Understanding brain and mind: representations of neuroscience in Swedish mass media

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Abstract

Findings from the neurosciences and their implications are subjects that are discussed and debated outside the specialised research context and by people that are not themselves part of the neuroscientific community. The article presents an empirical study of the ways that neuroscientific knowledge is represented in mass media. A sample consisting of all texts published in a major daily Swedish newspaper during one year that addressed the brain and neuroscience (n=202) was subjected to a qualitative analysis to elucidate how the brain and the relationship between brain and mental phenomena were represented. The results show that both objectifying and subjectifying representations of the brain are prevalent in the data. The representations of the relationship between brain and mind involves localisation of mental phenomena to structures and processes of the brain, explicit and implicit reductionist interpretations of neuroscientific findings as well as an element of identification where the brain is represented as something that defines the person. The results also highlight the role of metaphor and metonymy in these representations. In the discussion, the understanding of brain as an object susceptible to external influence and the notion of a double subjectivity are related to views on moral responsibilities.

Keywords: neuroscience, media, popularisation, metaphor

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Introduction

Scientific progress in understanding the human brain has been significant and this new neuroscientific knowledge is often claimed to be of great importance in different parts of society. Not only in medicine and health care, but also in other sectors and on a more fundamental level for the understanding of ourselves. These scientific findings and their implications are subjects that have been discussed and debated outside the specialised research context and by people that are not themselves part of the neuroscientific community. A kind of 'translation' of scientific knowledge is therefore required when it is made available to lay people and members of the public. This process is a form of popularisation in which ideas, knowledge and perspectives are interpreted and reformulated in ways that may facilitate lay interpretations and the assimilation of these into everyday knowledge. This article presents an empirical study of the ways that neuroscientific knowledge is represented in mass media and made available to a wider public. By examining a sample of texts from Swedish printed mass media that describe the workings of the brain and knowledge in the neuroscientific field it provides an insight into prevalent ideas about the brain in contemporary society and features of this popularisation of this scientific knowledge.

Brain knowledge in society

The brain is often associated with concepts that serve to define both what is uniquely human and what a person is (Dolan, 2007; Dumit, 2004). The biological structures and processes of the brain are often taken to be intimately related to the human mind and this relationship constitutes the basis of ontological questions that may be seen as fundamental for the understanding of ourselves:

> As an organ of reflection, meditation, and memory, the brain becomes synonymous with what defines the self through the existence of consciousness—of mind. Thus, the brain has been associated with a range of transcendent concepts—soul, spirit, mind, and consciousness—all relating in fundamental ways to one another, both in terms of their perceived location within the brain, and because of the way each works ultimately to define the person to whom the brain belongs. (Dolan, 2007, p 2)

> From a historical perspective, the importance of the body for the perception of the individual has been emphasised, according to Rose (2003). He claims that there has been a shift where a "somatic individuality" has come to replace the psychological individuality that was established in the 1900s. In effect, a biologisation of the person has taken place where the "neurochemical self" has become an important part of our self-understanding. Ideas about the body–mind relationship have also been investigated in studies of how images of the brain, made possible by visualisation techniques such as CT, PET, and fMRI,[1] can be important for changes in the public's notions and attitudes. For example, Schmitz et al. (2003) claim that these images have contributed to the medicalisation of those problems that today are diagnosed as ADHD, and Beaulieu (2002) suggests that they have been a contributing factor in the process where mental phenomena in general, to an increasingly extent, are understood

[1] Computerized Tomography, Positron Emission Tomography, Functional Magnetic Resonance Imaging.

> in relation to a biological frame of reference. The diffusion of brain images, together with other neuroscientific findings, can thus be seen as important for how people understand mental phenomena and how these are related to bodily correlates. Even if it is debatable whether changes in lay perceptions should be regarded as a direct result of the popularisation of neuroscientific findings, [2] knowledge of the brain seems to be key in sensemaking regarding human subjectivity. Vidal claims that "the neuroscientific hype" promotes a certain view of the human being: " As a 'cerebral subject', the human being is specified by the property of 'brainhood', i.e. the property or quality of *being*, rather than simply *having*, a brain." (Vidal, 2009, p 6)

The proclamation of the 1990s as "the decade of the brain" and the nomination of the 2000s as "the century of the brain" (cf. Vidal, 2009) conveyed great expectations for significant breakthroughs in neuroscience and its implications for society and for our self-understanding. In recent times, the old philosophical questions of the mind–brain relationship can therefore be said to be actualised in a special way – a question that some argue has been answered in a reductionist way, where "mental states are reduced to brain states, human actions are generated by brains rather than conscious individuals, and the key dimensions of our humanness – language, culture, history, society – are ignored" (Rose & Abi-Rached, 2013, pp 20f). Although it cannot be assumed that such reductionist interpretations are necessarily implied by neuroscience, and some researchers in the field criticise the way neuroscience is often claimed to be significant for our understanding of human consciousness (e.g., Tallis, 2010), such ontological conclusions are nevertheless prevalent in communications where scientific knowledge is popularised:

> Most neuroscientists are careful to speak of 'the neural correlates of mental processes', avoiding the language of causes, and the language of identity, which suggests that mental states are simply neural states. Their press releases and media accounts are less cautious. (Rose & Abi-Rached, 2013, p 54)

There are some studies of lay interpretations of neuroscientific concepts and findings. Focus group research with lay people has described a discourse of "neuroplasticity" and the "changing brain" (Pickersgill et al., 2015), and have shown how "individuals draw on both neuroscience and the neurological to articulate subjectivity" (Pickersgill et al., 2011). Since many are exposed to such concepts and ideas in the mass media, lay interpretations of media representations have also been examined. Joyce (2005) examined tropes used to discuss pictures produced by MRI technology in the media, popular science texts and hospitals. She identified rhetorical practices that produce "a construction of MRI in which the image and the physical body are seen as interchangeable, the MRI image is seen as superior to other ways of knowing the body, and the technology itself is portrayed as an agent" (Joyce, 2005, p 438). She found that images produced by 'high-tech' machines have a special status and that they "operate as signifiers of authoritative knowledge" (Joyce, 2005, p 457). In popular narratives, the MRI images are not seen as highly mediated representations, but "are embedded in ideologies that equate visual representations with the real and mechanical reproduction with objectivity" (Joyce, 2005, p 457), which is a stance that differs considerably from that taken by many professionals (Beaulieu, 2002). In a study of fMRI images in American print media

[2] Vidal characterises *brainhood* as an ideology that precedes and motivates scientific development rather than being its result, even if "an expanding constellation of neurocultural discourses and practices embodies and sustains that ideology." (Vidal, 2009:5)

Racine et al. (2005) also illuminate features they call "neuro-realism", "neuro-essentialism" and "neuro-policy":

> Neuro-realism is, therefore, grounded in the belief that fMRI enables us to capture a 'visual proof' of brain activity, despite the enormous complexities of data acquisition and image processing. (…) The concept of 'neuro-essentialism' reflects how fMRI research can be depicted as equating subjectivity and personal identity to the brain. In this sense, the brain is used implicitly as a shortcut for more global concepts such as the person, the individual or the self. This is the case in many expressions where the brain is used as a grammatical subject. (…) 'Neuro-policy' describes attempts to use fMRI results to promote political and personal agendas (Racine et al., 2005, p 160).

In an analysis of books and magazines, Dumit (2003) have also shown how the presentations of these images involve ideas about different kinds of brains – e.g., 'the normal brain' and 'the depressed brain' – which are attributed to different kinds of people and presented as demonstrating "a biological basis for mental illness" (Dumit, 2003, p 35).

In a Swedish context, Börjesson (1999) has studied publications in the daily press on children's neuropsychiatric problems. The analysis brings forth rhetorical, moral and political content – how the presentation of scientific findings carries implicit normative messages, and how the presentation can be regarded as a campaign that promotes a biomedical perspective and as "an attempt to launch a naturalised version of the phenomenon" (Börjesson, 1999, p 8). In a mass media study focusing on children's mental health that indicates a shift in how 'psy-experts' discuss these issues, Skagius (2019, p 77) found that "two modes of ordering (…) were prominent in the newspaper during significantly overlapping periods: a psychodynamic mode (1980s–1990s), and a neuro-centered mode (1980s–2008)". Like Dumit, Skagius shows how the neuro-centred model is associated with notions of different kinds of brains, which have implications for what is deemed to be appropriate ways to address children's difficulties.

There are earlier studies that suggest that "members of the public are largely indifferent to brain research" (O'Connor & Joffe, 2014; Pickersgill, Cunningham-Burley & Martin, 2011; Choudhury, McKinney & Merten, 2012), but others claim that the lay public engage with neuroscientific information in ways that have important implications for the construction of both everyday knowledge and policy. Rodriguez (2006) even claims that "a modern folk neuro psychology is emerging which provides an alternative, reductionist, and sometimes competing network of concepts for explaining the mind in comparison to conventional folk psychology" (Rodriguez, 2006, p 301).

