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Abstract

Developments in the field of neuroscience, according to its proponents, offer the prospect of an enhanced understanding and treatment of addicted persons. Consequently, its advocates consider that improving public understanding of addiction neuroscience is a desirable aim. Those critical of neuroscientific approaches, however, charge that it is a totalising, reductive perspective—one that ignores other known causes in favour of neurobiological explanations. Sociologist Nikolas Rose has argued that neuroscience, and its associated technologies, are coming to dominate cultural models to the extent that 'we' increasingly understand ourselves as 'neurochemical selves'. Drawing on 55 qualitative interviews conducted with members of the Australian public residing in the Greater Brisbane area, we challenge both the 'expectational discourses' of neuroscientists and the criticisms of its detractors. Members of the public accepted multiple perspectives on the causes of addiction, including some elements of neurobiological explanations. Their discussions of addiction drew upon a broad range of philosophical, sociological, anthropological, psychological and neurobiological vocabularies, suggesting that they synthesised newer technical understandings, such as that offered by neuroscience, with older ones. Holding conceptual models that acknowledge the complexity of addiction aetiology into which new information is incorporated suggests that the impact of neuroscientific discourse in directing the public's beliefs about addiction is likely to be more limited than proponents or opponents of neuroscience expect.

Keywords

Neuroethics Addiction Neuroscience Public understandings of science

Introduction

Addiction Neuroscience and Society: Sociological and Philosophical Positions

Electrical and biochemical investigations of the brain's responsiveness to addictive substances [1] have provided a model of addiction as a 'brain disease' in which repeated drug use produces changes in the brain in ways that impair individuals' ability to control their behaviour [2, 3]. Such understandings have therapeutic implications, offering a rationale for the use of psychopharmacological and other technological approaches that change brain functioning (e.g. deep brain stimulation) to treat addiction [4–6]. A brain disease model of addiction may also have policy and social consequences, such as in judging whether addicted persons have sufficiently impaired autonomy to be considered as less responsible for their actions [7] or as warranting legally coerced addiction treatment [8].

Proponents of neuroscientific explanations of addiction offer optimistic 'expectational discourses' [9] arguing that wider acceptance of the brain disease model will produce more effective treatments of addiction and reduce stigmatisation that can harm addicted persons and prevent them from seeking help [10]. Consequently, advocates argue for improved public understandings of neuroscience because 'efforts to treat addiction are hampered by prejudice and a public view that treats it as a disorder of self-control, not a disease.' [4] They suggest that neuroscientific 'facts' are being ignored because of a 'public perception' that addiction is a 'social [problem], to be handled only with social solutions.' [11] 'Public perception' that excludes the neuroscience perspective is seen as detrimental to the effective treatment of addiction.

Those critical of adopting an overarching neuroscientific framework for understanding and treating addiction charge that it is a totalising, reductive perspective that exaggerates the importance of neurobiological factors and marginalises or ignores other known causes of addiction [12–14]. These critics hold that neurobiological factors do not explain why people become addicted and should not be taken as the sole basis for understanding and treating addiction [13, 14]. Dingel and colleagues [13] express additional concerns that the acceptance of genetic and/or neuroscientific understandings of addiction will result in underfunding of socially based research and treatment methods. They argue that a reduced focus on the social context in which addiction arises in favour of ‘a vision of addiction as a phenomenon isolated within our bodies’ [13: 1363] will increase, rather than decrease, the view that addicted persons are to blame for their condition. An examination of the neuroscientific literature on addiction (e.g. [15]), however, shows that even its strongest proponents do not necessarily advocate neuro-essentialism: the view that behaviour and cognition can be explained solely by neurochemical events in the brain [16]. Neuro-centric is a more apt term because they place neurobiological factors at the centre of addiction aetiology, while acknowledging that other (environmental) factors play a role, albeit mediated through the brain [4–6, 11]. Neuro-centrism need not mean that one denies that non-neural factors can cause addiction. Rather, it is a position that deems non-neural causes to be of lesser importance than neural causes in the treatment addiction. Empirical Evidence on the Social use of Addiction Neuroscience

