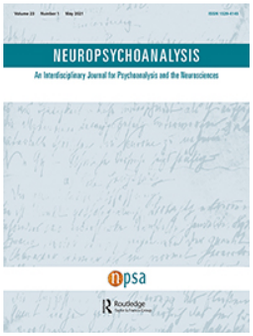

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The structure of neuropsychoanalytic explanations

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ABSTRACT

The "mechanism approach" to scientific explanation is to explain a phenomenon by showing how it is generated through the interactions among its constituents; that is, the explanation elucidates the internal causal structures of what is to be explained. The paper argues that the mechanism approach to explanation may function as a framework for constructing neuropsychoanalytic explanations. One important virtue of the mechanism approach is that it helps us see how different levels, such as the neuroscientific and psychoanalytic levels, are integrated with each other. It is argued that the mechanism approach does not entail reductionism or do away with meaning and understanding. Based on the preceding discussion, the paper touches briefly upon some challenges facing neuropsychoanalysis, such as its supposed clinical irrelevance, the relation between neuropsychoanalysis and psychology, and the future of psychoanalysis in view of the continuously growing knowledge about mind–brain processes.

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Introduction

Neuropsychoanalysis is an interdisciplinary field of research that aims to apply neuroscientific findings to psychoanalysis and vice versa. The bulk of this paper deals with what kind of *explanations* neuropsychoanalysis can offer. The word "explanation" is used in a wide variety of ways in ordinary English – for example, explaining the meaning of a word, explaining how to bake a pie, explaining why one made a certain decision, etc. However, this paper only discusses scientific explanations; more specifically, neuropsychoanalytic explanations. The philosophy of science offers different theories of what characterize the different kinds of scientific explanations, but there is agreement that it is a fundamental contrast between explanation and description. For example, a detailed description of a person's personality is not the same as an explanation *why* the person developed this particular personality. Scientific explanations are supposed to answer such "why-questions."

I will argue that neuropsychoanalysis is well suited to develop *mechanism-based explanations* of psychoanalytic phenomena. Put simply, the mechanism approach to scientific explanation is to explain a phenomenon by showing how it is generated through the interactions among its constituents; that is, the explanation exhibits the internal causal structures of what is to be explained Thus, causation plays an essential part in all mechanism-based explanations.[1] First, I will give an outline of the mechanism approach to explanation and show that it may function as a framework for constructing neuropsychoanalytic explanations. One important virtue of the mechanism approach is that it helps us see how different levels, such as the neuroscientific and psychological levels, are integrated with each other. Second, I will argue that the mechanism approach does not entail reductionism or do away with meaning and understanding. Finally, based on the preceding discussion, I will touch briefly upon some challenges facing neuropsychoanalysis, such as its supposed clinical irrelevance, the relation between neuropsychoanalysis and psychology, and the future of psychoanalysis in view of the continuously growing knowledge about mind–brain processes.

What is neuropsychoanalysis?

A prima facie problematic aspect of neuropsychoanalysis is that it is difficult to characterize or define psychoanalysis. There is a plethora of different psychoanalytic theories, such as Freudian theory, ego psychology, object relations theory, self-psychology, etc. These theories disagree on many important issues, and in addition, a lot of disagreement exists within each theoretical perspective. However, neuropsychoanalysis is not a separate school

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or theoretical perspective. On the contrary, neuropsychoanalysis should be considered as a methodological framework for testing psychoanalytic hypotheses and for constructing explanations for phenomena of neuropsychoanalytic interest. According to Solms and Turnbull (2011, p. 141): "Neuropsychoanalysis is not (in our opinion) a 'school' of psychoanalysis, in the way that we currently speak of Freudian, Kleinian, Intersubjective, and Self Psychology schools. Neuropsychoanalysis, we feel, is far better conceptualized as a link between *all* of psychoanalysis and the neurosciences." Thus, it appears that the psychoanalytic hypotheses worth testing and relating to neuroscience can be taken from all the different psychoanalytic schools.

According to Solms and Turnbull (2002, p. 6, 298 & 302), the clinical method of psychoanalysis has taken us about as far as it is going to, on its own, but it has proved hopelessly inadequate for the purpose of deciding between the competing psychoanalytic theories. In addition, we must take into consideration that the best-supported explanatory possibilities actually may not belong to any of the opposing psychoanalytic camps but are to be found in neuroscience and psychology. I agree with Solms and Turnbull (2002) that it is of utmost importance for psychoanalysis to take into consideration evidence outside the clinical psychoanalytic setting and relate psychoanalytic theories to theories and explanations in neuroscience and psychology.

Psychoanalysis has always been rich with bold and interesting hypotheses, but until recently it has not been the subject of extensive empirical research. However, in the past two decades a robust literature has been emerging (see, for example, Shedler (2010) and Gabbard (2014) for psychoanalytic research concerning psychopathology and therapy). Psychoanalysis has been rather isolated from other disciplines, such as experimental psychology and neuroscience, and researchers in these disciplines have been somewhat hostile, or at least indifferent, towards psychoanalytic perspectives. Neuropsychoanalysis attempts to give psychoanalysis an empirical foundation and bring it closer to the other related scientific disciplines.

