Testing hypotheses about the harm that capitalism causes to the mind and brain: a theoretical framework for neuroscience research

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Author contribution statement

D.S.K., A.H., B.P., & M.M conceived of the presented idea. D.S.K., I.S., V.G.F., A.H., B.P., L.D. & M.M developed the theoretical framework. D.S.K., I.S., V.G.F., A.H., & M.M performed the literature reviews. W.E-D, L.D. & M.M provided guidance and supervision. All authors discussed the results and contributed to the final manuscript.

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Abstract

This article reviews and discusses the part of neuroscience relevant to mental health within the contemporary capitalist context, and suggests ways in which the effects of this context on the nervous system can be reconceptualised and researched in the future. Firstly, the principal components of neoliberal capitalism are presented together with how it has historically influenced neuroscience. We then argue in favour of a neurodiversity perspective, as opposed to the dominant model of conceptualising neural (mal-)functioning, brain plasticity and potential for change and adaptation. We review the available empirical research indicating that the socio-economic environment is harmful to minds and brains. Lastly, we set out a theoretical framework that can generate neuroscientific hypotheses with regards to the effects of the capitalist context on brains and minds, as well as a frame for post-capitalist research.

Introduction

In this paper, we will argue that neuroscience can illuminate the effects of neoliberal capitalism on the brains and minds of the population living under such socio-economic systems. We outline how neuroscience research can assume a critical perspective on key features of current politics and morality. We will review and attempt to reconceptualise how the capitalist socio-economic environment and the behaviours that it demands for people to thrive, or for mere survival, put mind and brain at risk.

Underprivileged and marginalised² groups exist within all major capitalist-based societies, and risks to their mental health have been documented, but there is a large gap in neuroscience research with regards to conceptualising and testing the mechanisms likely to operate. To illustrate, millions of US citizens have very poor access to mental health provision (Agency for Healthcare Research and Quality, 2015). In the UK, Mental health suffered greatly under the austerity policies from 2008 onwards, with people living in poverty being affected more (Cummins, 2018). Another example is offered by Greece, whose debt crisis and failure as a capitalist economy, jointly with the subsequent rescue of its market by the International Monetary Fund, European Central Bank and the European Union (IMF, ECB and EU), led to a mental health crisis (Karanikolos et al., 2013; Parmar et al., 2016).

Such findings are well known, but to bridge the gap with neuroscience research, specific hypotheses are necessary both regarding risk factors immediate to the

² The terms “underprivileged”, “marginalised”, “priced-out”, “oppressed” and others are used in the text to describe in broad terms the groups most affected by inequality. It is important to acknowledge that this sometimes refers to minorities and sometimes it refers to the large majority of people who face economic inequalities and barriers.

individual, and, more importantly, regarding generative processes central to capitalism that produce such risk factors. Table 1 outlines the main effects/risk factors and generative processes.

[Table 1 here]

Effect	Generative process
Deprivation effects	
Material	Resulting from the marketization of basic needs or rights into profitable commodities, such as access to clean water, shelter, education, and healthcare. Lacking access to such needs can directly impact mental health but can also have an indirect impact via increased stress and reduce the overall quality of life.
Psychological	Deprivation over basic psychological needs will also exert detrimental effects on mental health. Include a lack of autonomy over one's time (e.g., via reduction of salaries and overworking), lack of job security and exposure to demeaning working conditions (e.g., deprivation of human dignity).
Isolation effects	
Workplace relations	Resulting from the enforcement of individual competition, instead of cooperation, as the means for ordinary individuals to survive and advance. This pervades how work relations are structured, as well as the general relations within the society.
Community relations	These include mental health effects arising from the destruction of communities, of physical, virtual and symbolic communal space and the degradation of collective groups (e.g., Unions). This also the resulting from the physical displacement of the workforce (i.e., internal and international migration) and insecure working conditions (e.g., gig economy).

Table 1 Deprivation and Isolation effects of capitalism

Neuroscience (research) historically situated

Ever since the brain was suggested to be the seat of thoughts, emotions and behaviours, cultures have used their own paradigmatic metaphors to describe its functioning, appealing to values, scientific and technological discourse of their time. From the automatons of the 17th century to the time of the train network and the electric circuit that lead to the Hodgkin and Huxley Nobel prize, and from the computer metaphor to machine learning, conceptualisations of the brain have always been heavily affected by and constructed within the socio-cultural context of their time. Therefore, it is not surprising that the capitalist way of thinking has permeated the modern fields of neuroscience.

Capitalism is defined as a socio-political system in which trade and industry are controlled by private owners for profit (Simpson & Weiner, 1989). More relevant to our times, Neoliberalism refers to the policies of economic laissez-faire and market deregulation. These include privatisation, globalised free trade, and in general the compression of the role played by any collective or social entity (e.g., Governments, Unions, etc.), either as resource allocator or as a regulator of common interests. This favours supposedly optimal self-organising, private actors, be they workers, multinational corporations or anything in between. The neoliberal economic paradigm, jointly with the theoretical framework that justifies its policies since the 1970s (Springer et al., 2016), affects almost every aspect of 21st century life, with important ramifications for the psychology of people living within its parameters.