> The popular press often reports on the latest findings of neuroscience and cognitive science, and in doing so it presents metaphors and icons about brains that work their way into our shared cultural background knowledge. Clearly, popular media has an important role in the diffusion of science. (Rodriguez, 2006, p 303)

The role of metaphors described here draws on how metaphor has been claimed to be of special importance in conceptualisations of the mind and mental activities. In line with how metaphor has been described as "the main mechanism through which we comprehend abstract concepts and perform abstract reasoning" (Lakoff, 1998, p 244), and how metaphor pervades scientific discourse and conceptualisations (Christidou, Dimopoulos & Koulaidis, 2004), the role of metaphor in these representations of neuroscience is made salient.

This article will present results from an empirical study, aiming to contribute to research on the popularisation of neuroscience in the mass media. To further the understanding of ideas about the brain and the mind–brain relationship that are diffused and made available to the public, an analysis of media representations will be conducted. The mass media environment is complex, with different channels of communication and actors offering a variety and often conflicting perspectives (Ohlsson 2018; Briggs & Hallin, 2016), and its relaying of neuroscience to a lay public cannot be assumed to play a simple authoritative role in relation to lay persons' understandings and views. However, insights into one form of publication can illuminate existing representations that are made available to a wider public. In this study, special attention will also be paid to the use of metaphor in order to contribute to existing research by highlighting the role of metaphorical expression and thinking in sensemaking regarding brain and mind. Thereby the results will both provide an insight into prevalent representations and show how theory of metaphor can contribute to an understanding of sense making regarding brain and mind.

Theoretical approach

The popularisation of neuroscience is here understood as a process in which neuroscientific theories, concepts and images are communicated to a lay public in ways that conform to the everyday knowledge and language. The theory of social representations (SRT) provides a framework for research on the processes where socially shared knowledge is transformed and (re)constructed, and this research tradition has acknowledged the important role of mass media in the construction of common-sense knowledge (Moscovici, 2008; Bauer and Gaskell, 1999; Jovchelovitch, 2007; Farr, 1995). As O'Connor and Joffe emphasise, "it cannot be assumed that neuroscience filters into public consciousness in linear, predictable ways" (2014, p 619), but the ways that issues are represented in mass media are important to investigate to understand part of the process where social knowledge is constructed. In the case at hand, it is a matter of how journalists draw on culturally shared knowledge to both interpret science and communicate this to an audience in such a way that representations of mind and brain can feed into the public's sensemaking and social representations.

Metaphor is prevalent in scientific discourse and conceptualisations, also described as a "unit of circulation" of knowledge between scientific and lay discourses (Christidou, Dimopoulos & Koulaidis, 2004). Boyd claims that metaphors can be considered "an irreplaceable part of the linguistic machinery of a scientific theory" when scientists use them to express "theoretical claims for which no adequate literal paraphrase is known" (1998, p 486). Freud's frequent use of metaphor in his theory of mind, as well as later metaphorical use of terminology from computer science, are examples of how metaphors not only play a pedagogical role in the teaching or explication of theories but also are constitutive for scientific conceptualisations. However, other metaphors can also play a productive role when communicating scientific descriptions and explanations to a lay audience (Mayer, 1998, p 561).

In conceptual metaphor theory (CMT), metaphor is not regarded as only a linguistic or rhetorical trope, but as something fundamental to human thinking and sensemaking; CMT claims that "there are metaphors in mind or 'conceptual metaphors'" (Gibbs, 2017, p 3) that are reflected in language. Lakoff and Johnson who pioneered this cognitive theory of metaphor stressed that "metaphor means metaphorical concept" (Lakoff & Johnson, 2003, p 6) and that their essence is "understanding and experiencing one kind of thing in terms of

another" (Lakoff & Johnson, 2003, p 5). Metaphor is an element of sensemaking whereby one domain of experience is understood in terms of another, and this plays an important role in the understanding of abstract phenomena:

> Because so many of the concepts that are important to us are either abstract or not clearly delineated in our experience (the emotions, ideas, time, etc.), we need to get a grasp on them by means of other concepts that we understand in clearer terms (spatial orientations, objects, etc.). (Lakoff & Johnson, 2003, p 117)

For example, metaphor facilitates the understanding of abstract concepts, such as mental phenomena, in terms of objects and substances, allowing one to "treat them as discrete entities and substances" (Lakoff & Johnson, 2003, p25). In the metaphorical concept, THE MIND IS AN ENTITY [3] , two conceptual domains are actualised, making it possible to understand the abstract in terms of the concrete. This metaphor can be further elaborated in different ways, e.g., THE MIND IS A MACHINE, and THE MIND IS A BRITTLE OBJECT (Lakoff & Johnson, 2003, p 27f). In these metaphors, an intangible domain is conceptualised in terms of a more tangible one – there is a 'mapping' between domains, where knowledge of a source domain provides ways to perceive and understand the target domain in certain ways (which is similar to conceptualisations in terms of analogy): "All metaphors are structural (in that they map structures to structures); all are ontological (in that they create target domain entities)" (Lakoff & Johnson, 2003:264). The structural aspect allows for epistemic correspondences to arise from the mapping between source and target domains – correspondences that "express relations holding between elements in one domain and elements in the other domain" (Gibbs, 2017, p 26). Knowledge of the workings of the source domain can thereby be used to make sense of the target domain that is perceived as structurally similar.

The theoretical concept of mapping is also used in CMT to account for metonymic conceptualisation:

> Metonymy is similar to metaphors in that there is a mapping between elements, but, unlike metaphors, these are typically in one conceptual domain. Instead of organizing relations from a source to a target domain, metonymy reflects a mapping that highlights certain features about an element. (Rodriguez, 2006, p 304)

In rhetoric, metonymy is defined as a figure of speech where one entity is used to refer to another entity that is closely associated or contiguous to it: "Metaphor is based on similarity whereas metonymy expresses simple contiguous relations between objects, such as part–whole, cause–effect, and so on" (Gibbs, 1998, p 258). An example of metonymic conceptualisation in terms of the part–whole relation (called synecdoche) is THE BODY PART STANDS FOR THE WHOLE PERSON, as in "'there are a lot of *good heads* in the university' where heads stands for 'intelligent people'" (Lakoff & Johnson, 2003, p XX). These kinds of expression where one aspect of something is used to represent the thing as a whole primarily serve a referential function, but like metaphors, they can also serve the function of providing understanding and making inferences.[4]

Metaphoric and metonymic expressions are thus not only linguistic features, but expressions of the concepts that structure thinking and the way that we are able to make sense

[3] The convention in metaphor studies to write metaphorical concepts in capital letters and metaphorical expressions in italics is adopted here.
[4] Cf. Barnden (2010) on the distinction between metaphor and metonymy.

of things. According to CMT, metaphoric concepts are pervasive in everyday life and, as Lakoff and Johnson's book title puts it, they are something that we "live by". By examining the metaphorical expressions in language, we can thus learn something about the way people make sense of things and construct their knowledge of them.

Method

A database for Swedish printed mass media (*Mediearkivet*, https://web.retriever-info.com/) was used to collect all texts from the print version of the national daily newspaper *Svenska Dagbladet* in the year preceding that of data collection (2019). This newspaper was chosen because it has a large circulation and readership (171 200 print copies and digital subscriptions in 2019). In similarity with the other major national daily newspaper in Sweden, *Dagens Nyheter*, it occupies a position as being trustworthy in comparison to publications with a tabloid character, A search was conducted that identified all texts containing the word stem *hjärna** (brain*) in both these newspaper. This resulted in a larger number of texts in *Svenska Dagbladet* (434) tha in *Dagens Nyheter* (313) which were retrieved as the sample for analysis. After excluding texts that were duplicates (e.g., shorter texts on the front page that referred to longer articles), short mentions of the brain in passing that did not provide data for analysis (e.g., reports on new helmets that reduce the risk of brain damage) the subsample compromised 202 texts that were given ID numbers (see Appendix for an overview).

The data were subjected to a two-step qualitative analysis. First, the data were analysed with a descriptive approach guided by two questions: (1) What is said about the brain in the text? (2) How is the relationship between the brain and mental phenomena depicted in the text? Codes, content categories and themes were inductively created following conventional steps in qualitative content analysis (Graneheim & Lundman, 2004). In the following results section, the themes are used as headings with content categories presented as subheadings. The results concerning the first question are presented as two themes: *The brain as object* (comprising five content categories) and *The brain as subject* (with three content categories). Results concerning the second question are presented in the section *The relation between mind and brain* that comprises three categories. Extracts from texts that exemplify content contributing to the categories are presented with their ID numbers in brackets. The extracts were translated from Swedish into English by the author. The analysis does not attend to the genres and authors of the texts, since the focus of the present study is on the representations per se as well as the role of metaphor in these.

In the second step of analysis, the theoretical concepts of metaphor and metonymy were applied to elucidate how the representations studied can be understood in terms of different kinds of mapping between domains. Examples of explicit metaphorical language in the texts and an interpretation in terms of conceptual metaphors are presented in the section *Metaphorical representations*.

The analytic process involved repeated re-readings of the sample texts and an iterative method with the purpose of illustrating important features of how brain and the mind–brain relation is represented in the material – representations that are assumed to reflect features of the construction of everyday knowledge. To ensure rigour and validity in the analysis, preliminary results were presented for evaluation in researcher seminars during the research process.

