Georg Northoff

Qualia and the Ventral Prefrontal Cortical Function

'Neurophenomenological' Hypothesis

Abstract: *The exact relationship between qualia and the function of the brain remains elusive. The present approach focuses on the linkage between the neural mechanisms of the brain and the phenomenological and epistemological mechanisms of qualia. It is hypothesized that distinct characteristics of the ventral prefrontal cortical function may be crucial for the generation of these phenomenological and epistemological mechanisms — this is reflected in the so-called 'neurophenomenological hypothesis'.*

The 'phenomenological–qualitative' character of qualia may be related with an early activation in the ventromedial prefrontal cortex (VMPFC). The experience of 'presence' in qualia may be accounted for by a co-activation in both VMPFC and hippocampus and a concurrent deactivation in the ventrolateral prefrontal cortex (VLPFC) and posterior cingulate. Past and future temporal dimensions may therefore be integrated within the experience of events, which in turn may account for the phenomenal characteristics of 'presence' and thus 'phenomenal time'. 'Non-structural homogeneity' in the experience of qualia may be accounted for by either 'supramodal character' or 'modality unspecifity' of the VMPFC. The 'heterogenous' stimuli can therefore be included and integrated within one 'homogenous' event as experienced in qualia. Finally, 'transparency' in the experience of qualia may be related with the 'reciprocal suppression' between VMPFC and VLPFC. Simultaneous cognitive processing during the experience of qualia may be suppressed and may consequently account for their transparent character.

Due to several methodological limitations, these 'neurophenomenological hypotheses' must be considered as preliminary. However, they may nevertheless serve as a starting point for the development of a more elaborate neuroscientific hypothesis of qualia in the future.

Correspondence: Georg Northoff, Beth Israel Deaconess Medical Center, Kirstein Building KS 454, 330 Brookline Ave, Boston, MA 02215, USA. *Email: gnorthof@caregroup.harvard.edu*

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I: Introduction

Mental states are often characterized by qualia which, in turn, are described by phenomenal–qualitative properties, the 'What is it like' character, and the First-Person Perspective (FPP) (Nagel, 1974; Metzinger, 1995; Chalmers, 1996). However, neither characteristic of qualia has been linked with specific functions of the brain so far. The failure to link qualia with the functions of the brain may be due to the following two reasons. Qualia could indeed be non-existent in humans so that any kind of linkage between qualia and brain function remains impossible. However, although the existence of qualia has been denied by some neuroscientists (see Crick, 1994; Crick & Koch, 1998), the strong phenomenological evidence (see below) makes such an assumption rather unlikely. The failure in the linkage could also be due to principal differences between qualia and the function of the brain in either ontological or methodological regard. Despite the fact that some dualist philosophers (Chalmers, 1996) argue for a principal ontological difference between qualia and brain function, this assumption seems rather unlikely from an empirical point of view: changes in the brain function are accompanied by changes in qualia and, in addition, a complete elimination of the brain leads to the absence of qualia. The failure to link qualia and brain function may therefore be associated with methodological differences.

While qualia, as discussed in philosophy, reflect their ontological nature and thus the 'What' of qualia, their phenomenal and epistemic mechanisms, i.e., the 'How' through which they appear is rather neglected. In contrast, the function of the brain, as investigated in neurosciences, focuses on the elucidation of neural mechanisms, i.e., the 'How' of the brain rather than its ontological nature, i.e., the 'What' of the brain. A linkage between the ontological nature of qualia, i.e., the 'What' and the neural mechanisms of the brain, i.e., the 'How', must necessarily fall short because the 'What' cannot be linked with the 'How'. As a result there remains an 'explanatory gap' (see also Ellis & Newton, 1998). Only the phenomenal and epistemic mechanisms, i.e., the 'How' of qualia, can be linked with the neural mechanisms, i.e., the 'How' of the brain. While this linkage may contribute to the investigation of the neuroscientific mechanisms of qualia, the linkage between the nature, i.e., the 'What' of qualia and the nature, i.e., the 'What' of the brain may contribute to the neurophilosophical exploration of the nature of qualia. Whereas the present contribution focuses on the neuroscientific mechanisms of qualia, their neurophilosophy is discussed within the framework of a 'philosophy of the brain' (Northoff, 2003a).

The phenomenal and epistemic mechanisms of qualia are described in a first step. This is followed by an investigation of various linkages between the ventral prefrontal cortical brain function and the phenomenal and epistemic mechanisms of qualia. The aim here is to develop so-called 'neurophenomenological hypotheses' (see below in the final section for further definition). Finally, the principal limitations, the preliminary character and the epistemic implications of these 'neurophenomenological hypotheses' are identified.

The following methodological remarks shall be made and kept in mind throughout the whole investigation.

First, our methodological approach comes very close to what Varela calls 'neurophenomenology' or 'first-person methodology' (see Varela, 1996; Varela & Shear, 1999). Similar to Varela's approach, we link first-person data about the phenomenal and epistemic mechanisms of qualia with third-person data about neuronal mechanisms of the brain so that both kinds of data can be regarded as 'mutual constraints'. However, we go beyond Varela's approach by considering the epistemic implications and the need for the development of a 'neuroepistemology' in the future. Varela neglects the distinction between the phenomenal/epistemic mechanisms of qualia, i.e., the 'How', and the ontological nature of qualia, i.e., the 'What', which is relevant for determining the focus of the investigation as either neuroscientific or neurophilosophical.

Second, qualia occur in various modalities: visual, auditory, emotional, etc. All of these reflect the different 'contents' of qualia. These different 'contents' may be subserved by similar phenomenological and epistemological mechanisms (or 'processes' as put by Varela and Shear, 1999, pp. 6–7) through which the former are generated and appear. In the following we focus on those neural mechanisms which underlie these phenomenal and epistemic mechanisms rather than on those accounting for the different 'contents' of qualia.

Third, we focus on the ventral prefrontal cortex, which is hypothesized to be crucial (i.e., necessary but not sufficient) for the generation of the phenomenological and epistemological mechanisms of qualia. The different 'contents' of qualia, in contrast, may be related to different cortical or subcortical areas like PAG, midbrain and brain stem in the case of emotions (Damasio, 1999; Panksepp, 1998). We consider emotional qualia as a paradigmatic example of qualia in the present investigation, which may be applied to other modalities of qualia as well.

Fourth, our empirical account of the ventral prefrontal cortical function relies predominantly on imaging studies of emotional and non-emotional experience and judgement. As a result, we conceptualize the function of the ventral prefrontal cortex in terms of 'anatomical and functional domains' (i.e., as reflected in the sections entitled 'neuroscientific findings'). These 'anatomical and functional domains', in turn, serve as the basis for the development of analogous 'phenomenal and epistemic domains' (i.e., as reflected in the sections entitled 'neuroscientific account' and 'epistemic implications') whose relationship is accounted for by so-called 'neurophenomenological hypotheses'.

II: Phenomenal and Epistemic Mechanisms of Qualia

1. Phenomenal mechanisms of qualia

a. The 'phenomenal–qualitative' character of qualia

Qualia are often characterized by means of 'phenomenal–qualitative' experiences in FPP. While the term 'qualitative' denotes a kind of 'raw feeling', 'phenomenal' describes 'pure experience' without any cognitive ingredients, e.g., reflection or recognition (Metzinger, 1995, pp. 22–4). The experience of qualia

in FPP has been characterized by 'What is it like' (Nagel, 1974; 1986) which can therefore be reformulated as 'What is the raw feeling as a pure experience like'.

The 'phenomenal–qualitative' character of qualia is either present or absent — this can be described as an 'All-or-Nothing' character. The experience either remains 'pure' and 'raw' with the consecutive presence of the 'phenomenal–qualitative' character or it is confounded by cognitive ingredients, i.e., reflexion and recognition with the consecutive disappearance and absence of the 'phenomenal–qualitative' character.

For example, the taste of 'sweetness' when eating chocolate can be described as a 'raw feeling' that has no other ingredients than the feeling and the experience of 'sweetness' itself. Accordingly, we have a 'pure experience' or a 'raw feeling' of the 'sweetness' in FPP. This can be described as a 'qualia of sweetness'. However, as soon as reflexion and recognition of the sweetness as sweetness starts, neither the feeling remains 'raw' nor the experience 'pure' and as a result, the 'phenomenal–qualitative' character disappears.

In contrast to experiences in FPP, the states in Third-Person Perspective (TPP) appear as non-phenomenal and non-qualitative. Due to reflexion and recognition, we rather observe than experience in TPP, which implies the disappearance and absence of the 'phenomenal–qualitative' character from the experience in FPP.

For example, we observe other people while they eat chocolate and recognize their facial expression. If we recognize disgust in the other person's face, we may infer that the chocolate tastes rather bitter or too sweet for them. Instead of directly making the experience of bitterness/sweetness ourselves, we infer them indirectly from our observations and rely on reflexion and recognition. However, due to the involvement of these cognitive ingredients — i.e. 'social cognition' in our observation — the 'pureness' of the experience as well as the 'rawness' of the feeling disappear — the observed states in TPP therefore appear as non-phenomenal and non-qualitative. The 'contents', i.e., the bitter/sweet chocolate in the experience and feeling of the other persons, can therefore be accounted for in TPP but the respective experience and feeling, i.e., the bitterness/sweetness itself, remains inaccessible.

b. The 'presence' of qualia

The 'presence' of mental states in FPP refers to the temporal dimension in the experience of events (Metzinger, 1995, p. 31; Gadenne, 1996, pp. 17–19). Events are experienced as 'timeless' in FPP, i.e., they appear present without any further temporal mediation by either the past or the future. Both temporal dimensions, past and future, are included and integrated within the experience of events in the presence. Including the past dimension within the presence can be called 'retention' and including the future 'protention' (Husserl, 1956). Integration and inclusion of past and future temporal dimensions within the presence generates the experience of time as 'phenomenal time' in FPP.

The 'sweetness' of a chocolate, for example, is experienced as 'timeless'. We are convinced that the 'sweetness' has always been there, will never change, and will remain a property of the chocolate forever. Experiencing the sweetness of

chocolate as a 'timeless eternity' reflects the inclusion and integration of past and future temporal dimensions within the presence.

The experience of events in 'phenomenal time' in FPP has to be distinguished from the observation of facts in 'physical time' in TPP. In contrast to 'phenomenal time', past, present and future dimensions can be distinguished from each other in 'physical time', and 'temporal integration' is thus replaced by 'temporal segregation'. The experience of 'temporally homogenous events' in 'phenomenal time' is therefore no longer possible. Instead, TPP may be characterized by the observation of 'temporally heterogenous facts' in 'physical time'.