In my view, neuropsychoanalysis' most important goal seems to be to update Freudian metapsychology, informed by neuroscientific explanations. In Freudian psychoanalysis, metapsychology has an uncertain meaning, but it comprises the most fundamental theoretical principles on which psychoanalysis must be founded. Freudian metapsychology is a framework for explaining psychoanalytic phenomena and neuropsychoanalysis attempts to establish an updated and empirically based metapsychology founded on neuroscience.

The mechanism approach to explanation

One of the central aims of philosophy of science is to offer a taxonomy of different kinds of explanation and to determine the criteria for genuine and valid scientific explanations. The philosopher of science Carl Hempel (1905–1997) argued that all genuine scientific explanations must refer to scientific laws (Hempel, 1965). In the philosophy of science, Hempel's *covering law model* of explanation was once the dominating theory about scientific explanation and many explanations in physics seem to follow the structure of Hempel's model. Explanations in physics usually refer to laws of nature: for example, Newton's laws, the Schrödinger equation, etc. However, there seem to be few such explanatory laws in psychoanalysis, biology, psychology, and the social sciences. Of course, correlations and generalizations exist in psychoanalysis, psychology, and biology; but these correlations and generalizations usually are not used for explanatory purposes, which means they are not used as premises in covering law explanations. On the contrary, we often find the correlations and generalizations puzzling and want them explained. This point can be illustrated with an example from medicine. The following generalization has been empirically confirmed and illustrates the placebo-effect:

(G) If people are given sugar pills but believe they are taking painkillers, then they will report reduced pain.

Anne took some sugar pills that she believed were painkillers, which explains why she reported less pain. The generalization G illustrates the placebo-effect and we referred to G when we explained Anne's reduced pain. But how do we explain G itself? Why do sugar pills and other placebos contribute to reduce pain? In order to answer this question, we must find the neuropsychological mechanisms underlying G. A complete mechanism-based explanation of G would include, among other things, a description of the brain states correlated with the relevant beliefs and expectations about painkillers, and then show how these brain states generate the release of endogenous opiates that cause reports of reduced pain. An explanatory causal generalization such as G can, therefore, be explained by showing how it is generated by underlying mechanisms.

Sciences such as biology, psychology, and the social sciences explain phenomena by describing the underlying mechanisms that generate them. However, this answer is not satisfying unless we understand what is meant by "mechanism." Without entering into controversies on the different specific characterizations of mechanisms provided by the various philosophical theories, we can adopt a minimal rough notion of

mechanism as offered by Glennan and Illari (2018, p. 92): "A mechanism consists of entities, which comprise activities and interactions that are responsible for the phenomenon we want to explain." A mechanism-based explanation of a phenomenon is a description or model of the mechanism. Thus, a mechanism-based explanation shows how parts and their interactions give rise to the phenomenon we want to explain. More precisely, the mechanism approach involves decomposing a system into its functionally salient components and then constructing a model that describes the interactions among the components that generate the phenomenon in question.

The mechanism approach is a philosophical theory about scientific explanation that was originally meant to provide a description of the structure of biological, psychological, and social scientific explanations (Machamer et al., 2000; Hedström & Swedberg, 1998). The idea of mechanism-based explanations goes back at least to the seventeenth century, and this way of explaining phenomena has undoubtedly been a tremendous success in the sciences. René Descartes (1596–1650) was among the first to introduce mechanistic explanations for much of human behavior, except behavior that was controlled directly by the mind (*res cogitans*), which according to his dualistic view was a separate entity from the brain, but interacted with it in the pineal gland. Hardly any contemporary philosopher or scientist accepts Cartesian dualism; neuroscience and cognitive science are built on the assumption that even higher mental functions such as memory, thinking, and problem solving can be scientifically explained in the same way as other bio-psychological phenomena. This assumption is a necessary condition for providing mechanism-based explanations of psychological phenomena. However, this assumption does not entail reductive physicalism, that is, the view that even mental states such as desires, experiences, and feelings can be completely physically explained and described. There are many non-reductive theories about the mind–body problem that reject both substance dualism and reductive physicalism; neuropsychoanalysis and the mechanism approach to explanation are consistent with at least most of them. Dual-aspect monism is one such non-reductive theory, proposing that there is just one kind of stuff that can be perceived either as something physical or as something mental (Solms & Turnbull, 2002, pp. 56–58).

The concept of *level* is widely used in the sciences, especially in relation to mechanism-based explanations. The concept of level can be defined in different ways, but in this context, it is sufficient to distinguish between ontological and epistemological levels (also named "levels of description" or "levels of analysis") (see, for example, Wimsatt (2007) for more details about the concept of level). See Table 1.

Ontological levels refer to different kinds of constituents of the world.[2] An object "located" at level n is constituted by objects at level n-1, and each of these objects comprises objects at level n-2, all the way down to the most fundamental physical level (elementary particles), that is, level 1. Constitution is a part-whole relation because an object at level n consists of objects (its parts) at level n-1. For example, a watch consists of a spring and several interconnected gears, and each of these components consists of molecules, and each molecule is a structure of atoms. The upshot is that objects at higher levels are nothing but the interactions between constituent parts on lower levels.

For each ontological level, there is an epistemological level consisting of theories, generalizations, explanations, concepts, and descriptions that refers to the objects at the corresponding ontological level.[3] In addition, different methods and instruments are related to each of the epistemological levels. It has turned out to be considerably harder to define the relations between the epistemological levels than between the ontological levels. However, mechanism-based explanations are able to characterize the relations among the different epistemological levels based on the part-whole relations at the corresponding ontological levels. The structure of mechanism-based explanations is presented in Figure 1.

