Mechanisms underpinning the mental health impact of the arts

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Abstract

Studies have demonstrated reductions in psychiatric symptomatology in diverse mental health conditions following participation in creative arts therapies, community arts programmes delivered on prescription, and arts activities undertaken for leisure. However, a critical consideration is how and why such effects can occur. In this Review, we summarise the evidence base on the underlying causal mechanisms that appear most common across artforms, most potent in terms of supporting causal effects, and transdiagnostic, underpinning the mental health impact of the arts on mild, moderate and severe mental illness. These mechanisms have emerged from interdisciplinary research across psychology, neuroscience, neuro/psycho-physiology, psychobiology, social science and behavioural science. We conclude with recommendations about the need to advance understanding on which specific transdiagnostic processes underpinning mental illness are most strongly influenced by the arts, how modular extensions of more universal arts interventions could be designed to activate diagnosis-specific mechanisms, how theoretical thinking can be developed on arts engagement as an 'exposome' supporting mental health, and quality and safeguarding can be ensured when using arts activities to support mental health.

Introduction

The "arts" encompass a diverse range of human practices ubiquitous in every human culture.[1,2] While styles and genres of art vary across cultures, arts practices are united in relating to the production/experience of human creativity and imagination and being designed to be appreciated primarily for their beauty, ideas and/or emotional power.[3] These practices coalesce into broad categories of participating in or watching dance/movement, literature, media, music, theatre/performance, and visual arts/craft/design (hereafter referred to collectively as "arts engagement").[4] From an anthropological perspective, the arts appear to have emerged and co-evolved to a large extent as part of human healing practices, and in many societies they are still intrinsically interwoven into health, building on strong traditions and knowledge capital.[5–8] In other societies – particularly Western, Global North contexts- engagement in the arts in the context of health lie on a spectrum from arts engagement within everyday engagement as part of community life (e.g. as hobbies, for leisure), to health-focused engagement (e.g. arts programmes delivered on prescription or with specific health-focused outcomes), to clinical engagement (e.g. arts therapies delivered by professional arts therapists).[4]

Over the past two decades, there has been increasing research into the effects of engagement with the arts on mental health.[9] A large body of this research has focused on clinical engagement in the arts; specifically the impact of creative arts therapies (such as art therapy, music therapy, and dance/movement therapy) on individuals with diagnosed mental health conditions, such as depression and anxiety.[10,11] These meta-analyses have demonstrated effects in in-patient and out-patient settings, across all age groups, from participatory arts activities with creative arts therapists like improvising, as well as more receptive activities like guided imagery with music. Increasingly, these results are being demonstrated from high-quality randomised trials with a low identified risk of bias. For severe mental illness, literature is more limited, as is the overall quality of studies to date. Nonetheless, within these caveats, meta-analyses of trials of music therapy for schizophrenia do suggest benefits for a range of symptoms, including so-called "positive" symptoms (such as delusions, hallucinatory behaviour, grandiosity, suspiciousness, and hostility), "negative" symptoms (such as emotional withdrawal, social withdrawal, and attentional impairment), and broader symptoms of psychopathology (e.g., anxiety, depression, and aspects of cognition).[12–14] There is also some exploratory work suggesting the potential value of creative arts therapies for other patient groups, including people with broader types of psychosis (such as bipolar disorder), personality disorders and post-traumatic stress.[15–17]

Alongside this literature on creative arts therapies specifically, though, there has also emerged a growing literature on broader arts engagement, led by artists or individuals themselves rather than accredited therapists. General participation in arts activities (e.g., making music or art) have been shown to improve mental health symptoms in people with diagnosed anxiety and depression as well as broader populations without formal diagnoses but showing some subclinical symptoms covering key clinical areas such as cognitive decline and dementias, traumatic loss, pregnancy, and caregiving-related stress.[18 19] There is evidence in a number of studies that effects can last several months following the end of relatively short-term interventions.

However, a critical consideration is *how* and *why* such effects can occur as a result of engagement with the arts. It is widely accepted that arts activities comprise various 'ingredients' or 'components' that enable processes of change, known as 'mechanisms of action' (see Figure 1 & Box 1 for a full explanation and graphical depiction of these terms). Work in the creative arts therapies has been more advanced in considering ingredients and mechanisms. One recent review that looked across all types of creative arts therapies proposed a combined list of therapeutic factors (also termed intervention components or ingredients) and mechanisms of change responsible for treatment effects. However, we lack similar considerations for arts engagement outside of the context of formal arts therapies. One previous review explored mechanisms of action linking leisure-based activities such as the arts and other past-times to mental and physical health outcomes, demonstrating that engaging in an activity as complex as the arts can activate a multitude of mechanisms.[20] However, there is likely a smaller number of more specific mechanisms that help to explain causal effects of arts engagement on mental health specifically.[21] Identification of these mechanisms is important to inform detailed design of experimental studies and of arts-based interventions.

Figure 1: Simplified schematic representation of the relationship between ingredients, mechanisms and outcomes in arts engagement.

Box 1: 'Active ingredients' in arts activities

In this Review, we highlight some of the mechanisms activated by engagement in the arts that are relevant to mental health outcomes. We take a transdiagnostic approach, considering mechanisms that have a relevance to broad types of mental illness.[22] This review is not intended to be exhaustive, but rather to outline the current state of play with regards to identified and evidenced mechanisms that may be particularly important to achieving mental health benefits. These mechanisms are supported by varying levels of evidence but have been selected by the authors as they appear particularly relevant to the mental health outcomes reported in meta-analyses and align with current theoretical conceptualisations of mental health and its underpinning processes. In identifying these mechanisms, we have drawn on literature from psychology, neuroscience, neuro/psycho-physiology, psychobiology, social science and behavioural science.