Results

The number of texts dealing with the brain shows that this is a topical issue in the media examined. The analysed material includes three article series – "With the brain in teaching" (*Med hjärnan i undervisningen*), "The brain and learning" (*Hjärnan och lärandet*), "When the brain falters" (*När hjärnan sviktar*) – and eight popular scientific books that have the word "brain" in their titles are presented and commented on. One book on human evolution that focuses on the workings of brains is also serialised in the newspaper, in which recurrent comparisons are made between humans and animals. The fact that the brain was also that year's theme of the annual TV show for young children "*Sommarlov*", broadcast every morning during the summer holidays, and in which tips for how to "exercise what is probably the body's most important organ" [S84] are given, contributes to the overall picture of just how much attention is paid to the brain in the material.

Theme 1: The brain as object

In many of the texts, the brain is mainly presented as a biological object and the analysis resulted in five content categories that correspond to characteristics of this object.

Biochemical processes. Several biochemical processes are specified in descriptions of the brain as a biological object. These are presented as essential for the functioning of the organ and as causes for mental and behavioural phenomena. Levels of different neurotransmitters and hormones are, for example, described as decisive for how emotional states occur in the individual: "Too low levels of the neurotransmitter serotonin in the brain is supposed to contribute to, or even cause, depression […] Serotonin does not induce euphoria, rather a resigned calm. Comfort and a sense of security" [S18]. The way that serotonin levels are presented here as the cause of both positive emotional states and depression is similar to the role it is accorded in other texts where it is explained that decreasing levels of serotonin "result in a withdrawn state, similar to depression" [S26]. "Decreased flows of the neurotransmitter dopamine" are also presented as characteristic of the disability ADHD and as "a biological vulnerability that interacts with societal changes" [S42]. Research on "whether OCD can be caused by disturbances in neurotransmitters (like serotonin)" is also reported on [S132]. In addition to neurotransmitters, hormones such as oxytocin are given a central role in biochemical processes that are represented as essential for experiences and behaviour: "Strictly biologically a lot happens at first eye contact. The brain activates empathy and social interpretation, it secretes our attachment hormone oxytocin" [S86]. The brain is here said to "activate" behaviour by secreting the hormone. In other formulations the brain's "reward system" is given a similarly central role in explanations of behaviour: it is described as "the foundation for all our behaviour" [S67] and its workings are related to the "psychopathic traits" of criminals [S177]. The causes of "high sensitivity" are also presented in terms of the workings of the nervous system: "The highly sensitive person is believed to be born with a more sensitive nervous system that makes them take in more sensory impressions from the environment and process them in a deeper way in the brain" [S178]. Less specific descriptions of brain processes are also presented as the biological foundation of different conditions, as when ADHD is described as "essentially a biologically caused disability"; "At group level the brains of people with ADHD look a bit different and they function a bit differently" [S138].

The primitive brain. The brain and its functions are often described as something very complex. It is recurrently stated that our brains are the result of long evolutionary processes, that "our brain, our body and their functions have been shaped over millions of years" [S112]. We are said to be carrying "evolutionarily programmed reaction" [S60], "mechanisms that we

have been bearing since ancient times" [S86] and "an ancient system that used to help us survive" [S105]. Another text states that "(o)ur inner signal systems are calibrated for survival. […] systems that have been calibrated in a world that was life threatening […] Our stress system is the result of many million years of evolution" [S176].

These renderings of the brain as having been shaped by evolution involves an understanding of the brain's functioning as something primitive. When the brain that is the result of evolution is confronted with life in contemporary society it seems like a relict that is badly adapted to its new milieu. It is stated that "the world that we humans have created is not made for the human brain" [S13], which explains why "our modern lifestyle is making our ancient brains feel so bad" [S157]. This explains why the technology that we interact with can affect us in effective ways: "The digital world hacks into deep-lying mechanisms that have been with us for millions of years" [S24]:

> Manufacturers of mobile phones, and social media in particular, have been extremely good at attuning their products to the reward system of the brain. Likes are withheld and portioned out when our reward system is triggered to a maximum, which creates an addiction. A basic mechanism that has helped us survive has been hacked and exploited. [S26]

In the situation we find ourselves in today, the brain appears to be primitive – it is adapted to conditions other than the present ones; it "feels bad" and makes us feel bad when, for example, stress systems that are not appropriate for the context are activated, and knowledge about its nature makes it prone to manipulation and exploitation.

The vulnerable brain. In several texts, the functioning of the brain is described in ways that make it seem like something precarious and vulnerable. Some of these deal with disease processes that are detrimental to brain functions (e.g., the article series "When the brain falters" on dementia). But there are also examples of how the brain is taken to be vulnerable in the sense of being easily influenced in ways that have a negative impact upon us. The neocortex is described as "a good thing – but it is easily disarmed. It does not take many glasses of beer to turn a human back into the ape-man stage" [S27]. Significant limitations of the brain are also implied in statements about the brain's attention span: "The brain can focus for about fifteen minutes, then something new needs to happen" [S173]. Once more, it is suggested that the difference between our contemporary environment and the environment in which humans are thought to have lived previously explains part of the vulnerability:

> Then, there was plenty of time for the brain to recover during the day, but where can we find that calm in the post-industrial world of today? We are surrounded by machines and devices that constantly call for attention and stress our brains more than what is good for them. [S72]

It is purported that "our brains are constantly revved up to constant high-stress levels, where nothing much is needed for the whole system to collapse" [S13]. It is a precarious state where the content of our daily lives "attacks the brain" [201] and we run the risk of developing inadequate behaviours and addictions:

> Our curious brains have difficulties with resisting the impulse to see what will appear with the next swipe of the finger on the screen. New is exciting, and information is a kind of reward. Curiosity is driven by the secretion of dopamine. [S85]

> The consequences of this are described for students who are said to be unable to manage the availability of computers in school where the presumed inability to "deal with slowness" is said to "devastate the ability to succeed in school." [S123]

The brain is said to be "under attack", essential parts are "easily disarmed", it is incapable of dealing with slowness, and needs rest. The texts describe fundamental weaknesses and a risk that "the whole system will collapse" when faced with contemporary life.

The malleable brain. Closely related to the images of a primitive and vulnerable brain are descriptions of the brain as a malleable object. The functioning of the brain is not only prone to disruptions but, as we have seen, vulnerable to manipulation in different ways. This is not only presented as a risk but also as an opportunity. "A digital detox" [S3] is suggested as a solution to the problematic addictions that have been mentioned previously, and the "plasticity" of the brain is construed as providing opportunities for more profound modifications of both brain structure and process:

> We are born with different brains, just as we are different from each other in other ways. But primarily we have a plastic brain that changes according to how we use it […] Whatever brain you have you can develop in a variety of ways. Every minute of your life you have the opportunity to do that. [S6]

This plasticity means that the brain does not only change as it matures during childhood and adolescence [S177]. Even if it is stated that "the brain is strongly affected by the activities that you engage in during adolescence, no matter what they are" [S85], this influence is not restricted to a limited period in life. Different activities are said to cause changes in the brain throughout life, whether it is learning a new language [S9] or dancing [S12]: "the brain is enhanced when exposed to new experiences and variation" [S8].This type of description offers great promise regarding the possibilities available for developing the brain through behavioural change with far-reaching consequences. But, as we have seen previously, certain behaviours might also inflict modifications that are considered negative or considered to be risks. The ability of "deep reading" is, for example, said to be impaired by "digital reading" because "the brain is changed when it adapts to the digital world" [S148]. Young people's "screen time" is said to "result in a generation with modified brains […] The very connections in the brain's circuity is affected in a way that leads to an impaired ability to concentrate" [S67].

Physical exercise is also related to the functioning of the brain and its well-being. In some texts this is described as a means of "maintaining the health of the brain over time" [S181], while others proclaims that it can be used to prevent specific health issues such as dementia [S62] and depression: "It has been proven that physical activity makes the brain stronger and more resistant to depression" [S139]. Diet is similarly described as a means to affect brain functioning: "food affects your brain in both the short and the long term" [S7], which makes it possible to choose a diet that impacts on "our cognitive capacity, such as memory, learning, concentration and problem solving" [S80], to "become smarter" [S84] and to "boost the brain" [S21] with dietary supplements.

In several texts, the potential to influence the brain is linked to opportunities to slow down the negative consequences of aging. It is emphasised that it is important to keep the heart and vessels functioning well to "preserve the brain's functions" [S126], and "challenging the brain" [S183, S176] is suggested as a way of counteracting negative aspects of the aging process.

The manipulation of brain functions by pharmacological means is presented as both something frightening and a possibility. This is the case in texts that deal with medication for ADHD containing methylphenidate which is described as "affecting the development of the brain in children" and its "structure" [S121]. One text reflects on how statements like "ADHD medication alters children's brains" can give a potentially frightening picture of a global and pervasive change: "Just the word 'changes' can be experienced as scary when it is connected to children's brains. But change is what we hope for. That is why you take the medicine [S138].

It is emphasised here that "in the children who were treated with ADHD drugs, the brains had become more like those of the normally functioning children", which paints the neurological change as the normalising of a deviation. Compared to this normalising treatment, the effects of psychedelic drugs are presented as something that affect the brain in a way that enhances various mental abilities. They are supposed to "add to the dynamics of the system" by increasing the communication between different parts of the brain, and "micro dosing" with certain drugs is proposed as a means of "sharpening one's creativity" [S128].