For the past few decades, healthy brains were often considered to be individualist and selfish computational machines, which process information in order to maximize personal utility via decision-making. That is, when faced with a decision, the decision-maker will make a cost-gain analysis and will decide based on self-interest

(Osborne, 2003). This perspective both fits with and feeds into the postulated mechanisms controlling the interactions among agents and environment, as assumed in neoclassical economics and Rational Choice Theory as it was described by the “Chicago School of Economics” (Becker, 1976; Weintraub, 1993). In several countries, this view dominated, and turned theories of social, cognitive, behavioural, and neuroscientific research seeking to describe phenomena into prescriptions of how people should attain well-being through selfishly rational decision-making. More recently these decisions are assumed to be characterised by bounded (i.e., limited) rationality (e.g., Dayan, 2012; Gershman et al., 2015; Neumann & Morgenstern, 2007).

Here, we review existing evidence that capitalism entails risk factors harming the brain and mind, we discuss existing approaches to understand these risks, and we present an orienting model giving rise to new hypotheses that can be tested through neuroscientific research. In particular, we advocate the neuroscientific metaphor of the human brain as the builder of models of self and others (Chater et al., 2006; Otten et al., 2017). Brains as neurodiverse constructors of generative models seek to model how human relations are generated, “who I need to be and who I can be in my community”. Building on second-person neuroscience (Schilbach et al., 2013), we claim that this self-and-others approach can direct more ecologically valid and humane research than the selfish rationality approach.

Asking whether capitalist socioeconomic conditions are detrimental to mental health immediately raises controversial questions regarding what we mean by “*mental health*”. Here, it is very important to acknowledge the insidious power of language and implied *meanings* to steer towards some answers but not others, and therefore we aim to make our own standpoint explicit, rather than prescribe universally optimal

meanings. We thus adopt a methodologically pluralist approach (Wildemuth, 1993), requiring a dynamic balance between the necessity for claims to be submitted to empirical testing and the necessity to critique the limitations of quantitative approaches.

Neuroscience, psychopathology and mental health

In much of public discourse, neuroscience bolsters medicalisation of human suffering and dissemination of singular biological explanations for complex psychosocial problems. Neuroscience thus comes to collide (and collude) with systematic and systemic³ psychiatric practice, which in theory recognises the importance of biopsychosocial understanding, but in practice is often reduced to biomedical management (Bentall, 2009). Such management is fuelled by the psychiatric drug market, which over-promotes psychiatric diagnoses, incentivises doctors to overprescribe (Duncan & Marsh, 2021), and has biased their knowledge through academic practices (Matheson, 2016). Two assumptions have resulted, which we challenge in order to reclaim a more accurate and helpful neuroscience. The first is that neuroscientific research deterministically creates and solidifies the stigmatising discourse around the brain, e.g., mental health difficulties arise from brain defects that people cannot recover from without biomedical intervention. And, secondly, that the investigation of the biological underpinnings of behaviour discounts rather than informs the rich relational and experiential foundations of mental health.

³ Systematic because it is widespread and defined by policies, guidelines and standard procedures and systemic because it doesn't necessarily reflect individual psychiatrists'/mental health workers' views

Psychopathology versus neurodiversity

According to Amartya Sen and Martha Nussbaum (Nussbaum & Sen, 1993), human minds afford a diverse spectrum of capacities. Capacities provide for the “beings” and “doings” that people can achieve when given the *real freedom*, namely the necessary means to pursue their goals. However, neuroscience, psychiatry, and psychology are currently dominated by a restrictive discourse of “maladaptation” and “functioning” as an organising principle to discuss “mental health”, underpinned by the neoliberal-capitalist stigmatisation of reliance on public services as unhealthy (Banerjee et al., 2017). The imperative to “function independently”, with limited support from one’s community and the welfare state, has infiltrated mental health services, clinical practice and mental health research (Ramon, 2008; Sugarman, 2015, 2019). This pathologises and stigmatises those deemed financially dependent, with dire consequences for their mental health.

Hence, we privilege the linguistic and conceptual framework of thinking about psychological wellbeing and its bio-psycho-social determinants that has been pioneered by the neurodiversity movement (Craine, 2020; Kapp, 2020b; Kirmayer et al., 2015). On the one hand, a notion of “neurodiversity” has broad appeal, if simply defined as the infinite variety of brain structure and function found among people. On the other hand, the neurodiversity movement asserts that those who diverge from the statistical norm along specific dimensions such as “autism” or “schizotypy” do not need to have their mind cured or made adaptive, but have a legitimate claim to a fulfilling life as they are (Craine, 2020; Kapp, 2020; Kirmayer et al., 2015).

Additionally, to the core insights offered by the neurodiversity movement, the process of legitimising psychiatric diagnoses through appeals to their neural basis is problematic, in view of the robust empirical evidence that their validity is poor

(Cuthbert & Insel, 2013; Insel et al., 2010; Peng et al., 2021). Happily, the current nosological construct of e.g., *schizophrenia* is not a pre-requisite in order to assert divergence along a dimension of schizotypy, or “schizophrenia spectrum” (Hoffman et al., 2007; Villeneuve et al., 2010). We thus follow the lead of the neurodiversity movement to claim that mental well-being should be defined by individuals embedded in their communities, whether or not they identify in terms of diagnosis-based spectra. The basis of current diagnostic criteria is the level of impairment (or “age-appropriate functioning”) in several areas of life (e.g., social, professional, family etc). In practice, this closely links diagnosis to the neoliberal imperative of financial independence. In contrast, in our neurodiversity framework, people who hear voices and are ‘economically unproductive’, may be perfectly healthy. This claim stands in contrast to mental well-being expected on the basis of orthodox criteria, especially the economically defined rational, self-interested, and efficient market agent. In other words, we reclaim and politicise mental health as ‘recovery’ (Davidson, 2016) or ‘to love and to work’ (McCabe & Daly, 2018) These are aspired to by many mental health professionals, but have been dwarfed by capitalist institutions. We hypothesise that definitions of mental well-being reclaimed by individuals embedded in their communities can show how the capitalist norm imposed by the everyday discipline of the market harms the neurodiverse and neurodivergent (Craine, 2020; Morioka et al., 2019).

