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Review

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Pleasure junkies all around! Why it matters and why 'the arts' might be the answer: a biopsychological perspective

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Today's society is pleasure seeking. We expect to obtain pleasurable experiences fast and easily. We are used to hyper-palatable foods and drinks, and we can get pornography, games and gadgets whenever we want them. The problem: with this type of pleasure-maximizing choice behaviour we may be turning ourselves into mindless pleasure junkies, handing over our free will for the next dopamine shoot. Pleasure-only activities are fun. In excess, however, such activities might have negative effects on our biopsychological health: they provoke a change in the neural mechanisms underlying choice behaviour. Choice behaviour becomes biased towards short-term pleasure-maximizing goals, just as in the addicted brain (modulated by the amygdala, posterior ventromedial prefrontal cortex' (VMPFC), striatum, nucleus accumbens; 'A-system') and away from long-term prosperity and general well-being maximizing objectives (normally ensured by the insula, anterior VMPFC, hippocampus, dorsolateral prefrontal cortex (DLPFC), anterior cingulate cortex (ACC); 'I-system'). This paper outlines, first, what 'pleasure' is and what 'pleasure-only' activities are (e.g. social media engagement, hyper-palatable eating). Second, an account is given of the type of action that might aid to maintain the neural systems underlying choice behaviour balanced. Finally, it is proposed that engagement with the arts might be an activity with the potential to foster healthy choice behaviour—and not be just for pleasure. The evidence in this rather new field of research is still piecemeal and inconclusive. This review aims to motivate targeted research in this domain.

Knowledge without action is madness and action without knowledge is void.
—Abu Hamid Muhammad ibn Muhammad al-Ghazalı [*Al-Ghazali*]; *Persian scholar*

1. Introduction: freedom of choice

Today's society is pleasure seeking. We expect to obtain pleasure fast and easily. We are used to hyper-palatable foods and drinks. We can choose to get pornography, games and gadgets whenever we want. We owe no explanation to anyone. Pleasure is good. Pleasure is right. The problem: with this type of pleasure-maximizing behaviour we may be turning ourselves into mindless pleasure junkies, handing over our free will for the next dopamine shot [1].

Philosophic, psychological and neuroscientific perspectives on what pleasure is are given in §2. Section 3 outlines the neural systems underlying choice behaviour, and §4 gives an overview of what pleasure-only activities are, and how these might cause behavioural addictions. Section 5 provides an account of the type of activities which might contribute to maintain biopsychological health, and §6 reviews evidence suggesting that enjoyment and practice of the arts might be such an activity. Evidence in this field is still piecemeal and inconclusive, however, this review seeks to provide an overview of available evidence to stimulate future research in this domain.

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2. What pleasure is

Two opposing philosophical traditions have suggested ways to reach 'happiness'. Hedonism advocates that happiness is achieved through pure pleasure and enjoyment, while eudemonism contends that happiness is only reached through complex and meaningful goals [2]. In accordance with recent developments in the field of positive psychology, it appears, however, that both hedonism (strive for pleasure) and eudemonism (strive for meaning) are required for happiness and genuine well-being in life. Individuals striving for both pleasure and meaning exhibit the largest life satisfaction, well-being, mental and physical health [3].

This view is echoed in the brain sciences. On a basic mechanistic level, a differentiation is made between low-level pleasures and higher-order pleasures. Low-level pleasure is a mere perceptual stimulation leading to a rewarding sensation (food, sex, etc.), while higher-order pleasures (the arts, scientific effort, etc.) engage broader neural networks implied in the attribution of meaning [4–6]. For the brain sciences, 'pleasure' is nothing more than a neuro-behavioural mechanism devised by nature to signal the re-establishment of an imbalance [7] (e.g. satiety and pleasure after re-establishing an imbalance in nutrients after ingestion of food). Dopaminergic action in the reward circuitries of the brain is responsible for this feeling and ensures that the individual engages in biologically relevant behaviour (e.g. we might not bother to incur in the costly behaviour of obtaining food if we did not feel pleasure in doing so). In this view, pleasure is a learning signal that reinforces a biologically relevant behaviour. Pleasure is a motivator of behaviour that is related to the fulfilment of any biological need (biochemical, homeostatic), and never an aim in itself [8–10]. Pleasure 'for pleasure sake' is a behaviour that the brain sciences classically describe as a problematic behaviour in drug addiction. The person is oblivious to any long-term implications of their behaviour and would do anything to obtain the next (pleasure) shot of their drug [11]; see also §4 (addiction).