As depicted in Figure 1 and Table 1, the phenomenon to be explained and its composing mechanisms are not two different phenomena. For example, a table is composed of its micro-physical structure, that is, the table and its micro-physical structure are not two different things. On the other hand, cause and effect are distinct events, objects, states, or processes with a possible time difference between them, but this does not make sense for composition. Thus, we must distinguish between causality and composition. The relation between ontological levels is *composition* (see Table 1), but according to the definition of mechanism (that is, activities and causal interactions among entities that are responsible for the phenomenon we want to explain), there are *causal* interactions within a mechanism (see Figure 1).[4]

The personal level

The personal level contains a description of the phenomenon we want to explain, called *explanandum*; the explanatory mechanism is named *explanans*. This level

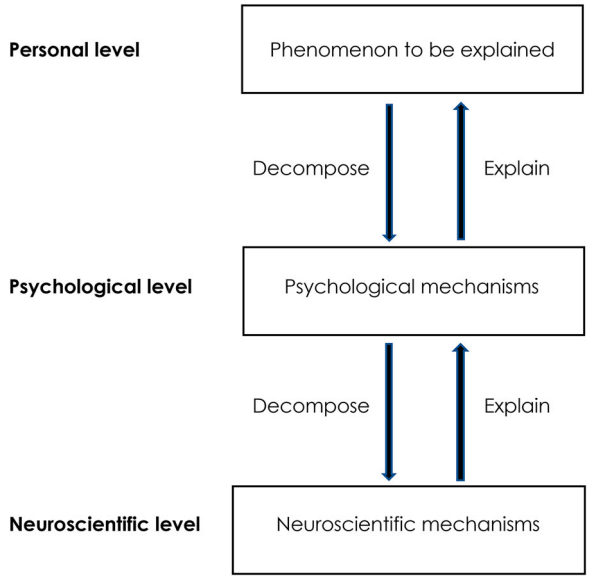

Figure 1. *Personal level*: A description of the phenomenon to be explained. *Psychological level*: The phenomenon is decomposed into its interacting constituent psychological processes, and this mechanism explains how the phenomenon is generated. *Neuroscientific level*: Neuroscientific explanations of psychological processes show how the phenomena are decomposed into, and thereby generated by, interactions between neuroscientific processes.

comprises explananda such as subjectivity, feelings, symptoms, behavioral patterns, and empirical generalizations, which are crucial in psychoanalysis. However, people do not live in a social vacuum, thus social interactions must be included at this level.[5] For example, some studies have suggested that the actions of close family members (particularly mothers and fathers) may trigger psychotic outbursts and relapses in persons with schizophrenia. This empirical generalization applies to parents who display considerable emotional involvement in the form of critical comments, negative attitudes, and over-protective behavior (Bentall, 2004). In this example, if this generalization denotes a causal relation, then we are allowed to conclude that emotional involvement causes and thereby explains psychotic outbursts. The concepts contained in this generalization, and the explanatory generalization itself, belong to the personal level. If we ask about the causal processes that link emotional involvement with psychotic outbursts, that is, how emotional involvement generates psychotic outbursts, then we are asking about the underlying explanatory psycho-biological mechanisms, which are unknown. However, knowledge of these mechanisms would provide an explanation of how emotional involvement generates psychotic outburst. The causal generalization constitutes a genuine explanation, but we gain a more detailed understanding of how actions of close family members cause psychotic outbursts by describing the underlying mechanisms. Also, the placebo example mentioned previously illustrates how an explanatory empirical generalization at the personal level (if people are given sugar pills but believe they are taking painkillers, then they will report reduced pain) can be explained by referring to underlying mechanisms.

Table 1. The social groups on ontological level 5 consist of people (level 4). People are composed of cells (level 3), which in turn are composed of molecules (level 2), which in turn are composed of atoms and elementary particles (level 1). Each ontological level has a corresponding epistemological level consisting of concepts, generalizations, explanations, and theories about its objects.

Level	Ontological	Epistemological
5	Social groups	Social sciences
4	People	Psychoanalysis, psychology
3	Cells	Biology
2	Molecules	Chemistry
1	Elementary particles	Physics

The personal level is also a level of meaning and understanding, that is, accurate descriptions of the analysand's own subjective perspective encompassing beliefs, memories, feelings, fantasies, and desires. In order to describe the analysand's subjectivity, the analyst must use his or her clinical expertise and relevant theoretical knowledge. The analyst's descriptions of the analysand's subjectivity are based on interpretations of verbal reports, body-language, crying, periods of silence, free associations, reports of dreams, and transference/countertransference.

Hermeneutics provides a general methodological framework for constructing interpretations; one of the central principles in hermeneutics is that we can know the meaning of a phenomenon only if we have a proper understanding of the context (Wiggins & Schwartz, 1991).[6] For example, an analysand's idiosyncratic associations may make sense only if you know her life history. Hermeneutics is well-suited for providing detailed and nuanced descriptions of the phenomena we want to explain. For example, based on the analysis of many kinds of patients we may obtain a detailed description of paranoid patients' style of thinking and feeling in contrast to normal people and other kinds of patients (Shapiro, 1973).