The human brain’s potential for growth and healing

Within the important constraints dictated by its neurodiversity, the individual brain is plastic, capable of sculpting itself in interaction with its environment. It is an inferential, roughly Bayesian brain, which builds models of the self-in-the-environment, thereby anticipating the consequences of observations and of actions.

Such anticipation is closely guided by the engrams of powerful experiences⁴ (Okuyama, 2018). Harmful engrams are inscribed by “toxic” environments - be it family, educational setting, work, a virtual community on social media or general societal factors like gender or race (Zadow et al., 2021; Ziegler et al., 2020). What is also true is that the brain can adjust to an improved, safer, caring environment whether it is due to lower levels of stress or through learning and enhanced problem-solving skills, through a different self-representation etc. (Leventhal & Brooks-Gunn, 2003; Linden, 2006; Osypuk et al., 2012).

According to Malabou (2009), the concept of plasticity is central in thinking about the brain and the “self”: “plasticity allows us to combine the thought of a sculpture of the self with that of transdifferentiation”, namely of a multidirectional process of both solidity (but not rigidity), suppleness (but not deformation), change and difference referring to the neural level, the “self”, and the social level.

This multidirectional process may operate for the better or the worse to shape the self and its brain. Ian Hacking (1999), for example, hypothesised that a diagnosis—such as that of depression may interact directly with the biology related to the condition diagnosed through the changes of behaviour that it can instigate (Slaby, 2010). On the other hand, empirical evidence indicates that psychotherapy, including mindfulness practice, changes the brain (Allen et al., 2012; Lane et al., 2015; Linden, 2006). There is a need to further understand how much of this change takes place in the therapy itself, and how much through bidirectional changes between patients and their environments, that allow them to receive support i.e., through reconstructing the

⁴ Engrams may result from recent or developmental personal experiences, but also from historical experience engraved in genes or cultural memes. This provides a lens through which to consider neurodiversity as sets of expectations both about both ‘how things are’ and ‘what is needed’.

meaning of past experiences and/or through improving their environments by managing stress.

Harmful influences to mind and brain in capitalism

Harm to mind

One of the key detrimental influences of capitalism on mental health is the production of inequality. For example, in the 30 years following 1977, 60% of the increase in US national income went to just the top 1% of earners; this is projected to become even more extreme without tax adjustment (Piketty, 2015). Piketty argues that inequality is not an accident but an intrinsic feature of capitalism (Piketty, 2013), while free-market economists argue that substantial inequality is good for the economy (Hasanov & Izraeli, 2011) and advocates of capitalism promote inequality as a great good (Tamny, J., 2016). Thus, it seems likely that capitalist policy-making creates inequality.

Yet the link between inequality (largely economic inequality, but also ethnic, gender and intersectional inequality) and mental health is indisputable; there is a lively debate on how to explain the association between inequality and poor mental health e.g., Burns (2015), Murali & Oyeboode (2004), Pickett et al. (2010, 2015), gender inequality - Yu (2018) and others. Layte (2012) explored various hypotheses about how income inequality may result in poorer mental health which provided some evidence about the role of social rank and anxiety as well as social capital and the resulting interpersonal and institutional trust and capacity to cooperate.

Many researchers remark that there is an alarming lack of in-depth and methodologically sound research into the complex effects of capitalism on the least well-off (Burns, 2015; Piketty, 2015). The effects of poverty are often studied in the

context of low socioeconomic status and neighbour effects (cf. Sharkey & Faber, 2014). Such studies have provided evidence that socioeconomic disadvantage is associated with higher prevalence of psychological distress, measured as psychiatric disorders (Richardson et al., 2015). One possible pathway is that higher rates of deprivation expose individuals to multiple stressors, resulting in high prevalence of depression and anxiety (Galea et al., 2007; C. E. Ross, 2000). Such stressors include local crime (Astell-Burt et al., 2015), childhood trauma (Heim et al., 2008; Lupien et al., 2009) and job insecurity (Meltzer et al., 2010). At the same time, school status may explain variation in depressive symptoms better than neighbourhood deprivation (O'Campo et al., 2015), in line with the idea that the effect of one's neighbourhood process may be more or less relevant to an individual depending on the stage of their life (Ellen & Turner, 1997) and the specific network of relationships within their community.

Another factor may be that neighbourhood disadvantage is associated with fewer resources to help individuals with mental health needs and weaker social support networks, exacerbating depressive and anxious symptomatology (Cutrona et al., 2006; Garipey et al., 2015). Additionally, increased exposure of residents from disadvantaged neighbourhoods to substance abuse has been linked to increased substance abuse disorders and associated mental health problems (Galea et al., 2004). Consistent with this perspective, some evidence indicates that moving away from highly deprived areas is associated with mental health benefits (Leventhal & Brooks-Gunn, 2003; Osypuk et al., 2012), supporting a causal relationship between low socioeconomic status and mental distress.

