years?" (co-habitation intention). Intention to have (more) children was also surveyed (fertility desire and intention).

Relationship satisfaction was measured on a ten-point scale, and exogamy by demographic information.

Looking at the findings, firstly, "respondents who met through a dating app do not differ significantly in terms of marital intentions, fertility desire or fertility intentions from those who met their partner offline. Nevertheless, non-residential couples formed through dating apps have significantly stronger intentions to move in with their partner than those who met offline" (Potarca 2020 p11).

There was no significant difference in rating of relationship satisfaction between offline- and online-initiated unions. However, "individuals in non-residential couples initiated on dating platforms are significantly more satisfied than those in non-residential couples initiated offline. Furthermore, individuals who met their non-residential partner via phone apps are less satisfied than those who met theirs through dating websites" (Potarca 2020 p12).

Concerning the third research question, partners who met through dating apps were more likely to vary in educational level than offline meetings, but there was no difference in origin or age based on type of mating.

In summary, at least for Switzerland, dating apps did not appear to inevitably lead to the negative consequences on relationships that critics proposed. But the study was cross-sectional, and "it only examined a snapshot of already established couples. Even though the

data set included partnerships with a lower level of commitment than marriage (ie: non-residential unions), it could not capture casual encounters or short-term-oriented connections that never formalise. Therefore, the hypothesis of apps users transitioning less into actual partnerships given the overload of choice or the objectification of potential mates is yet to be refuted" (Potarca 2020 p17).

Potarca (2020) preferred this interpretation: "It may be that despite their reputation and the presumed superficiality of swipe-based courtship, dating apps are representative of a modern dating culture where relationships that begin as hook-ups or short-term flings are not thereby excluded from developing into meaningful long-term connections" (p17).

It is relatively early days for the use of swipe-based dating apps, and the sub-samples of online users were quite small, despite the large overall size of the study.

Potarca (2020) attempted to control for confounders in the analysis, including selection bias (eg: choice of dating method and personality), and demographic variables like income and opportunity to meet others/use online methods.

Longitudinal research that tracks individuals prior to meeting a partner would be the ideal, as well as replications in other countries. Potarca (2020) admitted: "It may be that in other less conservative countries or in contexts where hook-ups are already engrained in partnering culture, like the US, users of swipe-based apps are more susceptible to the casual dating ethos of swipe-based apps, and hence more frequently engage in uncommitted sexual encounters, or form couples with looser family formation intentions. Furthermore, data from countries with a more rapid expansion of women's education, and thus a greater over-supply of high-educated women in search of partners, may reveal an even stronger effect of dating apps on educational exogamy. Focusing on other countries could also reveal whether online social networks pervasively encourage more unions between natives and people with different immigrant background, and whether the hook-upcentric reputation of dating apps deters immigrants looking for more traditional arrangements" (p18).

## 1.2. OLDER ADULTS

Older adults reported higher subjective well-being

when certain psychological needs were fulfilled (in 123 countries; Tay and Diener 2011). Three psychological needs, in particular, are important (Clark and Moloney 2020):

- Relatedness - A sense of belonging and connection to others.
- Competence - The ability to achieve goals set.
- Autonomy - Independence and choice.

Deci and Ryan (2000) described these three needs as "essential nutrients" for optimal flourishing, while Kloos et al (2019) found that "a 'balanced satisfaction' of all three needs is more important for well-being in older adults than the amount of satisfaction of each need individually" (Clark and Moloney 2020 p2).

Clark and Moloney (2020) investigated these three psychological needs and Facebook use by 127 65-94 year-olds in Australia who used the social networking site. The volunteers completed the Balanced Measure of Psychological Needs Scale (BMPN) (Sheldon and Hilpart 2012), which had eighteen items covering relatedness (eg: "I felt close and connected with other people who are important to me"), competence (eg: "I took on and mastered hard challenges"), and autonomy (eg: "There were people telling me what I had to do").

Overall, participants spent an average of 71 minutes per day on Facebook. Facebook use was significantly positively correlated with relatedness only [1].

The most frequent users of Facebook (average: 95 minutes per day) (n = 32) were compared to the least frequency (50 minutes per day) (n = 51). The former reported significantly higher relatedness than the latter. The most frequent users were more likely to self-report less mobility, in response to items like, "How often did you go to another room of your home, besides the room where you sleep?".

So, Facebook use was self-reported as beneficial, in terms of a sense of relatedness, to older adults, especially those with less mobility.

All measures were self-reported. Other studies have collected objective usage data from the social networking sites (Clark and Moloney 2020).

[1] In a study of adults 55 years and above, Sinclair and Grieve (2017) found an average of 126 minutes per day.

## 1.3. MENTAL HEALTH

With the growth of use of social media has come the question about its impact on mental health. "Social media is a wonderful platform of being praised or getting opinions from hundreds of real-life or virtual friends which can either boost the morale or down it as well. Additionally, social media may develop their identities and culture without interruption from parents or those in a position of authority. Furthermore, social media may promote social interaction or social connectedness being the base for meeting potential people of same interest, thoughts, feelings or belongingness" (Sharma et al 2020 p468) [2] [3].

A key variable is the extent of social media use. This includes the idea of "social media addiction", which is characterised by "being preoccupied by social media [salience], using social media in order to reduce negative feelings [mood modification], gradually using social media more and more in order to get the same pleasure from it (tolerance/craving), suffering distress if prohibited from using social media ([withdrawal), causing harm to other important life areas because of the social media use (conflict/functional impairment) and desiring or attempting to control the use of social media without success (relapse/loss of control)" (Sharma et al 2020 p468).