Advocates and critics of these philosophical positions on neuroscience entangle normative and descriptive statements—they make assumptions about what the public does think about addiction while also making normative claims about the likely consequences of these assumed beliefs. This debate roughly divides between those for whom neuro-centrism is a desirable but unrealised aspiration, and those for whom it is a highly undesirable trend that should be opposed. The limited empirical evidence, however, suggests that neither set of assumptions made about public understandings of neuroscience is entirely correct. This, in turn, raises questions about the normative conceptions predicated on these assumptions.

Rose [17: 188] has argued that neuroscience and its associated technologies are dominating cultural models to an extent that ‘we’ increasingly understand ourselves as ‘neurochemical selves’—a process that (perhaps adversely) impacts on the evolution of ethical citizenship. Empirical philosophy, sociological and anthropological investigations of individuals living with mental illness [18–21] and Angermeyer and colleagues’ [22] systematic review of literature on public beliefs about biogenetic causes of mental illness lend support to this view. Angermeyer and colleagues [22] found indicators of increased acceptance of biogenetic models of mental illness (including neuroscientifically based models) across a number of OECD countries but they also found that this had not resulted in any greater social tolerance of people who are mentally ill. Other studies have found that, while stigma has not been reduced, increased acceptance of neurobiological explanations can increase support for treatment [23].

On the other hand, Bröer and Heerings [24] argue that Rose [17] may have overstated his case. They analysed public discourse in the Netherlands on attention hyperactivity disorder (ADHD) and the self-descriptions of Dutch adults who identify as having these disorders. While neurobiological aetiologies of ADHD dominated public discourse, personal discourse(s) reflected a range of ideas that included, but were not dominated by, neurobiological explanations. They concluded that ‘[c]olonisation of subjectivity [by neurobiological explanations] [...] does not feature. Dominant [neurobiological] notions resonate, but people reassemble the public discourse and construct diverse personal discursive spaces’ [24: 13]. This suggests that individuals may make use of neurobiological explanations in a variety of ways.

Building on this previous research, our interest with this paper was to examine how neurobiological theories of addiction aetiology fit into the Australian public’s understandings of the causes of addiction. This work sits within the broader tradition of empirical ethics [25]. Its aim is to provide empirical evidence on the impact of neuroscience information on popular discourse to inform

sociological and ethical debates about the likely benefits and consequences of addiction neuroscience research. However, in a more general sense, our work may be beneficial from a critical neuroscience perspective [26]. In representing public understandings of addiction, we offer a lay epistemological perspective on addiction that may be useful in the broader process of producing ‘socially robust’ addiction neuroscience knowledge [26].

Methods

Methodological Framework

Our approach to investigating the influence of addiction neuroscience information was to examine how addiction neuroscience terminology and concepts naturally occurred in discussions about addiction. Our intention was to understand how neuroscience discourse was represented in participants’ speech in relation to their broader discourses on addiction. We took an iterative approach to thematic analysis, coding the data to exhaustively represent the common elements of the public’s discourses on addiction while also illuminating relationships between themes. Through this descriptive process we assessed how addiction neuroscience information could be said to have affected or been incorporated into public understandings of addiction. We analysed naturally occurring accounts rather than eliciting responses to explicit prompts about neurobiological information because we found the latter kind of data traced ‘acceptability’ rather than ‘influence’ of neurobiological discourse. We analyse public responses to explicit statements about the brain disease approach in a forthcoming article.