Interpretation is a dynamic process and interpretations need to be reformulated or even rejected in view of new information. In this sense, there is an essential similarity between the hermeneutic method and the way hypotheses are tested in all empirical sciences (Føllesdal, 1979). For example, an analyst may need to reject or change her interpretation

because of new information conveyed by the patient; likewise, a natural scientist must change or reject a hypothesis if it is not consistent with new data. A scientific attitude common to all scientists is that we base our theories on evidence and are willing to change our interpretations and hypotheses in light of new evidence (McIntyre, 2019).[7]

As we have seen, hermeneutics and other methods can be used to give accurate descriptions of the phenomena (at the personal level) that need to be explained. The explanations of phenomena, such as experiences, desires, dreams, parapraxes, psychopathological symptoms, and behavioral dispositions and patterns are usually found at lower epistemological levels, that is, the psychological and neuroscientific levels.

The psychological level

According to the mechanism approach, the processes referred to at the psychological level should explain the phenomena at the higher personal level.[8] Freud (1915) postulated the existence of unconscious mental states and mechanisms in order to explain different kinds of phenomena at the personal level: obsessions, ideas and intellectual conclusions that suddenly come into our head, the nature of post-hypnotic behavior, etc. For Freud, unconscious states and processes at the psychological level are inferences to the best explanation of phenomena at the personal level.

Psychological explanations refer to psychological mechanisms without specifying how these mechanisms are realized in the brain. Remembering, forgetting, and problem solving are phenomena at the personal level, but can probably be explained by mechanisms at the psychological level. Let us use memory research as an illustration. According to Hunt and Ellis (2003), sensory visual stimulations can be stored for a couple of hundred milliseconds in the sensory register, after which the information is transferred to the short-term memory. When the information in the short-term memory is rehearsed, it may be transferred to and stored in long-term semantic memory, that is, memory of conceptual facts about the world. Information in semantic memory may be retrieved by the short-term memory, where it is processed and further utilized for various types of problem solving. The relationships and concepts referred to in this explanatory model are purely psychological – they describe information transfers in abstract terms and do not refer to explicit processes in the brain. The example serves only as an illustration of a typical psychological explanation. It is not claimed that this is the best contemporary model of how we remember conceptual facts.

The decomposition of memory into its constituent psychological functions illustrates a common strategy in psychology and psychoanalysis. We decompose explanandum into its constituent psychological functions, and the interactions among these functions constitute the explanatory mechanism (explanans). Thus, decomposition and explanation are two sides of the same coin (see Figure 1). This decomposition strategy constitutes the essence of the mechanism approach (Cummins, 2000).

Freud's metapsychological speculations belong to the psychological level, because they refer to sub-personal unconscious mechanisms (unconscious motives, transfer of psychic energy, antagonistic forces etc.) that explain different kinds of behavior and experiences at the personal level. Almost all psychoanalytic explanations refer to unconscious mental states and processes and show how the explananda at the personal level are generated by mental mechanisms at the psychological level. If we define *cognitive* broadly, that is, to include motives and emotions, then Freud was essentially a cognitive psychologist, because the burden of explanation in Freudian theory was laid upon unconscious mental mechanisms (Erdelyi, 1985; McKay & Anderson, 2007).

Freud's (1911) explanation of paranoia is a good illustration of a psychoanalytic mechanism-based explanation at the psychological level. (I use this example as an illustration only. The question whether the hypothesis is warranted or not is not of importance in this context.) Freud conjectured that persecutory anxiety and paranoid delusions are the result of a defense against repressed homosexual wishes. The underlying mechanism is a transformation of homosexual love into hate (reaction-formation), this state being subsequently evacuated via projection on to an external persecutor. Thus, the paranoia is constituted by the operation of two defense-mechanisms (reaction-formation and projection) instigated by unconscious homosexual love. In less abstract terms, Freud (1911, p. 63) says that the starting point is the desire expressed by the proposition "I (a man) love him (a man)." Since this proposition is unacceptable to the individual's consciousness, it is transformed into its opposite (reaction-formation): "I do not love him – I hate him!" However, this feeling of hate is likewise unacceptable to the individual's consciousness and is therefore projected onto someone in the external world – "He hates me!" There is no prima facie obvious explanatory connection between an unconscious homosexual impulse and the subsequent paranoia; but if we accept the validity of the two defense mechanisms, reaction-formation and projection, we can see how the unconscious impulse

together with the two defense mechanisms constitute a possible underlying mechanism of paranoia. These mechanisms are purely psychological, but it has been suggested that an abnormal salience network functioning could be a brain mechanism underlying paranoia (Menon, 2011). However, if this is the case, it is not obvious that this neuroscientific explanation would be consistent with the Freudian psychological mechanism. Discoveries at the neuroscientific level may either confirm or falsify postulated psychological mechanisms and, conversely, confirmed hypotheses about psychological mechanisms may be of great help when we are looking for underlying neural mechanisms. Thus, the research process is a dynamic and mutual co-evolution of levels.

In a psychoanalytic context, meaning and understanding encompass the individual's subjective perspective in terms of affects, beliefs, desires, and fantasies. For the analysand, many of these mental states – for example, obsessional thoughts and feelings of anxiety – may appear as both enigmatic and painful. At least one revolutionary aspect of psychoanalysis is that it extended the limits of meaningful psychic phenomena by showing that behavior and experiences that were previously thought to be determined by, let's say, exhaustion or 'a trick of the brain,' were in fact meaningful due to being caused by unconscious motives, desires, beliefs, and fantasies. These unconscious states and their interactions belong to the psychological level, which means that meaningful phenomena are not confined only to the personal level. So far, psychoanalysis has mostly been concerned about giving an accurate account of mechanisms at the psychological level; but one of neuropsychoanalysis' aims is to link these psychological mechanisms to mechanisms at the neuroscientific level.