Sharma et al (2020) reported a review of quantitative studies on social media and mental health. Sixteen relevant peer-reviewed studies published between 1991 and February 2020 were found. The studies covered Facebook, Twitter, and MySpace in the main. Table 1.1 summarises key methodological differences between the studies.

The findings were both positive and negative. The researchers categorised them under the following headings:

---

[2] Denworth (2019) commented: "Anxiety about the effects of social media on young people has risen to such extremes that giving children smartphones is sometimes equated to handing them a gram of cocaine. The reality is much less alarming" (p38). The negative view was driven by Twenge (2017), for example, who noted the increase in depression and anxiety among young people in recent years and linked it to the growth in smartphones.

[3] Vuorre et al (2021) viewed the concern over smartphones and social media as the modern manifestation of fears about "dime novels" in the early 20th century, radio dramas in the 1940s, and later, comic books, television, and video games. So, "when fears emerge about a new technology, worries about previous technologies are largely abandoned without an agreement on — or good data indicating — whether, why, or how the previous technologies were or were not harmful" (Vuorre et al 2021 p2).

- Country of study - majority in the USA.
- Sample - mostly university students; size varied from 16 to 4935.
- Outcome measure - eg: psychiatric illness; self-esteem; emotional state.
- Design of study - clinical trials or quasi-experimental studies.

Table 1.1 - Key methodological differences in the sixteen studies in the review by Sharma et al (2020).

i) Self and well-being - "Mediating factors were how meaningful the users perceived the online activity to be and if they were exposed to more upward social comparisons, such as high activity social network or indulged in healthy habits" (Sharma et al 2020 p470).

ii) Social relationships - eg: feelings of closer to others after commenting on Facebook posts versus reduced desire for offline relationships. "Felt relatedness" was a key factor.

iii) Organisations - eg: celebrity endorsement of a product had a positive effect.

iv) Psychiatric illness - eg: educating individuals versus overestimation of alcohol intake norms from reading college students' posts.

Overall, Sharma et al (2020) noted the methodological differences and poor quality (eg: lack of details), which meant that it was "difficult to accurately ascertain the overall effect of social media indisputably. It is evidenced by the studies quality assessment where unclear bias is mainly seen for the selection, performance, detection and attrition bias" (p474).

However, 10-20 minutes of use of social media was enough to have an impact on the individual (positive or negative). "Studies are divided regarding effects on their overall well being having a limited positive influence. The detrimental effects noticed in a user's feeling of well being are feelings of meaninglessness and a lower state of state and trait self- esteem and self-evaluation" (Sharma et al 2020 p474).

Commenting on the research, Denworth (2019) confirmed that the "results to date have been mixed because the effects measured are themselves mixed" (p38). Small benefits and small costs, then, for the average user. Cross-sectional designs, correlations, and self-reports of social media use (of frequency and duration rather than content or context) are the problems for Denworth (2019).

Being correlational, the relationship between social media and user mental health is a "two-way street", and other variables need to be controlled (eg: age; mental health status prior to use) (Denworth 2019). Longitudinal studies can help in the direction of relationships. For example, a Canadian study (Heffer et al 2019) that followed around 600 adolescents for two years and over 1000 young adults for six years found that "social media use did not predict depressive symptoms but that depressive symptoms predicted more frequent social media use among adolescent girls" (Denworth 2019 p39).

Orben and Przybylski (2019) calculated that the impact of social media use on adolescent mental health was very small, and much less than bullying, say.

A major problem for Vuorre et al (2021) is "researchers overlooking time-dependent changes within technology's associations with mental health and thus treating them as fixed" (p2). To overcome this problem, Vuorre et al (2021) analysed data from 2 US cross-sectional studies of adolescents and one UK longitudinal study:

- Monitoring The Future (MTF) - 13-15 year-olds surveyed annually since 1991 in the USA.

- Youth Risk Behaviour Surveillance System (YRBS) - Biennial survey of 14-17 year-olds in the USA since 1991.

- Understanding Society (UndSoc) - 40 000 households in the UK followed since 2009.

Various measures of mental health were used (eg: depression; emotional problems), and television watching and social media use were self-reported. Television watching was used as a comparison technology.

Depression was not related to either technology, but emotional problems were positively associated. Conduct problems were also positively associated to both technologies, while suicidal ideation and behaviour were

only related to digital device use. The magnitude of the associations were "generally considered to be very small" (Vuorre et al 2021 p5). In terms of change, only depression was negatively associated with technology use, but this had "become consistently less negative over time" (Vuorre et al 2021 p8). The association between conduct problems and suicidality and technology use had remained stable. "Social media's relations with emotional problems had slightly increased, but television's had not" (Vuorre et al 2021 p9).

## 1.4. REFERENCES


Clark, R & Moloney, G (2020) Facebook and older adults: Fulfilling psychological needs? Journal of Aging Studies 55, 100897

Deci, E.L & Ryan, R.M (2000) The "what" and "why" of goal pursuits: Human needs and the self-determination of behaviour Psychological Inquiry 11, 227-268

Denworth, L (2019) The kids are all right Scientific American November, 36-41

Heffer, T et al (2019) The longitudinal association between social-media use and depressive symptoms among adolescents and young adults: An empirical reply to Twenge et al (2018) Clinical Psychological Science 7, 3, 462-470

Kloos, N et al (2019) Longitudinal associations of autonomy, relatedness, and competence with the well-being of nursing home residents The Gerontologist 59, 4, 635-643

Orben, A & Przybylski, K (2019) The association between adolescent well-being and digital technology use Nature Human Behaviour 3, 2, 173-182