In all, we describe 48 mechanisms, which we loosely categorise to aid readership, while acknowledging the inherent interconnectivity between many of the processes described. Throughout this Review, we focus on arts rather than creative arts therapies, anticipating that mechanisms relevant to general arts engagement are likely also active within creative arts therapies, but acknowledging that creative arts therapies can involve other non-artistic therapeutic mechanisms. Finally, we make theoretical proposals for how our understanding of the causal processes linking arts engagement to mental health can be advanced, in particular introducing the concept of an 'arts exposome' and making some recommendations for future research.

Mechanisms

Emotion regulation

Some of the most fundamental mechanisms underpinning causal effects of arts engagement on mental health relate to the emotional impact of the arts. Art can communicate emotions, with in-built features or 'cues' such as bright colours, smooth textures, symmetry, fast beats and consonance recognised even by infants as innately happy, and dark colours, roughness, angular lines, slow beats, and dissonance recognised as sad.[23–25] These cues can lead to induction of similar emotions in those engaging, for example through eliciting brain stem reflexes or via processes of emotional contagion.[26] Functional neuroimaging studies show that emotions experienced as a result of arts engagement involve activation of core brain structures that underlie emotion, such as the amygdala, nucleus accumbens, hypothalamus, hippocampus, insula, cingulate cortex and orbitofrontal cortex.[27] These areas play a role in several key networks such as the reward network, the salience network, the default mode network, the emotion regulation network, and the stress response network, all of which are involved in key survival-related functions.[27,28]

If the arts experience is perceived as pleasurable, at a neurobiological level it activates the dopaminergic mesolimbic reward pathway.[27] This leads to increased availability of the neurotransmitter dopamine within the nucleus accumbens, which plays an important role in mood, motivation and broader cognitive processes.[29] Notably, studies have demonstrated that this dopamine release occurs not only in response to the most intense emotional moments within arts experiences, but also (and often more prominently) in anticipation of such moments – either because the specific arts experience is already familiar to the participant or because visual, phonological or structural features of the experience have elements of predictability based on an individual's existing mental 'schema' for that arts experience.[29,30] In addition to dopamine, it appears likely that pleasurable arts experiences lead to the release of endogenous opioids such as endorphins, although evidence is more tangential here. For example, if people take opioid antagonists such as naltrexone that *blocks* endogenous opioid signalling before listening to music they consider pleasurable, they show fewer physiological signs of pleasure, even though they still report enjoying the music.[31] Conversely, if individuals take opioid agonists such as oxycodone that *activate* opioid receptors prior to pleasurable music, they experience greater physiological signs of pleasure.[32] Other studies using proxies for endorphin release such as pain thresholds also argue that endorphin increase as a result of the arts is likely, as well as highlighting a possible coevolutionary mechanism that is relevant to mental health linking arts engagement to pain regulation.[33]

Arts experiences that elicit positive emotions have obvious benefits to mental health. But arts experiences that provoke negative emotions, including sadness, fear or disgust can also be beneficial. Confronting and allowing oneself to

experience negative emotions can be beneficial psychologically, so negative emotions encouraged by arts engagement may provide an opportunity for an authentic emotional connection.[34] However, in contrast to real-life negative events, artistic representations tend to provoke positive emotions concurrently with the negative emotions as individuals recognise the experience as an artistic one, meaning negative emotions experienced through arts are tempered.[35] Indeed, individuals are adept at ~~cognitively~~ recognising that the negative scenarios within arts experiences are artificial. As a result, even though genuine negative emotions are still elicited, the lack of real-life action required in response to the portrayed events permits a psychological detachment from the ensuing emotional response.[36] Consequently, experience of negative emotions through the arts functions as a chance to understand and rehearse the management of our emotions and simulate possible responses to challenging circumstances (an example of predictive coding in action and something we return to in "Socio-behavioural mechanisms").[37] Evidence suggests that people with depression often experience intensified psychological and neurological responses to sad arts experiences, yet also perceive particular resonances with sad arts experiences, find these experiences enjoyable, use them in heightened way to rehearse their emotional responses, and can even feel happier after them.[38–40] This is notable given that depressive disorders are characterised not just by fewer happy emotions but also by suppression of negative emotions.[41] That said, it is important to be cautious in deliberately exposing people with mental health diagnoses to sad arts experiences. Experience of negative emotions through the arts can be more intense for individuals with depressive symptoms, so there are practical considerations about sensitive and appropriate exposure.[42,43]

In addition to using the arts to *elicit* emotions, another critical emotional mechanism providing explanation for the mental health benefits of the arts relates to emotion *regulation*. Psychological research demonstrates that when individuals are dealing with negative emotions such as stress, engagement in the arts can activate emotion regulation strategies that promote both avoidance (e.g. suppression, detachment and distraction) and cognitive reappraisal (e.g. discharge of negative emotions, acceptance, reappraisal and problem solving).[44] Which strategy is selected appears determined more by individual circumstances, personality and goals than by specific artforms, and there is little consensus as to whether any particular emotion regulation strategy recruited through engagement in the arts is most effective. However, it is notable that having greater creative freedom within the arts activity undertaken appears to be linked to greater emotion regulation experienced as a result.[45–47] This mechanism of emotion regulation is activated just as strongly in individuals experiencing depressive symptoms,[48,49] and has been demonstrated to underlie some of the improvements in symptoms reported in arts intervention trials from people with depression.[50,51]