Recruitment and Interviewing

In 2011, following ethical clearance from The University of Queensland Behavioural and Social Sciences Ethical Review Committee, 55 qualitative semi-structured interviews were conducted with individuals who reside in the Greater Brisbane region of Australia. The interview schedule was developed by JL and AC in consultation with WH and administered by employees of Roy Morgan research with expertise in qualitative interviewing. Interviews sought to elicit public understandings about addiction and their views about: addicted individuals’ control and responsibility for their drug use, the treatment and prevention of addiction, and their acceptance of claims made by proponents of the brain disease model of addiction. Questions asked included: what do you think drug addiction is? Why do you think some people become addicted? Interview questions were repeated to inquire about a range of specific legal and illegal substances. Five pilot interviews were conducted by Roy Morgan interviewers to test the flow and wording of the interview guide. Pilot interviews were reviewed by AC, WH and JL. Limited changes were made to the interview schedule at this stage and pilot data were included in the sample along with the 50 remaining interviews.

Participants were recruited via market research company Roy Morgan’s Single Source (SS) database, a nationally representative database containing records of 50,000 individuals. Individuals were selected by stratified random sampling of households within sub-regions of Federal Electorates. Once households were selected, the youngest male over 14 (or if not available the youngest female over 14) was asked to participate. This approach increased the representativeness of the sample of young people, particularly young males who are the hardest to recruit. Potential participants were randomly selected from SS, telephoned and invited to participate in the study (Table 1). Quota sampling was used to ensure that the sample was age and gender representative. In-depth semi-structured qualitative interviews, followed by a brief quantitative survey, were conducted face-to-face with willing participants at a location of their choosing, usually their home. The average length of time spent with each participant was approximately 45 min. Interviews were completed and transcribed in advance of coding and analysis.

Table 1

Sample characteristics

Coding and Analysis

We were interested in specifying how the public understood the causes of addiction within their own frames of reference, rather than interpreting them through the lens of neurobiology [27, 28]. In their analysis of ADHD discourses, Bröer and Heerings [24] classified public and personal discourses in terms of the categories ‘sociology’, ‘spirituality’, ‘psychology’, ‘neurobiology’ and ‘advantages’. Previous analyses of public understandings of addiction have classified discourses into ‘biogenetic’, ‘brain disease’, ‘biological’ or ‘psychological’ [22, 29]. While we expected some overlap between academic and lay terminologies and classifications, we did not assume that members of the public would necessarily use technical vocabularies or classifications in the same way as experts. Thus, we departed from previous literature in employing an iterative, inductive approach to derive a categorisation based on terms identified within the respondents’ discourse.

With this aim in mind, printed interview transcripts were read by CM. Statements that, directly or indirectly, made particular assumptions about addiction aetiology were identified. Text could be multiply coded if we considered that a passage articulated more than one theme e.g. where respondents explicitly conjoined their discussion of different causes in speech.

Excerpts were sorted into initial groupings by CM who yielded eight themes corresponding to different causes of addiction. This was subsequently revised to six following a consensus meeting of all authors. All interviews were subsequently coded by CM according to these six causes, allowing for excerpts to be assigned to multiple thematic groups, using nVivo 9 [30]. AC and JL reviewed the coding and discrepancies were resolved, and interpretations developed, with in-depth discussion to reach a consensus. Descriptive statistics characterising the sample were generated using SPSS 20.0.0 [31]. Some interview excerpts presented here were selected and edited in order to illustrate the nature of the identified themes as articulated by respondents. Others were selected in order to illustrate how interviewees expressly related different themes to each other. We elected to illustrate themes by providing multiple, short, exemplar quotes that defined elements of each theme instead of interpreting a smaller number of lengthier quotes that would have conveyed multiple themes together. As a result, we present an aggregate representation of the structure of participants’ multi-thematic discourse. For ease of reading, repeated statements were edited out as were ‘false starts’ to sentences.

Results

We allocated descriptions of addiction aetiology to six themes that we termed: ‘character’, ‘emotional-experiential’, ‘social-environment’, ‘rational-learning’, ‘biological-body’ and ‘drug’. Participants in our sample overwhelmingly viewed addiction as arising from multiple factors, typically identifying between four and six of these themes (Table 2).