Potarca, G (2020) The demography of swiping right. An overview of couples who met through dating apps in Switzerland PLoS ONE 15, 12, e0243733 (Freely available at https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0243733)

Sharma, M.K et al (2020) Influence of social media on mental health: A systematic review Current Opinion in Psychiatry 33, 467-475

Sheldon, K.M & Hilpert, J.C (2012) The balanced measure of psychological needs (BMPN): An alternative domain general measure of need satisfaction Motivation and Emotion 36, 439-451

Sinclair, T.J & Grieve, R (2017) Facebook as a source of social connectedness in older adults Computers in Human Behaviour 66, 363-369

Tay, I & Diener, E (2011) Needs and subjective well-being

around the world Journal of Personality and Social Psychology 101, 354-365

Twenge, J.M (2017) Has the smartphone destroyed a generation? Atlantic 320, September, 58-65

Vuorre, M et al (2021) There is no evidence that associations between adolescents' digital technology engagement and mental health problems have increased Clinical Psychological Science (https://journals.sagepub.com/doi/10.1177/2167702621994549)

# 2. OFFLINE PERCEPTION



## 2.1. OVERVIEW

Perception involves the processing of sensory information from the environment in order to make sense of what is happening. But perception can be "self-generated and independent of concurrent stimulation of the senses" (Fazekas et al 2021 p1), as in dreaming, hallucinations, voluntary mental imagery, and mind-wandering. This is called "offline perception" (OP) (Fazekas et al 2021) [4].

The brain activity during OP "can sometimes be deceptively similar to the phenomenology of stimulus-driven perception" (Fazekas et al 2021 p1). For example, in a neuroimaging study (O'Craven and Kanwisher 2000), imagining complex objects, like faces or scenery, produced brain activity similar to looking at photographs of such objects, "although the magnitude of activation was less in imagery" (Waters et al 2021 p4).

Waters et al (2021) made this summary: "the perceptual circuit in the brain, notably the association cortex, is a common feature of hallucinations, imagery and dreams. There is evidence of involvement of lower-level (primary) cortical areas in hallucinations, and in dreams to a lesser extent. By contrast, the primary sensory areas only seem to be engaged during salient, vivid and complex imagery (but not at all times)" (p4).

There is the possibility of a unified theory of OP [5]. "While dreaming, mind-wandering, mental imagery or

[4] "Stimulus-independent perception" (SI) is the preferred term of Waters et al (2021).

[5] Edmund Parish proposed a unified model of "fallacies of perception" as early as the 1890s (Waters et al 2021).

hallucination may seem like very different mental phenomena (and often the literatures remain separate), in terms of their neural and functional profile, they are best conceived of as different species of a larger genus, offline perception" (Fazekas et al 2021 p1).

However, Waters et al (2021) distinguished voluntary mental image from hallucinations and dreams because the former is not "perception-like" (Fazekas et al 2021).

Fazekas et al (2021) outlined three dimensions to OP:

i) Voluntary-involuntary - "It is voluntary when you close your eyes, count to three and visualise an apple. This is one way of exercising mental imagery, but other ways of doing so are involuntary — like earworms or flashbacks" (Fazekas et al 2021 p2).

ii) Conscious-unconscious - "Mind-wandering, dreaming and hallucination are often taken to be necessarily conscious, but mental imagery can be unconscious..." (Fazekas et al 2021 p2).

iii) Accompanied by a feeling of presence or not - eg: hallucinations have a feeling of presence in the sense that the individual believes the hallucinated object to be in front of them physically, where there is not the case with mental imagery.

An exception is "focused imagery" in religious experiences that "can transform such images into detailed perceptual experiences with an apparent external reality and independent agency. Shamanic training, for example, involves a learnt practice of projecting images into external space in the context of metaphysical beliefs, which can develop over time into religious visions. Similar to hallucinations, these may have clear substance and form, may be entirely convincing and may be interpreted symbolically or even literally" (Waters et al 2021 p3).

OP is also distinguished "along the line of 'normality'" (Waters et al 2021 p1) (eg: hallucinations are abnormal), and "frequency rates". For example, "hallucinations are more likely to be found in a proportion of the population with mental or neurological disorders compared with imagery and dreams, which are universal human experiences that occur almost on a daily basis" (Waters et al 2021 p1).

But there is a blurring of these lines "if one

considers examples of hallucinations reported in the general population by individuals without a need for care. These hallucinations are more often reported as positive, valuable and controllable than those experienced in the context of mental disorder. In addition, imagery and dreams are not always benign as they too forma part of a continuum that extends to intrusive thoughts and nightmares" (Waters et al 2021 p1).

## 2.2. MENTAL IMAGERY

Kosslyn et al (1995) defined visual mental imagery (MI)as "'seeing' in the absence of the appropriate immediate sensory input", and Pearson et al (2015) referred to "representations... of sensory information without a direct external stimulus" (both quoted in Nanay 2021). Nanay (2021) was more precise: "mental imagery is perceptual processing (that is, processing in the early sensory cortices, V1, V2, V4/V8, MT) that is not triggered directly by sensory input" (p1).

The issue for Nanay (2021) was whether MI is conscious or unconscious, and this author's preference was "not necessarily conscious (as potentially unconscious)" (Nanay 2021 p2). This is not to say that an individual cannot image an object, but that mental imagery can be both conscious and unconscious.

Nanay (2021) discussed different lines of perceptual evidence:

a) Ventral and dorsal streams - These are two visual sub-systems involving different areas of the brain. "To put it simply, the ventral stream is responsible for identification and recognition, whereas the function of the dorsal stream is the visual control of our motor actions" (Nanay 2021 p3). Normally, the two streams work together, but there are cases where one malfunctions.