'Meaningful' actions in the neurocognitive sense are actions that engage the entire neurobiological systems implied in the long-term maintenance of healthy bodily function—in addition to the reward circuitries of the brain. The arts have been suggested to have this potential as higher order pleasures [6], see also §7 (The Arts Hypothesis).

As an analogy, consider the following example. When nutrients are ingested through food, the whole point (i.e. 'meaning') of the activity 'food ingestion' is normally the nutrients (fats, carbs, etc.). As a side effect, we experience pleasure. When ingestion of food is purely driven by the motivation to experience pleasure, no matter the contents of the ingested food, the long-term consequence of imbalanced diet can be eating disorders (e.g. obesity), or other diet related disorders (e.g. type 2 diabetes).

The conscious experience of 'meaningfulness' of an action might be grasped under the concept of a 'me factor'. In neural terms a 'me factor' would be evidenced by the fact that such activity engages both low-level evaluative processes (e.g. value assignation, pleasure and reward) and higher-order memory and conscious experiential mechanisms (e.g. assignation of meaning). The latter are highly idiosyncratic and, therefore, proper and fully dependent on who we are and what our bodily systems are tuned-in to in a given moment ('me factor').

3. Neural systems regulating choice behaviour: quick pleasure versus long-term prosperity?

Two neural systems of the limbic brain and their connections to the rest of the brain are particularly important for our ability to choose between options: one basic system concerned with maximizing immediate reward ('A-system' for reference: amygdala, posterior ventromedial prefrontal cortex (VMPFC), striatum; including nucleus accumbens; also referred to as the 'reward system'), and another, concerned with maximizing future reward and prosperity ('I-system' for reference: insula, anterior VMPFC, hippocampus, dorsolateral prefrontal cortex (DLPFC), anterior cingulate cortex (ACC)) [11]; for a similar account see [12].

Neural circuits of the A-system respond to events in the environment and trigger the optimal physiological state in the body for the organism to deal with the event (e.g. motivating the choice to approach or to avoid) [13–15]. It triggers the autonomous nervous system through neurochemical action to prepare the adequate physiological state for this fast behavioural response [16–19]. Any behavioural response triggered directly by the A-system will, therefore, be a rather coarse reaction (e.g. fight or flight, pleasure–displeasure).

The neural circuits of the I-system process internal stimuli related to bodily processes (e.g. homeostasis), some of which may be the result of information from the A-system. The I-system relates any stimuli to previous experience and value [13,20–22] to foster the optimal behavioural response, 'all things considered'. This may include downregulation of the A-system, to enable long-term reward.

Both systems are innervated by brain stem nuclei that contain serotonin, noradrenaline, dopamine and acetylcholine cell bodies and are, therefore, casually related to the experience of affect (which is important for 'feeling' the difference between options) and of pleasure (i.e. the enjoyable feeling after making the good/right choice; see electronic supplementary material, figure S1).

4. When it goes wrong: addiction

The human reward system evolved to respond to natural rewards (rewards we find in nature; foods like meat, vegetables, crops, sex, shelter, etc.). These contain a deeper 'meaning' to human psychobiological health: the nutrients of food, the shelter before the cold, reproduction for sex, etc. The reward system does not differentiate between natural and artificial rewards. However, normally, negative feedback loops in the brain signal when homeostasis is re-established. This stops the organism from ingesting something or carrying out an action more often than required by the biological state of the body [23].