Table 2

Addiction aetiology themes and a selection of associated keywords (n=number of interviews in which a theme and/or keyword occurred at least once)

The majority of participants situated the causes of addiction both internally and externally to the individual and often as a relationship between individual and environmental factors. Character, emotion and experience, capacities for rationality and learning as well as physical and bodily aspects, were all factors located within an individual (although they could be affected by external stimuli). Aetiological themes external to the individual included the social-environment as well as the properties of drugs themselves.

Biological-Body

Participants made numerous references to genes, biology, the body and the brain. Employing a diverse technical vocabulary, these references reflected a belief that addiction was not simply the result of conscious or 'mental' processes and/or moral agency:

there's a biological mix in there that—it just—somehow the body just really takes to it and it triggers something. [female, 40–49, university]

So there's again, it's complicated, I think it's both the physiological response of their body and also the psychological. [female, 40–49, university]

The 'body' was often closely related to, or synonymous with, other biophysical entities such as 'biology' (as above) and the 'brain' (see below). Overall, the number of respondents who referenced the 'body' in their discussion of addiction (n=39, 71 %) exceeded those who spontaneously made reference to the brain (n=28, 51 %).

Both biological and genetic factors were used to explain why some persons exposed to drugs became addicted and others did not:

I think some people have it in their genes to be more susceptible to that than other people. Some people can cope and others have got it in their genes that they are inclined to get addicted. Yeah. [female, 60–69, secondary school]

As we discuss in a subsequent section, our sample tended to explain family predispositions towards addiction in social terms—a trait that was 'inherited' through role modelling and learned behaviours. However, a minority explicitly articulated that family patterns of addiction had a genetic basis:

Some people I think may have a predisposition to being taken in by drugs and alcohol. Maybe it's something genetic; maybe there is a trait in their family. [female, 60–69, certificate/diploma]

Genetic and biological discourses situated a cause of addiction within the individual, even if it is not necessarily inherited. References to the body and 'chemistry' included more detailed descriptions of the physiological effects of drug use and withdrawal.

Many respondents made reference to biological factors in relation to 'cravings'—implying that cravings are an important element that defines drug addiction. The body was frequently described as the site of craving:

Well [dependency is when] people crave it—their whole body craves whatever drug it is of choice that they're after. They can't function without it. [male, 40–49, secondary school]

However, explanations involving bodily cravings also referenced the brain:

I don't know how the—what the exact physiological processes are but I believe that that's the—some centres, receptors in the brain, they crave it and they need to have it and if you don't, you know, you go through this painful withdrawal. [male, 60–69, secondary school]

Relatedly, some respondents referred specifically to the possibility that body 'chemistry' and 'chemical imbalances' could cause addiction in some people:

I can only think it's, again, a chemical imbalance that happens in the body once the drugs got into the body, but I don't know how it happens. [female, 70+, certificate/diploma]

I would imagine heroin addiction is probably more of a chemical thing in a sense that you become chemically addicted in your brain. [male, 40–49, university]

Such explanations echoed an explanatory discourse brought about through the mainstreaming of Selective Serotonin Reuptake Inhibitors (SSRIs) [32].

Overall, discourses of biology and physiology incorporated discussion of the brain specifically and discourses of the 'body' and of the 'brain' often mirrored one another in important ways e.g. in respondents' discussions of cravings and chemistry. Assuming that chemically based discussions are attributable to the popularisation of certain neurobiological processes, our observation suggests that neuroscience information is influencing people's conceptions of the body as a whole. Discourses on cravings and chemistry showed two different ways in which neurobiological information informed public understandings. While references to 'chemistry' depicted the relevance of a specific state of an addicted person's brain or body, references to 'cravings' linked neurobiological processes with an emotional state of desire to use a drug. Similar overlap was apparent in the case of the respondent who linked an individual's ability to 'cope' with their genetic makeup i.e. who offered a biological explanation for what might otherwise be deemed a personality or character trait. Yet, as we will explore, character traits, emotions and other factors considered to be part of the addiction process were not always rooted in biological causes.