For example, with optic ataxia, where the dorsal stream is malfunctioning, an individual can recognise an object in front of them, but is unable to manipulate it appropriately. The opposite is visual agnosia (ventral stream malfunctioning), where an individual can perform the appropriate motor actions with an object, but is not able to name it. The traditional view is that the dorsal stream is unconscious, and ventral system conscious (Nanay 2021).

Levine et al (1985) drew a parallel with dorsal and

ventral imagery. But Nanay (2021) dismissed this argument as problematic, and lacking in evidence, particularly when "considering dorsal vision unconscious through and through" (p3).

b) Unilateral neglect - Some stroke patients are unable to perceive one side of their visual field, and so "tend to eat only from the right side of their plate, bump into obstacles on their left, and so on" (Nanay 2021 p3). Studies show that these individuals can unconsciously perceive the "blind field" (or contra-lesional side). For example, priming experiments that present a certain word in the blind field show that it influences a conscious decision in the visual field.

Patients with neglect can also show "imaginal neglect" (ie: they neglect one side of their mental imagery). For example, when Rode et al (2007) asked patients to imagine the map of France, and describe it, the reports gave more details of the "visual side" and little of the "blind side". Nanay (20210 took this as evidence of unconscious mental imagery.

c) Priming - The presentation of information too fast to consciously perceive will influence a subsequent conscious decision.

Nanay (2021) quoted the following experiment by Kwok et al (2019) to support unconscious mental imagery. Participants were presented with a colour, say red, as the priming task for a few seconds, and asked to imagine an object of that colour or deliberately avoid thinking about it. Then the participants were presented with two objects to perceive (eg: a red one and a green one), and the reaction time to the primed colour (red) was quicker in the condition thinking about the object (as expected). But reaction time was also quicker in the "avoiding" condition, which Nanay (2021) took as unconscious mental imagery priming the reaction time.

d) Aphantasia - This is a condition where individuals report no conscious mental imagery, though some individuals do have images in their dreams. Nanay (2021) argued for evidence of unconscious mental imagery among these individuals with this experiment (Jacobs et al 2018).

It involved a 31 year-old female student with aphantasia ("AI") and healthy controls. Participants were presented with a geometric shape for 500 ms, then a delay, before saying where the shape had been on the computer screen (out of four choices). This was the

working memory condition, and both "AI" and control scored around 90% success. In the imagined condition, participants had to imagine the geometric shape in a particular spot before a delay and the saying where the shape would have been on the screen. Both "AI" and the controls scored similar success. So, "while the controls use conscious mental imagery, 'AI' uses unconscious mental imagery" (Nanay 2021 p6).

Nanay (2021) accepted that this was one individual with aphantasia, and that "[A] lot more experimental studies could and should be done on subjects with aphantasia that could convince us conclusively that at least some aphantasics do have unconscious mental imagery" (p7).

## 2.3. MIND WANDERING

Mind wandering has been studied by self-reports and experience sampling techniques like Ecological Momentary Assessment. For example, individuals are randomly contacted and asked to report what they were thinking about in the previous few minutes. Add to this, the use of neuroimaging to show the parts of the brain active during self-generated thinking.

For example, Karapanagiotidis et al (2021) asked 169 volunteers at an English university to retrospectively report their thoughts while undergoing resting state functional magnetic resonance imaging (rs-fMRI). Afterwards, the participants completed a number of questionnaires about physical and mental health.

Twenty-five categories were used for the thoughts (eg: about future; about something negative; involved self; creative), and six were found to be most common - normal thoughts; spontaneous thoughts; intrusive thoughts; problem-solving; about here and now; in the form of visual images. The latter was strongest, and was significantly related to "internally directed attention" (based on the questionnaires) (eg: high self-consciousness; high level of focus), and to a particular pattern of brain activity involving the lateral fronto-temporal network.

Gross et al (2021) used the experience sampling method to collect data on dreaming and mind wandering (examples of what they called, stimulus-independent thoughts, SITs), and stimulus-dependent thoughts (SDTs) (ie: thoughts in response to external stimuli). The participants were 131 undergraduates in California who

completed the seven-day study. Randomly eight times in a 24-hour period, a smartphone message was sent and participants completed a short survey about their thoughts at that moment (using ten dimensions like goal-directedness, bizarreness, and meaningfulness).

In total, 54% of responses were defined as SDTs, 30% waking SITs, and the remainder dreams. In terms of the ten dimensions, both types of SITs had similarities and differences, and together differed from SDTs. For example, "dreams differed from both SITs and SDTs, as in the case for bizarreness; dreams were more likely to be bizarre than both SDTs and SITs, and the latter two did not differ in likelihood. At other times, dreams were intermediary between SITs and SDTs, such as in the case of meaningfulness; SITs were most commonly classified as meaningful, followed by dreams, and then SDTs. At other times, no differences were found between SDTs and dreams, as in the case of goal-directedness, when SITs were more likely to be identified as more goal-directed than both dreams and SDTs" (Gross et al 2021).

The experience sampling method is an ecologically valid means of measuring mental states, but the quality and amount of responses declined over the seven days of the study. Waking the participants twice nightly could have affected both daytime and night-time thoughts (Gross et al 2021).

The main theoretical approach is the continuity hypothesis, which argues that "waking and dreaming are not discrete states of consciousness with clearly defined parameters but rather represent continuous attentional states" (Levin and Young 2002 quoted in Gross et al 2021). Gross et al (2021) reported "mixed support" for this theory.