Since 'physical time' and 'phenomenal time' refer to distinct kinds of relationships between past, present and future temporal dimensions, they may dissociate from each other. For example, we may experience a long duration, i.e., hours of sweetness, of the chocolate in FPP but in fact started to eat the chocolate just five minutes ago — there is dissociation between 'phenomenal and physical time'.

c. The 'non-structural homogeneity' of qualia

'Non-structural homogeneity' in the experience of mental states in FPP refers to the appearance of 'homogeneity' and 'wholeness' of events in the experience which makes their segregation and distinction into different structures, parts or elements impossible (Gadenne, 1996, pp. 26–8). Due to this 'wholeness', the experienced events can be characterized by simpleness, monadicity/atomicity and spatial homogeneity (Levine, 1983, pp. 357–9; 1990, p. 478; 1993). These phenomenal characteristics are either present or absent so that they show an 'All-or-Nothing' character with a consecutive 'Yes–No decision'.

For example, the bitterness of a chocolate is experienced as a 'whole' and 'homogenous' event rather than in distinct parts, structures or elements. If one changes and distorts the event itself, its 'homogeneity' and 'wholeness' would be replaced by distinct parts, elements and structures: 'wholeness' and 'homogeneity' are therefore either present or absent.

In contrast, the states in TPP appear as structural and heterogenous. The 'homogeneity' and 'wholeness' in the experience of events in FPP is replaced by 'heterogeneity' and 'incompleteness' in the observation of facts in TPP. The experience of 'whole' and 'homogenous' events in FPP is replaced by the observation of 'single' and 'heterogenous' facts in TPP. Due to 'heterogeneity', distinct parts, elements and structures can be distinguished from each other. Due to 'incompleteness', the facts, as observed in TPP, no longer appear simple, monadic and atomic. Moreover, they no longer show an 'All-or-Nothing' character since there may be a gradual continuum between the different degrees of 'heterogeneity' and 'incompleteness' (Dennett, 1988, pp. 73–4, 44–5; Churchland, 1985, pp. 20–2; Northoff, 1999, pp. 41–3).

For example, we observe another person while she/he eats a chocolate. Though we may observe that it is a chocolate, we nevertheless remain unable to observe all the details of this process. Our observation remains therefore 'incomplete' and only shows us certain — i.e.. 'heterogenous' — parts, elements and structures of the whole process — i.e., the event of eating and tasting a chocolate.

d. The 'transparency' of qualia

'Transparency' in the experience of events in FPP refers to 'lucidity', 'immediateness', 'feeling of direct contact', 'feeling of completeness' and 'phenomenal certainty' (Metzinger, 1995, pp. 25–7).

'Lucidity' describes the 'direct giveness' of the event itself which is experienced as if it is an (objective) 'part of the world'. 'Immediateness' points out that the event is experienced without any mediation so that we are 'in contact' with the 'whole', i.e., complete event itself, which is reflected in the 'feeling of direct contact' and 'the feeling of completeness' (Metzinger, 1995). 'Phenomenal certainty' refers to the 'absolute conviction' about the existence of the event within the world.

For example, while experiencing the 'sweetness' of the chocolate, the chocolate itself appears present as 'part of the world' itself and thus as 'directly given'. Moreover, we have the feeling that it is not only the 'sweetness' we taste but, in addition, the chocolate itself. Despite the taste of 'sweetness', the chocolate appears non-mediated so that we have a 'feeling of direct contact' with and 'feeling of completeness' of the chocolate itself. Finally, we are absolutely certain about both the 'sweetness' and the chocolate itself since we cannot be mistaken about our own taste and the objects of the taste.

In contrast, states in TPP can no longer be characterized by 'transparency'. Since TPP is able to distinguish between experience and observation, the observed facts do not necessarily appear as (objective) 'parts of the world'. They may, on the contrary, also be related with the own experience. Accordingly, the facts appear no longer as 'directly given'. This makes 'lucidity' impossible. Moreover, TPP involves cognitive mediation and the observed facts do therefore not appear as non-mediated and complete which results in the loss of 'direct contact' and 'completeness'. 'Immediateness' is consequently replaced by 'mediateness' with 'feeling of indirect contact' and 'feeling of incompleteness'. Finally, due to the possibility of 'relativization' by means of cognition, doubt about the observed facts becomes possible. The 'absolute conviction' and 'phenomenal certainty' are therefore replaced by 'relative conviction' and 'factual certainty'.

The distinction between FPP and TPP is reflected in the example of the phantom limb (Heinzel, 1998). While the patients experience a non-existent limb in FPP and are absolutely certain about its existence, they are well able to observe and know in TPP that there is no additional limb. While they experience 'lucidity', 'immediateness' and 'phenomenal certainty' of an additional limb in FPP, they observe and know in TPP that there is no additional limb, i.e., they show 'factual certainty'.

2. Epistemic mechanisms

a. The first-person perspective

'Phenomenal–qualitative', i.e., mental states, as experienced in FPP, can be characterized by 'centralization'. FPP itself represents a 'standpoint' and thus a 'centre' from which the experience is made (Metzinger, 1995, pp. 27–30; Northoff, 2000). It is this 'centre' which we associate with a person or its 'I' —

Metzinger calls the inference from a 'centre' to an 'I' 'centre-intuition' (Metzinger, 1993, pp. 236–7).

For example, the taste of 'sweetness' of a chocolate is experienced from a certain 'standpoint' or 'centre' which we associate with our own person. Subsequently, I attribute the taste of 'sweetness' of chocolate to my own person — it is me or my 'I' who experiences the taste. This attribution, i.e., the 'self-centralization' is, for example, disturbed in 'ego-disturbances' like depersonalization/derealization in schizophrenia (see Northoff, 2001). The schizophrenic patient no longer attributes the experience of 'sweetness' to its own person, i.e., its 'I' but rather to another person. The 'phenomenal–qualitative' character of the experience itself is now preserved while its attribution to the own person is disturbed. Accordingly, the own FPP and its 'phenomenal–qualitative' states are related with and attributed to another person so that the schizophrenic patient's 'I' is replaced by the 'I' of another person.

How can this 'centralization' be further characterized?

First, 'centralization' can be described by a 'point of view'. It is a particular 'standpoint' from which the 'I' makes the experience of mental states. This particular 'standpoint' is different from all other 'standpoints' and therefore distinguishes me from all other persons. It is therefore my basis, i.e., 'standpoint', which provides me with a 'point of view' 'from the inside', i.e., the point from which I experience the world.

The basis for this 'point of view' is provided by the body as a 'lived body' (see Merleau-Ponty, 1966; Leder, 1992; Northoff, 1995; 2000; 2003; Metzinger in Northoff, 1997; Hurely, 1998). We experience our own body not as a purely 'physical body' but rather as a 'phenomenal body', i.e., as a 'lived body'. The 'lived body' serves for integration and 'embedment' of the 'I' within the environment (Northoff, 2003a). It therefore provides the 'anchor', i.e., the 'standpoint', from which the 'I' experiences and observes the environment.

Second, 'self-centralization' is closely related with 'pre-reflexive self-confidence' which, in turn, is characterized by a 'feeling of identity', an 'infinite closeness' and a 'self-transparency' (Metzinger, 1995, pp. 27–30). Due to attributing the experience to a 'centre' like the 'point of view', we experience 'pre-reflexive self-confidence'.

The close linkage between the experience and the 'I' gives me a particular confidence about my own person, i.e., 'self-confidence'. Since the 'self-confidence' itself cannot be put into doubt by cognitive involvement, it can be characterized as 'pre-reflexive'. Accordingly, attributing the experience to the own person remains beyond any doubt which, phenomenally, is reflected in the 'feeling of identity', 'infinite closeness' and 'self-transparence'.

This 'pre-reflexive self-confidence' is altered in schizophrenic patients with identity disturbances. They experience a considerable doubt about their own identity which results in the attribution of their own experiences to another person (Northoff, 2001; Metzinger, 1993). Since the experience of 'phenomenal–qualitative' states remains intact by itself, one may speak of a dissociation

between 'phenomenal qualia' and 'self-centralization' and thus of so-called 'non-centred phenomenal qualia' (Metzinger, 1993).

b. The third-person perspective

In contrast to FPP, TPP does not presuppose any kind of centre from which the own person, other individuals and/or the world are observed. Unlike in the case of experiences in FPP attributing observations to the 'I' of a particular person remains no longer necessary in TPP. There is consequently no particular linkage between observations made in TPP and the own person, i.e., the 'I'.

The absence of such a linkage results in the lack of a 'point of view' 'from the inside' in TPP which, in contrast, may be characterized by a 'point of view' 'from the outside' (Northoff, 2003a). Moreover, due to the inclusion of cognitive ingredients, observations can be put into doubt so that 'pre-reflexive self-confidence' is replaced by 'reflexive self-doubt'.

The body, as observed in TPP, can therefore no longer be considered as a 'lived body' that 'anchors' my own person within the world. Instead, the own body is observed as one body and thing among others. The 'phenomenal body' in FPP is thus replaced by the 'physical body' in TPP.

III: The 'Neurophenomenological Hypothesis': Neuroscientific Account of Phenomenal and Epistemological Mechanisms of Qualia

1. The 'phenomenal–qualitative' character of experience

a. Neuroscientific findings

Several imaging studies (PET, fMRI) demonstrated signal increases, i.e., activation in medial prefrontal cortical regions and particularly in the ventromedial prefrontal cortex (VMPFC), during the experience of different kinds of emotions (positive, negative, sadness, disgust, etc.) in the different modes (visual, auditory, etc.) (Phan *et al.*, 2002; Davidson & Irwin, 1999; Baker *et al.*, 1997; Northoff *et al.*, 2000; Morris *et al.*, 1999; Simpson *et al.*, 2001; O'Doherty *et al.*, 2001b; Teasdale *et al.*, 1999; Lane *et al.*, 1997). Moreover, non-emotional experiences, although to a lesser degree, also induced signal increases, i.e., activation in VMPFC (Northoff *et al.*, in revision). Accordingly, involvement and activation in the VMPFC seems to be specific for experiences in general rather than emotional experience in particular.

Due to the apparent involvement of the VMPFC in both emotional experience and non-emotional experience, one may assume that neural activity in the VMPFC is rather related with experience itself than its particular contents, which is either emotional or non-emotional. The VMPFC may subsequently account for the 'form' rather than the 'contents' of an experience. In contrast to the 'form', the 'contents' of experience may be associated with neural activity in the respective cortical/subcortical regions. For example, emotional contents are related with neural activity in the PAG, midbrain and brainstem nuclei which subserve the generation of emotions (Damasio, 1999; Panksepp, 1998; Simpson

et al., 2001). The visual contents in experience may, on the contrary, be associated with neural activity in the primary and secondary/tertiary visual cortical areas (Lang *et al.*, 1998; Lane *et al.*, 1997; Reimann *et al.*, 1997; Paradiso *et al.*, 1999). The relationship between the VMPFC and these cortical/subcortical areas may be accounted for by 'top–down modulation' whose exact mechanisms remain however unclear (see also below as well as Barbas, 2000 and Northoff & Bermpohl, 2003).