Thus, the brain is represented as an object that can be influenced and manipulated in an active and purposeful way. With reference to research in the neurological field, both specific mechanisms and more global effects on the brain's functioning and "health" are depicted, which are linked to desirable states and abilities. Knowledge of these opportunities are thus associated with a responsibility; when writing about "brain health" it is claimed that there is a need for "knowledge about how individuals and families can care for their brains" [S13]. When new books on the theme "exercise and brain health" are introduced in the newspaper, the reader meets imperative book titles such as "Eat brain smart!" [S7] and encouraging tips for how one can improve one's brain status with a "training book to accelerate the brain's plasticity" and "increase the brain's capacity" [S14]. When the brain is presented as continuously changing as a result of the activities one engages in, the call to actively engage with one's brain is addressed to everyone: "indeed, the strengthening and losses of neurons continue throughout life. You have to encourage the connections you want to keep" [S115]. The reader is also advised to consider how important it is to take breaks to promote the processes of the brain:

> When our thoughts are allowed to wander, something happens in our brains. […] there are other parts that work than when we do something mentally demanding. And this second activity seems to be at least as important. The break is an opportunity for the brain to understand what it has just learned, to process experiences and draw important conclusions [S195].

We need to "encourage" connections for certain learning to take place, give the brain the opportunity to "understand", "process" and "draw conclusions". We need to consider which activities we are engaged in to support the functions of the brain and give the brain "help to work at a high level" [S200]. The brain also needs help when it becomes "overloaded"; the reader is told that we need to "calm down" and "regulate our nervous system" [S13]. The possibilities for influencing the brain are hereby construed as a project of managing one's brain in everyday life. But there are also calls for the expanded responsibility of others when it is emphasised that "(w)e can improve nutrition and schooling and ensure that people grow up with well-developed brains that have not been put under extreme stress." [S185]

Technological possibilities. In addition to the picture of how one can influence the brain with various means in everyday life, a more visionary picture also emerges of the potential in a growing knowledge of the brain as an object. It is reported that researchers have "brought life

to dead brains" with the "hope of one day being able to transplant brains" [S63], how by surgically implanting electrodes into the brain researchers were able to provide relief "for extremely painful obsessions" [S131], and how "a paralysed man can walk again with the help of a robotic suit that he himself can control via brain signals" [S158]. In the reporting on research results, significant applications in several areas are envisioned:

> In recent years, brain research has given us more and more knowledge about what the brain needs, and we thus have a clear instruction book about what we need to change in our society for increased mental well-being. [S13]

The existing state of knowledge about the brain is frequently presented as impressive – often in relation to how brain imaging technology has been developed and used in research. It is stated that "magic has become measurable"; "(s)ome forms of magical thinking, which people in different cultures have engaged in for millennia, can today be explained with the help of modern brain imaging techniques" [S88]. It is also said that "(r)ecent years of brain research have shed new light on all kinds of human personality traits" [S176]. Under the heading "It can already read thoughts" claims are made that "(a)lready with today's technology it is actually possible to know roughly what a person is thinking with considerable precision", which is paired with descriptions of how "the boundary between man and machine is erased" and visions of "a technology where the computer seamlessly integrates with our brains" [S110]. The possibility of "controlling a phone with thought" is presented as being within reach in light of how "already today you can read signals from the brain with fairly good accuracy" [S199]. Other descriptions are more reserved, but no less promising:

> Read our minds? An AI that turns your thoughts into words on a screen – does that sound surreal? It is actually a reality already today, albeit not flawlessly. […] their AI can translate brain activity into words on a screen in real time. [...] To say that AI can read our thoughts is perhaps taking it too far – but remember that development is fast. [S190]

Technological development is presented as the basis for how neuroscience has developed knowledge that is already crucial today in various practical areas. Not least in the field of education. Here, references to neuroscience serve as arguments in a debate between different educational models:

> But in fact, the debate between traditionalists and progressives is already settled, as the teacher and debater Isak Skogstad shows in his newly published book *Uncomfortable Truths about School* [*Obekväma sanningar om skolan*]. Advances in cognitive research and neuroscience in recent years lead to the conclusion that methods associated with traditional learning are largely superior to progressive pedagogy […] There is such a wealth of research that by now we know very well what systems work and which do not. [S166]

An "abundance" of research is mentioned to corroborate the claim that the debate is "settled", and the knowledge of cognition together with neuroscience is presented as the starting point for designing teaching in the best possible way. The assumption reappears in a description of how more and more people are turning to "research on the brain" in "search of the key to learning" [S173].

Some texts thus give a picture of how knowledge about the brain has already reached the state where questions that have been considered for a long time in other disciplines (such

as education) can now be answered by neuroscience. In other texts, an expectation is expressed that in the future neurological research will provide completely new insights into and understandings of phenomena that are considered in other disciplines and vital in the work of professionals. For example, it is claimed that "(i)n the long run, they can provide architects with evidence for their strategies that previously could only be supported by intuition." [S83]

Theme 2: The brain as subject

Alongside representations of the brain as a biological object, there are many texts which attribute properties to the brain in a way that makes it appear as a subject. Such subjectifying representations are presented below as a theme based on categories that present how the brain is attributed experiences and volition, the capacity to act as an agent, and how the brain is represented as a separate subject that exists in a relationship with the subjectivity of the person.

Experiences and volition. As we have seen, the brain is described as "curious" and "searching for stimuli". There are many other formulations that attribute to the brain the properties of being able to have experiences as well as having a will. In the texts, there are several examples of how the brain is said to have negative and painful experiences: "A lot of sitting can be experienced as stressful by the brain, because it causes the brain to experience the body as stuck" [S13]; texts describe how the brain can become "exhausted" [S2], how it "cannot bear to think things through thoroughly" [S47] and how it can "feel bad" [S157]. When it is claimed that "(m)ental illness is a signal that our brains are not feeling well" [S13], this feeling certainly appears to be related to the individual's mental well-being, but at the same time something separate from this. In addition to having these experiences attributed to it, the brain is also capable of volition in formulations about how it pursues certain states, such as "remaining in old habits":

> (A) new behaviour is unfamiliar and triggers fear in the brain […] a part of the brain wants to automate things. Doing things in a new way requires energy from the brain and it wants to save as much energy as possible […] the brain is designed not to want to break habits. [S59]

The formulation does not only localise "fear" to the brain, but also attributes to the brain a will to do different things. In other cases, there are formulations about how the brain wants "dopamine kicks" [S123] – that is, how it strives for a certain kind of experience – and how the brain of the highly sensitive person "wants to shut down" [S178] when it experiences sensory overload.

Agency. Language that represents the brain as an active and acting subject is common in the texts. "To constantly have to ignore the impulse to pick up the mobile phone is not a passive action for the brain" [S24] is a formulation that assigns to the brain the act of ignoring an impulse. Formulations such as "the reading brain" [S64] make the brain a reading subject, as does the formulation about how the brain is limited in this respect: "the brain simply cannot read and listen to different things at the same time" [S4]. The brain is said to "make decisions" [S2], "guess what is going on" in the external world and inside the body when it "creates feelings" [S73], and it is said not only to "want predictability" [S104] but should also be able to "be confused" [S132]. The brain is described as capable of information processing

and interpretive activity in descriptions of how "(t)he brain wants to create ingroups and outgroups" [S175] and how "a hundred objects can be gathered in a group, and the brain reads it together as one" [S160]. It is said to "process experiences", "draw conclusions", "understand" [S195] and "simplify difficult events and complex contexts into concepts and even better symbols and images" [S136]. The brain's activity is described as directed towards a future that it constantly works to "predict": "The brain creates images and prepares for what is to come" [S88].

> In a continuous loop, the brain tries to anticipate what will happen next. It guesses, calculates, draws conclusions. […] Your brain tries to understand what is happening by linking the sensations in the body with past experiences and what is happening in the moment. […] The brain is a self-organising prediction machine. [S75]

To the frontal lobes is attributed the task and ability to "inhibit impulses, take another person's perspective, understand consequences, plan and maintain attention" [S85]. Not least, the brain is accredited with a capacity for learning: "Our brain is a device that is simply very good at learning new things" [S111].

A double subjectivity. The subjectifying representations in the texts lead to a form of subject dualism where the brain as subject is opposed to the individual's own experience of subjectivity – a dualism where two wills can confront each other and try to do something to the other. For example, the brain is said to "reward us" to make us continue with a certain behaviour [S26]. It can work to "guide us correctly in how we should behave in different situations" [S33]. It can alert the individual to danger ahead by "sounding the alarm" [S117], and it is said to manage

> our planning, impulse control and it keeps us focused on what we need to do. It is the one that stops us from going on Facebook as soon as we are bored, or binge eat crisps when we are hungry. [S195]

On the other hand, the individual is described as being able to act towards the brain and guide the brain's work, to "help the brain work in the right direction" [S59]. We can "teach" the brain different things, such as how to deal with distractions [S200].