The continuity hypothesis assumes that "we tend to dream of things we experience, think, or worry about in waking" (Windt 2021 p1). Windt (2021) described the continuity hypothesis and the opposing view of a distinction between waking and sleep as "the state-dependence question". One problem in trying to resolve these different views is the lack of common terminology (Windt 2021).

Windt (2021) proposed "a conceptual framework that distinguishes different kinds of spontaneous thoughts and experiences independently of their occurrence in sleep or wakefulness" (p2). For example, dreams occurring in rapid eye movement (REM) sleep differ from non-REM (NREM) sleep "mentation/dreams", and from waking experience. Key to Windt's (2021) distinction that conscious states is the

"immersive here-and-now experience". Dreams are such immersive experiences, while dreamless sleep is not, say. Mind wandering, however, can feel immersive, yet it is not in the way of dreaming. Windt (2021) used the metaphor of "the difference between watching a film on a cinema-screen and having an immersive and interactive virtual reality experience. In the former case, even if you are gripped by the movie, you do not become part of it; even if bodily sensations temporarily recede into the background, you are still viewing the film from an external perspective. By contrast, in immersive virtual reality, you (or the avatar you identify with) are the centre of the virtual environment and feel present in it" (p6).

## 2.4. SURPRISE-INDUCING THOUGHT TRANSITIONS

Mills et al (2021) began: "There are many colloquial expressions that are used to describe the peculiar experience of a thought catching us by surprise as it surfaces into awareness. Such thoughts are accompanied by a feeling of spontaneity in their arising and appear to come 'out of the blue' or 'out of nowhere'. This compelling sense of out-of-nowhere-ness arises because we cannot immediately tell, at the subjective level, why this thought with its particular contents should have occurred at that particular moment of time. This experience is quite distinct from the many other thoughts we experience, whose sources are readily traceable to something in the preceding stream of thought or our environment" (p1).

This "out-of-nowhere-ness" (or "surprise-induced thought transition" (SITT); Mills et al 2021) overlaps with the experience of mind-wandering. "Mind-wandering encompasses a broad range of mental experiences that can include mental content with a readily identifiable stimulus-related or goal-related source, and do not necessarily elicit feelings of surprise or spontaneity" (Mills et al 2021 p2).

Mills et al (2021) emphasised the "abrupt transition" in thought content of SITTs. They gave this example: "You are listening to a lecture when suddenly your attention is captured by an unexpected thought: you wonder if your dog has been alone at home for too long that day. This thought has arisen without any deliberate intention on your part, you did not anticipate its arising and you wonder why you should think of this at that particular time" (Mills et al 2021 p2) (example 1).

The change in thought content can also be a "wayward transition" as in this example: "You are listening to the same lecture when you suddenly find yourself thinking about a playground you used to play at in your childhood" (Mills et al 2021 p2) (example 2).

The experience of surprise (or a breach of expectation) is key to SITTs. Mills et al (2021) linked their explanation of the phenomenon to predictive perceptual processing. This is the idea that the brain is continually predicting the incoming sensory information, and actual signals are matched to those predictions. "Predictive processing allows the brain to process the multitude of incoming signals highly efficiently, by transmitting upwards into the neural hierarchies only the unpredicted portions of these signals (the mismatches) and filtering out the predicted portions (the matches)" (Mills et al 2021 p2). Applied to SITTs, they are predictive errors as to when a though should occur. "The degree to which different thoughts generate prediction error would be unique to each person" (Mills et al 2021 p3).

Mills et al (2021) developed this idea with two dimensions - that this thought would occur at this particular moment (transition probability), and that this thought would occur at all (occurrence probability). "Abrupt transitions" have low transition probability, but high occurrence probability (ie: when the thoughts that occur are surprising, but the content is unsurprising). Using the example 1 above, it is surprising to think about the dog at that moment in the lecture, but the content is not surprising because you have a dog and concern about it is relevant when you are away. "Wayward transitions", however, are low on both dimensions (ie: surprising moments and content). With reference to example 2 above, to suddenly think of a childhood playground is unexpected at that moment and in content as it has no relevance to the lecture or everyday life.

Mills et al (2021) admitted that SITTs might appear maladaptive behaviour for the brain "to produce thought transitions that increase rather than decrease surprise and prediction errors" (p5). Their solution was that "such thought transitions bespeak the importance of novelty seeking for predictive systems. Novelty-seeking behaviours are essential for learning and development, starting in infancy. The generation of thoughts that violate our implicit statistical predictions are likely an adaptive mechanism for testing and improving our predictive models through exploring hypothetical

prediction errors and proactively adapting the models to account for them" (Mills et al 2021 p5).

In terms of the neurobiology of SITTs, Mills et al (2021) could only speculate that large-scale brain networks, like the fronto-parietal control network (FPCN), the salience network (SN), and the ventral attentional network (VAN), are involved. The "Dynamic Framework of Thought" (Christoff et al 2016) proposed that spontaneous thoughts arise from the interaction of multiple large-scale brain networks involving different areas of the cortex. This approach emphasises the combination of activity in different areas as in a network rather than a specific area activated for a specific cognitive process.

## 2.5. HALLUCINATIONS

### 2.5.1. Visual

"Hallucinatory experiences are incredibly heterogeneous, and they can occur in a single sensory modality or in multiple modalities simultaneously, with content ranging from simple to complex, banal to bizarre, and amusing to harrowing, and insight into the unreal nature of these experiences might be present or absent" (Rogers et al 2021 p1).