The neuroscientific level

The processes described at the neuroscientific level explain the psychological phenomena at the psychological level, which in turn explain the phenomenon at the personal level. The example about memory showed that memory can be decomposed into its constituent psychological functions (short-term memory, etc.); but we gain a more satisfactory explanation if we are able to discover at least some of the brain mechanisms at the neuroscientific level that generate these functions. Knowledge about these mechanisms may even help us to suggest new hypotheses and bring about a reformulation of the original model (Bechtel, 2008; Cummins, 2000). Every updated textbook in cognitive neuroscience shows that we have learned a lot about the neural mechanisms underlying memory, and this knowledge has definitely influenced the psychological models of memory processes.

It is important to keep in mind that Figure 1 gives only a coarse-grained account of mechanism-based explanations, because many intermediate levels are not shown in the figure. For example, the brain can be described and investigated at many different epistemological levels: biochemical level, neuronal level, connections between individual neurons, or as an assembly of interacting brain modules.

The function of the neuroscientific level can be illustrated with some psychoanalytically relevant examples. For example, there is evidence that memories about traumatic and stressful events related to extreme fear cannot be encoded, because the hippocampus, which is necessary for their formation, is partially or completely shut down by high levels of adrenal steroids that result from intense stress. The memories are not repressed, but simply not formed or encoded in the first place (Yovell et al., 2015, pp. 1534–5). Since the aim of neuropsychoanalysis is to bridge neuroscience and psychoanalysis, we may ask what is the relation between Freudian repression and the neuroscientific account? It looks as if the Freudian account may have been falsified, because it is very different from the neuroscientific hypothesis and seems to have less empirical support. On the other hand, we may conclude that the Freudian notion of repression just needs to be reformulated, because both accounts are similar in referring to traumatic experiences that are likely to be forgotten but can still influence behavior.[9] This example illustrates a general problem in theory development, because when hypothesis Y replaces hypothesis X, there are two possibilities. We can say either that X is rejected and has been replaced by Y, or that Y constitutes an improvement of X. The repression example may be one of many cases where it is impossible to decide between these two possibilities, because there is no fact of the matter what the correct conclusion is. However, as long there is agreement that our theories and models are becoming increasingly more accurate, it may not matter much how we choose to describe this increase in knowledge.

References to the distinction between implicit and explicit memory has become ubiquitous within psychoanalysis, not only in neuropsychoanalysis. Explicit and implicit memory can be decomposed into different subsystems and neuroscience has made a lot of progress in describing the brain mechanisms that underlie the subsystems (Gazzaniga et al., 2009).

Most people identify memory with explicit memory, where the individual is consciously aware of the knowledge held and can recall it or recognize it among several

alternatives. There are two kinds of explicit memory: episodic and semantic. Episodic memory is the memory of specific personal experiences (e.g. yesterday, I went to the cinema and saw *Star Wars*). Semantic memory is memory of facts, such as world and language knowledge (e.g. Paris is the capital of France, and 'Schnee' is the German word for snow).

Implicit memory refers to the measurable effects on behavior caused by past experiences that the person does not consciously recall. Implicit memory comprises different memory systems, such as procedural memory and classical (Pavlovian) conditioning. Procedural memory is involved in acquiring sequences of actions produced by experiences we don't explicitly remember (see, for example, Gazzaniga et al., 2009, Ch. 8). The actions include such things as the ability to play piano, habitual maladaptive ways of relating to others, and transference/countertransference. These phenomena can probably be understood in terms of implicit memory (Fonagy, 1999; Sletvold, 2003).

Implicit memory reaches maturity earlier than explicit memory, which means that most of a person's earliest memories (before age 3) are implicit. Amnesia of early childhood is therefore not due to repression, but because the explicit memory systems in the brain have not yet developed sufficiently (Weinberger & Stoycheva, 2020). Since implicit memory is somewhat independent from explicit memory, a child can learn maladaptive behavior patterns without any explicit memory of the experiences that gave rise to the behavioral patterns.

Neuroscientific research may also contribute to clarify some core psychoanalytic concepts. For example, Solms and Zellner (2012) pointed out the great controversy in psychoanalysis about whether there is such a thing as an objectless drive, as Freud claimed. However, evidence reviewed by Panksepp and Biven (2012) indicated that the SEEKING system is initially objectless. Initially, there is a *feeling* of motivation, desire, or expectancy, but the affect's specific 'aboutness,' its object or what it is about, is acquired afterwards through learning and perception. It is not entirely clear whether and how the constructs of drives and affects are related, but the example indicates at least that conceptual controversies in psychoanalysis may be informed by neuroscientific research.

Figure 1 refers to that which in medicine is called "pathology." If, on the other hand, you are looking for the "original" or distal causes of a phenomenon, that is, how it originally arose, this would be a question of the phenomenon's etiology. In the language of psychoanalytic theorizing, this distinction resembles that between the genetic and the dynamic aspects of psychoanalytic phenomena. The focus here has been on dynamics, but genetic and dynamic aspects are different sides of the same coin: the genetic causes can be seen as setting the dynamic causes in a historical context. For example, the pathology of a phobic symptom could be an internal constellation of conflicting motives, but the etiology could be a childhood trauma.