In contrast, the judgement about emotional experiences, which involves a strong cognitive component, induced activation in the ventrolateral prefrontal cortex (VLPFC) (Nakamura *et al.*, 1999; Hariri *et al.*, 2000; Gorno-Tempini *et al.*, 2001; Northoff *et al.*, 2002). Moreover, similar activation in VLPFC can also be observed in non-emotional judgement (i.e., about spatial position) (Northoff *et al.*, in revision) as well as in various cognitive tasks that require some kind of judgement (i.e., response selection, attention, working memory, etc.) (Duncan & Owen, 2000).

Similar to the VMPFC, activation in the VLPFC seems to be independent from the 'contents' that are processed. This has been, for example, demonstrated in the case of working memory where monitoring and storage of different kinds of contents, i.e., spatial and non-spatial, lead to activation in VLPFC (Stern *et al.*, 2000).

In addition to spatial dissociation in the ventral prefrontal cortex, experience and judgement may be characterized by temporal dissociation. As observed in the measurement of evoked potentials (EP) with electroencephalogram (EEG)/intracranial recording, experience and judgement could be distinguished from each other as early as 160–200 ms with respect to potentials and topographic maps (after stimulus onset) (Halgren *et al.*, 1994; Kawasaki *et al.*, 2001; Northoff *et al.*, submitted). Moreover, the onset of temporal dissociation was associated with the spatial dissociation between VMPFC and VLPFC at 160–200 ms which was present throughout the whole time interval between 200 and 500 ms (Northoff *et al.*, submitted). Emotional and non-emotional contents, on the other hand, could not be distinguished from each other until later, i.e., at 500 ms which, spatially, was reflected in the parieto-occipital involvement (Schupp *et al.*, 1997; 2000; Halgren *et al.*, 1994; Northoff *et al.*, 2002). Accordingly, the formation of a spatiotemporal pattern of neural activity in the ventral prefrontal cortex is primarily oriented on the differentiation between experience and judgement rather than on the differentiation between the different 'contents', i.e., emotional and non-emotional.

Accordingly, VMPFC and VLPFC may be regarded as two different 'anatomical domains'. They show different anatomical characteristics (see Barbas, 2000), different connectivity (see below and Barbas, 2000) and different functions, i.e., experience and judgement. Experience and judgement may be characterized as two different 'functional domains' which can be described by spatiotemporal dissociation and thus 'double dissociation' in anatomical (VMPFC, VLPFC), physiological (temporal divergence; see below for further details) and psychological (absence or presence of cognitive involvement; see below for further details) regard. In contrast to experience and judgement, emotional and

non-emotional 'contents' may not be characterized as two different 'functional domains': they cannot be accounted for by 'double dissociation' (see above).

In summary, neuroscientific findings during an experience can be characterized by (i) the linkage between experience and involvement of the VMPFC as distinguished from judgement and VLPFC; (ii) an early (160–200 ms) temporal dissociation between experience and judgement with different spatiotemporal patterns of neural activity in the ventral prefrontal cortex between 200 and 500 ms, (iii) the orientation of primary spatiotemporal dissociation in the ventral prefrontal cortex on experience and judgement as different 'functional domains' rather than on different 'contents', i.e., emotional and non-emotional.

b. The neuroscientific account

The term 'phenomenal' describes 'pure experiences', i.e., without any reflexion or recognition which would imply the absence of cognitive ingredients. Experience is not supposed to involve any cognitive ingredients which could account for its 'phenomenal–qualitative' character. Experience may thus be characterized by 'pure experience' and 'raw feeling' which account for its 'phenomenal–qualitative' character.

In contrast, judgement about the 'contents' in experience, i.e., emotional and non-emotional judgement, can be characterized by the involvement of cognitive ingredients, i.e., reflection and recognition (see above). Phenomenologically, this may be reflected in the absence of the 'phenomenal–qualitative' character so that there is neither 'pure experience' nor 'raw feeling' in judgement (see Figure 1). Accordingly, the distinction between experience and judgement may account for the presence and absence of the 'phenomenal–qualitative' character.

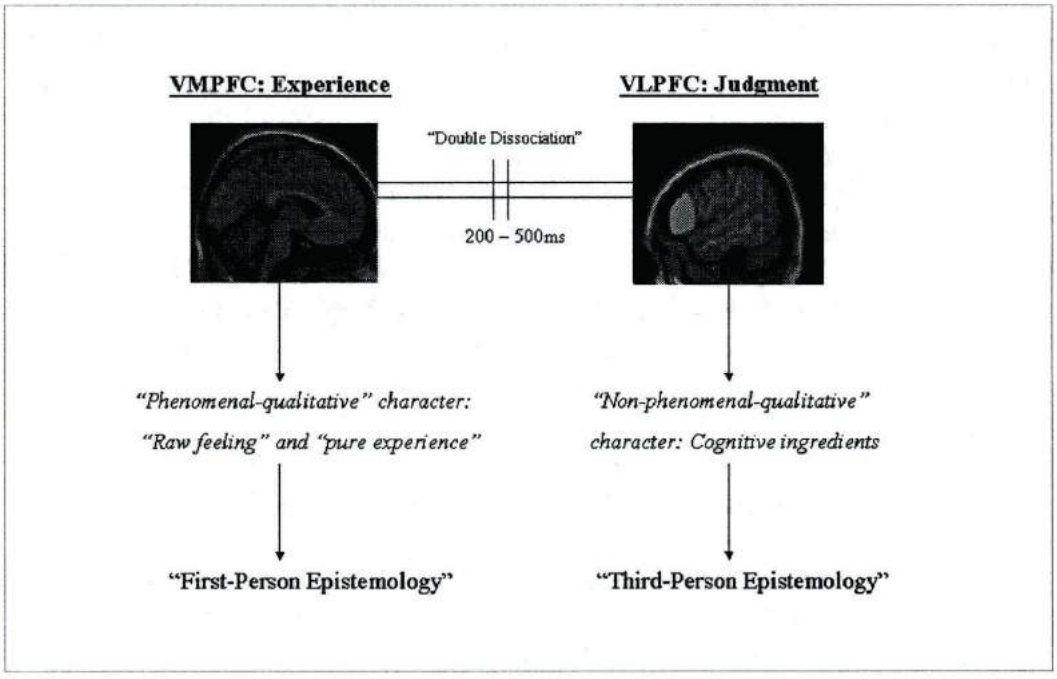

Figure 1
'Double dissociation' in ventral prefrontal cortex and phenomenal and epistemic properties

One may, however, argue that, from a neuropsychological point of view, any experience may imply some kind of implicit judgement and thus cognitive ingredients. Accordingly, experience in general may not be as 'raw' and 'pure' as it is presupposed in its characterization as 'phenomenal–qualitative'. Conversely, any judgement may imply some kind of experience which can be related either to the experience/re-experience of the event to be judged or to the experience of the judgement itself. Accordingly, judgement in general may not be as 'unraw' and 'impure' as it is presupposed in its characterization as 'non-phenomenal–qualitative'.

However, there is no doubt that the degree of cognitive involvement is much stronger in judgement than experience. For example, judgement requires explicit monitoring and manipulation, i.e., working memory, since otherwise any kind of judgement remains impossible. Experience, in contrast, does not necessarily presuppose working memory. Accordingly, even if cognitive involvement remains a matter of degree, the distinction between experience and judgement and consecutively the one between presence and absence of the 'phenomenal–qualitative' character can be maintained.

Early involvement of the VMPFC may be regarded as crucial for the 'phenomenal–qualitative' character of experience (see Figure 1). We demonstrated that: several studies showed early involvement of the VMPFC in experience (see above). On the contrary, absence of the early involvement of the VMPFC, as it is for example the case in judgement (see above), is characterized by strong cognitive ingredients as well as the consecutive absence of the 'phenomenal–qualitative' character. Moreover, the crucial role of the VMPFC is further supported by the consideration of lesion studies in humans. Subjects with lesions in the VMPFC show severe deficits in experience (Damasio, 1999). They seem to lack experience and thus the 'phenomenal–qualitative' character since they often appear indifferent and apathic while their judgements and cognitive abilities apparently remain intact. Consequently, early involvement of the VMPFC may be regarded as a necessary natural condition for the possibility of experience in general and thus for its 'phenomenal–qualitative' character.

We have characterized the 'phenomenal–qualitative' character by 'raw feeling'. This raises two problems. First, the definition of the term 'feelings' and their role remain unclear: some authors regard 'feelings' as central (Panksepp, 1998) while others attribute only a peripheral, i.e., epiphenomenal, role to them (LeDoux, 1996; Damasio, 1999). However, even if 'feelings' remain peripheral, they may nevertheless be characterized as 'raw' as defined by the absence of cognitive involvement. Accordingly, it is the degree of cognitive involvement rather than their definition and role which determines a 'feeling' as either 'raw' and 'pure' or 'non-raw' and 'impure'.

Second, if 'raw feelings' are supposed to be central for the 'phenomenal–qualitative' character of experience, one may assume a relationship between 'feelings' in particular and neural activity in the VMPFC. This has not been demonstrated yet and therefore awaits empirical confirmation.

'Phenomenal–qualitative' properties can be characterized by an 'All-or-Nothing' character. There is no gradual continuum between the presence and absence of the 'phenomenal–qualitative' character: qualia are either present or absent. This 'All-or-Nothing' character may be accounted for by an early spatiotemporal dissociation, i.e., 'double dissociation', between experience and judgement in the ventral prefrontal cortex (see above). At the time point of 160–200 ms (see above), neural activity may diverge either into the VMPFC or the VLPFC where it remains in the consecutive time interval (200–500 ms). Due to this early dissociation, an overlap in the processing between experience and judgement remains almost impossible so that they can clearly be distinguished from each other. This means that there is a clear-cut distinction between presence and absence of the 'phenomenal–qualitative' character. However, there has been no direct empirical evidence so far for the assumption of this linkage between early spatiotemporal ventral prefrontal dissociation and the 'All-or-Nothing' character of 'phenomenal–qualitative' properties.

One may consider the reverse case of late spatiotemporal dissociation. Late distinction does no longer imply an 'All-or-Nothing' character but rather a degree in continuum. For example, emotional and non-emotional contents are apparently distinguished from each other rather late, i.e., at 500 ms which, spatially, is accompanied by different degrees of intensity of neural activity in the parieto-occipital cortex (see above).

While we can clearly distinguish between experience and judgement, we remain unable to do so in the case of emotional and non-emotional contents. Instead of presupposing an 'All-or-Nothing' character, one may rather assume a gradual continuum between emotional and non-emotional contents. Due to their late dissociation, there is considerable overlap between the processing of emotional and non-emotional contents in the preceding time interval (200–500 ms) which, phenomenologically, may be reflected in the impossibility of an 'All-or-Nothing' character. Accordingly, early spatiotemporal dissociation may be regarded as a necessary natural condition for the possibility of an 'All-or-Nothing' character with the consecutive presence or absence of 'phenomenal–qualitative' properties.