In the addicted brain, pleasure is experienced, but no satiety, because no actual biochemical imbalance is re-established. This continuous pleasure stimulation over time induces the amygdala to be hyper-activated [11], while the insula is hypo-activated [24]. This is the basis of the problematic and inadequate decision-making of addicted individuals: they have little access to the top-down regulatory control processes acquired through socialization mediated by frontal and prefrontal networks, which would help signalling the long-term implications of different choice options [25] (I-system).

With this shifting in the neural underpinnings of 'choice' [11,26,27] comes the feeling of craving. Craving is a painful

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state of wanting, similar to hunger [5,11]. Craving increases the incentive value of any stimulus related to the 'drug' (A-system; [24,28,29]). The more the individual has to resist or wait for the 'drug', the higher its incentive value and motivation to obtain it [25,30]. Craving strips the individual of their willpower to resist [11,31].

There are behaviours or actions that can act like 'drugs', lead to craving, compulsion-like behaviours and even to behavioural addictions because of their rewarding nature [25,30,32]. Everitt & Robbins [33] suggest that an initial conscious choice to engage with a stimulus (a game, sports, certain smart phone apps, social media, hyper-palatable foods, etc.), becomes a habit, and then develops into a compulsion by instrumental learning mechanisms [34]. Loss of autonomous, healthy choice behaviour is the result [11,33,35].

5. Pleasure-only activities

Studies comparing the brains of people with substance addictions and behavioural addictions have found that there are common neural mechanisms mediating drug addiction and behavioural addictions (for reviews, see [27,31,36]). Many of today's easy pleasures have the potential to create behavioural addictions. Evidence suggests this is the case for smart phone social media app use[1,2] [37–39], gambling [40], sports [41–44], sex and pornography [45–47], hyper-palatable foods [36,48–50], gaming [51,52] and the Internet [53].

Intermittent reinforcement learning is one of the key mechanisms involved in the aetiology of addiction. This is because, in addition to signalling the re-establishment of an imbalance, 'pleasure' is a learning signal (see also §2 'what pleasure is'). We repeat what caused pleasure in the past. More than 50 years of reinforcement learning research has demonstrated that intermittent reinforcement is the most potent reinforcement schedule which causes the fastest learning (and addictive behaviour) and is the most resistant to extinction [54,55]. Intermittent reinforcement is when a desired action outcome is only obtained on part of the attempts to obtain it, and, when the ratio success rate is variable and unpredictable. For example, to receive a message, to see something that we like on social media, to win a gamble, to achieve a sporting outcome—all these events cause pleasurable chills, but they are unpredictable and happen on a variable basis. Two examples illustrate the cascade of effects when overexposed to pleasure-only activities: social media use and hyper-palatable eating:

Facebook and other social 'network' platforms have potent secondary reinforcer properties [38,56,57]. They create craving because of the intermittent reinforcement schedule, triggered by the notification icon: we never know when it will appear [58]. Therefore, social media have the potential to cause behavioural addiction [37–39]. In addition, social media encourage dysfunctional personality styles (narcissism, low self-esteem, shyness, excessive need for confirmation; [59–62], antagonism (e.g. by encouraging jealousy and other interpersonal negative emotions; [63–66]) and in-group–outgroup formation by mechanisms such as dysfunctional social comparison processes [67,68] and other mental health problems (especially to anxiety and depression). This is because the compulsive use of these platforms exposes the individual to prolonged and unnatural social and psychological pressure, forcing the individual to make choices that are not optimal for their own psychological health [69–72].[3,4,5] These important negative health effects are caused by social media engagement, obsession for image and superficial appearance deprived of meaning and content.[6]