Cognitive regulation

These regulation benefits extend from the emotional to the cognitive sphere. The cognitive impairments caused by mental health problems such as depression are well evidenced, including deficits in attention, memory, learning and executive function, and cognitive biases such as distorted information and dysfunctional beliefs about one's self and the world around.[52] But some studies have suggested improvements in depressive symptoms as a result of arts engagement occur alongside improvements in diverse cognitive functions.[51] Some of the cognitive findings parallel those identified in research on nature and greenspace such as attention restoration benefits from viewing nature that provides "soft fascination", escapism and connectedness.[53] This suggests that arts engagement such as viewing artworks in museums may help to reduce mental fatigue and restore attentional focus.[53,54] Evidence of cognitive benefits has some preliminary support from small-scale neuroimaging studies demonstrating increased activation of regions involved in cognitive tasks such as the dorsolateral prefontral cortex, Pallidum-DMN circuit and increased insular connectivity in people with MDD and Schizophrenia in response to arts activities such as music listening.[55–57]

Indeed, if arts engagement is repeated and regular, studies suggest it can enhance neuroplasticity. Neuroimaging studies on the arts are still at a relatively early stage of development. But a number have demonstrated that exposure to multi-sensory arts experiences and environments is associated with improved formation of synapses in the brain, while sustained arts engagement – in particular training in the arts- is related to increased fMRI activation in brain regions involved in attention (supramarginal gyrus), increased EEG response in temporal-limbic areas involved in emotions and memory, increased grey matter volume in regions involved in executive functions (superior, medial and inferior frontal gyrus) and memory formation and retrieval (hippocampus), and increased white matter integrity in regions involved in reward perception (striatum).[59,60] Naturally, an important consideration is whether such structural and functional

changes have measurable implications for mental health. Nonetheless, some preliminary studies suggest this could be the case. For example, a study involving daily music listening found that neuroplastic changes such as increased grey matter volume in limbic areas correlated with reduced symptoms of depression, tension, fatigue, forgetfulness and irritability.[61]

Arts engagement also trigger states of flow – mental states of deep engagement, focus and immersion that are beneficial to mental health. Arts experiences actually appear particularly effective at inducing flow states relative to other behaviours.[66] Flow is thought to arise out of synchrony of attentional and reward networks and is beneficial to mental health both in reducing symptomatology and enhancing wellbeing.[67,68] Flow also increases the propensity for experiencing 'chills': a psychophysiological phenomenon that occurs at the point of cross-over in dopamine release between anticipation and realisation of pleasure and occurs alongside changes in heart rate, body temperature and cerebral blood flow.[69] While chills can occur as a result of basic manipulation of expectation, they can also occur as part of broader 'peak' artistic experiences, accompanied by feelings such as awe, reverence, rapture and harmony and activation of aesthetic brain networks.[70,71] Such instances can provide more transformative moments associated with psychological catharsis, healing, liberation and an enhanced sense of meaning in life, further enhancing mental health.[70]

From a positive psychology perspective, arts engagement also enhances psychological processes that are considered core psychological needs and are causally related themselves to mental health outcomes. Improved sense of control in life, autonomy, mastery, purpose, and perceived coherence are all widely reported qualitatively by research participants in arts interventions.[62] There is evidence to suggest that activating these psychological processes even within the narrow domain of leisure engagement in the arts can lead to global improvements in perceived meeting of psychological needs, as well as in broader wellbeing.[64] As a result, through arts engagement, individuals can accumulate psychological resources that they can draw on to respond to and buffer against stress and threats.[65] Overall, building on the mechanism of positive emotion elicitation through arts experiences, arts engagement appears to activate upwards spirals of positive emotions, cognitions and also actions, in line with "broaden and build" theory.[58]

Arousal & stress modification

Core ingredients of arts such as tempo, volume, texture, dissonance, symmetry, shape and surprise can moderate physiological arousal levels. Via signalling across the autonomic nervous system, a substantial body of clinical and non-clinical studies demonstrate that calming arts activities can reduce arousal within the cardio-respiratory system such as decreasing sympathetic nervous system activity as evident in heart rate, respiration rate and blood pressure and increasing parasympathetic nervous system activity as evidenced in heart rate variability.[72–74] More preliminary evidence also suggests effects such as relaxation of facial muscles and improved rhythmicity of gastrointestinal contractions in response to relaxing arts activities, indicating potentially wide-ranging autonomic nervous system activity in response to the arts.[75,76]

This reduction in physiological arousal as a result of arts activities is enhanced in art-forms such as music or poetry that generate rhythms. Due to processes of sensorimotor integration within the brain, perception of rhythms activates multiple brain regions involved in movement, including premotor cortex, supplementary motor area, cerebellum and basal ganglia, even if a listener does not actually engage in any movement.[77] If the rhythms coalesce into regular beats, neural oscillations align to these beats, leading to physiological entrainment of processes such as heart rate and breathing to the specific frequency of the beats being perceived. As a result, arts experiences that provide slow beats can be used to physiologically entrain movements, respiration and heart rate to lower levels. Entrainment also has other benefits beyond arousal modification, including supporting cognitive processes that are beneficial to mental health, such as enhancing attentional control mechanisms like attentional selection and optimising cognitive processing during attentionally demanding tasks.[78] This specific pathway from arts-based entrainment to cognitive functioning has some initial support from preliminary studies.[79]