Character

We use the term 'character' to convey the roles attributed to individual personality and moral agency in becoming addicted that were evident in all interviews. 'Bad choices' and/or a lack of certain moral capacities were seen to produce addiction. 'Will power' (or lack thereof) was a phrase used repeatedly to explain why one individual might become addicted to a substance while another might not:

I think some people have addictive personalities, some people have personalities that they can't cope for themselves to some extent, obviously people have different levels of will power, people have different levels of motivation for not becoming addicted to drugs [female, 40-49, secondary school]

Other interviewees described how 'character' might lead people to substance use (and abuse) as a way of coping with insecurities and/or overcoming shyness and other social anxieties. As in the response below, character-based drivers could relate to features of personal identity:

they're vulnerable because of their—probably their own disposition, personality issues, they're not very secure in their own identity. Which is quite normal I guess for teenagers and—but, yeah, I think it's just circumstances of the individual [male, 50-59, university]

Interest in the pursuit of particular kinds of lifestyle was seen as another pathway into addiction:

So, you know, they—they crave for situations in which they take the drugs as well as just the drugs themselves. [male, 18-24, secondary school]

There were differences in the accounts of 'character' between those members of our sample who empathetically appreciated how vulnerability and low self-esteem might lead to addiction and those who made more negative judgements about character reflecting moral 'weakness'. Some interviewees explicitly said that addiction might be caused by 'weak personality':

Maybe too—it starts off in the personality, a weak personality that could be a cause. [male, 60-69, secondary school]

Some participants' remarks indicated that they saw a relationship between one's moral identity and the physical body while also showing that they did not necessarily consider that these processes were reducible to one another. For instance, one respondent suggested that mental 'strength' was required to overcome the physical effects of drug use and addiction, thereby implying a relationship, but not an identity, between 'the will' and 'the body':

It's all got to do with the reward centre in their brain, but [...] some people are stronger at ignoring it than others. [male, 40–49, secondary school]

Emotion-Experience

The second most prevalent view of addiction aetiology depicted addicted persons as emotionally and experientially driven. The emotional-experiential model of addiction reflected a hedonistic conception of human beings as driven by pleasure seeking and pain avoidance. This theme was linked in certain ways to the theme of 'character' and was often related to internal mental and physical functioning as well as factors in one's social-environment that could influence life experiences and emotional states.

A number of interviewees spoke of the positive and negative acute drug effects—the 'rush', 'high', 'thrill', 'buzz' and withdrawal effects—as a cause of addiction:

Starting off taking something possibly for pleasure, liking it a lot, continuing it, can't stop it, addicted. [female, 40–49, certificate/diploma]

It gives them a high that they don't get from anything else. Of course when they come down they feel really terrible so they want more so they'll feel better. [female, 50–59, certificate/diploma]

Some linked pleasure-seeking with the need to escape boredom or idleness, or as a marker of dissatisfaction with one's life:

It's probably the rush they get from it and how they feel on it. Why is because maybe reality is not good enough for them, they want to keep out of it. [female, 50–59, secondary school]

I can understand how easy that would be for someone whose life isn't—maybe isn't particularly fulfilling, whether they're filling a gap, maybe they're boost themselves, either—lots and lots of different reasons. [female, 40–49, university]

As evidenced in these excerpts, some interviewees disapproved of those who could not live contentedly without drugs, while others were more sympathetic to persons who lacked a sense of personal fulfilment, particularly if it was linked to social disadvantage or isolation. Emotional-experiential accounts that emphasised the former referred to addicted humans as thrill seekers; the latter (evidenced below) treated drug use as a form of self-medication—a way of dealing with traumatic life experiences that were beyond the individual's control. These accounts were not isolated from the other causes identified. The excerpt below, for example, highlighted overlaps between the role of emotion and experience, one's character, the properties of drugs on the body and social-environment—appealing to five of the six identified themes:

For some people, it's an escape from the world. And life throws nasties at us, lots and lots of nasties, some people more than others and for some people, their only way of coping with that is through the use of something that makes them physiologically feel better. [female, 50–59, university]