Ultimately, part of these detrimental effects could be offset by investing significant resources in welfare state, to provide free, universal access to essential services such

as housing, clean water, education and, healthcare, thus significantly reducing risk of physical and mental distress. However, such regulatory interventions conflict radically with the neoliberal ideology, where the free market is assumed to be necessary for the optimal allocation of goods and services. This ideology, which is not supported by historical data, has pushed towards the commodification of basic needs, to the detriment of the quality of life and the mental health of large swaths of the population. By not alleviating and by allowing the increasing inequalities to perpetuate, capitalism is perpetuating the deleterious effect of poverty on the mind and brain (Muntaner et al., 2007).

Stigmatisation is also crucial. Although far from being specific to capitalism, it is likely to be an important process through which capitalist societies produce inequalities. Stigmatization is negative labelling and discrimination through exertion of social power (Hatzenbuehler et al., 2013), thus any socio-economic system within which difference (or diversity) is linked with power is likely to stigmatise certain groups. Current neoliberal discourses are selective as opposed to intersectional i.e., they may condemn stigmatization along some axes of identity (e.g., condemning sexism), but they continue to stigmatize identities associated with impaired productivity and class. Thus, those with disabilities and mental health problems are particularly prone to being labelled as free-riders and other psychologically harmful categories in market societies (Scambler, 2018). Stigma can result in reduction of purely economic opportunity, but critically it results in psychological harm (Zeng et al., 2018). A specific form of stigma found in capitalism is attached to those that ‘fail’ in the market, be it simply through poverty (Yang & Walker, 2020) or through failed entrepreneurship (Engel & Pedersen, 2019).

The relationship between socioeconomic status and mental health does not seem to be exclusively linear. Individuals in the "middle" of the capitalist hierarchy (i.e., in so-called contradictory class locations) may also experience high levels of distress. The term contradictory class location refers to the absence of adequate control over one's work that the top of the hierarchy enjoys, together with the experience of threat from lower strata (and peers). It has been found that individuals in the middle of the organisational hierarchy (such as managers, supervisors, salaried professionals and other contradictory class locations) tend to suffer higher rates of anxiety (Prins et al., 2015). This is important, as it highlights that class can affect one's mental health irrespective of economic status. Muntaner et al. (2007) have argued that it may be social stratification based on characteristics other than social class that determines mental health outcomes and have suggested that it may be the level of exploitation or a number of other class determinants that may enrich this research area.

Academia may be an example of interest to the reader. PhD students and early career researchers (i.e., those in the middle of the organisational hierarchy) seem to be disproportionately affected by anxiety (Nature, 2019), despite their prestigious position in society in general. Contributing factors may include academic capitalism (Jessop, 2018), the winner-takes-all ethos of academia alongside the exploitative culture of overwork, and the fact that the short doctoral and postdoctoral contracts allow many employers and supervisors to look the other way when it comes to a duty of care (Nature Editors, 2019).

Next, it is important to mention the growing role played by addiction in modern-day capitalist societies which also illustrates the inextricable link between brain and mind. Addiction is commonly defined as the maladaptive repetition of a certain behaviour, despite adverse consequences (Dayan, 2009; Kuznetsova, 2002; Redish et al., 2008).

This definition has been traditionally applied to the use of substances of abuse (e.g., nicotine, alcohol, illicit and prescription drugs, etc.), and more recently it has been extended to several other behaviours that are deprived of a direct pharmacological interference e.g., gambling, internet gaming, social media use etc. (Lindström et al., 2021; Ognibene et al., 2019; Petry et al., 2015). We have already mentioned the fact that capitalist societies are characterised by built-in inequality conducive of dysphoria, stress, and anxiety, which have long been known to foster addiction disorders (Volkow & Morales, 2015). In comparison with these forms of addiction, which can be considered an undesired by-product of the capitalist socio-economic structure, new forms have emerged that are actively pursued to generate the repetition of profitable behaviour. The most evident examples of these strategies are offered by the development of new chemical compounds that artificially increase the addictive power of a known substance (cf. the case of nicotine, Biswas et al., 2016; Rabinoff et al., 2007), or the use of incentive campaigns to promote the unnecessary prescription of highly addictive and dangerous drugs (cf. the case of opioids Gray et al., 2021; Van Zee, 2009). Furthermore, the understanding that addictions are driven by dopaminergic responses to unexpected outcomes (Dayan, 2009; Redish et al., 2008) is being used to design schedules of reinforcements that increase the chances of repeated use, as in social platforms (Lindström et al., 2021; Ognibene et al., 2019; Petry et al., 2015) or online gaming. These features are directed at increasing sales or access to personal data, for future targeted advertising, even at the expenses of mental well-being of the platform user (cf. internal Facebook studies showing a correlation between Instagram use and dysphoria or suicidal ideation (Seetharaman, 2021).

In the interest of space, we will only briefly mention here the (evident and evidenced, though not directly causal) effects of the fashion and media industry on women's

identity and the links that have been made to eating disorders and body dysphoria (Levine & Murnen, 2009).