Reductions in arousal are beneficial to mental health as they can lower levels of anxiety and stress (explored further below) and improve positive emotions.[80,81] But stimulating arts activities can also bring mental health benefits via alternative pathways. Good mental health is supported by a good prevailing balance between sympathetic and

parasympathetic nervous system activity: good autonomic tone. Autonomic imbalance – either consisting of over-prevalence of sympathetic or parasympathetic activity – is associated with adverse mental health outcomes.[82,83] As a result, in addition to increasing parasympathetic activity, briefly increasing sympathetic nervous system activity in a controlled way periodically is also beneficial. Evidence from physical activity research highlights that regular exercise-induced sympathetic activity leads to increases in post-exercise parasympathetic activation and underpins broader improvements in autonomic tone, and it has been suggested that arts-induced sympathetic activation may have similar benefits.[84]

In support of both reductions and short-term controlled increases in arousal being beneficial to mental health, psychological and neuro-endocrine research report subjective and objective reductions in stress through both approaches. Reductions in perceived stress and cortisol levels in response to relaxing arts activities have been shown in people experiencing stressful situations (such as hospital procedures).[85–93] Equally, reductions in cortisol have been found in response to arousing engagement in participatory arts activities, even when participants report increases in perceived arousal levels.[94–98] Notably, an exception is when the arts activity is stress-inducing, as in the case of professional artists like musicians and actors, where increases in cortisol levels can be found if performers perceive the performance to be stressful (although if they do not, then cortisol reductions are still found).[99,100] This evidence all indicates that arts engagement may work through the hypothalamic-pituitary-adrenal axis to promote adaptive allostasis (systemic regulatory adaptation to environmental demands).

With regular arts engagement, there is strong evidence of sustained and cumulative psychological reductions in both arousal and stress. Individuals who engage regularly in arts activities over multiple weeks can experience progressive lowering of sympathetic markers such as blood pressure and pulse rate, especially if individuals showed dysregulation of these markers in the first place.[101,102] Broader epidemiological explorations of people's arts engagement over the course of a year have additionally found lower blood pressure and pulse rate in people who are more engaged, net of socio-demographic, behavioural and health-related confounders.[103] With regards to stress, over several weeks of arts interventions, individuals typically report reductions in psychological stress, and there is preliminary evidence to suggest that cortisol reductions may become more pronounced over several weeks and diurnal patterns of cortisol may potentially improve, indicating more sustained neuroendocrine stress reductions.[97,104,105] All of these psychophysiological stress-related processes are relevant to mental health given dysregulation of autonomic nervous system and endocrine system activity appear bidirectionally related to anxiety and depression.

Molecular regulation

In addition to changes in neuroendocrine markers, molecular biology research has identified further biological pathways that provide mechanistic underpinning to the relationship between arts engagement and mental health. Preliminary studies of arts interventions such as drumming, dance and music therapy lasting just a few weeks have demonstrated downregulation of neuroinflammatory pathways, including cytokines (chemical messengers coordinating immune response and inflammation) like interleukin 6 (IL-6), interferon gamma (IFN-ɣ), tumour necrosis factor alpha (TNF-α) and monocyte chemoattractant protein-1 (MCP-1) and broader proteins such as C-reactive protein (CRP; a non-specific marker of inflammation) as well as increases in anti-inflammatory biomarkers like immunoglobulin G (IgG; an antibody involved in long-term immunity).[97,106,107] Some of these changes have occurred alongside improvements in heart-rate variability and reductions in adrenaline and cortisol, suggesting these neuro-immunological changes may be related to changes in arousal and stress-related psychophysiological pathways. Such intervention studies remain small in scale, but both cross-sectional and longitudinal cohort data corroborate a relationship between more frequent arts engagement in day-to-day life and lower inflammatory markers.[103,108,109] These epidemiological studies expand the scope of inflammatory markers to include other proteins such as fibrinogen, white blood cells, and markers involved in the regulation of inflammation such as insulin-like growth factor 1 (IGF-1), indicating that the arts may influence a broad network of pathways related to inflammation. Inflammation is bidirectionally related to mental health, with short-term increases in inflammatory markers related to increases in negative emotions, and longer-term higher levels of inflammatory markers found in individuals with depression.[110–112] Levels of certain specific markers such as high CRP, high leukocytes (white blood cells) and low IgG are also associated with future psychiatric disorders, even multiple years

later.[113] As such, even early findings of variation in biomarkers of inflammation highlight a potentially important mechanistic pathway in the relationship between arts and mental health.

In addition to studies on specific biomarkers, the first studies are now emerging suggesting that arts engagement can affect more deep-seated biological processes such as gene expression. Preliminary RNA (ribonucleic acid) studies focusing on music listening and music making in people with musical training or aptitude have suggested that both activities upregulate the gene synuclein alpha (SNCA), which is involved in dopamine regulation and neuroprotection, as well as other genes also involved in processes that relate to mechanisms discussed above such as synaptic function, cognitive functions such as learning and memory, and neurogenesis.[114,115] Some of the upstream regulators of these genes comprise other biomarkers demonstrated in other studies to be affected by the arts, including IGF-1, TNF-α, IFN-ɣ and cytokines involved in glucocorticoid regulation. Even in individuals without prior musical training or aptitude, further pilot RNA research has suggested that music engagement following acute stress leads to more effective reversal of genomic stress induction signatures than comparison activities such as reading newspapers.[116] These findings are at a very early stage of investigation, and would require substantial further work to be established, but it is possible that they underpin and reinforce findings from neuroendocrine studies on arts and stress reduction.