Here, social-environmental factors—'life's nasties'—could create contexts that required an individual to 'cope'. The character of an individual was taken to influence how effectively an individual might deal with misfortune and, consequently, whether or not they used drugs to 'feel better'. While the language of 'coping' and 'feeling better' suggested an emotional driver to this process, this respondent explicitly said that drug use affected one's physiological state. Thus, this respondent conveyed a causal pathway in which social-environment interacted with character to prompt drug use that, in turn, affected the person's emotional and experiential states. Presenting the complexity of this discourse diagrammatically, where the symbol \rightarrow implies a causal relation and \leftrightarrow an interaction of variables, the above excerpt is shown to convey the following two causal 'stories' simultaneously:

((social-environment \rightarrow emotion-experience) \leftrightarrow character) \rightarrow Drug/addiction
Drug \rightarrow (emotion-experience \leftrightarrow biological-body)

Importantly, the pattern of discourse appeared to be a-hierarchical. Causes were interrelated but none privileged.

Social-Environment

The social-environment was seen to influence addiction at various levels. Addiction was explicitly linked to certain forms of social dysfunction within social units ranging from family, peer and work groups to broader society and culture.

Family was cited as a key enabler of addiction:

when they start for the very first time when they're youngsters or their parents are—I think that's the beginning. If—if—I think something like—I'm not saying it's hereditary—alcohol or even drugs, but if it's around you all the time it would be hard to fight it. [female, 50–59, secondary school]

Well perhaps parental example. Around the dinner table, you know, Dad not coming home drunk or staying home after—staying with his mates after work and then children see it and they develop this pattern—this thought pattern, well this is normal, it's acceptable. To drink at the pub or to have one too many at the table. [male, 60–69, secondary school]

In our sample, the family was seen to operate as an important social factor, rather than as a genetic factor. Importantly, while a few referred to (genetically) inherited addictive tendencies, it was more common to explain the observation that addiction 'runs in families' by appealing to the effects of upbringing and individuals' capacity to learn from the behaviour modelled by parents.

Friendships and work environments were also seen as providing possible pathways to addiction:

I think some people become addicted because their mates, the peer thing, their mates do it, I should do it and they don't know how to—they don't know how to say no and then step back before it becomes an addiction, before their brains require that boost. [male, 40–49, university]

As in the above example, many respondents understood addiction to be the outcome of complex causal chains. In this example, one's social-environment was described as providing a situation that supported a pattern of behaviour that would result in a particular physical (brain) dependency. This statement was consistent with a brain disease model of addiction without being neuro-centric because the interviewee cited a specific kind of social-environment as leading to substance use in the first instance. Indeed, this person highlights that lay and neuro-centric beliefs differ in the emphasis on, and ordering of, causes rather than in the identification of specific kinds of causes. Lay understandings conveyed diverse causal pathways that implied different locations at which neurobiological factors could operate in the overall causal process.

More generally, most respondents were aware that both 'social and biological' and/or 'environmental and medical' factors were relevant to understanding addiction:

'Cause it's not just a medical thing, it's an environmental thing too. [male, 40–49, university]

I definitely think there's some sort of—some people have an affinity to—just due to their biology. And there will also be I think the way a person's brought up, behavioural and cultural reasons as well. [male, 18–24, secondary school]

Australian society/culture was readily noted as a driver of addiction, particularly in the case of alcohol:

it seems to be a cultural—an underlying sub-culture, quite a large one in Australia that, you know, binge drinking. The concept of schoolies and that—that's indoctrinated at a very early age, irrespective of socio-economic class. [male, 50–59, university]

Finally, some cited regulatory structures as causes of addiction. The following excerpt, for example, explicitly links the addictiveness of a substance to its accessibility:

I think [alcohol] would be more addictive [than heroin] because of its ease of access and it's legal. [...] Heroin definitely addictive, but the average Joe, I don't know if they'd know where to go and get it. But everyone knows where the bottle shop is and within this suburb probably within a five [kilometre] radius I could pick five bottle shops to get access to real easy. [male, 40–49, university]

Rational-Learning

Drug addiction was often described as the result of learned behaviour and knowledge—a 'rational actor' model of human behaviour. This view implied that certain mental properties—the ability to act 'rationally', or with emotional intelligence, according to their knowledge-base—could to some extent function independently of, or override, the effects of drugs on the biological body.