Harm to brain

Epidemiological data regarding inequality and competition is suggestive, but the hypothesis that these forces cause neurobiological impairments requires accumulation of evidence regarding putative causal pathways, complemented by methodological debate regarding the limitations of each neuroscientific paradigm. Evidence from animal studies of stressors analogous to those found in capitalist labour markets demonstrate putative mechanisms, but generalisation to human beings requires much additional research, for which we call for here. Cross-sectional human neuroscientific studies also provide evidence, albeit correlational, while longitudinal ones allow temporal separation of exposure (e.g., childhood disadvantage) and impairment (e.g., adult brain structure). Capitalist systems also provide ‘natural experiments’, especially boom-and-bust market dynamics, which afford within- as well as across-subject exposures, both for individuals and whole populations.

Free markets are stressful by construction, with some highly prevalent types of market stress having close parallels with animal laboratory stressors causing neurobiological harm. These include *unpredictable chronic mild stress* e.g., being in a demanding job with little control leading to psychiatric morbidity (Stansfeld et al., 1999), *social defeat* e.g., social defeat hypothesis of schizophrenia (J. Selten et al., 2016; J.-P. Selten & Cantor-Graae, 2005), and *resource uncertainty* e.g., millennial precarity, academic precarity (Berg et al., 2016; Brunila & Valero, 2018; Worth, 2019). ‘Unpredictable Chronic Mild Stress’ reliably causes anhedonia in rodents and is also known to affect brain structure and neurochemistry (Khan et al., 2018). Social

defeat, whose human analogue is endemic in capitalism, is well-known to cause brain impairments. In animal research, social defeat (SD) is the forced exposure of a less endowed index animal, usually a smaller male, to a dominant animal which proceeds to inflict species-specific (usually inter-male) aggression onto the index animal. SD impairs the brain acutely, e.g., reducing neurotrophin expression in rodents (Pizarro et al., 2004) while in its chronic form it impairs dopamine reward signalling (Cao et al., 2010). Resource uncertainty strikingly resembles the *variable foraging demand* paradigm, a form of stress that impairs primate neural development (Coplan et al., 2006). Here, mothers with infants are subjected to variability in nutritional resources, while these never drop to a mean level that could cause physical malnourishment. In capitalism, induction of insecurity is a key way in which work flexibility has been implemented. The mental and physical cost of this stress is contained by, or better externalised to, families and carers, so that feminized labour is exploited to palliate the harm caused by work insecurity (Watson, 2016). This hypothesis, that market subjects may suffer neurobiological wear analogous to laboratory subjects, should strongly motivate researchers to fill the very considerable gaps between animal and human neuroscience in this domain.

Pioneering work has been performed by Martha J. Farah and colleagues, who found that socioeconomic deprivation in childhood is associated with impaired function (e.g., executive function deficits in childhood), but also structural brain changes. Studies commonly find reductions in cortical and subcortical grey matter in children, some detectable as early as five weeks of age (Betancourt et al., 2016). Numerous studies have shown brain structure to depend on socioeconomic status, but the distribution of findings varies, possibly due to methodological reasons that plague brain imaging reliability in general (Farah, 2017). Nevertheless, large studies provide

evidence that brain surface area is reduced in the presence of poverty (Noble et al., 2015).

[Figure 1 here]

Another important, recent development is the introduction of neuroimaging sensitive to molecular processes, rather than just macroscopic anatomy. One study showed that growing up in a deprived neighbourhood before the age of 12 was associated with slower growth of a myelin-sensitive marker in adolescence (Ziegler et al., 2020); that this was independent of a number of covariates such as IQ, parental occupation and positivity of parenting; but that it was partly mediated by parental education (see Figure 1). The sample in this study was screened for absence of psychiatric and neurological disorder, and no participants fulfilled the World Bank definition of poverty (not having enough to fulfil basic needs). This suggests that an ordinary unequal-ranking neoliberal economy significantly impacts the brain structure of the children of those deprived of privilege (Dufford et al., 2020; Kim et al., 2013), although causality is to be demonstrated.

[Figure 1 here]

Research also connects brain-related measures affected by poverty and inequality to measures of mental function. The concept of IQ admits critique, but there is much evidence that it constitutes a reliable measurement of performance with clear brain correlates (Moutoussis et al., 2021). In turn, the development of IQ is impaired by poverty (Hamadani et al., 2014; Turkheimer et al., 2003), suggesting an adverse effect on the brain. Recent studies have started to demonstrate how the correlation between deprivation and IQ performance is mediated by specific brain features in advanced capitalist countries. McDermot and co-workers (2019) found evidence that

reduction of the surface area of specific brain regions, such as inferior parietal and lateral temporal areas, mediates the relationship.

Not only brain structure, but also brain functional connectivity (FC) appears affected by economic disadvantage, the evidence mostly concerning young people from neoliberal societies. Here we should note that functional connectivity is a measure of ‘what the brain does’, specifically, what brain regions are organised into different networks, how active and how coherent these networks are. FC reflects both the biological structure of the brain but also the particular (mental) states occupied during scanning. Thus, despite being an entirely neurobiological measurement, it should not be seen as ‘neurobiological destiny’. In an important recent study, a neighbourhood level measure of deprivation, the Area Deprivation Index, was associated with reduced FC in several brain networks (such as the Default Mode Network the Ventral Attention Network and others) in 9–11-year-old US children. In turn, the areas of reduced connectivity were associated with general cognitive, internalizing and externalizing symptom scores (Rakesh et al., 2021). Another recent study found that parental education was associated with a general decision-making ability, which was in turn associated with reduced functional connectivity in opercular, posterior cingulate and other FC networks (Moutoussis et al., 2021). This study, which controlled for participant IQ abilities, did not find an association with neighbourhood-level deprivation.