Research on hallucinations is limited by the reliance on self-reports, and their spontaneous nature which makes neuroimaging of little use. "High-stimulation environments like during noisy functional magnetic resonance imaging (fMRI) (appendix 2A) may actually curtail hallucination events. Consequently, capturing any data during spontaneously occurring hallucinatory episodes, especially neural data, can be a matter of luck. Further, 'symptom-capture' studies (requiring subjects to monitor and report hallucination-present and hallucination-absent periods) depend on subjects' co-operation and ability to reliably detect and report hallucination appearance and disappearance" (Rogers et al 2021 p2). Furthermore, the scientific study of hallucinations is still heavily biased toward those of pathological origin" (Rogers et al 2021 p2).

Rogers et al (2021) reflected upon the study of hallucinations in the laboratory using methods based on induced hallucinations and hallucination analogues. The aim is hallucinations "induced on demand" (Rogers et al

2021 p3). For example, classical conditioning-induced hallucinations where visual and auditory stimuli are continuously paired together, and then the visual stimulus is presented alone and the individual should hallucinate the auditory stimulus (or vice versa) (Rogers et al 2021).

Even if such perceptual experiences can be induced on demand, there is the problem of an agreed definition of hallucinations, which more widely depends on two approaches (Rogers et al 2021):

i) Discrete categories - "Intuitively, many people may feel that perceptual experiences can be easily sorted into the discrete categories of veridical perception (accurate perception of the external world), illusions (misperceptions or distortions) and hallucinations..." (Rogers et al 2021 p3). But experimentally induced experiences inhabit a "grey area" (Rogers et al 2021).

ii) Continuous spectrum - This is based on the strength of the match between actual stimulus and conscious experience from strong (veridical perception), to moderate (illusions), and to weak (hallucinations) with no clear boundaries between them (eg: Waters et al 2014). Rogers et al (2021) favoured this approach with laboratory-induced hallucinations.

Another problem is the extrapolation of findings from laboratory studies to real-life hallucinations, particularly as pathological hallucinations appear to have sub-types (Rogers et al 2021).

Some methods are closer to visual illusions than hallucinations. For example, the McCullough effect involves staring at a colour pattern, which when removed will continued to be seen for a brief period (ie: an after-effect) or affect the subsequent viewing of a black and white pattern (Rogers et al 2021).

Other methods including visual/sensory deprivation (eg: blindfolding), or the "strange-face-in-the-mirror effect" (Caputo 2010), where "gazing into a mirror under low illumination causes appearance of strange faces" (Rogers et al 2021).

### 2.5.1. Auditory-Verbal

"Hearing voices" or auditory-verbal hallucinations (AVHs) are "vivid perceptions of speech that occur in the absence of any corresponding external stimulus but seem very real to the voice hearer" (Thakkar et al 2021 p1).

Jones (2010) gave more details: AVHs "encapsulate a diverse phenomenological experience, which may involve single and/or multiple voices, who may be known and/or unknown, speaking sequentially and/or simultaneously, in the first, second and/or third person, and which may give commands, comments, insults or encouragement" (quoted in Thakkar et al 2021).

Though they are associated with psychotic disorders, "it has become increasingly apparent that voice hearing seems to be experienced across the wellness spectrum, with a small but significant percentage of the general population hearing voices without seeking treatment or receiving a diagnosis of a psychotic disorder" (Thakkar et al 2021 p2).

The voices occur spontaneously for both groups (treatment and non-treatment seekers), but "non-treatment-seeking voice hearers feel a sense of agency over their voices that permits them some control over their onset and offset. This may help them to frame the experiences in a positive light and protect them from the self-destructive negative, ruminative thoughts that could render the voices hostile and threatening, and send them to the clinic seeking help" (Thakkar et al 2021 p2).

The two main theories of AVHs are a failure in self-monitoring, and prediction errors (Thakkar et al 2021). The former proposes that individuals fail to identify the voices as self-generated inside the head due to "compromised efference copy signals - 'copies' of motor signals that are sent to sensory processing regions" (Thakkar et al 2021 p2). Put simply, the brain fails to "tag" self-generated sensations as "I am the author of it" (Thakkar et al 2021).

Thakkar et al (2021) outlined an evolutionary basis in that "there are situations, particularly in young animals, in which it is advantageous for self-generated movement not to generate an efference copy signal (or for that signal to be ignored) and for a self-generated movement to be processed as if it were generated externally. This permits the animal important information about how it controls its own body—information that would typically be suppressed via an efference copy signal" (p4).

In terms of the second theory, the usual process of sensory prediction and update after prediction errors is altered in AVHs, such that "hallucinations might arise when prior predictions exert an inordinate influence over perceptual inferences, creating percepts with no corresponding external stimuli at all" (Thakkar et al

2021 p3). It has been possible in a small way to create auditory hallucinations in healthy volunteers by prolonged association (eg: a visual stimulus and a tone together until the visual stimulus produces a hallucinated tone) (Thakkar et al 2021).

Corlett et al (2018) tried to combine the both theories. When "self-tags" fail, individuals rely on prior expectations. The individual produces thoughts, which are not tagged as "own thoughts", and the individuals expects to hear voices, and so the thoughts become experienced as AVHs.

## 2.6. LUCID DREAMING

Gott et al (2021) described "lucid dreaming" as "a state of consciousness during sleep whereby neurophysiologically demodulated aspects of cognition — self-reflection, critical analysis and introspective insight — are aberrantly restored and made available within one's dreams. To the extent that the brain is capable of generating its own sensory content (divorced of external stimuli), lucid dreaming comprises a delicate centre-point in a neurobiological balance: retaining wake-like levels of reflection and volitional control, but vastly surpassing waking imagery in its immersion and depth, while circumventing the myriad of hazards associated with psychopathological and pharmacological hallucination" (p1). In everyday language, dreamers can control their dreams.