In this way, a picture emerges of a duality between two consciousness that exist within the individual – a duality that is sometimes described as conflicting, e.g., in a text about the exertions of a participant in a marathon march. Here, the language portrays a dialogue between two voices where the brain is equated with reason: "Reason is my worst enemy. The brain wants to survive and therefore it screams: Stop it! Stop walking! Rest! Then it is important not to listen, but to defy the mental limit." A split into two persons is described: "One who just wants to stop walking, and one who wants to keep going, focused on accomplishing the set goal. The two voices converse and wrestle with each other." [S61] A similar duality is discussed in a text that links it to problems of understanding consciousness and free will. Here, too, the brain and consciousness are given voices to represent the relationship between different instances within the human being, which is illustrated with the reaction to a red traffic light: "how does the brain say: 'Aha, stop!'?" [S69] In these representations, the individual thus splits into two subjects who are described either as being able to adopt a supportive and guiding approach to each other, or to relate to each other conflictually. The latter is evident in formulations about how it is possible to "trick" one's brain: it can be made to "think that it is night" when it is not [S55], and it can be "tricked" into "wanting to keep exercising" [S59]. In texts dealing with attempts to lose weight,

descriptions of a struggle recur, and it is said that our own brains can work against us [S97, S105].

The relationship between mind and brain

The analysis that was conducted based on the second analysis question led to three categories that capture recurring elements in how the brain is related to psychological phenomena in the analysed texts. This involves how such capacities of the brain that the previous analysis has highlighted are localised to specific biological elements, how many representations draw on a reductionist ontology, and also how the brain is presented as something the defines the individual person.

Localisation. In the representations of the relationship between mental phenomena and the physical brain, connections are made that not only refer to the brain as a whole, but also localise different mental functions and processes to specific parts or regions. Some localisations are vague, such as references to an unspecified "part of the brain that wants to automate things" [S59], or "(t)he brain's reward system" which is said to be the "closest neighbour in the brain" to "our centre of learning" [S105]. Other localisations refer to larger parts of the brain, such as "the deep emotional parts of the brain" [S92]:

> The brain has a reptile part, a dog part and an ape part that are responsible for reflexes, drives and abilities – and above it all hovers the newest part, the neocortex, which makes us human. It allows us to reflect, control ourselves and think about consequences. [S27]

Several texts attribute important mental faculties to the neocortex and the frontal lobes. To the latter are attributed "the ability to restrain impulses" [S112]; they "must inhibit impulses, take another person's perspective, understand consequences, plan and maintain attention" [S85]. It is claimed that "(t)his part also takes care of our planning, impulse control and keeps us focused on what we should" [S195]; and it is said to be important for "language, emotion regulation and our ability to value how our own behaviour affects others" [S177]. The neocortex is briefly characterised as "the 'thinking' part of the brain" [S119]. A certain part of the cerebral cortex is said to "take care of logical deduction and detailed observation" [S12] and the cerebral cortex is also pointed out in a concrete way as the home of language: "That's where the grammar is located [...] The thicker the cerebral cortex a person has in a particular part of the left frontal lobe, the better the ability to understand grammar" [S9].

In summary, there are several statements about how specific parts of the brain are linked to different mental faculties. However, there are also examples of how the relationship between the involved parts of the brain and mental phenomenon is described as complex or unknown. Emotions are, for example, described as something dynamic and elusive: "there are no special connections for emotions in your brain. The patterns look different every time" [S75]. It is also stated that "no neurologist has found NCC, neural correlates to consciousness. We can locate brain centres for most things, but not for consciousness" [S69].

Reductionism. There are a few examples of formulations that contradict reductionist understandings of the relationship between the mental and the neurological. One text states that pain, as a subjective phenomenon, cannot be reduced to what takes place in the nervous system: even though measurements of nerve cells can be made by magnetic camera examination during pain stimulation, this does not mean that they provide an image of pain:

"Actual pain will never be measurable" [S17]. Another text claims that "(a)ll these brain images from functional magnetic resonance imaging (fMRI) scans actually say very little, or nothing, about psychological processes" [S162]. But such nuanced descriptions of the mind–brain relationship are rare and often it is unclear to what extent an expression should be interpreted figuratively or literally when a writer is identifying a phenomenon with something corporeal. How, for example, does one understand the statement where "language development, reading ability and hand motor skills" are given as "examples of parts of the brain that can be influenced by screen use" [S67]? The alternation between talking about neurological and psychological phenomena often makes it unclear how these are related to each other. In a text about children's language learning, it is said that "(i)t's all about how the brain develops" and "(e)verything seems to be connected to how our brain works. […] Because, as you get older, a range of cognitive skills develop". The cognitive skills are linked here to the functioning of the brain and even if terms such as "cognitive tools" and "learning strategies" [S167] are used, the relationship between these and the developing brain comes across as confused. It can also be noted that two article series included in the analysed material have titles explicitly stating that they deal with questions about the brain: "With the brain in teaching" and "The brain and learning". In these series, however, there are texts where nothing is said about the brain. Here we find articles that deal with the importance of pedagogical approaches and relationships between teachers and students for student learning and development [S10], about happiness research [S170], about breaking bad habits [S171] and about how secrets make us feel worse [S186], without this being related to the brain in any way. This could be understood to mean it is taken for granted that if we talk about things like pedagogy, relationships, happiness or habits, we are really talking about the brain and its functioning. Bringing these articles under the headings of the article series thus expresses an implicit reductionist understanding of these phenomena.

Reductionist arguments that explicitly claim that mental phenomena can be completely explained and described in neurological terms are not found in the material, but there are many representations that seem to implicitly draw on underlying reductionist assumptions about the relationship between mind and brain. Aspects of mind are represented in ways that seem to make them identical with neurological phenomena. Our experience of making free and conscious decisions is problematised based on research about "what happens in the brain before we know that we will do what we do" [S50]. Empathy is also said to have "come into focus" through studies of our brain [S134], and the text about dancing links interpersonal interaction and empathy to the phenomenon of synchronicity: "Several studies have shown that the brains of people who dance together can be 'linked' together. The low-frequency brain waves of the dancers then adapt to each other" [S12]. Connecting brains and synchronising their activity comes across as a way of describing something that is essential to social interaction and empathy. Aesthetic pleasure is also something that is transferred to the brain when writing about "the most perfect chord sequence for the human brain" [S172]. Also, unconscious impulses and how they are allowed to be expressed appear as phenomena that can be described in neurological terms:

> Our unconscious is full of primitive desires and prejudices that most of us continuously suppress in order to behave at least reasonably civilized. The American neurobiologist Robert Sapolsky has described it as different parts of the brain competing to determine our behaviours. [S112]

We also encounter images of depression as fundamentally a bodily condition. Depression is given as an example of mental illnesses that are "characterised by rigid brain dynamics"

[S128] and as a consequence of when "the brain stops caring about what is happening in the outside world." [S75].

Identification. We have seen how the subjectifying representations involve examples of how two subjects are set against each other – how the brain is characterised as an autonomous subject alongside the person's consciousness. But there are also representations based on an idea of identification; that the brain defines the person and who they are. This is not only the case in statements that explain problematic conditions such as Asperger's, ADHD, ADD and anxiety problems where it is claimed that "brains look a bit different" [S138], or when the actions of a ruthless violent criminal lead to the question "what made his brain so atrophied?" [S56]. The linking of traits and behaviours to a brain that functions in a certain way is also done in a more general way: "personal characteristics are not something we choose, but something we get", they come with "the brain and the programming we have been assigned" [S120]. A writer describes how she "always had a volatile nervous system" which is given as an explanation for her sensitive personality: "Being forced to live protected from too much stimulation is part of the story of me" [S169]. Descriptions of how highly sensitive people are "believed to be born with a more sensitive nervous system" [S178], reports on how brains of "creative people" are studied to understand the basis of creativity [S16] and formulations such as "having a math brain" [S6] give an image of how personal traits and abilities are rooted in neurological characteristics. Understanding your brain thus appears to be a way to understand yourself as a person.

But the knowledge of the brain is also presented as a means for a more profound self-knowledge that involves fundamental insights into the human condition:

> We are born with different brains, just as we are different in other ways. But above all, we have a brain that is plastic, that changes based on how we use it [...] Whatever brain you have, you can develop it in a multitude of ways. Every minute of your life you have the opportunity to do so. [S6]

The idea of the brain as something that defines the person is combined here with a description of its plasticity, which results in a picture of possibilities; how you "every minute" [S6] of your life have the opportunity to shape your brain and thus who you are. The picture of the malleable brain and how we develop as people is also connected to how others around us can contribute to this process:

> If you are taller than your classmates, people may treat you as if you are older and therefore talk to you as if you are more mature and knowledgeable. It makes you and your brain develop a little extra. Like a self-fulfilling prophecy. [S144]

Knowledge of the malleability of the brain appears as something that can lead to an insight into human possibilities. Descriptions of the functioning of the brain also lead to problematisations of things that are often taken for granted about humans. The questions how "we persist in believing that we are rational" [S41] and "the neurophilosophy of free will" are said to be "crucial for our view of responsibility and what it is to be human" [S50].

Metaphorical representations

In the texts, we find a pervading dualistic figure of thought that treats mind and brain as two conceptual domains that are related to each other in different ways. These domains serve as a

foundation for a rich variety of metaphorical expressions for representing and making sense of both mental and neurological phenomena. We see this in representations of processes and causation that draw on our everyday life experiences to reify and explain the workings of the brain. For example, experiences of how a lot of mental activity can make one tired serve as a source domain when construing an argument about how neurological activity can make the brain *tired* (target domain). Metaphorical expressions claiming that the brain can be made *strong and resilient* [S139], that one can improve one's *brain fitness* and thereby increase its *capacity* [S14] serve as examples of how experiences from one domain can be used in metaphorical expressions that present opportunities to conceptualise what is happening in the brain.