Discussion

A plethora of research supports the claim that social inequality (in the form of economic inequality, of material deprivation, and more) is detrimental to well-being, linked to dysphoria and psychological difficulties. Neuroimaging research has clearly

linked economic disadvantage with changes in brain structure and function (Hao & Farah, 2020). We suggest that neuroscientific research ought to urgently and rigorously address questions specific to the processes implemented by neoliberal capitalism, rather than just deprivation or other fragmentary socio-economic outcomes.

Capitalism, currently in its neoliberal, globalised stage, is inextricably linked with inequality, but more importantly for us, it constitutes the context in which brains exist, develop, and function. Approaching the study of the brain from this angle allows us to use the rich theoretical work established by epidemiology, sociology, political science, critical theory, feminist and queer studies and many more, in order to formulate specific, empirically testable hypotheses.

For example, Zygmunt Bauman's work on liquid modernity (Bauman, 2000) suggests that increasing globalisation, privatisation of services and the information revolution have resulted in an environment that demands an individual flexibility that instigates great anxiety and fear⁵. Similarly, the status anxiety hypothesis, whereby anxiety is fuelled by social ranking and social mis-trust (Burns, 2015; Wilkinson & Pickett, 2006), and the social capital hypothesis (Burns, 2015; Kawachi et al., 1997) have not been adequately explored in neuroscience. These provide a helpful framework in order to study not only economic inequality, but also the effect of anxiety and fear due to inequality on brain and behaviour.

More specifically for the neoliberal context, the constant push for productivity, the individualisation of responsibility and the "self" as a "brand" to be managed have

⁵ Bauman is very far from being a neuroscientist, yet in neuroscience anxiety and fear behaviours are recognized as the normal responses to potential and present threat, respectively. Translating to contemporary capitalist context, it would be expected for people facing frequent economic threats to live in anxiety and fear.

been linked with psychiatric diagnoses (Sugarman, 2015). The effect of precarious employment and the gig economy, the high rates of competition (for grades, for jobs, for houses etc), the sense of individualised and internalised responsibility and guilt for unemployment or need for benefits are aspects of the current environment that are bound to have an effect on the nervous system.

Capitalist societies inculcate and enforce the idea that working relations between humans must be based on competition, described as necessary for entrepreneurs to maximise profit and survive in the free market, as well as a way to improve one's performance by promoting meritocratic incentives. The boundaries of the resulting working relations are ill-defined (especially in unregulated neoliberal markets and hence incentivise exploitation of the vulnerable. Profit motivates capitalists to find ways to pressurise or tempt (as yet legally) unprotected individuals, in order to gain competitive advantage. If capitalist economic activity were bounded, it might be possible to characterise all vulnerable groups and legally protect them. However, it is central to capitalism that enterprise ever expands into new areas, creating groups deprived in relative or absolute terms, whose mental health it endangers. For example, when intercontinental slavery became possible, slave markets boomed. When child labour becomes profitable, and before it is made illegal, child labour is marketed. When women and workers in caring roles are vulnerable, reproductive labour, that is, work maintaining the human potential of society, is unfairly exploited (Adams, 2020).

In addition, the capitalist appeal to a supposed meritocracy disempowers those 'losing' within the system, as a dominant narrative dictates 'if you try hard enough you will be a winner', promoted despite (and to counter) evidence that inequality is an enduring characteristic of the system (Piketty, 2013, 2015), thus assigning

personal responsibilities for unavoidable features of the current social structures.

Here the ideology sanctifying competition meets with its harmful result in lived experience, contributing to isolation effects (Table 1).

Much neuroscience research can be seen as a site of reproduction of neoliberal capitalist ideology, seeing the well-functioning human as a successful market decision-maker. However, it would be misleading, as well as unethical, to neglect the study of the harmful effects that this perspective has on brain development and on the well-being of real-life individuals. Yet economic inequality, deprivation and discriminatory exercise of power are almost never seriously considered in neurobiological studies of mental health, which often regard socioeconomic influences as nuisance variables to be controlled for, if at all. As in illustrative example, Xiang and co-workers found that control participants displayed deep ‘theory of mind’ when playing with each other a game requiring trust (Xiang et al., 2012). The control participant’s ‘theory of mind’ deteriorated when they played with patients with borderline personality disorder, the maladaptive cognition of the latter being the focus of that paper. However, when healthy people *matched for socioeconomic status to the BPD participants* played with the same control subjects, the same deterioration was induced. Yet, instead of concluding that something important was found about the (underprivileged) stratum from which BPD participants came, and pursuing this research, the authors concluded that ‘*lower SES may be one source of influence for the incapacity of the Borderline subjects to sustain cooperation with their investor partners*’. Instead of examining how lived experience may have given rise to key findings, why the patients with psychological problems may come from these ‘lower’ social strata, and whether there are legitimizing rather than pathologizing ways of understanding the apparent suboptimality of ‘lower’

strata, most neuroscience research unnecessarily sticks to a blinkered evolutionary - medical analytic and interpretative framework.