Social connections

Engagement with the arts – even passively viewing artworks – engages the social brain connectome, recruiting brain networks that are involved in complex social behaviours (as well as serving other purposes). [117] When arts engagement takes place with others, it additionally provides important opportunities for people to come together and bond socially, with arts activities leading to faster development of emotional closeness than non-arts counterparts.[33,95] The presence of this effect between mothers and babies as well as between members of social groups has been used to argue for complementary evolutionary roles for the arts in ritualised mother-infant interactions and the development and sustaining of social networks.[33,118] This effect is enhanced through mechanisms previously discussed above, such as entrainment, which supports socio-emotional connections such as emotional sharing, empathy and group bonding.[78] In group arts activities, it has been hypothesised that social bonding effects are facilitated through physical mirroring (e.g. gestural mimicry in communication or dance) and engagement of mirror neurons.[119] Arts engagement – especially when involving behavioural synchrony- also promotes prosocial cooperation, acting in a positive feedback loop with greater prosociality in turn encouraging further arts engagement.[120,121] Over time, arts engagement can also reduce loneliness and enhance social connections.[62,122–124] All of these social behaviours are critical to mental health outcomes, either through providing social support or buffering the risk of experiencing detrimental deficits in social connections such as social isolation.

Artforms that involve narrative (such as books, films, storytelling and theatre) can activate additional mechanisms that support social connections. When stories are communicated, audiences can experience neural coupling, both in linguistic regions of the brain (e.g. early auditory areas, Wernicke's area, and Broca's area) and extralinguistic areas known to be involved in the processing of semantic and social aspects of the story (e.g. the precuneus, dorsolateral prefrontal cortex, orbitofrontal cortex, striatum, and medial prefrontal cortex).[125] This coupling can support successful communication, enhancing opportunities for social connections with other individuals within a group such as the person telling a story. But it also facilitates a relationship with fictional characters, such as those being acted out within the story; a phenomenon known as parasocial interaction.[126] Despite the fictional counterpart in a parasocial interaction, the interaction can still support mental health and wellbeing – providing it is perceived as pleasant and stable- by fulfilling a need to belong.[126] Specifically, parasocial interactions can provide opportunities for 'social snacking' (reminding a person they are connected and accepted) and 'social shielding' (acting as a buffer against feelings of social exclusion).[127,128] According to social learning theory, narratives communicated through the arts can also provide concrete tools for mental health, such as providing demonstrations of behaviours or dialogue that can be observed and then imitated or modelled in the audience.[129] Nonetheless, this mechanism is only activated beneficially in some circumstances. "Werther effects"- whereby an arts exposure leads to a health-damaging behaviour-have been reported from people consuming arts where themes of mental health and suicidality have not been appropriately and sensitively approached in narrative.[130–132]

Self-awareness and identity

In addition to impacting our interaction with others (real or imaginary), arts engagement also supports self-awareness. Arts engagement can provide a locus for minds to focus on, helping to reduce excessive self-focus (common in many mental disorders) by redirecting attention to the arts activity at hand. This effect can be akin to mindfulness. Indeed, engaging in art activates the executive control network, salience network and default mode network in a pattern similar to that activated during mindfulness, especially when one is emotionally moved by arts experiences.[133,134] Arts engagement also encourages reflective consideration about a person's way of thinking and own cognitive processes; known as our 'metacognition'.[135] Interrogating why oneself is feeling a certain way – even about something as specific as liking a piece of art – builds self-awareness, a skill that seems to be transferrable to other domains of life.[136]

Additionally, engagement with different types of arts activities allows the exploration of different self-identities and self-categorisations in relation to different social groups.[137] For people with mental illness, this navigation of the personal and social self can provide alternative self-categorisations to being a 'patient' (e.g. being 'an artist'), supporting the construction of positive identity and acceptance.[138,139] In line with social identity theory, this effect is enhanced if individuals feel that an arts-based identity (e.g. as a singer, art-maker or theatre-goer) is significant and meaningful to them.[140] This can be both protective preventatively and supportive therapeutically for mental health, with identities built through arts-based activities helping to challenge stigmatising and isolating identities, reaffirm and rebuild personal identities in the face of traumas (including supporting narrative reconstruction), and buffer against future mental illness.[141,142] However, the formation of an identity around an arts group can also be damaging if that group brings with it exposure to stigma, dysfunctional group dynamics, social marginalisation, or harmful behaviours such as substance abuse.

Behavioural regulation

Arts engagement also provides diverse opportunities for strengthening behavioural processes that support mental health. Increased self-efficacy, agency and self-determination have been reported as a result of engaging in the arts, and are all related to anxiety and depression, often as processes that can buffer the effects of stressors.[143] These effects have frequently been reported alongside improvements in other psychological processes such as increased positive self-identity, confidence, social relatedness, and fulfilment of psychological needs such as mastery and autonomy, suggesting interconnected processes.[143] An important ingredient in the achievement of these effects appears to be novelty, with studies particularly reporting these outcomes when arts engagement provides opportunities for novel situational exposures.[143] Self-efficacy, agency and self-determination underpin many core behaviours, including healthy habits such as diet, exercise and avoiding substance use as well as broader behaviours such as engagement in productive employment. As a result, it appears likely that increasing engagement in the arts can also help individuals to strengthen the behavioural mechanisms that support broader life decisions and behaviours that are conducive to good mental health and wellbeing. Indeed, some studies suggest that engaging in the arts leads to increases in other health-promoting behaviours (known as "behavioural spillover"),[144] with both cross-sectional and longitudinal associations between arts engagement and broader health behaviours demonstrated in epidemiological studies, even when accounting for likely confounding factors.[145,146]