When paying attention to metaphorical expressions in the analysis, three metaphors were found to be most prominent. First, several examples of the metaphor THE BRAIN IS A MACHINE are found in the material. Claims are made where machines are used as a source domain to attribute different *mechanisms* to the brain and describe both its proper functioning and instances of malfunctioning, such as: the brain can *go into overdrive* [S13]; the brain can be *overloaded* [S13] and the brain is *a system that can collapse* [S13]. In addition, the brain is explicitly described in terms of a certain kind of machine: the brain is a *prediction machine* [S75], or a *conjecture machine* [S118]. In similar terms, the brain is said to be a *device* that learns new things [S111]. A variant of the machine metaphor is the metaphor THE BRAIN IS A COMPUTER. We find this metaphor used in descriptions of *evolutionary programmed reactions* [S60] and claims that personal traits are *programmed in the brain* [S120]. The digital world is also said to *hack into deep-lying mechanisms* [S24] and the mobile phone is said to *hack into* basic needs [S157]. This shows how the metaphor facilitates sensemaking regarding the brain by construing it in terms of different technological domains.

The second metaphor that is recurrently used in the material is where the brain is used as a source domain to represent mental phenomena: MIND IS BRAIN. This enables mappings from the concrete brain to both mental processes and abilities. The claims that *brain imaging techniques can read thoughts* [S110] and *AI can translate brain activity into words* [S190] can be seen as instantiations of a variant of this metaphor: MENTAL PROCESSES ARE NEUROLOGICAL PROCESSES. Another variant is salient in the texts in which faculties of mind are localised to specific parts and regions of the brain. Even if this sometimes only implies a link between the two domains, there are also examples where entities in the target domain are equated with entities in the source domain: MENTAL FUNCTIONS ARE BRAIN REGIONS/STRUCTURES:

- *different parts of the brain compete to determine our behaviour* [S112]
- *language, reading ability and hand motor skills are parts of the brain* [S67]
- *a part of the brain wants to automate things* [S59]
- *a part of the brain has the ability to stop impulses* [S112]
- *a part of the brain can take another person's perspective* [S195]
- *a part of the brain handles our planning* [S195]
- *a part of the brain makes us stay focused on what we should do* [S195]
- *a part of the brain handles logical deduction* [S12]

Some of these metaphorical expressions can, finally, be considered reflections of a third metaphor that has special importance for the representations that involve subjectification and personification. Lakoff and Jonson describe personification as an extension of ontological metaphors, when a physical object is specified as being a person who "allows us to comprehend a wide variety of experiences with nonhuman entities in terms of human motivations, characteristics, and activities." (Lakoff & Johnson, 2003, p 33) The material

comprises a large number of examples of how the basic metaphor THE BRAIN IS A SUBJECT is expressed in different variants:

THE BRAIN IS A THINKING AND LEARNING SUBJECT
- *the brain can be confused* [S132]
- *the brain draws conclusions* [S195]
- *the brain simplifies complex things in concepts, symbols and images* [S136]
- *the brain collects, manipulates and stores information* [S64]
- *the brain is a good learner* [S111]

THE BRAIN IS AN EXPERIENCING SUBJECT
- *the brain can feel stressed* [S13]
- *the brain can feel bad* [S157]
- *the brain is interested in faces* [S184]
- *the brain can experience a perfect chord sequence* [S172]

THE BRAIN IS AN AGENT
- *the brain reads* [S64]
- *the brain ignores or inhibits impulses* [S24, S111]
- *the brain makes decisions* [S2]
- *the brain tries to understand what is happening* [S75]
- *the brain takes another person's perspective* [S111]

THE BRAIN IS AN AGENT WITH DESIRES AND INTENTIONS
- *the brain wants to automate things* [S59]
- *the brain does not want to break habits* [S59]
- *the brain wants to create ingroups and outgroups* [S175]
- *the brain wants to preserve energy* [S59]
- *the brain wants dopamine kicks* [S123]

Lakoff and Johnson write that personification involves "imputing human qualities to things that are not human" (2003:35). In other cases, it might be clear that this is not intended to be taken literally but rather figuratively. In this case, however, it is far from obvious how the wide variety of metaphorical expressions that map the source domain of an agentive and experiencing subject to the target domain of the brain is to be understood.

Discussion

When knowledge from neuroscience is presented to a wider audience, it produces representations regarding both the nature of the brain and its relationship to mental phenomena. This is done in a journalistic context where the writers articulate their understanding for a lay audience. As we have seen, this entails both explicit and implicit claims of an ontological nature that can have great significance for understanding what it means to be a person. In the analysed material, we have encountered images that can be perceived as alienating, by portraying the brain as an entity within us that acts on its own, as well as images that promote a kind of identification with the brain.

Such representation may have far-reaching implications for ideas about how to conduct one's life. As we have seen, the representations of the brain as an object included notions of vulnerability and malleability. It was associated with notions of both risks and

possibilities. O'Connor & Joffe (2014) identified a similar theme in their study: *The brain is a resource subject to individual control* – not only was the brain associated with pathology and described as "something that goes wrong", but also with the suggestion that "neurocognitive capacity can be altered by individual lifestyle choices" in accordance with a "desire to improve brain functioning" (p 626). These representations involve a more or less pronounced idea of responsibility; we need to take measures to protect the vulnerable brain. We can act to not only protect the brain, but also to nurture and influence the functioning and development of the brain in a positive way. Our biology does not appear to be our destiny or something that determines us, but something "plastic" which can be optimised (cf. Rose & Abi-Rached, 2013). From this follows a moral responsibility in everyday life towards ourselves and others in our care. At the same time, the representations in the texts amount to contradicting notions of responsibility. On the one hand, the plasticity of the brain seems to encourage an active and responsible subject, but on the other hand we have seen representations of the brain as an active subject on its own terms. This implies a loss of control for the person to whom this brain belongs. If the brain is doing the thinking, making choices, and being the source of our urges as well as both our successful and failed attempts to control our impulses, we cannot be regarded as culpable when things go wrong. If the technology that surrounds us is "hacking" into our nervous system, how can we be blamed for the result? Rodriguez's claim that "modern brain symbols provide tangible representations for the target of blame assignment" when understanding child development (Rodriguez, 2006, p 322), certainly seems to apply also when making sense of our selves.

Some of the analysed texts seem to involve deterministic and reductionist conceptions. Their representations allows for a view of our choices and behaviour as determined by "an agentic brain", a view that implies that our choices are not really our own – what I believe to be my own choice is actually only how I experience the workings of the brain. Rodriguez also found that "brain" can be conceptualised as a causal agent that produces ideas and as an experiencing agent, but he found no examples in his corpus of speech acts that used "brain" as an agent for desires or intentions. In reflecting on this he adds:

> given the metaphors that already structure our concepts about the brain and mind, it is just a matter of time until the diffusion of terms and ideas from neuroscience makes it easy to use the brain for all causal roles of folk psychology in ordinary language and casual settings. (Rodriguez, 2006, p 314)

This apparently seems to be the case when considering the data at hand. Here the agentic and causal role of the brain seems to be more salient and involve even volitional aspects of mind.

When studying how metaphor use in ordinary language can be related to folk psychology Rodriguez also accounts for different ways that metaphorical mapping can be related to different conceptions of this kind:

> The fact that mind and brain are mapped together does not fully determine the nature of this identification (for the speaker or hearer). On the one hand, it may be that the brain organ is thought to merely enable or support the mind, and such language use merely implicates some vague association. On the other hand, it may be that the brain activity and brain states not only enable the mind, but they either cause, or are identical with, mental experience. (Rodriguez, 2006, p 310)

The way that Rodriguez shows how brain regions are identified with mental functions, and neuronal firing with mental activity, (Rodriguez, 2006, p 316ff) is similar to both the explicit localisations of mental processes that are presented in several texts and the metaphorical

expressions that have been presented in the results section. The way he describes a "vague association" corresponds with the often-unclear assumptions about the nature of the relationship between mind and brain in this material. But as we have seen, many representations also seem to be implicitly drawing on underlying reductionist assumptions.