Spatiotemporal dissociation in the ventral prefrontal cortex implies a characterization of experience and judgement as different 'functional domains' (see above). These 'functional domains' can be characterized by 'double dissociation' with mutually exclusive occurrences: either experience is present while judgement remains absent or vice versa, i.e., judgement is present while experience remains absent.

Analogously to their characterization as different 'functional domains', one may characterize the phenomenal properties of experience and judgement as different 'phenomenal domains'. 'Phenomenal–qualitative' and 'non-phenomenal– qualitative' properties may accordingly be regarded as different 'phenomenal domains' which can be characterized by 'double dissociation' with mutually exclusive occurrences. Either 'phenomenal–qualitative' properties are present while 'non-phenomenal–qualitative' properties remain absent or 'non-phenomenal– qualitative' properties are present while

'phenomenal–qualitative' properties remain absent. Accordingly, one may assume a direct linkage between 'functional domains' and 'phenomenal domains' which, however, awaits further empirical confirmation.

'Double dissociation' with a mutually exclusive occurrence remains, for example, impossible in the case of emotional and non-emotional contents. Co-occurrences between emotional and non-emotional contents is possible so that there is no 'double dissociation' with mutually exclusive occurrence. This may be due to the absence of an 'All-or-Nothing' character between the emotional and non-emotional contents which, in turn, may be accounted for by their late dissociation (see above).

Imagine, for example, late, i.e., 500 ms, spatiotemporal dissociation between experience and judgement. In this case, a distinction between 'phenomenal–qualitative' and 'non-phenomenal–qualitative' properties may not be as clear-cut as it is the actual case. The presence of 'phenomenal–qualitative' properties could no longer be distinguished as clearly from their absence and the 'All-or-Nothing' character would thus be replaced by a gradual continuum as it is also the case between emotional and non-emotional contents (see above). If, however, the 'All-or-Nothing' is replaced by a gradual continuum, 'double dissociation' and mutually exclusive occurrences between experience and judgement remain impossible. Accordingly, early spatiotemporal dissociation may be regarded as a necessary natural condition for the possibility of 'double dissociation' with mutually exclusive occurrence.

In summary, the neuroscientific account of 'phenomenal–qualitative' properties of experience may be characterized by (i) the involvement of the VMPFC as a necessary condition for the 'phenomenal–qualitative' properties in experience; (ii) an early spatiotemporal dissociation between experience and judgement in the ventral prefrontal cortex as a necessary condition for the 'All-or-Nothing' character of 'phenomenal–qualitative' properties; (iii) the distinction between experience and judgement as different 'functional domains' as a necessary condition for the characterization of different 'phenomenal domains' with 'double dissociation' and mutually exclusive occurrence.

c. Epistemic implications

Within the present framework, the First- and Third-Person Perspective (i.e., FPP and TPP) can be distinguished on phenomenological, neuropsychological and neurophysiological grounds.

Phenomenologically, FPP shows 'phenomenal–qualitative' properties which remain absent in TPP. Neuropsychologically, FPP may be characterized by the absence of cognitive ingredients. This is, for example, the case in experience. TPP, in contrast shows rather strong cognitive ingredients, which is, for example, the case in judgement (see above). Neurophysiologically, FPP may be linked with the involvement of the VMPFC and medial prefrontal cortical regions while TPP seems to be associated with the VLPFC and other lateral prefrontal cortical regions. One may therefore assume 'double dissociation' and a mutually

exclusive occurrence between FPP and TPP in phenomenal, neuropsychological and neurophysiological regard.

The possibility of 'double dissociation' with the mutually exclusive occurrence between FPP and TPP remains incompatible with either elimination or subordination of one perspective in favour of the respective other. An elimination of FPP remains incompatible with any empirical evidence since the necessary natural conditions for FPP (i.e., early involvement of the VMPFC) are independent and separate from those underlying TPP. Subordination of FPP under TPP also remains incompatible with empirical evidence. The spatiotemporal pattern, which accounts for experience, should be a *form fruste* of the one underlying judgement in this case. For example, similar to judgement, the VLPFC should be activated — even though to a lesser degree — during experience as well which is not the case.

Accordingly, any kind of epistemology (see below for further details), which presupposes either elimination or subordination of either perspective remains incompatible with empirical evidence. These kinds of epistemology remain therefore naturally, i.e., empirically implausible, which, however, does not necessarily exclude the possibility of their logical plausibility (see Northoff, 2003a).

Due to 'double dissociation' and mutually exclusive occurrence, one may characterize FPP and TPP as different 'epistemological domains'. If FPP and TPP are regarded as different 'epistemological domains', the respective epistemologies, i.e., 'First- and Third-Person Epistemology' (Stevenson, 1999; Northoff, 2003), can no longer be regarded as contradictory. Instead, they may rather be regarded as complementary and co-existent. Accordingly, neurophysiological, neuropsychological and phenomenal evidence favours complementarity and co-existence between 'First- and Third-Person Epistemologies'.

Since 'First- and Third-Person Epistemology' are well compatible with empirical evidence, both kinds of epistemologies presuppose 'naturalization', i.e., 'naturalized epistemology'. Though the exact definition of the term 'naturalized' cannot be discussed within the present context (see Northoff, 2003), it shall indicate at least the compatibility between epistemic account and empirical evidence, i.e., empirical plausibility. Accordingly, even 'First-Person Epistemology', which has often been regarded as an obstacle to a 'naturalized epistemology' in philosophical discussions, remains compatible with empirical evidence and thus with 'naturalization'. Conversely, a 'naturalized epistemology' no longer implies elimination of the First-Person Perspective.

In summary, epistemological implications of a neuroscientific account of 'phenomenal–qualitative' properties can be characterized by (i) 'double dissociation' between FPP and TPP with respect to their underlying natural conditions; (ii) elimination or subordination of either perspective remaining incompatible with empirical evidence; (iii) characterization of both 'First- and Third-Person Epistemologies' as two different 'epistemological domains' within the framework of a 'naturalized epistemology'.

2. *The 'presence' of experience*

a. Neuroscientific findings

The VMPFC is strongly connected with the hippocampus (Barbas, 2000; Barbas & Blatt, 1995) which accounts for the encoding and storage of present events (Buckner & Wheeler, 2001). This connectivity pattern is reflected in the co-activation of both regions as observed in imaging studies. Both experience of actual, i.e., present, events and re-experience of past events, i.e., autobiographical memories, seem to induce a co-activation in VMPFC and the hippocampus (Mayberg *et al.*, 1999; Liotti & Mayberg, 2001; Maguire & Mummery, 1999; Maratos *et al.*, 2001; Maddock *et al.*, 2001; Fink *et al.*, 1996; Andreasen *et al.*, 1995). Since the hippocampus remains crucial for encoding and storage of events, one may assume an involvement of these processes in the experience of events, i.e., the events may be encoded and stored while they are experienced.

In addition to the co-activation between VMPFC and hippocampus, a concurrent deactivation in VLPFC and posterior cingulate has been observed during experience (Mayberg *et al.*, 1999; Liotti & Mayberg, 2001; Liotti *et al.*, 2000; Bartels & Zeki, 2000; Northoff *et al.*, 2002). Both regions, i.e., VLPFC and posterior cingulate, are involved in the retrieval of past events as memories. Their deactivation during the experience of actual events might reflect a suppression of the retrieval of past events which otherwise might interfere with the experience of actual events. However, the exact functional implications of this pattern of concurrent activation and deactivation in VMPFC/hippocampus and VLPFC/posterior cingulate remain unclear.

There is, nonetheless, some indirect support from findings in patients with major depression. These patients show highly intense negative experiences while, at the same time, they remain unable to remember any kind of positive event in their past. Accordingly, they can no longer distinguish between present and past events. The imaging findings demonstrate hyperactivation in the VMPFC and the hippocampus in the acute depressive state (Mayberg *et al.*, 1999; Liotti & Mayberg, 2001). Hyperactivation is accompanied by hypoactivation in the VLPFC/DLPFC and the posterior cingulate. This hyperactivation may account for their intense negative experience while the hypoactivation may be related to their inability to retrieve, i.e., memorize past positive events. The disappearance of the depressive symptoms is accompanied by the 'normalization' of neural activity in both VMPFC/hippocampus and VLPFC/posterior cingulate in the post-acute state.

Conversely, tasks that require the retrieval of past events as memories subsequently show a co-activation of both VLPFC and posterior cingulate (Buckner & Wheeler, 2001). Judgement of emotional and non-emotional 'contents', which presupposes some kind of retrieval of past events for comparison with the actual event to be judged, induces co-activation in both regions (Simpson *et al.*, 2000; Paradiso *et al.*, 1999; Northoff *et al.*, 2002). On the other hand, these tasks lead to deactivation (or non-involvement) of the VMPFC and the hippocampus. Accordingly, the functional balance between VMPFC/hippocampus and

VLPFC/posterior cingulate seems to be crucial for the regulation of the relation between present and past events.

It should be noted that, similar to the VMPFC and the hippocampus (see above), the involvement of the VLPFC and the posterior cingulate seems to be independent from the respective 'content' that is to be retrieved. For example, the retrieval of both spatial and verbal contents leads to activation in VLPFC and posterior cingulate (see Buckner & Wheeler, 2001). Consequently, the involvement of these regions seems to depend on processes and functions like, for example, retrieval rather than their respective 'contents', i.e., spatial and verbal or emotional and non-emotional.

In summary, neuroscientific findings during experience demonstrate (i) co-activation in VMPFC and hippocampus which may account for simultaneous encoding and storage of the events during experience; (ii) concurrent deactivation in posterior cingulate and VLPFC which may account for the suppression of the retrieval of past events during experience.

b. The neuroscientific account

Neuropsychologically, the 'presence' of mental states may be reflected in the experience of present events and the simultaneous suppression of past events. Past events could also be integrated within present events which is the case in re-experience of past events within the present context. We demonstrated that both kinds of experience can be characterized by the co-activation in VMPFC and hippocampus. While it is obvious that the VMPFC is closely associated with experience itself (see above), the hippocampus seems to subserve encoding and storage of present events (Buckner & Wheeler, 2001). Experience is subsequently accompanied by simultaneous encoding and storage of the respective events.

If novel events shall be encoded and stored, they may be compared, integrated and included into the other, i.e., past, events which are already encoded and stored. The integration and inclusion between past and present events during encoding and storage may account for the integration between both temporal dimensions, i.e., past and present. Phenomenologically, this temporal integration is reflected in 'retention' which makes the distinction between past and present events during experience impossible (see above). As a result the event is no longer experienced as restricted to the presence. Accordingly, co-activation between the VMPFC and the hippocampus may be regarded as a necessary condition for the possibility of linkage between different temporal dimensions as it is phenomenally reflected in 'retention' and 'presence' in the experience of events (see also Ellis & Newton, 1998, who speak of 'temporal thickness').

For example, imagine the absence of co-activation between VMPFC and hippocampus. The present events in experience could no longer be encoded and stored simultaneously in this case because the hippocampus is no longer involved. The linkage between past and present events and thus between the different temporal dimensions remains impossible so that 'retention' in the experience of events would be absent.