Specifically, some interviewees considered that those who took drugs did so because of a lack of awareness of the risk of adverse effects such as addiction. Furthermore, inconsistently with the brain disease model of addiction, a few participants believed that an addicted individual would be able to modify their behaviour if provided with appropriate information:

They can—they can be stopped, all is just they need awareness, they need to tell by somebody that this is not good for you, it could be harmful to you, to your body, side effects and after effects and to his life, to his personal life. [male, 25–29, university]

I think that a lot of people who end up going into drug addictions do so out of lack of information or lack of reason when they first get into it. [male, 18–24, secondary school]

An individual's capacity to learn was seen as a protective factor, insofar as interviewees believed that persons could be educated about the risks of drug taking. However, learning was also seen as a possible cause of addiction if an individual had poor role models from whom to learn, as in earlier interview excerpts about the impact of family dysfunction on addiction risk.

Some interviewees focussed on emotional education and intelligence, such as the ability to teach 'self-control', 'resilience' and/or to build 'character' as important factors that could influence drug addiction risk:

there needs to be education, along the lines of cognitive behavioural therapy for people to really understand themselves, and why they act the way they do. [...] so they will minimise the prospects of them making a choice to go down a drug related path of dealing with emotional issues [...] I don't think people are taught to be resilient, and I think teaching people a level of resilience and emotional strength would go a long way towards preventing a lot of addictive behaviour [...]. [female, 40–49, university]

This theme, therefore, often linked with one's 'character' and 'social-environment'. Some interviewees saw character as, at least to some extent, a learned behaviour and social-environment was viewed as influencing learning in both familial settings and formal educational institutions.

Although there was significant overlap between these explanations it was not possible to reduce any of these themes to another. This feature of discourse—where ideas are shown to be readily recombined with a number of other, related, factors—is significant in understanding the impact of new scientific knowledge on public understandings.

The Drug

The final, and least commonly cited (cf. [33]), explanation of addiction was related to the characteristics of the drug. These were mentioned by 71 % of interviewees but this figure may be inflated because the interview questions specifically asked participants about the comparative addictiveness of different drugs. The drug's addictive properties were primarily referenced in terms of its 'chemistry' and its interaction with an individual's biological-body:

once you've had it then you, your body's had it before and knows what it's like and then it knows the release that you got from it and also just the natural addictiveness has just taken control, I suppose. [male, 18–24, secondary school]

It's just part of the chemical makeup of the drug. So once you start using it, you have—you choose to—you tend to want to use it again. [male, 18–24, secondary school]

A minority of participants identified the interaction between the properties of the drug—characteristics of its ingestion and its effects—and the realities of an individual's social-environment in facilitating the use of particular drugs:

Well, say you're at work and you go on break and you go on break with your work friends or whatever and you all smoke and stuff like that [...] because smoking is—it's not like sitting down and drinking a bottle of wine or something. It's something you can do. It's a couple of minutes and then it's gone and then it's a couple of minutes later on so it's harder to separate that from the other things you do during the day. [female, 18–24, certificate/diploma]

Discussion

Advocates of neuro-centric understandings of addiction claim that increased public acceptance of the brain disease model of addiction will reduce stigma and improve the treatment of addicted persons [4, 10]. However, critics of neuroscientific approaches express concern that acceptance of neuro-centric views may marginalise other, socially based, causes and treatments of addiction and increase stigma [13]. Our findings suggest that the Australian public has not uncritically adopted neuroscientific understandings of addiction to the exclusion of other causal factors and consequently allocations of responsibility are diffuse and varied. Elements of a neurobiological understanding have, however, been incorporated into existing lay explanations of addiction. We found that the brain was explicitly stated as causally involved in addiction in a bare majority of interviewees. However, many more (95 %) respondents cited social-environmental factors as causes of addiction. Neuroscientific understandings, therefore, were not observed to have 'colonised' popular understanding of addiction to the extent that they have marginalised other causes, as their detractors suggest. Equally they have not been resisted in the ways that their proponents fear. This supports Bröer and Heerings' [24] argument that the socio-cultural 'impact' of neurobiological discourse on lay understandings of mental disorders may have been overstated.