Metaphor and metonymy

As we have seen, metaphor plays a central role in representations of mind and brain in the analysed texts. But also, metonymy seems to be an important resource in this sense making. As Gibbs (2022) states, distinguishing metaphor from metonymy can be quite challenging, and Rodriguez shows how metaphor and metonymy are mingled in a complex way: not only do "brain" and "mind" have overlapping meanings that make metaphorical mappings possible in both directions, but "mind"' and "brain" can both "serve as metonymic links that can stand for the properties and items of mental experience and behavior" (Rodriguez, 2006, p 310). What has been described in terms of metaphors in the previous section might also in part be understood as involving metonymic relations, that is relations "between two contiguously related conceptual entities" (Kövecses & Radden, 1998, p 39). Kövecses and Radden point out that "(d)efault metonymies are characterized by a highly salient vehicle entity which affords easy mental access to a target entity" (1998, p 64) which means that the salience of concrete entities makes them useful as sources for understanding more abstract ones, and the salience of visible phenomena (such as the body) provides a starting point for gaining mental access to non-visible phenomena (such as the mind) which are contiguously related. This seems to be the case in some of the analysed texts where a conceptualisation in terms of PART FOR WHOLE is prevalent in the form of BRAIN STANDS FOR THE WHOLE COMPLEX SYSTEM OF THE PERSON. Arguably, some statements about the brain are not to be understood literally, but rather as concerning the whole experiencing and acting individual in a metonymic way. In this way, statements about the brain can be regarded as shorthand for talking about the person. However, whether this is the authors' intention, and how the reader might interpret such statements, are open questions. In cases where the *pars pro toto* relation is not understood as a figure of speech but rather as the reflection of an ontological view it enables reductionist representations which can be characterised as *brain overclaim* and *neurofallicies.* That is, understandings that involve *neuroessentialism*:

> The concept of 'neuro-essentialism' reflects how fMRI research can be depicted as equating subjectivity and personal identity to the brain. In this sense, the brain is used implicitly as a shortcut for more global concepts such as the person, the individual or the self. This is the case in many expressions where the brain is used as a grammatical subject. (Racine et al., 2005, p 160)

It could be argued that the representations produced in a popularising discourse favour such an equating of mental phenomena as a consequence of relying on metaphoric and metonymic representations. If it is true that mind is confused with its corporeal correlate – that it is seen in terms of identity rather than proximity – we could speak of a 'dead metonymy' in the same way as the metaphorical formulations which are no longer perceived as metaphors are called 'dead metaphors'. In the same way, interpretations of images of the brain's processes could be based on such a dead metonymy when they are claimed to show 'the thinking brain'. They would function as "attempts to render 'mind' thinkable by means of images" (Rose & Abi-Rached, 2013, p 54) that risk leading to a false conclusion that what you think you see is 'thinking' rather than a physical phenomenon (blood flow).

In summary, metaphor and metonymy can be said to enable, and perhaps even promote, objectifying and reductionist thinking. Even when one does not start from an ontological view that implies reductionism, a reductionist position might be endorsed by representations involving metaphor and metonymy. These representations are important because they touch on central aspects of what it means to be human. There are striking similarities with how Pramling and Säljö (2007) discuss implications for how we understand the use of metaphors in writing about DNA and genes in popular science magazines:

> With the anthropomorphic claims made about DNA, genes become populated by concepts of agency that are used in other domains: they 'decide', 'do', 'know', and so on. The picture that emerges is one of determinism; it is on this level that the outcomes of life are decided on, as it were. (Pramling & Säljö, 2007, p 291)

The presentation of neuroscience in the mass media could thus not only have consequences for how readers learn about this scientific area, but also contribute to learning about what it means to be a human and a person on a more fundamental level. The representations of the brain that we encounter in the mass media can thus be said to constitute potentially powerful cultural tools for rethinking ourselves.

Knowledge claims and legitimation of expertise

The texts repeatedly refer to what "research" has shown, what someone who is a researcher in the field says, and what has been learned in a scientific context about the functioning of the brain. It is worth noting how this knowledge from the neuroscientific field is claimed to have implications also within other contexts – both in other scientific disciplines and in the everyday context of our lives. As a reader of the texts, one encounters knowledge claims that go beyond statements about the somatic and are extended to apply to a variety of phenomena in our everyday lives. For example, in one text we are introduced to a teacher who, having familiarised himself with the new neuroscience, not only finds himself gaining new knowledge about learning, but also questioning what he previously thought he knew about this:

> Craig Barton was a successful teacher. He thought. Until he started looking at what research was saying about the brain and learning. […] 25 books, 300 research papers and three months later, Craig Barton had questioned everything he believed to be true about learning. [S4]

This quote exemplifies how neuroscientific research is not only understood as a promise of decisive knowledge, but also how it is claimed to have revolutionary potential already today in various practical areas. Here, the possibilities of pedagogical application are sketched in a similar way to how neuroscientific research has previously been presented as something that can resolve conflicts between representatives of different pedagogical methods. When it is stated that brain research has given us a "clear instruction book" in the field of mental health, this application in various fields seems unproblematic – as if a direct translation of knowledge about the brain to knowledge about psychological and social phenomena is possible.

In addition to supplementing or replacing existing knowledge in other disciplines and fields of activity, it appears that neuroscience can be used to give legitimacy to these. The possibility of being able to refer to what is known about the brain seems to be a way of giving weight to one's own activity – anchoring one's knowledge and arguments in research that is

reliable and highly valued. The anticipation of how brain research eventually will "provide architects with evidence for strategies that previously could only be supported by intuition" [S83], for example, seems like hope for a new, more secure basis for the knowledge that these professionals already have. This element of legitimating claims can partly be understood in the light of Säljö's (2002) description of a consistent element in the ontology that characterises our culture:

> a very basic assumption in much academic and, I would also add, everyday thinking in our culture; if something is to be considered as "real", it has to have a thing like character and be ultimately grounded in physical objects or structures. Brains, following this things ontology, are real, while ideas – powerful as they may be – are not. (Säljö, 2002, p 390)

The "thing-like" would thus be perceived as more "real" – as something whose existence is more certain – a form of existence that is less possible to question than that which, for example, ideas have. By tying ideas and other mental phenomena to the brain, they would thus take part in this privileged form of existence, with the result that knowledge about them can also appear reliable in a new way. A similar form of legitimation is also commented on in a text in the studied material where the impact of neuroscience is said to have led to a "naturalisation" of various ideas:

> Few theories and areas of research have had the same impact over the past half century as those dealing with the brain. […] arguments from science are transferred to and shape a political discourse, naturalizing ideas and freeing them from historical burden and responsibility. In this case, it is about how the brain's plasticity enables a 'naturally' anchored elevation of flexibility as a characteristic, which in turn legitimized a neoliberal market, where mobility, uncertainty and precariousness are presented as givens. [S163]

In the material, therefore, not only is legitimisation presented as a possibility, but we also encounter a critical reflection on how such things as political ideas can seem to gain legitimacy and support from neuroscience. However, the transfer of knowledge from neuroscience to other domains is problematic. Vidal (2009) comments on how research studies are

> notoriously vague in their use of the interpretative notions, such as 'role', 'mediation', 'foundation' or 'representation', that should make sense of their results by suggesting the connection that behaviors and brain activation patterns may have beyond statistical correlations. (Vidal, 2009, p 23)

If Vidal here highlights notoriously vague descriptions of the relationship between what can be studied neurologically and the implications of such findings, we have seen how the studied texts also contain many statements that are more specific and made with great certainty. As has been commented at the outset, it is probably reasonable to understand this as a consequence of popularisation and the fact that the texts are written by people who lack expert knowledge in the field. Racine et al. (2005) make similar observations in their analysis of media material and describe what they call neurofallacies in the interpretations made in the media portrayal of research:

> …the way in which some results are presented in the media can be loaded, and whether portrayal of the results is entirely consistent with the intentions of interviewed scientists is an open question. Often we find staggering leaps. (Racine et al., 2005, p 161)

Conclusions

The examined sample gives a unique insight in the context of Swedish mass media and the results show how this discourse is saturated in brain-talk in a way that indicates that neuroscience is presented as a scientific endeavour of great significance to the public. Not only does it come across as a fascinating field of research in its own right but also as a site of new knowledge production that is significant for people in their everyday lives. In addition, great expectations are held regarding the future implications of this expanding brain knowledge. In many ways, the presentation of neuroscience in the media resembles Lundin's description of modern biotechnology as "an industry of hope", or "a cultural dream machine" (2004, p 11) that promises ever greater opportunities to reshape and improve ourselves.

Further, the results show how the use of certain metaphoric language is intrinsically related to representations that draws on and promotes certain ontological positions in sensemaking about defining aspects of the human being. Whether metaphor and metonymy are used figuratively or literally they provide a means for conceptualision that make certain understandings possible. Both objectifying and subjectifying representations of the brain in the texts involve mappings that provide partial understanding while concealing other aspects. As Lakoff and Johnson remind us, the choice of metaphor matters: THE MIND IS A MACHINE allows for understandings other than THE MIND IS A BRITTLE OBJECT: "These metaphors specify different kinds of objects. They give us different metaphorical models for what the mind is and thereby allow us to focus on different aspects of mental experience" (Lakoff & Johnson, 2003, p 28). Even if the brain is not consistently used as a source domain and the mind as a target domain, since there are examples of mapping in both directions (blending), there is a strong tendency for metaphors and metonymies that result in a reification of mind that not only has consequences for how brain and mind are perceived, but also for how different fields of knowledge and areas of expertise are acknowledged.

Considering how both dead metaphors and dead metonymies are involved in this meaning making that gives the representations a taken-for-granted character, it might be worthwhile to conclude by stressing that the way brains, minds and people relate to each other is a matter of meaning making where a wide variety of positions are possible. As we have seen, even if there is a tendency in the analysed material towards reifying and reductionist representations, other ways of understanding this ontological question are present. The kind of critique that Coulter expresses regarding the claims of cognitive neuroscience are important in the ongoing discourse in which scientific views and findings are communicated to a lay public:

> 'Brain' is a name for a bodily organ whose operations, processes, states and functions indeed enable us *as persons* to behave in ways which license the avowal and ascription of 'mental' predicates. However, even the so-called 'mental' predicates are truly predicates whose locus of attribution is the person, and not any real (physical) or projected ('mental') component thereof. (Coulter, 2008, p 19)

The findings in this study contributes to the understanding how metaphor and metonymy in textual representation furnishes not only certain views on the mind-brain relationship, but also

are intrinsic to the knowledge claims that can be made by actors in different fields of practice and scientific disciplines.