Relatedly, arts engagement may also support behavioural processes that reduce the risk of behaviours that are detrimental to mental health. Creative evaluation of art provides opportunities for recruiting a unique configuration of neural processes that are not typically used together during traditional problem-solving tasks, such as the executive and default network regions.[147,148] This co-activation of typically anticorrelated networks appears particularly pronounced in creative cognition.[147,148] Indeed, the most aesthetically moving artworks uniquely engage the default mode network (DMN) and particularly the anterior medial prefrontal cortex, which typically shows suppression during external tasks.[133] This suggests that intense aesthetic experiences facilitate a neural state where external sensory and semantic processing (as supported by the executive control network and sensory regions) becomes integrated with internal self-referential and evaluative processing (as supported by the DMN). Such integration may be an important neural substrate of the arts' capacity to serve as powerful tools for self-reflection and personal meaning-making, as they enable observers to simultaneously process external artistic features while relating them to personal memories, emotions, and values. As a

result, creative evaluation of art may allow for the combination and integration of both cognitive and affective as well as deliberate and spontaneous forms of evaluative thought.[149,150]

In addition, creative evaluation of art and also creative production of art (particularly narrative art) appear to build the "moral imagination", helping people conceptualise which behaviours are good and right, imagine different possible scenarios and actions, make ethical decisions, and adapt behaviours in challenging situations, reducing subsequent behavioural adjustment issues.[151,152] Narrative art in particular has been shown to support individuals in understanding the perspectives of others, enhancing "theory of mind" and leading to reductions in egocentrism.[153–155] Indeed, according to the predictive coding model, the freedom for cognitive play engendered by arts engagement is a critical counterpoint to day-to-day routine, refining the predictive machinery of the brain to respond to a wider array of social situations and scenarios. As such, arts engagement is theorised not just as a frivolous escapism but an opportunity for serious collective experimentation with alternative models in a liminal space that hones our brain's capacity to predict and adapt to events in our lives, including ones that might ordinarily lead to behaviours that are maladaptive to our mental health.[37] In support of this, arts engagement is associated with improved control of inhibitions and self-control of one's own behaviours; mechanisms in themselves related to longer-term effects relevant to mental health, such as reduced antisocial behaviours.[156,157]

Integrated map of mechanisms

Our review of the literature took a transdiagnostic approach, considering mechanisms that are relevant to diverse mental health outcomes, which are now summarised in Figure 2.

Figure 2: Integrated map of mechanisms

Our review took the theoretical approach of considering the causal mechanisms that could link active ingredients in arts activities to the outcomes of reduced mental health symptoms. However, an important limitation currently is that there are comparatively few studies that consider explicitly whether these mechanisms causally link to the mental health outcomes reported in the meta-analyses of randomised trials of arts engagement. Studies focused on mechanisms and outcomes remain largely separated. As a result, in this paper we have discussed the strength of causality from arts to the mechanisms explored, but causal arguments linking these mechanisms to mental health outcomes largely rely on non-arts studies that have identified the relationship between these mechanistic processes and psychiatric symptomatology. This presents a clear research gap that should be prioritised in future research. Additionally, the 48 mechanisms described were identified and selected by the authors based on their expert clinical and scientific judgment of relevance to mental health outcomes and alignment with current theoretical conceptualisations. Our analysis substantially drew on interdisciplinary literature across psychology, neuroscience, psychobiology, and the social sciences, but in such a vast and diverse range of fields different experts might prioritise different mechanisms or organize them differently. Nonetheless, our review paves the way for future systematic reviews employing more structured methodologies to validate and potentially expand upon specific mechanisms identified here.

Nonetheless, the collective learnings from this review enable some advances in overall thinking on the causal relationship between arts and mental health. First, from a theoretical perspective, there has been a call for health researchers to move beyond focusing on single individual specific theories to explain complex effects and towards incorporating a broad range of potential theoretical perspectives within research on complex interventions.[165] Previous work on mechanisms linking arts to health has used the lens of complex adaptive systems science; an approach that acknowledges both the complexity of multi-modal interventions such as arts and of the real world and has been widely applied by ecological, eco-social and social-ecological theorists.[166] Our review of the literature echoes this theoretical approach, demonstrating that there is no single mechanism that predominates as a plausible causal process linking arts to mental health outcomes, and instead a diverse network of networks operating across psychological, neurological, biological and social processes. But it also extends this thinking. As has been discussed in this review, some of the mechanisms outlined are dependent on other mechanisms combining in order to achieve complex outcomes. For example, self-determination is a "hybrid" mechanism in that it emerges from the combined activation of individual

mechanisms of autonomy, relatedness and competence.[167] And the induction of positive emotions involves underlying physiological processes such as dopamine release and activation of reward networks. Other mechanisms are recursive, reinforcing one another via feedback loops, or self-reinforcing. For example, a reduction in sympathetic nervous system activity improves behavioural synchrony, which in turn has stress-reducing effects including further dampening of sympathetic nervous system (a feedback loop), while the development of new self-identities as a result of arts engagement can encourage further engagement with the arts (an example of self-reinforcement) [21,166]. Together, this integrated picture of mechanisms highlights that the mental health impact of arts engagement cannot be understood in terms of isolated mechanisms or even as the sum of the individual mechanisms, so the causal contribution of any individual mechanism should not be overstated.[166] Instead, all mechanistic research into the effects of arts engagement needs to consider the interconnectivity of such mechanisms if we are truly to appreciate how they act in synergy to influence mental health outcomes.