It is a matter of the great importance for public health to research at least two key hypotheses here. First, that placing people in a competitive context distorts their reward and social brain functions towards psychopathic-like evaluations, legitimising the suffering of their competitors, employees and bosses; and, second, that living under competitive threat and repeatedly experiencing ‘being a loser’ has a detrimental effect on the brain. In particular, as introduced in Table 1, we discern: 1) *deprivation effects*, associated with the marketization of essential needs, at great cost to the well-being of those priced out or continuously at risk of being priced out; and 2) *isolation effects*, associated with the behavioural incentive structure, built to favour individualist competition and stigmatising any ‘uncompetitive’ individual unwilling or unable to conform.

Specific needs for further research

In epidemiological mental health and neuroscience, excellent inroads have already started to be made in researching the impact of key features of capitalism on mind-brain health, in that measured ‘poverty’ is rarely poverty in the sense of the World Bank definition, i.e. ‘not having enough material possessions or income for one’s basic needs’, it is relative poverty, such as family income below a certain proportion of the median for a country, or a deprived neighbourhood environment (Fry, 2010) . They are thus about structural inequality, both a major outcome of and (supposedly) a key motivational engine in capitalism (circular causation). Such approaches should be widely expanded and systematically planned in advance, to assess rigorously the impact of the application of capitalist principles upon neural development and mental

health, especially 1) privatising welfare state functions such as housing, health and education, 2) funding cuts and austerity measures 3) IMF, EU, and related public spending policies imposed on countries 4) socio-economic differences between rich and poor countries 5) longitudinal boom-bust cycles.

Second, we propose that human neuroscience must test the set of hypotheses whereby well-known laboratory animal models of stress causing behavioural and neural toxicity may apply, in suitably attenuated forms, to the analogous stressors that many people encounter in free-market societies. These are summarized in Table 2.

Third, we propose that all human neuroscience purporting to investigate mechanisms important for mental well-being must be powered (both in the statistical and social sense) to relate mechanisms to real, contextualised lives. Rather than ignoring or controlling for socio-economic conditions, gender, intersectionality etc., research should collect high quality data and be designed to answer whether apparently maladaptive factors have resulted from lived experience within market economies. Such contextualizing and, ideally, longitudinal data should include the voice of those lacking privilege, both in co-designing and interpreting the contextualizing components of research. Mental health and neuroscience research should be designed to influence societal change, rather than focus on individual maladaptation.

Fourth, we propose that mental health and neuroscience research should ask how the mind-brain deals with, and is affected by, systems and relations of power as exerted by those who control financial and social resources, upon those who have much less. In neighbouring fields outside neuroscience, there are some examples of that type of work. At the psychological level, the Power-Threat-Meaning-Framework (PTM) is an initiative developing a framework relevant to both negative and positive notions of

power, and an alternative to individualistic diagnoses. It aims to conceptualise the role of power in forming personal meaning and facing psychological distress (Johnstone & Boyle, 2018). Prior to PTM, other psychotherapeutic approaches have aimed to specifically address the issue of social justice. These include feminist counselling (L. R. Ross, 2010), and examples of clinics aiming to create gender and cultural accountability such as “Just Therapy” clinic in Australia (Tamasese & Waldegrave, 1994). Neuroscience could contribute to these emancipatory psychologies, to develop dovetailing thinking about how neurodiverse structure and function mediates the relationship between living conditions, personal experience and behaviour. It should also aim to test the claims of important contributions such as the PTM.

The neural structure and brain function of individuals living under the dominant power of others needs elucidation in general, but one aspect is particularly deserving of research. This is the hypothesis that stigma, and specifically internalization of stigma, mediates the psychological harm associated with inequality in capitalism.

Researching a post-capitalist mental health

Although we believe that empirical testing of hypotheses regarding the risks that capitalism poses to the mind and brain is paramount, we must also make suggestions about how to conduct research which does not take for granted the now implicit norms of capitalist societies. We, thus, propose moving away from the capitalist framing of pathology based on maladaptive decision-making within a taken-for-granted, good-enough, normal market society. We propose a post-capitalist framing of pathology which highlights failures of society to provide good-enough communities, wherein individuals can both fashion and fulfil their needs. This

proposed shift in the emphasis on health and pathology for the purposes of research is illustrated in Table 2.

Finally, we propose to maximize the voice of the under-privileged in the design and conduct of all research purporting to subserve mental health. This would shift the dynamic of research from the repetition of the hierarchy of “the expert that performs research onto the participant” to a more collaborative and horizontal relationship.

There is considerable work being done on this, but a further shift of researcher and funders’ attitudes is critical e.g., Pincham et al. (2020).

We first draw on the tradition of Participatory Action Research (PAR) and the work of Paulo Freire in critical pedagogy (Baum et al., 2006). This involves reflection upon the nature of knowledge and the extent to which knowledge can represent the interests of the powerful and serve to reinforce their positions in society, and affirms that experience can be a basis of knowing and that experiential learning can lead to a legitimate form of knowledge that influences practice. In the same vein, the more recent trend of including Experts By Experience in service improvement (Baum et al., 2006), we suggest that psychology and neuroscience research projects should if at all possible be co-designed with individuals with lived experience, survivors of harm (including as caused by services), service users, front-line workers and other key stake-holders.