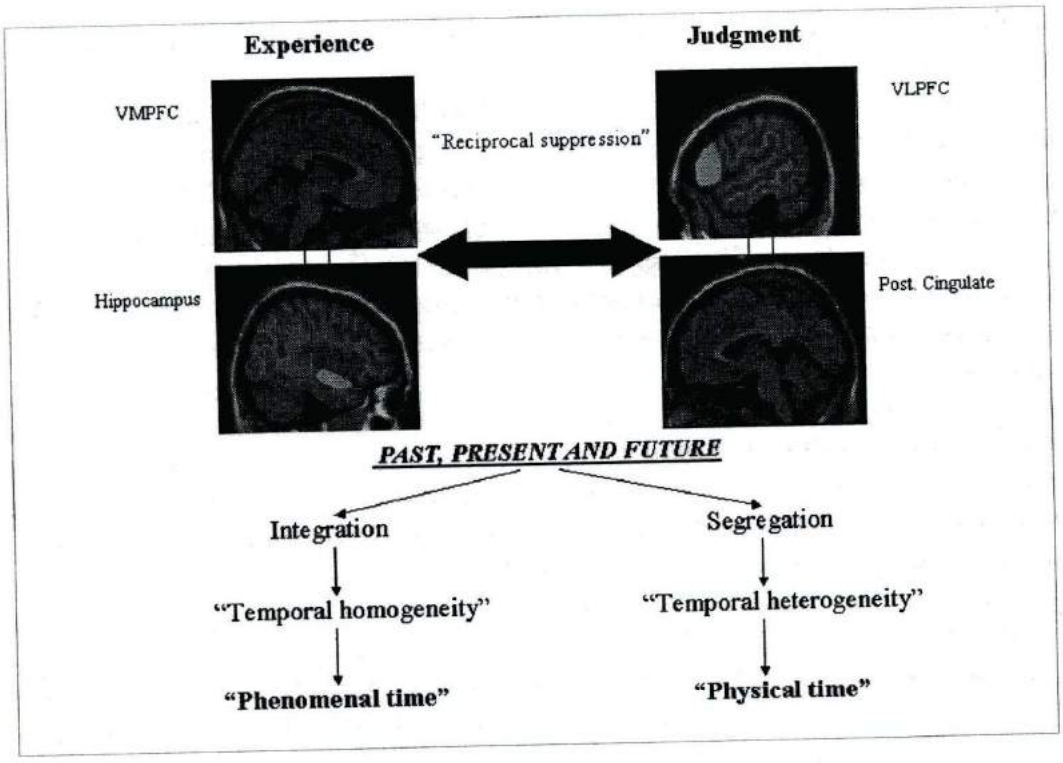

Figure 2
Patterns of neural activity and processing of temporal dimensions

The linkage between present and past events in encoding/storage may be further reinforced by a simultaneous suppression of the retrieval of past events which may be accounted for by concurrent deactivation in VLPFC as well as posterior cingulate (see above).

Due to retrieval, encoded and stored events from the past can be signified as past events, which temporally distinguishes them from present events. However, if the process of retrieval is suppressed, the distinction between past and present events remains impossible. As a result, past and present (and future) temporal dimensions cannot be distinguished from each other and 'temporal integration' predominates over 'temporal segregation'. The experience of events therefore includes all three temporal dimensions so that events are experienced in 'phenomenal time' (see also Gregory, 1996). Accordingly, the co-occurrence of activation in VMPFC/hippocampus and deactivation in VLPFC/posterior cingulate may be regarded as a necessary condition for the possibility of 'phenomenal time'. See Figure 2.

Imagine, for example, a concurrent activation of VMPFC/hippocampus and VLPFC/posterior cingulate. Encoding/storage of the present event and retrieval of past events as past events would occur simultaneously in this case. The present event would thus be designated and signified as present and as such distinguished from past events. The 'temporal integration' between past, present and future events would be replaced by 'temporal segregation'. Phenomenologically, this would probably result in the absence of 'retention' and 'protention' and thus of 'presence'. 'Phenomenal time' and 'temporal

homogeneity' would no longer exist but only 'physical time' and 'temporal heterogeneity'. One may consequently consider the concurrent deactivation in VLPFC and posterior cingulate as a necessary natural condition for the possibility of 'temporal homogeneity' and 'phenomenal time'.

In contrast to experience, judgement can be characterized by the activation in VLPFC and posterior cingulate. This may reflect the involvement of retrieval of past events, which allows for both comparison and distinction between past and present events. Comparison between past and present events is a necessary presupposition for an accurate judgement. Due to the fact that retrieval re-actualizes past events, it brings them into working memory where they can be compared with the present events. At the same time, past and present events have to be distinguished from each other since otherwise they may be confused in the judgement. Due to the fact that retrieval signifies retrieved events as past events (see above), they can be distinguished from the present event in temporal regard. As a result, both past and present (and future) temporal dimensions can be distinguished from each other during judgement so that 'temporal segregation' predominates over 'temporal integration'. 'Temporal homogeneity' and 'phenomenal time' are replaced by 'temporal heterogeneity' and 'physical time'. Co-activation in VLPFC and posterior cingulate may therefore be regarded as a necessary condition for the possibility of 'physical time'.

It should be noted that both kinds of time, i.e., 'phenomenal time' and 'physical time', remain mutually exclusive. There is either 'phenomenal time' while 'physical time' remains absent or there is 'physical time' while 'phenomenal time' remains absent. This 'double dissociation' with the mutually exclusive occurrence between 'phenomenal and physical time' may be accounted for by the reciprocal relationship between VMPFC/hippocampus and VLPFC/posterior cingulate. Either the former are activated while the latter remain deactivated or non-involved or else the latter are activated while the former remain deactivated or non-involved. This reciprocal relationship between VMPFC/hippocampus and 'VLPFC/posterior cingulate' should therefore be regarded as a necessary condition for the possibility of 'double dissociation' between 'phenomenal and physical time'.

In summary, the neuroscientific account of 'presence' of experience may be characterized by (i) co-activation between VMPFC and hippocampus as a necessary condition for 'temporal integration' with subsequent 'retention' and 'protention', i.e., 'presence' of events in experience; (ii) concurrent deactivation in VLPFC and posterior cingulate with suppression of 'temporal segregation' as a necessary condition for 'temporal homogeneity' and 'phenomenal time' in experience.

c. Epistemic implications

Epistemologically, 'phenomenal time' is linked with experience in FPP while 'physical time' is more likely to be associated with judgement in TPP. Subsequently, FPP and TPP can be characterized by different temporal properties.

The description of FPP and TPP by different temporal properties further endorses their characterization as two different 'epistemological domains'. Time

is reflected in different ways in FPP and TPP: either as 'phenomenal time' or 'physical time'. Accordingly, this consideration of time lends further support to the distinction between FPP and TPP as two different 'epistemological domains'.

In addition to the temporal distinction, FPP and TPP may be distinguished in spatial regards as well. While FPP is associated with the body as a 'lived body', i.e., 'subjective body', TPP can rather be related with the body as an 'objective body' (see above and Northoff, 2003a). Accordingly, FPP and TPP as different 'epistemological domains' can be distinguished in both regards, i.e., temporally and spatially.

Moreover, the temporal properties which characterize FPP and TPP are not only different but mutually exclusive as well. 'Phenomenal time' cannot co-occur with 'physical time' and 'physical time' cannot co-occur with 'phenomenal time'. Analogously, one may assume that a co-occurrence between FPP and TPP may be impossible. Neither FPP can co-occur with TPP nor can TPP co-occur with FPP — there is 'double dissociation' between FPP and TPP with regard to their temporal properties. The possibility of 'double dissociation' between FPP and TPP makes any kind of elimination or subordination of either perspective in favour of the respective other impossible since this would contradict with the distinction between 'phenomenal and physical time'.

It should be noted that the terms 'co-occurrence' and 'co-existence' cannot be equated with each other. While 'co-occurrence' refers to simultaneous occurrence, i.e., manifestation as actual presence, and therefore includes a temporal dimension, 'co-existence' refers to the principal existence of FPP and TPP independent from their actual manifestation. For example, FPP and TPP may exist but they may not occur at the same time, i.e., they are co-existent but not co-occurrent. In contrast, 'co-occurrence' without 'co-existence' remains impossible since the former necessarily presupposes the latter. This distinction between 'co-occurrence' and 'co-existence' must thus be considered as crucial for the characterization of the relationship between FPP and TPP.

In summary, the epistemological implications of the neuroscientific account of 'presence' may be characterized by (i) distinct temporal properties in FPP and TPP lending further support to their characterization as different 'epistemological domains'; (ii) the possibility of 'double dissociation' between the temporal properties of FPP and TPP which implies the impossibility of both elimination and subordination of either perspective.

3. The 'non-structural homogeneity' of experience

a. Neuroscientific findings

The VMPFC receives afferences from all five primary sensory areas (Barbas, 2000; Koetter *et al.*, 2001; Carmichael & Price, 1996) so that it can be characterized as 'polysensory'. Moreover, the afferences from the different sensory modalities converge and overlap on each other reflecting a 'polymodal' distribution within the VMPFC. In addition to the connections with the primary

'external' sensory areas, the VMPFC is connected with certain subcortical areas like the PAG, hypothalamus and brain stem nuclei, which account for the generation of emotions as an 'internal' sensory modality (Damasio, 1999). Finally, the VMPFC is reciprocally connected with the amygdala. Similar to the VMPFC, the amygdala receives afferences from both 'external' and 'internal' sensory modalities and can thus be characterized as 'polysensory' and 'polymodal' by itself. Subsequently, the VMPFC receives both direct and indirect (via the amygdala) input from all sensory modalities. Functionally, these connections may be reflected in the top–down modulation of the sensory areas by the VMPFC — the exact mechanisms remain, however, unclear (Simpson *et al.*, 2001; Barbas, 2000; Northoff & Bermpohl, 2003).

In contrast to the VMPFC, the VLPFC receives sensory input predominantly from the secondary and tertiary 'external' sensory areas related to visual, auditory and somatosensory modalities (Barbas, 2000). Unlike in VMPFC, these afferences do not converge on each other so that the VLPFC can rather be characterized by 'unimodal' than 'polymodal' distribution. Moreover, the VLPFC does not receive strong afferences from the subcortical areas which subserve the generation of emotions.