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Reviews for version 1

Peter Holmqvist:

In this well-written and structured paper the author explores and analyzes how neuroscientific findings have been discussed and represented in all the articles published in 2019 in a Swedish newspaper. The author uses qualitative content analysis to analyze the material, along with the theoretical concepts of metaphor and metonymy, drawing primarily on Lakoff and Johnson's writings. The analysis is divided into four sections: 1) Brain as object 2) Brain as subject, 3) The relation between mind and brain, and 4) Metaphorical representations. The paper concludes with, first, a section where the author summarizes the findings, relate them to previous studies and discuss some of the societal and philosophical implications of how neuroscientific knowledge is represented in the media. There is then, secondly, a short concluding section. As noted above, the paper has a clear structure and it is easy to follow the different steps in the author's reasoning. The paper also deals with a highly relevant subject, considering the centrality of neuroscientific knowledge claims and practices in contemporary society. However, there are several sections of the paper that I would say are in need of more work and polish, particularly the sections of theory, method and conclusions. I believe that this paper is innovative, but for this to show the author needs to strengthen the paper's core argument and be more explicit with its "take-home message." The paper is also rather long, over 15 000 words, making it somewhat arduous to read at times. I think that a more streamlined and efficiently written paper would make it easier for the reader to grasp the most important findings and knowledge contributions of the paper.

Comments:

Brain knowledge in society

Peter Holmqvist: While the section situates the paper in the research field(s) I find that there is a too heavy emphasis on how neuro-knowledge is authoritative and determining of lay persons' understandings and views. I am not disputing that this is, often, the case, but there are several studies that complicate and problematize this notion, and that instead highlight the translation of and negotiation with neuro-knowledge that people do. See for instance Singh, Ilina. "Brain Talk: Power and Negotiation in Children's Discourse about Self, Brain and Behaviour." Sociology of Health and Illness 35, no. 6 (2013): 813–27. Such a reframing of the introduction would better clarify that the media offers various, and at times conflicting, discursive resources for understanding and conceptualizing ourselves and society. (The author does touch on this in the first paragraph under Theoretical Approach but it is in passing and deserves to be discussed in more detail in the Introduction.) I am furthermore missing something about what this paper contributes with to the existing research. What does it add? How does it expand our knowledge of this phenomena? Is it an empirical contribution? A theoretical one?

Purpose

Peter Holmqvist: Here I have two main questions. My first questions concerns how the author views the relation between media and the neurosciences. It is stated that "journalists draw on culturally shared knowledge to both interpret science and

communicate this to an audience" but this should be clarified and discussed further, particularly in relation to the material and analysis. What role does the journalists play in the communicating and sharing neuroscientific findings? How do the ways that journalists communicate relate to the specific media type, to the textual genre, and so on? (I will return to these questions in my comments on the paper's method.) The analysis is written in a way that fully conflate any distinction between actors. It is, in other words, impossibly to discern who is actually speaking/writing in each article. Is it the journalist? An interviewed expert? Is it a quotation from a book? If the journalist actively draws on particular shared knowledges and interpretive repertoires, shouldn't that be discussed in relation to what the author then analyzes? If the author wants to further develop these aspects perhaps books such as these can be of interest: Briggs, Charles L., and Daniel C. Hallin. Making Health Public: How News Coverage Is Remaking Media, Medicine, and Contemporary Life. London: Routledge, 2016; Ekström, Anders, ed. Den Mediala Vetenskapen. Nora: Nya Doxa, 2004. Secondly, the choice of material could be discussed more in-depth. Why choose Svenska Dagbladet and not, say, Dagens Nyheter? And are there aspects of it being a morning paper, and not an evening paper such as Expressen or Aftonbladet, that could be important for contextualizing what and how it communicates scientific findings? If the paper is meant for an international audience then it could be relevant to also position the paper in the Swedish media landscape as a whole. We also know that the textual genre matters and that knowledge and information can be presented differently depending on if it is a letter to the editor, an interview, an advice column, etcetera. I am also not clear about why the author chose 2019 as the year to focus on. Did something particular happen that year? Was it just a year chosen at random? Would something change if it was 2020 or 2018 instead? My general comment on the Method section is therefore that I would like to see a developed discussion of the material and the process leading to this particular paper and year.

Theme 1: The brain as object

Peter Holmqvist: The Results section is generally interesting to read and easy to follow. But there are some things that I believe could be improved upon. One is, as already mentioned, to consider the choice to omit any details concerning who is 'speaking'. A second thing that I kept coming back to while reading was that it is difficult to grasp the relation between the different main and sub-themes, particularly when it comes to their significance or 'weight'. Was any of the main and/or sub-themes more prevalent? Was the view of the brain as an object and the view of the brain as a subject equally widespread in the articles? Was it more common to present the brain as vulnerable compared to as it being malleable?

The relationship between mind and brain

Peter Holmqvist: I am thinking about if it is possible to somehow integrate The relationship between mind and brain and Metaphorical representations with the rest of the analysis. Especially as Theme 1 and Theme 2 are quite dense and packed with quotations, whereas the former two sections appear more analytical and theoretical.

Conclusions

Peter Holmqvist: A recurring thought while reading was – and this ties back to my comment on the paper's Introduction – that I had a hard time clearly grasping what the paper's contributions were. It is never spelled out what, exactly, does the paper show and find that previous studies haven't. It is instead quite easy to believe that it actually doesn't represent anything especially new since the author consistently refers to other studies with similar findings (this mainly concerns the Discussion section), both concerning how the brain is discussed and represented and the uses of metaphors and metonymy and the consequences of such uses for our understanding of ourselves and various scientific objects. I am quite certain that this paper does have novel contributions and findings – maybe it is the empirical material combined with the national context, or with the theoretical concepts, or all three, or something completely different – but I would be greatly helped as a reader if the author explicitly and very plainly told me what they were.

Reviews for version 2

Nicklas Berild Lundblad:

This is an interesting article, built on a study of popular media content and the representations therein of neuro-scientific findings. The kind of metaphor and metonymy explored by the author skews our perspective in definitive ways, something that is amply explored and highlighted.

Comments:

> *A kind of 'translation' of scientific knowledge is therefore required when it is made available to lay people and members of the public*

Nicklas Berild Lundblad: I think this idea of translation is potentially important and worth expanding on -- see George Steiner's book After Babel.

Nicklas Berild Lundblad: I wonder if this tendency - neuro-realism etc - is unique to neuro science, or if it is a variation on a theme. I would also be interested in understanding if there are unique ways in which lay-people translate scientific findings when it comes to neuro-science.

Nicklas Berild Lundblad: There is an argument for thinking through analogy and metaphor here. Metaphors are fleshed out analogies, so the mechanism here is probably layered from analogies to metaphors to mental models. See https://www.sciencedirect.com/topics/psychology/mental-models#:~:text=Originally%20proposed%20

Nicklas Berild Lundblad: I like the methodology - robust, interesting. I do wonder about the translation step - does something happen when you translate "hjärna" to "brain"? Vad är "mind" på svenska? Här finns något att problematisera.

Nicklas Berild Lundblad: The tendency to consider science as settled in the popularized version is a good, and really important observation. Most researchers would be happy to admit that we know less than 10% of what we need to know about the brain to make confident predictions in any more complex case of causation or even correlation. The public is not flustered by that.

> *conduct one's life. As we have seen, the representations of the brain as an object included*

Nicklas Berild Lundblad: The observation that representations of the brain have direct implications for behavioural adaptations is really interesting and spot on -- this is perhaps something that makes neuro-science uniquely interesting from a representational perspective, compared to, say cosmology. Although you could argue that popular

understanding of entropy and heat death could inspire life style changes, but they rarely do.

Nicklas Berild Lundblad: I am not enturely sure that metaphor and metonymy as forms enable or promoto objectifying or reductionist thinking. I think the particular use they are put to does so. In poetry they do quite the opposite. So there is something about the use here. These may well be special classes of metaphors - compressive metaphors - and that would be interesting to explore.

Peter Holmqvist:

The paper does in general feel more polished and the author has addressed several of the comments I raised in relation to the previous version of the text. I still feel that its unique contributions and strengths are somewhat obscured in the final sections and that they deserve to be pointed out even clearer, but these are minor things that do not detract the paper's significance as a whole. I would therefore recommend it for publication. (But see if it is possible to reformat the paragraph in the beginning that is currently formatted as a quotation.)

Comments:

From a historical perspective

Peter Holmqvist: This paragraph is formatted as a quotation, but I know that it is not from the previous version.

Peter Holmqvist: I am still curious about the choice of - and importance of - 2019 as the year to focus on, but I am happy that more details regarding the newspaper and analytical focus have been added.

Peter Holmqvist: The article's significance is now somewhat more explicitly addressed in this section.