Overeating sugar changes the brain as do other addictive drugs [27,48]. Intermittent sugar intake acts as a secondary reinforcer and therefore changes the neurochemistry of the reward system. With time, it causes a hyper-activation of the dopamine and opioid systems, producing an increase in the incentive value of the sight of hyper-palatable foods [49]. In addition, the food industry has developed the 'bliss point' which is the point at which people never feel satiated and carry on eating despite having ingested enough calories. This happens when a food product contains the exact right mixture of sweet, fat and salty [77]. This makes people overeat despite caloric excess [78,79]. The 'hunger hormone'[7] ghrelin is segregated when the body is in need of nutrients and is the conscious correlate of 'hunger'. Yet, it will also be released into the bloodstream when eating 'empty foods', that is, foods that have been deprived of their nutrients (e.g. fibres, vitamins, minerals; such as concentrated fruit juices and other processed foods [80,81]) but still have their content of sugar and fat—making the individual feel hungry in spite of already having ingested too many calories. Furthermore, hyperglycaemia (caused by the excess calories) induces a 'fat retention' mode in the body [82,83]. It is a vicious circle because the individual stays hungry despite ingesting food—which becomes directly stored as fat. The hormone 'leptin' would usually mediate this effect [84]. However, high fat foods elicit less leptin and will, therefore, cause overintake of calories, as the negative feedback loop is missing [85]. The number of ingredients is another tool used by the food industry to trick our perceptual systems into eating (and thus 'buying') more [47,50]. The food industry combines an artificial number of ingredients (especially flavours) into a mix that does not exist in nature, and which therefore triggers intense pleasure (without nutritional value)—because these substances act directly on the A-system (reward). Apart from food addiction, the results of this imbalance caused by the choice of artificial foods are obesity and other eating disorders.

6. Meaningful activities: triggering a 'me factor'

Activities that strengthen the links between the A- and the I-systems might decrease the probability of developing behavioural addictions and aid to maintain bodily systems healthy from the outset because choices would be long-term prosperity maximizing.

The neural system linking A- and I-systems is the insula. The insula is centrally implicated in the interoceptive awareness of bodily states and signals [86]; for example, of bodily feedback signalling satiety, e.g. when 'it is enough' activity, food. The learned interpretation of these interoceptive signals in relation to preceding events and contextual information [22,87] is thought to form the basis of healthy emotional function [13,14,20,21,88,89] and decision-making [90,91]. Conversely, impaired interoceptive abilities have been related to addiction [92] and eating disorders [93–95].

It has been suggested that activities that might engage the insular and somatosensory systems could help to reverse the adverse effects of addictions (insula hypo-activation), by enabling access to the frontal control networks of the brain (I-system supporting meaning and awareness of long-term implications, through the insula) [96]. Two pathways provide the

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neuroanatomical basis for the link between A- and I-systems; see the electronic supplementary material, Neuroanatomical link A- & I-systems. Activities that elicit this holistic activation pattern are activities that are not only pleasurable and rewarding, but also have a meaning to us because they engage our previous personal memories and life experience. The important point is that the activity engages both A- and I-systems and triggers the interoceptive feeling of 'me', a 'me factor'.

7. The arts hypothesis

Interoceptive accuracy can be measured with objective tests (i.e. tests that are independent of how good or bad the person *thinks* they are at estimating their interoceptive signals) [97,98]. Attempts at identifying groups of people who might be specifically interoceptively aware have largely proved unsuccessful [96,99,100]. Notably, however, artists such as musicians and dancers have been found to have an enhanced objective awareness of their interoceptive states [101,102], suggesting an interesting route to heightened interoceptive awareness through the arts. This merits further investigation—also with respect to which aspects of interoceptive awareness are related to well-being [103].