Due to its 'polysensory' and 'polymodal' character, activation in VMPFC during experience may remain independent from the respective content, i.e., the sensory modality, which accounts for the 'contents' in experience. Accordingly, activation in VMPFC during experience may be characterized by a 'modality unspecifity'. The VMPFC has been shown to be activated during emotional experience in different sensory modalities. Visual (i.e., pictures), auditory (i.e., music clips), gustatory (i.e., tastes) as well as tactile (i.e., pain) emotional experience all induced activation in VMPFC (Lane *et al.*, 1997; Baker *et al.*, 1997; Morris *et al.*, 1999; Teasdale *et al.*, 1999; Northoff *et al.*, 2000; Simpson *et al.*, 2001; O'Doherty *et al.*, 2001b). Distinct methods of induction of emotional experience, verbal (i.e., words), non-verbal (i.e., faces), emotional imagery and recall of script-driven past autobiographical events also lead to activation in VMPFC (Lane *et al.*, 1997; 1998; Mayberg *et al.*, 1999; Liotti *et al.*, 2000; Shin *et al.*, 2000; Rauch *et al.*, 2000; Halgren *et al.*, 1994; O'Doherty *et al.*, 2001a).

Due to its 'polysensory' and 'polymodal' character, the VMPFC is able to receive and integrate signals from both the 'external' environmental and the 'internal' bodily milieu, i.e., it may 'sample the entire external and internal environment and may act as an environmental integrator' (Barbas, 2000, p. 322). Accordingly, neural activity in VMPFC depends crucially on the respective environmental and bodily events. Activity in the neurons in VMPFC can, for example, be rapidly modified in the light of the animal's recent experience of events, e.g., the reversal of a visual stimulus (Thorpe *et al.*, 1983). What is more, as described above, the VMPFC is also involved in emotional processing. Taken together, one may therefore regard the VMPFC as a 'critical node in the processing of environmental and internal cues to generate feeling states' (London *et al.*, 2000).

'Polysensory' and 'polymodal' integration between different sensory modalities requires early involvement as well as a high level of continuous neural

activity in the VMPFC (see below for further reasons). The VMPFC is activated early (160–200 ms) during emotional experience, which has been demonstrated in both humans and macaques (Kawasaki *et al.*, 2001; Thorpe *et al.*, 1983; Northoff *et al.*, 2002; Halgren *et al.*, 1994; Streit *et al.*, 1999; 2000). Other prefrontal areas like the VLPFC, on the other hand, show a later onset of neural activity at around 280 ms after stimulus onset. One may consequently assume 'temporal priority' of neural activity in VMPFC as compared to VLPFC, which, however, has to be supported by further studies.

Functionally, the 'temporal priority' may underline the crucial importance and priority of 'polysensory' and 'polymodal' integration in the VMPFC before the onset of further cognitive processing in the lateral prefrontal areas.

In addition to the early onset, 'polysensory' and 'polymodal' integration requires a continuous high level of neural activity in VMPFC. Physiologically, the VMPFC has been characterized by a tonic mode of function with a high level of continuous ongoing neural activity (Raichle *et al.*, 2001; Gusnard & Raichle, 2001, Northoff *et al.*, 2002). This tonic activity serves as an active 'resting state' of the brain and may be regarded as a 'physiological baseline' that sets the initial level for changes in neural activity, i.e., activation and deactivation in other regions.

Deactivation may consequently be regarded as the predominant mode of neural activity in the VMPFC. This is supported by results from previous imaging studies (Simpson *et al.*, 2001; Raichle *et al.*, 2001; Gusnard *et al.*, 2001; Northoff *et al.*, in revision). While cognitive tasks induced clear-cut deactivation in VMPFC, the level of neural activity was only slightly, if at all, raised during emotional experience. Moreover, the magnitude of signal decrease, i.e., deactivation in the VMPFC during judgement, correlated with the level of signal intensity during experience which preceded the judgement (Northoff *et al.*, in revision). Accordingly, the initial level of neural activity in the VMPFC seems to determine the magnitude of deactivation in subsequent tasks.

In summary, neuroscientific findings during experience demonstrate (i) 'supramodal character' and 'modality unspecifity' of neural activity in VMPFC; (ii) the onset of neural activity in VMPFC is earlier than in VLPFC which reflects 'temporal priority'; (iii) functional characterization of the VMPFC as a 'physiological baseline' with tonic neural activity and predominant deactivation.

b. Neuroscientific account

'Non-structural homogeneity' can be characterized by 'wholeness', 'homogeneity' and 'event-character' (see above). This makes the distinction between the different parts, elements and structures in experience impossible. These phenomenal properties, i.e., 'wholeness', 'homogeneity' and 'event-character', may be accounted for by the conjunction of 'polysensory' and 'polymodal' properties within the VMPFC.

While the VMPFC provides the 'form' of the experience which is reflected in its 'wholeness', 'homogeneity' and 'event-character', the 'internal' and 'external' sensory areas rather account for the 'content', i.e., the modality of the experience, which may be auditory, visual, emotional, etc. The linkage between 'form' and

'content' of experience may be subserved by the close connections and 'top–down modulation' between the VMPFC and the various sensory areas (see above).

Due to its 'polysensory' character, the VMPFC receives information from all bodily and environmental events in different sensory modalities that by themselves reflect 'heterogenous' stimuli rather than 'homogenous' events (see Northoff, 2003a). Due to its (VMPFC) 'polymodal' character, these different stimuli converge within the VMPFC. As a result, the differences between the 'single ' and 'heterogenous' stimuli become indistinguishable for the VMPFC itself which subsequently leads to their transformation into a 'whole' and 'homogenous' event (Northoff, 2003a). Accordingly, the conjunction of both 'polysensory' and 'polymodal' properties must be considered as a necessary natural condition for the possibility of 'non-structural homogeneity' in our experience of events.

If, for example, the 'polysensory character' is linked with 'unimodal distribution', the different stimuli cannot converge onto each other which makes their integration within a 'whole' and 'homogenous' event impossible. The conjunction of both 'polymodal' and 'polysensory' properties in the VMPFC remains, therefore, necessary for 'non-structural homogeneity' in our experience of events.

Moreover, the conjunction of 'polysensory' and 'polymodal' properties remains necessary for the linkage between bodily and environmental events. Due to this conjunction of both kinds of properties, 'internal', i.e., bodily, and 'external', i.e., environmental, sensory afferences converge and become indistinguishable from each other within the VMPFC. If, however, both kinds of afferences can no longer be distinguished from each other, a distinction between bodily and environmental events also becomes impossible. Phenomenologically, this may be reflected in 'phenomenal space' as distinguished from 'physical space'. While 'phenomenal space' reflects the confluence of bodily and environmental space within a 'whole' and 'homogenous' event, 'physical space' reflects the spatial distinction between bodily and environmental stimuli as 'single' and 'heterogenous' stimuli.

However, the question for the exact neural mechanisms for the integration of 'heterogenous' sensory stimuli into a 'homogenous' event in experience remains. We already demonstrated that, spatially, afferences from different sensory modalities converge and confluence within the VMPFC. In addition to 'spatial convergence', one could assume 'temporal convergence' as well. The VMPFC seems to be involved quite early in the processing of sensory stimuli, i.e., at around 160–200 ms (see above). This early involvement may reflect the interdependent as well as simultaneous processing of different sensory stimuli on the basis of their spatial confluence in VMPFC. The 'heterogenous' stimuli can, as a result, be mutually compared, adjusted and merged to each other which may result in the generation of a 'homogenous' event. However, the exact neural mechanisms which account for both 'spatial and temporal convergence' within the VMPFC have yet to be explored.

One could, for instance, imagine that the VMPFC is activated and involved relatively late — that is at 500 ms. The different sensory stimuli would be processed separately and thus independent from each other in this case making their

integration almost impossible. At this late time point, sensory–cognitive processing may be already completed and finished which would make mutual adjustment and merging rather difficult. It could therefore be assumed that early involvement of the VMPFC can be regarded as a necessary natural condition for the integration of 'heterogenous' stimuli into a 'homogenous' event and thus for 'non-structural homogeneity' in experience.

An early integration of 'heterogenous' stimuli into a 'homogenous' event may be further reinforced by 'temporal priority' of VMPFC (see above). The VLPFC (and DLPFC) subserve working memory with storage/retrieval and manipulation/monitoring which account for the dissection and segregation of events into different parts, elements and structures. Due to the fact that the VLPFC seems to be involved later than the VMPFC (see above), the early emphasis is put on integration rather than segregation. Before events can be dissected and segregated into distinct parts, elements and structures, they must be generated as 'whole' and 'homogenous' events. Phenomenologically, 'temporal priority' may thus be reflected in 'wholeness' with 'simpleness', 'atomicity' and 'monadicity' of the events in experience (see above).

One may also envision the reverse case, i.e., the 'temporal posteriority' of the VMPFC as compared to the VLPFC. In this case, the VLPFC would be involved earlier than the VMPFC and dissection and segregation would therefore start earlier than integration. Experience would potentially no longer be characterized by 'homogenous' events and thus 'non-structural homogeneity' but rather by 'structural heterogeneity' with distinct parts, elements and structures. 'Temporal priority' may therefore be regarded as a necessary natural condition for the possibility of 'wholeness' of events in our experience.

Finally, the VMPFC can be characterized by a high level of tonic neural activity, which reflects the 'physiological baseline'. This tonic activity can either be preserved, as is the case during experience, or interrupted with consecutive deactivation, as during cognitive–behavioural requirements (see above). Phenomenologically, the functional alternative between preservation and interruption of tonic activity may be reflected in the 'All-or-Nothing character' of 'non-structural homogeneity' (see above). The high level of tonic neural activity is either preserved or interrupted, meaning that 'non-structural homogeneity' is either present or absent which results in a 'Yes–No decision'.

In contrast to the VMPFC, the VLPFC can be characterized by different degrees of activation being either more or less intense. Accordingly, the respective phenomenological properties, e.g., 'structural heterogeneity', may be characterized by a gradual continuum between their presence and absence with the consecutive impossibility of a 'Yes–No decision' (see above).

In summary, the neuroscientific account of 'non-structural homogeneity' of experience may be characterized by (i) the conjunction of 'polysensory' and 'polymodal' properties within the VMPFC as a necessary anatomical–connectional condition for the generation of 'whole' and 'homogenous' events in experience; (ii) the 'spatial convergence', i.e., 'modality unspecifity', and 'temporal convergence', i.e., 'temporal priority', within the VMPFC as necessary

physiological–functional conditions for the confluence and integration of 'single' and 'heterogenous' stimuli into 'whole' and 'homogenous' events in experience; (iii) a tonic mode of neural activity in VMPFC as a necessary condition for the 'All-or-Nothing' character of 'non-structural homogeneity' in experience.

c. Epistemic implications

Epistemologically, the 'modality unspecifity' may be reflected in the 'supramodal character' of FPP. FPP is not tied to any particular sensory modality since the different sensory modalities can no longer be distinguished from each other within FPP itself. Due to its 'supramodal' character, FPP has been considered as a 'point of view' from which all sensory stimuli can be viewed.

This 'point of view' has been linked with the body (see above). Empirically, this may be reflected in the close connections of the VMPFC with certain subcortical regions (PAG, midbrain, brain stem), which can account for the 'internal' sensory function of the body itself. The 'point of view' and thus FPP may subsequently be anchored within the body, which can therefore be regarded as the 'centre of experience' (Metzinger, 1995) — FPP is 'embedded' and subsequently requires an 'embedded epistemology' (Northoff, 2003a).