Individuals in our sample conceived of the causes of addiction as multifactorial i.e. they (often explicitly) identified several different causal factors, and often saw all of the themes that we described as playing an important role in addiction. As described in the methods, our approach was inductive in deriving thematic categories from our data. A recently published paper comparing neuroscience discourses with the beliefs of individuals in treatment for drug addiction in North America lends some support to the validity of our thematic categories [34]. Specifically, Netherland's article employed similar thematic categories of 'pleasure', 'rationality', 'environment' and 'volition' to structure her description of key positions in neuroscientific and addicted individuals' discourse about addiction. Future research may usefully examine whether the thematic categories identified in both our studies may be considered as pervasive conceptual structures for understanding addiction.

Participants' acknowledgement of the complexity of the causes of addiction suggests a non-reductive mode of knowledge-use. As our interview excerpts demonstrate, interviewees articulated numerous linkages between themes. The extent of overlap between the themes suggested that a more parsimonious description of public views on the causes of addiction would be possible if certain themes were subsumed under others. However, it was our impression that participants' discourse was not organised hierarchically but laterally. Interviews revealed the utilisation of a broad range of interwoven philosophical, sociological, anthropological, psychological, and neurobiological vocabularies by members of the Australian public. This suggests a willingness to synthesise newer understandings, such as those offered by neuroscience, alongside older ones that use moral, psychological or social-environmental terminology (cf. [35, 36]).

Our findings suggest that the uptake of neurobiological explanations at a population level will not necessarily produce the major conceptual changes in individuals' beliefs about addiction hoped for by advocates of these explanations. Instead, neuroscience appears to offer a new lexicon that is absorbed within existing public understandings, thereby modestly reshaping pre-existing beliefs in a sometimes indeterminate fashion. Knowledge of neurobiology would not replace older understandings. This model explains why apparent increases in the acceptance of biogenetic explanations of addiction has not resulted in widespread change of public attitudes about addicted individuals' control and responsibility for their behaviour, or markedly reduced stigmatisation of that behaviour [22].

Our interviews attest to the sophistication of public understandings of addiction that reflects a constellation of views not markedly different from the views of addiction specialists [37]. While our findings support those of Bröer and Heerings' [24] study of individuals living with ADHD, they differ from other studies of individuals diagnosed with mental illness that have shown a greater appropriation of neuroscientific understandings (e.g. [18, 20]). A fertile site for future inquiry would be investigating similarities and differences in the causal attributions made when individuals reflect upon their own condition, as opposed to when one is asked to reflect on another's condition.

Conclusion

Our sample of 55 members of the Australian public accepted multiple perspectives on the causes of addiction, including elements of neurobiological explanations. This study aimed to provide a qualitative understanding that was representative of the Australian public's views on addiction by offering an impressionistic representation of respondents' complex expositions on addiction and its causes. Our findings suggest that members of the Australian public are willing to incorporate new scientific understandings of addiction, including neuroscientific knowledge, into their existing causal beliefs. However, these new ideas are likely to be added to their already complex understandings of addiction rather than them replacing pre-existent beliefs. An important limitation of this study is its likely bias towards representing the views of Euro-Australians and against the representation of other cultural groups—another interesting possible area of future study. Given the characteristics of our sample, our findings should be considered a useful starting point for generating hypotheses and survey questions for further quantitative research. If our findings prove to be representative, increased acceptance of neuroscientific understandings of addiction might not entail the radical changes in public attitudes, relating to treatment and judgment, and policies that its proponents expect or its critics fear.

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62 C. Meurk et al.

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