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Tables

Effect	Generative process
Deprivation effects	
Material	Resulting from the marketization of basic needs or rights into profitable commodities, such as access to clean water, shelter, education, and healthcare. Lacking access to such needs can directly impact mental health but can also have an indirect impact via increased stress and reduce the overall quality of life.
Psychological	Deprivation over basic psychological needs will also exert detrimental effects on mental health. Include a lack of autonomy over one's time (e.g., via reduction of salaries and overworking), lack of job security and exposure to demeaning working conditions (e.g., deprivation of human dignity).
Isolation effects	
Workplace relations	Resulting from the enforcement of individual competition, instead of cooperation, as the means for ordinary individuals to survive and advance. This pervades how work relations are structured, as well as the general relations within the society.
Community relations	These include mental health effects arising from the destruction of communities, of physical, virtual and symbolic communal space and the degradation of collective groups (e.g., Unions). This also the resulting from the physical displacement of the workforce (i.e., internal and international migration) and insecure working conditions (e.g., gig economy).

Table 1 Deprivation and Isolation effects of capitalism

Laboratory model:	Psychobiological human research:
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Chronic mild stress	Chronic socioeconomic disadvantage
Social defeat	Market life events (loss of occupational identity, employment, housing)
Variable foraging demand	Precarity

Table 2: Laboratory animal paradigms and their hypothesized human analogues

From the individualist, market-oriented	To a community-oriented
Researching new individualistic diagnoses	Scientifically-based formulation/conceptualization of mental distress as the effect of a harmful context on a neurodiverse individual
Well-adjusted to norms	Expressing neurodiversity
‘Healthy behaviour’ derived from Western, rich, young, highly educated research participants	Healthy behaviour as affordance to fulfil need in an appropriate niche when given the appropriate support/assistance
Assumption of independence	Interdependence
Therapy for symptom alleviation (People adapt to their environment)	Therapy to empower for justice (People change their environment incl. through alleviating symptoms)
Most efficient remission in terms of positivist mental health measurements	Collaboratively seeking improvement through treatments
Biological interventions marketed as cure (vs reality of symptom control or debilitating effects)	Collaborative biological interventions in the service of recipient empowerment to achieve their own goals.

Table 3: Proposed shift of research framing from (maladaptive) market agent to (ill-provided-for) neurodiverse community member

Figures

Critical Glossary

Term	Definition	Historical usage, caveats and controversies
Capitalism	Legal protection of the freedom to own property, and to buying and selling labour, goods and services for the purposes of making monetary profit.	Capitalism privileges the <i>freedom to</i> exert financial power, pursue private profit and accumulate capital, over the <i>freedom from</i> need.
Disease	Biological process damaging the healthy function of part or parts of the body	Term often used to justify researching and treating madness by biological means, based on the early success of preventing and treating cerebral syphilis, and of researching and treating other states based on analogous hypotheses about the brain. It is a peripheral term to the dominant biopsychosocial model of psychiatry.
Health	State of structure and function of a part or parts of the body that sustains its biological function.	Whereas this definition has a simple interpretation for externally assessed organs, e.g., a ‘healthy’ heart can sustainably maintain blood flow that adequately perfuses the body, porting the term to ‘mental health’ is much more problematic.
Illness	State incompatible with health of the whole person.	
Madness	Extreme deviation from neurotypical perception, rationality and action, to a degree that ordinary individuals without medical or psychological training would recognise as highly maladaptive.	
Mental Health		
Mental illness	Literally, subjective state incompatible with mental	Crucially, not a term used by classifications of mental disorders. For

	health in an individual who did not previously display this state. In practice, state of fulfilling criteria for a mental health disorder.	example, the ICD-10 made specific reference to <i>not</i> using it. However, it is used widely with the implication that psychiatrists are doctors like all others, the conditions they treat are bodily problems like, say, diabetes, etc.
Neoliberalism	Contemporary form of capitalism with a strong state promoting financialization and private enterprise, while striving to move all profitable economic activity to the private sector.	The term is mostly defined and used by the critics rather than the subjects of the free-market beliefs in question.
Severe Mental Illness	Term denoting that specialist psychiatric services are responsible to manage high risk and/or highly divergent experience and behaviour. Closely associated with psychosis.	Term is used to ration services (so that most people who don't have 'SMI' have no access to highly trained staff) but also to reinforce highly questionable categories such as 'schizophrenia' and the biomedical model of their management.
Poverty	World Bank definition = Not having enough material possessions or income for one's basic needs.	
Psychiatry	The branch of medicine centrally concerned with treating the mad, but which also applies the tools developed in the process to any form of psychological suffering that may benefit from said tools. The large bulk of psychiatrists do not adhere to a medical but to a biopsychosocial model of the problems they deal	This is another term which is in practice circularly defined - psychiatry is what psychiatrists are given to do by society, which does not use a singular criterion but a network of interests to allocate, or not, authority to psychiatrists. Crucially, organisations such as the Royal College of Psychiatrists do not define the term.

	with.	
Patient	The recipient of (mental) health services.	The term 'patient' has been associated with passive subjugation to paternalistic interventions. A number of alternatives have been used, such as 'client', 'service-user', 'help-seeker', 'clinical subject'. None is satisfactory.

Table 4