Genetic or etiological explanations are, of course, essential in developmental psychology and in theories about biological and cultural evolution. In Freud's account of human development, the past plays a vital role ("Child is father of the man"); he also offered evolutionary explanations of the origin of religion, culture, the incest taboo, etc. Psychoanalytic case studies usually offer a mix of mechanism-based and etiological explanations and the mechanism approach may throw some light on etiological explanations. For example, when we look back upon history from a bird's-eye view, that is, without zooming in at the details, the changes may seem quite abrupt or even incomprehensible. First there was event A, and some time afterwards, the very different event B occurred. However, in a historical or etiological explanation we want to know how A caused B. We seem to gain a better and more satisfactory explanation if we can provide the causal links between A and B. We explain how A generates B by providing the intermediate links, X_1, X_2, … ,X_n. The result is this causal chain: $A \rightarrow X_1 \rightarrow X_2 \ldots .. X_n \rightarrow B$. In this case '$X_1 \rightarrow \ldots , \rightarrow X_n$' represents the generative causal explanatory mechanism that explains how A causes B. These intermediate links or mechanisms can be at lower levels relative to A and B. For example, different neuropsychological mechanisms may explain how childhood trauma can cause dissociation and other symptoms later in life.[10]

I have provided a characterization of mechanism-based explanations and shown how they relate to neuropsychoanalysis. In the remainder of the paper, I will first discuss the criticism levelled against neuropsychoanalysis: that it is reductionistic and ignores meaning. Finally, I will sketch three challenges that neuropsychoanalysis needs to meet.

The threat of reductionism

Assume that neuroscience has been able to explain some psychoanalytical phenomena. We may then ask, "Why do we need to refer to phenomena at the psychological and personal levels at all? Why not refer exclusively to neuroscience and describe the phenomenon in purely neuroscientific terms?" If we follow this argument to its fundamental physical level, then it seems that physics could explain and describe every

phenomenon. This would be an instance of reductionism, which, in the philosophy of science, means that one theory (e.g. neuroscience) can be shown to do all the work of another theory (e.g. psychoanalysis). The goal of reduction is to replace higher-level explanations by those at the lower levels. However, I would argue that the mechanism approach does *not* entail this kind of radical reductionism, because it does not follow from the mechanism approach that there is one privileged epistemological level. Higher epistemological levels (e.g. the psychological level) are more abstract and deal with concepts that ignore many of the details at the lower levels (e.g. the neuroscientific level). We need higher epistemological levels because a great deal of the information at lower levels will be irrelevant for the phenomena we are trying to describe and explain. Introducing concepts at higher levels allows us to describe causal patterns that we would not be able to describe by using concepts belonging exclusively to lower epistemological levels, because we would not 'see the forest for the trees.' For example, when we explain why a peg passed through a hole in the wall, it is sufficient to refer to the geometrical properties of the peg and the hole. It is not necessary to give a detailed description of the wall's atoms and their interactions, because the peg would have passed through the hole no matter what kinds of atoms were involved. The geometrical shapes and the rigidity of the peg and the wall are the only explanatory relevant properties, and we may miss the importance of these properties if we instead provide a complicated microphysical explanation (Putnam, 1975). The example indicates a case where an explanation referring to only higher-level concepts is the better one. Thus, searching for detailed mechanisms is not always necessary in order to explain; however, in many cases, we gain a more satisfactory explanation if we are able to do so, as shown in the examples referred to earlier.

It is a fundamental hermeneutic principle ("the hermeneutic circle") that we understand a part only if we know the whole context, but the understanding of the whole context amounts to our understanding of the individual parts. We find something akin to the hermeneutic circle in the mechanism approach, as well. According to Machamer et al., "Higher level entities and activities are essential to the intelligibility of those at lower levels, just as much as those at lower levels are essential for understanding those at higher levels. It is the integration of different levels into productive relations that renders the phenomenon intelligible and thereby explains it" (2000, p. 23). In addition, there is a reciprocal *dynamic* relation between the epistemological levels, because we may need to reformulate an explanandum after we have found its underlying mechanisms. As mentioned earlier, neuropsychological studies proposed that memory is not a unified phenomenon but consists of different memory systems. On the other hand, the discovery of new explananda may entail both a reformulation of already known mechanisms and postulation of additional ones.

Psychoanalytic purists who think that psychoanalytic explanations should be completely autonomous, and that psychoanalysis should not intermingle with psychology and neuroscience, risk turning psychoanalysis into a museum object. An unwillingness to look for explanatory mechanisms outside psychoanalysis may lead to stagnation, as the history of chemistry illustrates. According to Walsh (1997), chemistry in the nineteenth century wa an immature discipline that tried to distance itself from physics, afraid that the physicists' new conception of "atom" would lead to an overthrow of chemistry by physics. The chemists wanted to secure their autonomy by denying that chemical reactions could be explained by reference to interacting atoms. Today, much of chemistry is based on physics and no chemist would formulate hypotheses violating the laws of physics. A solid knowledge of physics is a part of every chemist's education. What is interesting is that even though phenomena studied in chemistry can be explained physically by reference to interacting atoms, chemistry is not reduced to physics. Most universities still have departments of both physics *and* chemistry. In fact, hardly any examples can be found in the history of science where one epistemological level has been totally replaced by another level. Thus, it is not likely that psychoanalytic institutes and departments of psychology would be replaced by departments of neuroscience.