Furthermore, engagement with the arts demonstrably has the potential to engage both the A- and the I-systems in lay people and art experts alike [104–107]. Low-level stimuli features of works of art trigger our attention, including shapes and tones, and other features such as symmetry and beauty [108–114]. Besides, the arts push boundaries, surprise, reveal, and excite both artist and spectator. This all causes pleasurable chills (value assignation and pleasure; A-system). The discipline 'neuroaesthetics' studies these low-level perceptual processes and how they relate to aesthetic preferences [115–117]. In this endeavour, neural structures of reward and pleasure have been found to be engaged during aesthetic experiences [107,111,118–120].

The I-system is engaged, for example, when personally significant artwork triggers idiosyncratic memories and personal knowledge and abilities (e.g. [113,121]). A piece of art gains personal significance [122], and meaningfulness [6] because it triggers memory and frontal experiential systems (I-system). The moment of meaning-assignation, also called 'mastering' or 'understanding' an artwork, is therefore a pleasurable experience [123–126], engaging similar brain mechanisms as the 'aha!' moment when the solution to a problem comes to mind [127,128]. This suggests that moments of understanding and finding a meaning to an artwork might be the moment where A- and I-systems are optimally involved.

In this context, it is important to refer to the concept of 'flow' as a marker of A- and I-systems engagement. Philosophers, scientists and poets have long argued that through the absorption of our mind in creative activities states of well-being and a sense of purpose in life are achieved [129]. Maslow [130] called this state peak experience. It is described as a situation or state in which we are optimally connected to the activity and where personal skills and task demands are in ideal balance [131]. An example of an activity that can induce flow is engagement with the arts. Personal engagement with an activity produces strongly pleasurable states of flow [132]. These moments might be only a few seconds long, or last for hours. The important aspect is the total absorption into one coherent focused neurocognitive state. Artists experience strong moments of flow during their artful activity [133] and the self-rated meaningfulness of a produced artwork (e.g. a song) correlates with the intensity of the flow experience, both in experts [134] and in lay people (therapeutic context [135]). Flow is said to produce eudaimonia [4–6].

Importantly, the arts do not induce states of craving without fulfilment—as do activities with reinforcement schedules which are prone to create habits and addiction such as intermittent variable ratio or interval reinforcement schedules (e.g. social media, gambling, football, extreme sports, drugs, see §5). Rather, the above suggests that the arts can help overwrite the detrimental effects of dysfunctional urges and craving (caused by the hyper-activation of the amygdala [11] and the hypo-activation of the insula [24], by focusing the mind into one coherent state which activates the A- and I-systems alike. It is true that not all art has a resolution or grand finale which soothes the senses after a turmoil of action and strong emotional discharge—and could thus induce craving (A-system hyper-activation). Movies and books with cliff-hanger endings exist, as do musical pieces without final note that leave a teasing yearning in the listener. However, when such 'endings' are chosen they are forming a greater whole with other elements of the artwork or the context—and thus do eventually represent a successful resolution and mastering in the artist and spectator. In this vein, a view expressed in the art therapy domain is that *active* arts therapy empowers individuals by engaging them in active interaction and discussion, thus creating new avenues of thought, assigning idiosyncratic and non-threatening new meanings to situations which were formerly problematic to the individual [136].

Furthermore, the arts do not search for a perceptual 'Bliss point' (see also §5; the electronic supplementary material). They do not just repeat over and over again a sensory stimulus that excites the senses and induces craving for more of a 'pleasurable itch' (e.g. sugar, sexualized body displays, certain musical lyrics, tones; i.e. a perceptual 'bliss point'). A ballerina lifting her leg up into a perfect line of 180° in a teasingly slow manner will certainly induce a feeling of craving in the spectator for the ballerina to reach the climax expression of the pose [113]; see electronic supplementary material, figure S2. However, she *will* get the leg there eventually, as part of a choreography with a meaning to the spectator. The virtuosity of the movement—and the meaning the artist and/or spectator makes of it—form a greater whole. This 'whole' goes beyond low-level perceptual features such as the angle of the lines that the body draws in space (90° versus 180°; [113,137]).