Due to the 'temporal priority' of the VMPFC (see above), cognitive dissection and segregation in VLPFC/DLPFC starts later than integration; this may be called 'temporal delay'. Since cognitive dissection may be regarded as a type of recognition and reflexion, there is a time interval or delay between the onset of integration and the onset of dissection. Phenomenologically, this may be reflected

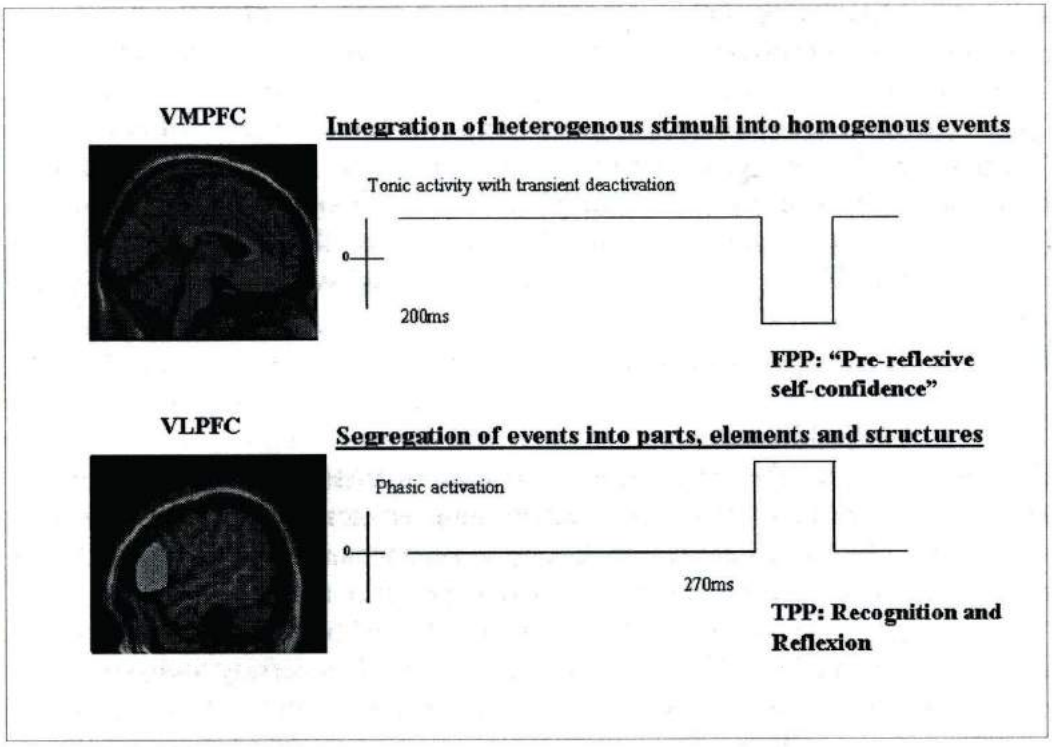

Figure 3
Ventral prefrontal cortical function and 'non-structural homogeneity' of events in experience

in 'pre-reflexive self-confidence' with a 'feeling of identity' and 'infinite closeness' (see above). Moreover, due to the absence of simultaneous cognitive activity, an 'intersubjective' communication of these experiences remains impossible, which may result in the 'intrasubjective' character of mental states. It is therefore possible to presuppose 'pure subjectivity' with complete 'self-transparence' in experience in FPP (see above). The conjunction of 'temporal priority' in VMPFC and 'temporal delay' in VLPFC may thus be considered as a necessary natural condition for the possibility of 'pre-reflexive self-confidence'.

TPP, in contrast, may rather be characterized by transient cognitions that account for the dissection and segregation of 'homogenous' events into 'heterogenous' parts, elements and structures (see Figure 3). It is because of this cognitive segregation and dissection that the 'point of view' as well as 'pre-reflexive self-confidence' and 'self-transparence' are lost in TPP. Due to cognitive involvement, the states in TPP can be verbalized and are, therefore, unlike the ones in FPP, intersubjectively accessible.

The switch between FPP and TPP may be related to the reciprocal modulation between VMPFC and VLPFC. The 'physiological baseline', which reflects tonic activity in VMPFC (see above), may be regarded as a 'psychological baseline'. This 'psychological baseline' may account for our continuous stream of ongoing experiences in FPP, which may be interrupted transiently by cognitive–behavioural requirements as associated with TPP. One may subsequently infer that FPP shows 'continuous presence'. The 'transient presence' of TPP may meanwhile be accounted for by modulation and interruption of the 'psychological baseline'. However, further investigations in both regards, i.e., neuroscientifically and epistemically, are necessary to support this assumption.

In summary, epistemological implications of a neuroscientific account of 'non-structural homogeneity' can be characterized by (i) the relation between 'polysensory'/'polymodal' anatomical structures of the VMPFC and 'supramodal'/'bodily' character of the 'point of view' in FPP; (ii) the relation between 'temporal priority' in VMPFC and 'pre-reflexive self-confidence' and 'self-transparence' in FPP; (iii) the relation between the interruption of tonic activity in VMPFC by phasic activation in VLPFC and switch from FPP to TPP.

4. The 'transparency' of experience

a. Neuroscientific findings

Experience can be characterized by activation in VMPFC whereas judgement about the contents of experience rather induced activation in VLPFC (see above). In addition to activation in one area, concurrent deactivation in the respective other has been observed in both experience and judgement.

Experience leads not only to activation in VMPFC but also to the concurrent deactivation in VLPFC (Northoff *et al.*, submitted). Conversely, judgement and other cognitive processes like noun generation induce not only activation in VLPFC but, in addition, concurrent deactivation in VMPFC (Simpson *et al.*, 2001; Northoff *et al.*, in revision; Gusnard, 2001). The functional relationship

between VMPFC and VLPFC during experience and judgement may therefore be characterized by 'reciprocal suppression'.

Analogous relationships of 'reciprocal suppression' have been observed between the following: dorsomedial (DMPFC) and dorsolateral (DLPFC) prefrontal cortex, sub/pregenual and supragenual anterior cingulate, ipsi- and contralateral motor cortex, and primary and secondary/tertiary visual areas (Bush *et al.*, 2000; Greene *et al.*, 2001; Mayberg *et al.*, 1999; Northoff *et al.*, submitted).

In addition to 'reciprocal suppression' between VMPFC and VLPFC, experience and judgement show mutually exclusive spatiotemporal patterns of neural activity. Despite the fact that both showed similar time windows (200–280 ms, 280–370 ms, 370–500 ms, 500–700 ms, 700–800 ms), the distribution of neural activity within these time windows differs between experience and judgement (Northoff *et al.*, submitted). Neural activity during experience is located early in VMPFC (200–500 ms) and later (500–800 ms) in the posterior, i.e., parieto-occipital, association cortex. Neural activity during judgement, in contrast, is located early in VLPFC (200–500 ms) and later in VMPFC (500–800 ms). Experience and judgement can subsequently be characterized by different and mutually exclusive spatiotemporal patterns, i.e., there is 'double dissociation'.

It should be noted that the main and primary spatiotemporal dissociation rather accounts for the distinction between experience and judgement than it does for the emotional and non-emotional contents within experience and judgement respectively (Northoff *et al.*, submitted). Both emotional and non-emotional experiences induce more or less the same spatiotemporal pattern and only differ in the degree of intensity. This also remains true for emotional and non-emotional judgement. For example, similar to non-emotional judgement, emotional judgement induces signal increases, i.e., activation in VLPFC, and signal decreases, i.e., deactivation in VMPFC. It needs to be noted that both activation and deactivation show less intensity in emotional judgement when compared to non-emotional judgement (Northoff *et al.*, in revision). Accordingly, the spatiotemporal pattern of neural activity seems to be determined rather by 'functional domains', i.e., experience and judgement, than by contents or modes, i.e., emotional and non-emotional.

In summary, neuroscientific findings during experience demonstrate (i) 'reciprocal suppression' between VMPFC and VLPFC during experience and judgement respectively, though in reverse ways; (ii) mutually exclusive spatiotemporal patterns of neural activity during experience and judgement, i.e., 'double dissociation'; (iii) determination of spatiotemporal differentiation in the ventral prefrontal cortex by 'functional domains', i.e., experience and judgement, rather than different contents or modes, i.e., emotional and non-emotional.

b. The neuroscientific account of 'transparency'

Activation in VMPFC and DMPFC during emotional and non-emotional experience has been shown to be accompanied by a concurrent deactivation in VLPFC and DLPFC (see above). Since cognitive processes like working memory, which accounts for storage/retrieval and manipulation/monitoring, involve the

VLPFC/ DLPFC (Stern *et al.*, 2000), deactivation in these regions may lead to the suppression of working memory. Simultaneous cognitive processing with storage/retrieval and manipulation/monitoring of the events during the experience itself may therefore remain impossible. This lack of simultaneous cognitive processing during experience may account for the phenomenal property of 'transparency' as characterized by 'lucidity', 'immediateness' and 'phenomenal certainty' (see above).

'Lucidity' describes the 'direct giveness' of the events in our experience that we experience as ('objective') 'parts of the world' (see above). Due to the simultaneous suppression of working memory, the events in experience can no longer be monitored and/or manipulated. However, if monitoring/manipulation remains impossible the phenomenal distinction between 'subjective' experience and 'objective' world becomes blurred so that the events are experienced as 'directly given' and as 'part of the world' itself.

If, in contrast, the distinction between the own person and the world can be made, the events can be related with the experience of the own person. Accordingly, they would no be longer experienced as 'directly given' and as 'part of the world' (see also Ellis & Newton, 1998). Instead, due to mediation through the experience of the own person, they would be rather experienced as 'indirectly given' and, at least partially, as 'part of the person' itself.

'Immediateness' of events in our experience can be described by the absence of cognitive mediation, i.e., reflexion and recognition. Due to this simultaneous suppression of working memory, the events cannot be related with the 'subjective' experience itself. Phenomenally, this results in a 'feeling of direct contact'. The events themselves can also not be put into doubt by reflexion and are thus considered as complete which, phenomenally, results in a 'feeling of completeness'.

Cognitive mediation like working memory accounts for further processing of the events of experience with their consecutive segregation into parts, elements and structures (see above). Phenomenologically, the onset of cognitive processing may be reflected in the replacement of 'immediateness' by 'mediateness' because the contents are no longer given by themselves, i.e., 'immediately', but rather in a modulated, i.e., 'mediated' way. Moreover, the 'feeling of direct contact' and the 'feeling of completeness' are replaced by the 'recognition of indirect contact' (i.e., as mediated by the own 'subjective' experience) and the 'reflexion of incompleteness' (i.e., by putting the contents into doubt).