A second advance on thinking relates to how these mechanisms are activated by the specific active ingredients present in different arts activities. This review was led by evidence from clinical trials on the psychological benefits of arts engagement for people with mental illness. The arts interventions within those trials have typically focused on regular engagement in a specific arts activity over the course of several weeks or months as a form of time-limited intervention. However, arts engagement in people's daily lives is part of a broader pattern of transient creative activities that can include combinations of both deliberate and inadvertent arts exposure; brief and extended periods of engagement within a single day and across the life-course; and different types of arts activities encompassing different ingredients. As this review highlighted, the mechanisms activated can be very sensitive to the specifics of ingredients (e.g. whether an arts activity is arousing or relaxing, or communicates positive or negative emotions). As a result, it is artificial to consider that an individual's engagement in a specific arts intervention is going to activate mechanisms in isolation from other arts experiences ongoing in their lives. In other words, if an individual engages in a calming art class painting pictures of flowers once a week, but spends time outside of the group watching highly arousing horror films, both are going to activate mechanisms that could causally influence mental health outcomes. An alternative way of thinking that we put forward here is to conceptualise arts engagement as a form of "exposome". The term "exposome" refers to the totality of exposures to a given factor. As a concept, it allows us to move beyond thinking about arts engagement as an 'intervention' that is distinct and separate from the rest of a person's life, and instead to consider all the types of arts engagement that people may be exposed to day-to-day and how the patterns of exposure could collectively activate mechanisms that lead to mental health outcomes. Using this theoretical approach, the ingredients in the art class and horror films might activate their own specific mechanisms, but the strength of these mechanisms might vary depending on the intensity and frequency of the exposure, and it would be the combination of these mechanisms that would elicit overall effects on mental health symptoms like depression and anxiety.

Putting these two advances together, Figure 3 presents a first illustration of an updated theoretical model for understanding the arts and mental health outcomes that builds on our initial illustration presented in Figure 1. As Figure 3 demonstrates, arts engagement is often categorised in definitions of the arts as distinct "artforms".[4] But engagement in these different artforms can in fact lead to common exposure to particular active ingredients that transcend these artform categorisations. For example, theatre and dance are considered different arts experiences, but both contain common ingredients such as physical movement (represented in a hypothetical "Ing 1") while theatre and literature both contain storytelling (represented in hypothetical "Ing 2"). Our exposure to such ingredients can be considered as being situated on a plane, with axes representing our frequency of exposure to the ingredient (represented on the X axis) and the degree of attentional focus that we give the ingredient (represented on the Y axis). As such, some ingredients we may only receive infrequently and with marginal levels of attention (e.g. the ingredient of cognitive stimulation elicited by singing Happy Birthday in tune on a special occasion), while others we may be consciously aware of receiving frequently (such as the ingredient of tactile stimulation that we may receive by engaging every day in clay pottery making). Combinations of these ingredients in turn lead to the activation of different mechanisms. For example, the combination of the ingredients "cognitive stimulation", "challenge", and "frequent dose" could activate the mechanism of mastery. Overall, this new model provides a means for articulating how arts exposures as part of day-to-day life could have (mental) health benefits even outside of formal arts interventions such as arts therapy sessions. It

also demonstrates that even when individuals participate in specific interventions, this does not present the entirety of their arts exposure. Arts experiences outside of formal interventions are likely moderators of the mechanisms activated by those formal interventions as the externally-experienced ingredients will interact with the intervention ingredients, affecting how specific mechanisms are activated. As such, the design of trials incorporating arts interventions ideally needs to consider wider arts behaviours within analyses.

Figure 3: Illustrative arts exposome and conceptual model for its influence on active ingredients exposure and mechanisms of action activation

Finally, although the mechanisms in this review are discussed in abstract from individual and contextual modifying factors, these wider environments are critical to acknowledge.[165] Both arts engagement and mental health are determined at multiple levels and are affected by historical, political, economic, temporal and spatial factors.[168,169] For example, if an individual is referred to an arts therapy intervention or prescribed an arts activity, this provides different therapeutic ingredients to self-initiated engagement that could lead to differences in activation of mechanisms such as agency, attentional focus and meaning attribution. So, it is important to acknowledge that the specific mechanisms activated and the ways they relate to mental health outcomes are individual and context dependent.

Summary and future directions

Literature on the mental health impact of arts engagement points towards a combination of potential causal mechanistic processes underlying effects. This Review has summarised the core mechanisms of action activated by engagement in the arts that could explain the relationship between arts and mental health. Our review was led by considerations of literature demonstrating improvements in mental health in people with psychopathological symptoms, although this included sub-clinical symptoms as well as diagnosed disorders. We specifically focused on mechanisms likely activated by general arts engagement; in other words engagement that can take place as part of everyday leisure, but can also form components of health-focused arts programmes such as arts-on-prescription and creative arts therapies. However, we highlight that the more health-focused activities likely bring other therapeutic mechanisms not reviewed here.