8. Discussion: choice hygiene

Extensive lists of symptoms that can help to detect behavioural addictions are available in [138,139]. For example, the continued execution of the excessive behaviour despite negative consequences (health-related, occupational and social) is a particularly debilitating sign of addiction and is probably the most striking and easily detectable to friends and family members.

One might argue that it should be up to the individual's free choice whether, or not, to let their choice behaviour be biased, and whether they care if their pleasure boosting A-system is hyper-activated at the expense of a hypo-activation of the insula. However, when it comes to decisions affecting larger groups of people, or a nation, (such as during elections and votes) one may want to ensure that the people making the choices are autonomous agents and not individuals blinded by short-term reward prospects.

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The current societal situation maps onto Al-Ghazali's quote at the beginning of the article: we engage in actions without knowing about their effects on us while neuroscience and biopsychology have in the past 20 years provided extensive evidence highlighting negative effects of certain actions on our biopsychological health. The present review article aims to suggest ways to link knowledge to action and vice versa.

'Choice hygiene' may include, for example:

— to *be aware* of activities that can create behavioural addictions (only engage with them occasionally and following a set time frame);
— to *know* that if one repeatedly exposes oneself to activities that produce hyper-activation in the A-system there is a risk of causing a behavioural addiction (plan and adhere to periods without the activity);
— to *know* the signs of a behavioural addiction in oneself and others (e.g., knowing that finding excuses, rationalizations, self-delusion, justifications and 'important' reasons to engage with an activity despite obvious evidence against it, is a symptom of compulsion/addiction; e.g. 'I just have to check something on social media regarding an "important" question');
— to *know* that behavioural addictions have a neural basis and that its neural firing pattern alters brain structure and requires time to remit once altered (once a compulsion/addiction is manifest, remedy is difficult and might require professional help);
— to *know* what are the meaningful activities for *me* (triggering the 'me factor') and which is their healthy dosage (training in any art form from early age provides the individual with an important tool later in life).

9. Conclusion: empowered by knowledge to be free?

A very important aspect of the 'freedom of choice' which we enjoy in Western societies is being ignored. In particular, that this freedom of choice requires an increased responsibility of the individual—of *us*: that of being informed about the effects of our choices—also at the level of neurobiological health. We need to be empowered by knowledge to be free. For example, today's mainstream acceptance of pleasure-seeking behaviour might have detrimental effects for society as a whole.

Individuals' freedom used to be limited by religion, culture and tradition. Generations fought and achieved freedom of individual choice. However, we now might be on the edge of losing this freedom again, to a new prison that is made in our own brain. The arts are mostly neglected as anything more than a nice *passe*-time,—although poets, philosophers and scientists have always advocated for the importance of the arts for personal autonomous development. Recent neuroscientific and biopsychological evidence suggests an interesting potential of arts practice as a means to maintain a free mind—even in neurobiological terms.

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Endnotes

[1]Deloitte mobile consumer survey: https://www2.deloitte.com/uk/en/pages/technology-media-and-telecommunications/articles/mobile-consumer-survey.html.
[2]UK has never been more addicted to smart phones: http://www.bbc.co.uk/news/business-37468560.
[3]Facebook lurking makes you miserable, says study: http://www.bbc.co.uk/news/education-38392802.
[4]Twenty-four hour social media 'link to teenage anxiety'. See http://www.bbc.co.uk/news/education-34220964.
[5]Girls becoming more unhappy, says study: http://www.bbc.co.uk/news/education-37223063.
[6]Positive effects of social media can be found in [73]. For example, social media have beneficial effects in the medicine setting [74,75] and may be a useful tool to manage depression [76].
[7]GHRL ghrelin and obestatin prepropeptide (*Homo sapiens* (human)). See http://www.ncbi.nlm.nih.gov/gene?Db=gene&Cmd=DetailsSearch&Term=51738.

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