Lucid dreaming is relatively rare, but it has been argued that the ability can be trained by an individual questioning, "Am I dreaming?" regularly throughout the day. The idea is to produce a critical questioning of reality (Gott et al 2021).

Gott et al (2021) attempted to train lucid dreaming using virtual reality (VR) with 39 Dutch students. Participants kept a detailed dream diary over six weeks, including a rating of their lucidity. The VR group received twelve sessions which involved games and scenarios including bizarre and dream-like elements (eg: clocks running backwards in a university canteen). There were two control groups - one were told to say, "Am I dreaming" 5-10 times per day (active control), and a passive control with no instructions.

Contrary to expectations, no significant differences in lucid dreaming were found between the three groups. Though the VR group did report more unverified lucid

dreams by the end of the training.

"Lucid dreaming has been shown to occur with stronger dream control in patients with bipolar disorders and schizophrenia...; which include dissociative and depersonalisation-like symptoms as part of their central pathology" (Gott et al 2021 p6). Interestingly, Gott et al (2021) noted that anecdotally participants in the VR group "described mild to moderate feelings of dissociation following VR game exposure, which typically persisted for 1–2 h, and gradually diminished thereafter. Such dissociation symptoms are well known in the VR literature: initially taken to be 'vertigo' or 'sea sickness' type effects, this phenomenon—referred to in the literature as 'VRISE' — is quite distinct from motion sickness [Sharples et al 2008] and remains poorly understood. Descriptions of VRISE overlap with and quite accurately describe the dissociative symptoms exhibited by participants — a conclusion supported by the psychological literature, which independently describes VR technology as a potent tool for inducing dissociated states for clinical applications" (p5).

It is possible to draw the conclusion that lucid dreaming and dissociation are both linked to the prefrontal cortex (Gott et al 2021). Understanding how cognitive control is gained in lucid dreaming has implications for the treatment of hallucinations (Fazekas et al 2021).

## 2.7. APPENDIX 2A - FUNCTIONAL MAGNETIC RESONANCE IMAGING

The development of neuroimaging has allowed the study of the living brain "in action". One widely used of these non-invasive techniques is functional magnetic resonance imaging (fMRI). This technique "takes advantage of activity-coupled blood flow changes from which blood oxygen level-dependent (BOLD) signals can be obtained to infer neural activity. This inference is justified because neuronal activity drives increases in local blood flow via processes collectively termed neurovascular coupling" (Mishra et al 2021 p1).

But "the BOLD signal is not straightforward; rather it is an integration of the oxidative metabolism in the tissue, which uses oxygen, and the increase in local blood flow, which supplies the oxygen" (Mishra et al 2021 pp1-2). Put simply, "BOLD responses do not directly reflect neural activity" (Mishra et al 2021 p2).

For example, comparing the cortex and deeper brain regions like the hippocampus (Ekstrom 2021), "there may

be region-specific differences in how neural activity is translated into BOLD responses" (Mishra et al 2021 p2).

Blood flow to the brain and within it can be influenced by general physiology (eg: heart rate; breathing). This is a question of how these processes impact BOLD signals (ie: non-neural effects) (Das et al 2021).

Love (2021) argued for the studying of the brain at all levels. "Cognitive scientists have relied heavily on model-based fMRI to develop theories of how the brain works, and often the cellular and molecular processes underlying these phenomena are ignored as not being important enough for the purposes of the deductions. Yet, a model is only as good as its assumptions, which are defined, to some extent, by what we already know to put into the model" (Mishra et al 2021 p3).

### 2.7.1. Levels of Analysis

Behaviour can be studied at different levels of analysis, from the individual neuron or biological process to the social group as a whole. It is better to see the levels as interacting (ie: multiple levels of mechanism), though arguments do persist over which level is the "real" one. "Certainly, different levels of analysis provide different viewpoints on the same phenomena. However, different levels are not equivalent to one another" (Love 2021 p3).

How to understand the relationship between the different levels of analysis? A reductionist approach would focus on the lowest level because most information is available. But "higher level concepts are central to our understanding. For example, how could people make sense of the economy without higher level concepts such as unemployment, inflation, money supply etc?Likewise, how could neuroscience progress if we only referred to atoms or even neurons without any higher level conceptual organisation" (Love 2021 p3)?

One useful concept is "supervenience" (Kim 1988), which "holds that a change in a higher level entity must involve a change in the lower level entity, but not vice versa" (Love 2021 p3).

Concentrating on neuroscience, Love (2021) reflected on the idea of "biological plausibility", which is used to describe a "satisfying explanation". "Are higher level descriptions never biologically plausible and if so, why? Alternatively, can one go too low toward physics and no longer be biologically plausible" (Love 2021 p5)?

Consciousness is a classic example of a phenomenon that requires multiple levels of analysis. If it could be reduced to the firing of neurons to understand it, then the experience ("qualia") is lost, but consciousness as a whole does not emerge without the physical processes.

The discussion about levels of analysis and biological plausibility in neuroscience is evident in neuroimaging. BOLD, for example, is a different level of measurement to single-cell recording. Love (2021) pointed out that "measures themselves are not levels of analysis, but that different measures can be appropriate for evaluating mechanisms at different levels of analysis" (p6).

Importantly, BOLD does not seem to be "a matter of simple aggregation" (Love 2021 p6) of single cells. The upshot is that "the interpretation of BOLD response is not always straightforward. For example, BOLD response is affected by the local vascular anatomy, differs according to age, and certain regions are susceptible to imaging artefacts" (Love 2021 p6).

Love (2021) continued: "On the positive side, BOLD's divergence from simple aggregation presents some opportunities. Perhaps rather than just reflecting grey matter activity, BOLD may also reflect white matter and astrocyte activity as well (p6).