We have seen that radical reductionism is false, because we need concepts at higher epistemological levels in order to describe patterns that cannot otherwise be described. On the other hand, the epistemological levels are not completely autonomous or isolated from each other. The mechanism approach constitutes a middle ground between these two extremes, because it entails *integration* without reductionism or isolationism.[11] The integration derives from the fact that lower levels have explanatory relevance for higher levels.

Since neuropsychoanalysis is not a reductionistic project, we need not fear that it will replace meaning and understanding with "soulless" neuroscience. This conclusion was contradicted by Blass and Carmeli (2007, p. 36), who contended that "Neuropsychoanalysis ascribes to biology a kind of significance that does away with the value of meaning and psychic truth which is at

the foundation of psychoanalysis." This claim must be firmly rejected because meaning and psychic truth are found at the personal and psychological levels, and the mechanism approach (and thereby neuropsychoanalysis) does not entail the elimination of these epistemological levels. Besides, if neuroscience can contribute to explain some meaningful phenomena, it does not follow that we have 'done away' with the phenomena. On the contrary, an explanation of a phenomenon presupposes the *existence* of the phenomenon, because it does not make sense to explain nonexistent phenomena. Of course, there may be many psychoanalytic phenomena where neuroscience cannot make any significant contributions, but this is essentially an empirical question that cannot be settled a priori.[12]

Three challenges for neuropsychoanalysis

For the remainder of the paper I would like to show how the tripartite mechanism-based explanatory model can serve as a framework for addressing three challenges to neuropsychoanalysis and psychoanalysis in general. My modest aim is just to show how these three challenges to neuropsychoanalysis relate to the mechanism approach to scientific explanation. It is far beyond the scope of this paper to go into further details.

Neuropsychoanalysis' clinical irrelevance

Neuropsychoanalysis has been accused of being clinically irrelevant because it has not made a single contribution that clinicians admit have made a difference to their work (Talvitie & Ihanus, 2011). According to Blass and Carmeli (2015, p. 1561), "The analyst concerned with a meaningful process of understanding the analysands' inner psychical dynamics has no need to be concerned with the biological matter of the brain … "

It may be right that neuropsychoanalysis is predominantly a theoretical and explanatory enterprise, but if neuropsychoanalysis can contribute to construct more accurate theories and explanations of psychoanalytic phenomena, it is hard to see how it can avoid being clinically relevant. It would be remarkable if a better understanding of how the mind works had no clinical consequences. For example, theories and explanations in physiology are obviously relevant for medical therapy, and well-established empirically confirmed theories in physics and chemistry have undoubtedly helped engineers to construct new and better technology. On the other hand, one can agree with Blass and Carmeli (2015) that the analyst *qua* therapist has no need to be concerned with neuroscience, simply because therapists, whether they are psychoanalysts or general practitioners, should not necessarily think about abstract theoretical issues when practicing therapy, but rather should focus on communicating with the patient. For the general practitioner, it may be sufficient to know that a therapy for a certain disease actually works. In other words, it is not necessary to remember all the detailed explanations of the symptoms and the full theory about the disease in order to give correct diagnosis and therapy. There usually is a division of labor between the general practitioners and the scientists who do research on diseases, but therapy should be based on both research and empirically confirmed theories. Likewise, research and theory development in neuropsychoanalysis, when therapeutically relevant, should influence therapy. The relation between theory and practice is a general problem that takes us far beyond the scope of this paper, but according to Manson (2003), theoretical psychoanalytic knowledge of different mechanisms provides broad causal templates for identifying relevant psychological factors lying behind phenomena observed in the consulting room. The hermeneutic method mentioned previously is of utmost importance for the analysts' ability to formulate ideographic explanations and interpretations. However, these explanations and interpretations are based on theoretical assumptions about explanations, for example of the observed phenomena.

To what extent the mechanism-based explanations provided by neuropsychoanalysis will be therapeutically relevant is an open question. However, one can agree with the critics that the burden of proof is on the neuropsychoanalysts to show that neuropsychoanalysis can contribute to improved therapy.

Neuropsychoanalysis and psychology

Psychoanalytic hypotheses not only should be consistent with neuroscience, but also should cohere with other scientific disciplines, such as anthropology, evolutionary biology, and psychology. Freud's most interesting and revolutionary ideas are related to the psychological level and he gave up the attempt to base psychological hypotheses on neuroscience, even though the ultimate goal was to give psychoanalysis a neuroscientific foundation. However, this was left for future work.

Neuroscience has made tremendous progress since Freud's time; but, by focusing exclusively on the relation between psychoanalysis and neuroscience, neuropsychoanalysis risks ignoring the psychological level, that is, psychological evidence and alternative psychological explanations. The explanations that compete with the psychoanalytic explanations are mainly other

psychological explanations and not neuroscientific ones. Psychoanalysis and psychology are framing hypotheses at the same psychological level, prompting Erdelyi (1985) to describe psychoanalysis as 'Freud's cognitive psychology.' Thus, in order to confirm psychoanalytic hypotheses, it is not sufficient to show that they are consistent with neuroscience; they also must be corroborated at least as much as the competing psychological hypotheses. The psychological disciplines seem to be as important as neuroscience when we attempt to construct mechanism-based explanations. Neuropsychoanalysis should therefore pay attention to and evaluate the alternative psychological explanations before searching for the underlying brain mechanisms of the postulated psychoanalytic explanations.