Overall, we took a transdiagnostic approach, selecting the mechanisms that have potential therapeutic benefits for a range of diagnosed mental disorders. This approach is timely given that the biopsychosocial processes underlying mental health problems are transdiagnostic, there is substantial heterogeneity within specific diagnoses and discrimination between supposedly different disorders is often weak, and patients commonly experience phenotypic plasticity in symptoms over time or symptoms of multiple disorders or comorbidities that have common mechanistic roots.[22] As a result, there have been increasing calls for taking more transdiagnostic approaches in researching the effects of therapeutic interventions within mental health, which it is appropriate to follow in this consideration of the arts.[158–163] Notably, we show that arts engagement activates mechanisms that are relevant to diverse transdiagnostic processes that underlie many mental health conditions, including emotional reasoning, attentional deficits, recurrent negative thinking, and avoidance behaviours.[164] However, we argue that one of the unique and important features of the arts is that they also activate mechanisms beyond those involved in psychological therapies, providing more holistic support to individuals and underlining the need for continued research into this important human behaviour.

Specifically, we recommend that future research should focus on understanding causal equivalence between arts and other transdiagnostic mental health treatments. In particular, it will be key to directly compare arts interventions to transdiagnostic psychological therapy interventions in non-inferiority trials to quantify whether the arts are as effective at supporting outcomes, particularly for populations where access to psychological therapies may be restricted. There is also a strong value to investigating the potential additive effects of the arts in combination with psychological therapies to identify whether co-prescribing both approaches could lead to stronger outcomes and reduced remittance. Some such comparative research is underway,[172,173] but in-depth consideration of these questions will be crucial to guiding future research. Alongside this research, it is also important to move from transdiagnostic to more specific diagnostic

considerations. Future research should prioritise identifying whether adding additional ingredients to arts activities in the form of modular extensions can activate additional diagnosis-specific mechanisms. For example, the incorporation of performances or exhibitions within a person's engagement with a community arts group could be used as a modular extension to activate the mechanism of social exposure to provide more targeted symptom support for people with social anxiety disorder.

Focusing on the mechanisms specifically, it is important to explore more directly the synergies and differences between the mechanisms that arts engagement activate vs those activated by other therapeutic interventions. In transdiagnostic psychological intervention research, it is broadly recognised that remittance of mental health symptoms is achieved through combinations of spontaneous remittance, response to common therapeutic mechanisms, response to core CBT mechanisms, and response to diagnosis-specific mechanisms.[22] Applying this approach by extension to the arts, we can hypothesise that the effects reported within trials are the result of a combination of these factors too. Multi-arm randomised trials incorporating comparison interventions may provide clarity that while some mental health improvements are a result of spontaneous remittance, the activation of mechanisms both common to psychological therapies and more specific to arts activities is important to achieving clinical outcomes (see Box 2 for an example). Indeed, trials involving active comparators have become common in creative arts therapies research for other outcomes (e.g. neurological disorders), providing precedence and effective models that can be applied to broader arts interventions within mental health. However, it is key that all such work is designed to be appropriate for dynamic systems, ideally incorporating hybrid effectiveness-implementation approaches that allow for consideration of broader dynamic features of the delivery of arts programmes and the wider environment. [170,171]

Box 2: A case study of a series of trials identifying common and specific mechanisms activated by singing programmes for women with postnatal depression

Importantly, this review has considered the mechanisms that can be activated by the arts that are likely relevant to mental health outcomes. The mechanisms in the review also have a relevance to people with no symptoms and high levels of flourishing, as they present likely causal processes that are important to the maintenance of good mental health and wellbeing and prevention of mental illness. But it does not necessarily follow that all arts engagement does lead to these mechanisms being activated, nor the ensuing beneficial outcomes for mental health. Any behaviour capable of affecting as many distinct neuro-psychological, bio-physiological and socio-behavioural processes as the arts can is also capable of adverse influence. For everyday engagement in the arts, this risk is ever present, as we outlined in examples above. We might assume that more clinically focused arts-engagement might be more immune to these potential adverse effects as greater consideration is typically given to the ingredients individuals are exposed to. But in these instances, the quality of delivery of arts interventions becomes paramount. Variation in the active ingredients of a facilitator's experience and style and the intervention design could lead to core therapeutic mechanisms not being activated, or even the mis-specification of elements with resultant therapeutic harm.[3] This is particularly a concern for arts programmes delivered by artists who may not be trained in how to work with clinical populations, as is common in arts-on-prescription programmes. Consequently, future research is encouraged that considers in more detail the specific ingredients that provide good quality arts interventions and the ingredients most likely to cause harm if they are mis-specified within arts experiences. We additionally recommend that researchers track the specific mechanistic pathways activated by these iatrogenic ingredients so that we have a more comprehensive understanding of which causal processes can lead to mental health harm as a result of arts engagement and how these effects can be minimised. Such work can follow research models being used for testing potential iatrogenic effects of school-based mental health interventions.

Finally, this Review puts forward new ideas around conceptualising individual arts experiences as part of a broader "arts exposome", highlighting the importance of both specific arts interventions for mental health, but also day-to-day exposure to arts as part of everyday life. Future research is encouraged that expands on this initial exposome model to enable us to move beyond a focus on time-limited arts interventions within studies to consider how the entire arts exposome affects mental health over time. Additionally, it is important to note that recent frameworks for considering the exposome, the psycho-exposome or the socio-exposome fail to acknowledge arts as an important exposure, or acknowledge the complexity of exposure it presents.[174] So research is also recommended that considers how arts

engagement sits alongside and interacts with other factors within the entire exposome so as to provide a deeper understanding of the size and extent of its impact on mental health.

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Conflicts of interest

All authors declare no financial or non-financial conflicts of interest.

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