Love (2021) returned to the debate over the "real" level of analysis: "Even though measures are not levels of analysis, the same chauvinism seems to reign in which researchers' preferred measure is proclaimed to be fundamental. Of course, there is not a fundamental measure, just as there is not a fundamental level of analysis. Certainly, finer grain measures, both in terms of spatial and temporal resolution, would be desirable. However, even if we had the magic machine that recorded every aspect of every cell at every millisecond, we would still need higher level accounts to make sense of this data deluge" (pp6-7).

All of this is saying that findings in neuroscience have much to teach, but caution is needed in how to interpret it as a whole. "A grasp of levels of analysis is key to scientific progress. For better or worse, the day-to-day conduct of science is shaped by scientists' understanding of levels. Notions of mechanism, emergence and reduction, even what one considers a satisfying explanation, are all tied to levels. How scientists construe the relationship between their work and others' is tied to levels. A poor understanding of levels can lead to incoherent claims of biological plausibility and unsubstantiated beliefs that what one studies is somehow fundamental. These misconceptions can slow scientific

progress by obscuring where the true fault lines and uncertainty lie" (Love 2021 p7).

## 2.8. REFERENCES


Caputo, G.B (2010) Strange-face-in-the-mirror illusion Perception 39, 1007-1008

Christoff, K et al (2016) Mind-wandering as spontaneous thought: A dynamic framework Nature Reviews Neuroscience 17, 718-731

Corlett, P.R et al (2018) Hallucinations and strong priors Trends in Cognitive Science 23, 114-127

Das, A et al (2021) Rude mechanicals in brain haemodynamics: Non-neural actors that influence blood flow Philosophical Transactions of the Royal Society B 376, 21090635

Ekstrom, A.D (2021) Regional variation in neurovascular coupling and why we still lack a Rosetta Stone Philosophical Transactions of the Royal Society B 376, 21090634

Fazekas, P et al (2021) Offline perception: An introduction Philosophical Transactions of the Royal Society B 376, 21090686

Gott, J et al (2021) Virtual reality training of lucid dreaming Philosophical Transactions of the Royal Society B 376, 21090697

Gross, M.E et al (2021) Comparing the phenomenological qualities of stimulus-independent thought, stimulus-dependent thought, and dreams using experience sampling Philosophical Transactions of the Royal Society B 376, 21090694

Jacobs, C et al (2018) Visual working memory performance in aphantasia Cortex 105, 61-73

Jones, S.R (2010) Do we need multiple models of auditory verbal hallucinations? Examining the phenomenological fit of cognitive and neurological models Schizophrenia Bulletin 36, 566-575

Karapanagiotidis, T et al (2021) Interactions between the neural correlates of dispositional internally directed thought and visual imagery Philosophical Transactions of the Royal Society B 376, 21090691

Kim, J (1988) What is "naturalised epistemology"? Philosophical Perspectives 2, 381-405

Kosslyn, S.M et al (1995) The cognitive neuroscience of mental imagery Neuropsychologia 33, 1335-1344

Kwok, E.L et al (2019) Measuring thought control failure: Sensory mechanisms and individual differences Psychological Science 57, 811-821

Levin, R & Young, H (2002) The relation of waking fantasy to dreaming Imagination, Cognition and Personality 26, 3, 201-219

Levine, D.N et al (1985) Two visual systems in mental imagery: Dissociation of "what" and "where" in imagery disorders due to bilateral posterior cerebral lesions Neurology 35, 1010-1018

Love, B.C (2021) Levels of biological plausibility Philosophical Transactions of the Royal Society B 376, 21090632

Mills, C et al (2021) Out of the blue: Understanding abrupt and wayward transitions in thought using probability and predictive processing Philosophical Transactions of the Royal Society B 376, 21090692

Mishra, A et al (2021) Key relationships between non-invasive functional neuroimaging and the underlying neuronal activity Philosophical Transactions of the Royal Society B 376, 21090622

Nanay, B (2021) Unconscious mental imagery Philosophical Transactions of the Royal Society B 376, 21090689

O'Craven, K.M & Kanwisher, N (2000) Mental imagery of faces and places activates corresponding stimulus-specific brain regions Journal of Cognitive Neuroscience 12, 1013-1023

Pearson, J et al (2015) Mental imagery: Functional mechanisms and clinical applications Trends in Cognitive Science 19, 590-602

Rode, G et al (2007) Looking while imagining: The influence of visual input on representational neglect Neurology 68, 432-437

Rogers, S et al (2021) Hallucinations on demand: The utility of experimentally induced phenomena in hallucination research Philosophical Transactions of the Royal Society B 376, 20200233

Sharples, S et al (2008) Virtual induced systems and effects (VRISE): Comparison of head mounted display (HMD), desktop and projection display systems Displays 29, 58-69

Thakkar, K.N et al (2021) Reconciling competing mechanisms posited to underlie auditory verbal hallucinations Philosophical Transactions of the Royal Society B 376, 21090702

Waters, F et al (2014) Visual hallucinations in the psychosis spectrum and comparative information from neurodegenerative disorders and eye disease Schizophrenia Bulletin 40, 233-245

Waters, F et al (2021) Hallucination, imagery, dreaming: Reassembling stimulus-independent perceptions based on Edmund Parish's classic misperception framework Philosophical Transactions of the Royal Society B 376, 21090701

Windt, J (2021) How deep is the rift between conscious states in sleep and wakefulness? Spontaneous experience over the sleep-wake cycle Philosophical Transactions of the Royal Society B 376, 21090696