The purpose of this short discussion is to observe that there is a psychological level in addition to the neuroscientific level and, therefore, one should not forget to take into consideration alternative explanations at this level. For example, we previously have seen that psychological explanations referring to the distinction between explicit and implicit memory differed from the psychoanalytic explanations.

Some opponents of neuropsychoanalysis have claimed that neuropsychoanalysis is clinically irrelevant, reductionistic and ignores meaning, but this criticism has been rejected. Nor should it be an insurmountable problem to take alternative psychological explanations into consideration before looking for underlying brain mechanisms. However, I will now turn to a challenge for neuropsychoanalysis that is more difficult to meet.

Neuropsychoanalysis and the future of psychoanalysis

Ramus (2013) levelled a rather harsh criticism against neuropsychoanalysis by claiming that research on phenomena that are of interest to psychoanalysts today takes place outside the psychoanalytic context. Psychoanalysis may have been heuristic in stimulating much research, but it is difficult to see what contributions psychoanalysis makes to the current research on mind and behavior. Psychoanalytic ideas mostly seem to be ignored in psychology, psychiatry, and neuroscience. In addition, the results in cognitive neuroscience only partially support the psychoanalytic hypotheses, and neuroscientists do not refer to psychoanalysis or use psychoanalytic concepts in their research. The observed correspondences between psychoanalysis and neuroscience seem to be superficial and hardly support the psychoanalytic hypotheses (Paris, 2017). Psychologists and neuroscientists seem to agree that they already have the necessary methodological, conceptual and theoretical resources to give empirically confirmed explanations of everything that psychoanalysis purports to explain. This harsh and perhaps exaggerated criticism of psychoanalysis and neuropsychoanalysis indicates that the greatest challenge facing psychoanalysis today is to convince psychologists, psychiatrists and neuroscientists of the scientific relevance and contributions of psychoanalytic theories and ideas.

Psychoanalysis is an enterprise with a great past. It has been a major influence on psychology and psychiatry and has been rich in suggesting interesting hypotheses. However, the future of psychoanalysis is uncertain, and psychoanalysts need to answer the criticisms cited above. It is not my purpose to delve further into this these challenges, but I think Westen (2002, p. 371) was on the right track when he pointed out, "One of the major ways in which psychoanalysis can contribute to cognitive neuroscience, rather than just learn from it, is to bring to bear clinical data and conceptualizations that would probably not emerge from the laboratory." Psychology and neuroscience are primarily experimental sciences, but the experimental method, like all methods, has its limits. Human suffering, sexuality in all its aspects, fantasies, and dysfunctional behavioral patterns are difficult to bring to the laboratory, but they are genuine phenomena that psychology and neuroscience need to take into consideration in order to be true branches of science that study *whole* human beings and not just a few aspects of human experience and behavior. For psychoanalysts, the interesting phenomena or aspects are usually those related to therapy. Whether the resulting mechanism-based explanations of these phenomena will be *psychoanalytic* in any meaningful sense of that word is an open question.

Notes

1. Machamer et al. (2000) is the starting point for the contemporary debate about mechanism-based explanations. My account of mechanism-based explanations is partly based on Craver (2007) and Bechtel (2008).
2. *Ontology* concerns the nature of reality and what kinds of entities there are. A theory's ontology are the entities that the theory claims exist. For example, repressed memories are a part of the Freudian theory's ontology.
3. *Epistemology* is the study of knowledge and is concerned with general questions related to knowledge. For example, what are the sources of knowledge and what are the necessary and sufficient conditions of knowledge?
4. Cf. Craver (2007). The nature of causality is a huge area to which this paper cannot do justice, but see Mumford and Anjum (2013) for a short and concise

introduction to different philosophical theories about causality.

5. Since the personal level also includes social interactions, it would perhaps have been more accurate to name it 'the personal-relational level', but I choose 'personal level' for simplicity's sake.
6. Hermeneutics concerns the methodology of interpretation and deals with meaningful human actions and the products of such actions.
7. Issues regarding the scope and limits of hermeneutics in psychoanalysis go far beyond the scope of this paper, but I will return to this topic in the section about the possible clinical relevance of neuropsychoanalysis.
8. The psychological level could be named the 'sub-personal' or 'cognitive level.' However, all non-psychological neurophysiological processes are also sub-personal, and the term cognition seems to exclude emotions and drives, which are of utmost importance in psychoanalytic explanations.
9. The existence of Freudian repression is still controversial. Holmes (1995) argue that repression does not exist and Erdelyi (2006) equals repression with suppression, which has been more thoroughly investigated (Cf. Anderson and Green (2001) and Anderson et al. (2004)). However, it is far beyond the scope of this paper to discuss the validity of repression.
10. Perry et al. (1995). Cf. Glennan (2010) for more about the function of mechanisms in historical/genetic explanations.
11. Because mechanism-based explanations integrate different levels, they are also named 'multilevel mechanistic explanations.'
12. The conclusions in this section are consistent with the non-reductive view on the mind-body problem as previously described.

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