Imagine, for example, the simultaneous activation in both VMPFC and VLPFC: in this case, working memory would no longer be suppressed during experience and experience and judgement would be processed simultaneously. Neither 'direct giveness' and 'immediateness' nor 'feeling of direct contact' and 'feeling of completeness' would exist since the contents of experience would always be mediated by simultaneous, i.e., on-line, cognitive processing with recognition and reflexion. The difference between experience and judgement would vanish since, due to the simultaneous temporal occurrence of both, they could no longer be distinguished from each other.

'Phenomenal certainty' describes the absence of doubt with respect to the events in experience as well as the experience itself (see above). Due to simultaneous suppression of cognitive processing, i.e., working memory, reflexion about both the events and the experience itself remains impossible. If, however, reflexion is suppressed neither the events nor the experience itself can be put into doubt. As a result, the comparison between different events and experiences remains impossible — both can no longer be 'relativized'. Phenomenologically, this lack of 'relativization' may be reflected in a 'phenomenal certainty' about both the events and the experience itself.

With the onset of cognitive processing, 'relativization' of events and experience becomes possible so that both can be put into doubt and 'relativized'. The 'phenomenal certainty', which can be characterized by 'absolute conviction', is thus replaced by 'factual certainty' as a 'relative conviction'. Moreover, due to the 'reciprocal suppression' with mutually exclusive occurrences and 'double dissociation' between VMPFC and VLPFC (see above), a reciprocal relationship between 'phenomenal certainty' and 'factual certainty' may be assumed: the higher the 'phenomenal certainty' the lower 'factual certainty' and vice versa. Intense experience makes accurate judgement rather difficult, and accurate judgements are usually not accompanied by intense experiences (see also Northoff, 2003a). Accordingly, experience and judgement are not only different 'functional domains' but they are also reciprocally dependent on each other. Strong 'phenomenal certainty' may therefore be accompanied by 'factual uncertainty' while high 'factual certainty' may go along with 'phenomenal uncertainty'. However, the exact linkage between neural mechanisms and phenomenal properties has yet to be explored.

Imagine, for example, simultaneous maintenance of both experience and judgement on a high level. In this case, intense experience would go along with accurate judgement — the negative correlation between experience and judgement would be replaced by a positive one. In other words: The more intense the emotional experience is the more accurate is also the judgement. Activation in VMPFC would no longer be accompanied by a concurrent deactivation in VLPFC but rather by activation. Both VMPFC and VLPFC would, as a result, be co-activated at the same time. In addition, 'phenomenal certainty' would no longer preclude 'factual certainty', which concludes that 'factual certainty' and 'phenomenal certainty' would be dependent on each other. In contrast to our current situation, we would remain unable to make accurate judgements that are independent from our own experience.

In summary, the neuroscientific account of 'transparency' in experience may be characterized by (i) simultaneous suppression of VLPFC during experience as a necessary condition for the lack of cognitive mediation, i.e., working memory, of the contents of experience which, phenomenally, results in 'lucidity' and 'immediateness'; (ii) mutually exclusive spatiotemporal patterns of neural activity in VMPFC and VLPFC as a necessary condition for the lack of reflexion and recognition during experience which, phenomenally, results in 'feeling of direct contact' and 'feeling of completeness'; (iii) a reciprocal relationship between

experience and judgement as different 'functional domains' in the ventral prefrontal cortex as a necessary condition for the reciprocal interdependence between 'phenomenal certainty' and 'factual certainty'.

c. Epistemic implications

On the basis of the above-discussed considerations, FPP and TPP may not only be characterized as distinct 'epistemological domains' but in addition, by 'reciprocal dependence'.

As demonstrated above, FPP and TPP show different, i.e., opposite, phenomenal properties with respect to 'transparency'. However, these different, i.e., opposite, phenomenal properties may reciprocally modulate each other, i.e., the presence of one is accompanied by absence of the respective other and vice versa. This reciprocal relationship between their different phenomenal properties may account for the 'reciprocal dependence' between FPP and TPP. For example, while an intense experience in FPP may induce low accuracy of judgements in TPP and vice versa, highly accurate judgements in TPP may be accompanied by a less intense experience in FPP.

Even though they show different phenomenal properties, FPP and TPP are linked and connected with each other. It is this interdependence between FPP and TPP that is often neglected in an epistemological discussion (see also Northoff, 2003a). This interdependence between FPP and TPP thus remains incompatible with either elimination or subordination of the one perspective in favour of the respective other.

The different, i.e., opposite, character of the phenomenal properties in FPP and TPP may be reflected in the philosophical development of the two main lines in epistemology. Idealism and constructivism can be characterized as 'First-Person Epistemologies' while empiricism and realism may rather be described as 'Third-Person Epistemologies'. Similar to FPP and TPP with their respective phenomenal properties, both kinds of epistemology are often regarded as mutually exclusive (see Northoff, 2003a for a more elaborate discussion).

However, as demonstrated above, the FPP and TPP cannot only be characterized by their different phenomenal properties but, in addition, by a 'reciprocal dependence'. Due to this 'reciprocal dependence', FPP and TPP cannot be considered as contradictory and opposite but rather as complementary and interdependent. Similarly, idealism/constructivism and empiricism/realism being 'First- and Third-Person Epistemologies' may no longer be regarded as mutually exclusive but rather as distinct 'epistemological domains' (see also Northoff, 2003).

Historically, TPP has either been cut off from FPP as it is reflected in empiricism/realism or FPP has been cut off from TPP as it is reflected in idealism/constructivism. Accordingly, both perspectives and their respective epistemological frameworks have been considered as mutually exclusive and incompatible with each other. Both kinds of epistemologies thus presuppose 'isolation' between FPP and TPP. This 'isolation' may be called 'isolated epistemology'. 'Co-existence' and 'reciprocal dependence' between FPP and TPP may, in contrast, be better accounted for by a different epistemological

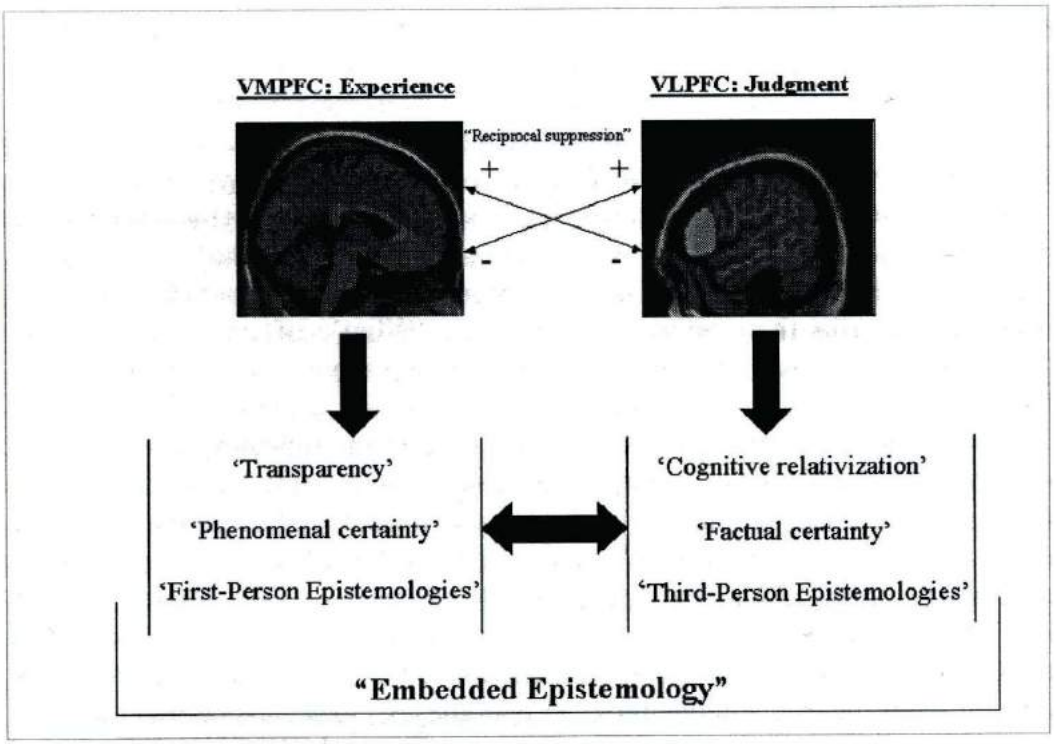

Figure 4
'Reciprocal suppression' in ventral prefrontal cortex and distinct 'phenomenal and epistemological domains'

framework, i.e., 'embedded epistemology', which links both perspectives with regard to the environment (Northoff, 2003a). See Figure 4.

In summary, epistemological implications of a neuroscientific account of 'transparency' can be characterized by (i) a relation between 'reciprocal suppression' between VMPFC and VLPFC on one hand and the different phenomenal properties in FPP and TPP on the other; (ii) a relation between the different phenomenal properties in FPP/TPP and the distinction between 'First- and Third-Person Epistemologies'; (iii) the characterization of 'First- and Third-Person Epistemologies' as distinct 'epistemological domains' which are rather complementary than contradictory.

IV: Conclusion: What Can We Learn From the 'Neurophenomenological Hypothesis'?

We developed several 'neurophenomenological hypotheses' about the linkage between the ventral prefrontal cortical brain function and the phenomenological and epistemological mechanisms of qualia. Some methodological limitations and neurophilosophical implications of these 'neurophilosophical hypothesis' shall be pointed out in the following.

1. Methodological limitations

First, a 'neurophenomenological hypothesis' must be distinguished from both 'neuroscientific and neurophilosophical hypothesis'.

A 'neuroscientific hypothesis' solely focusses on the neural mechanism of the brain and rather neglects the phenomenal and epistemic mechanisms of qualia. However, since the 'neurophenomenological hypothesis' considers and links the phenomenal and epistemic mechanisms of qualia with the neural mechanisms of the brain, they must be distinguished from a 'neuroscientific hypothesis'.

A 'neurophilosophical hypothesis' implies a linkage between the nature of the brain, i.e., the 'What', and the nature of qualia, i.e., the 'What'. The present account focussed more on the phenomenal mechanisms, i.e., the How', linking brain and qualia than on the nature, i.e., 'What', of qualia and brain. 'Neurophenomenological hypotheses' should consequently be distinguished from 'neurophilosophical hypotheses'.

It also needs to be mentioned that 'neurophenomenological hypotheses' cannot be equated with 'neuroepistemological hypotheses': the latter focus on the linkage between neural and epistemic mechanisms. We showed the epistemic implications of our 'neurophenomenological hypotheses' which, however, were not linked with specific neural mechanisms by themselves. For example, the various epistemic abilities and inabilities of the First-Person Perspective were not related with any particular neural mechanisms. These epistemic implications, as derived from 'neurophenomenological hypotheses', may thus be regarded as a first step towards the development of 'neuroepistemological hypotheses' and 'neuroepistemology' in the future (see Northoff, 2003a).

Second, our 'neurophenomenological hypothesis' presupposes the crucial role of the ventral prefrontal cortical brain function in the generation of the phenomenological and epistemological mechanisms of qualia. In contrast, other cortical and subcortical regions may account for the different 'contents' of qualia that, due to the lack of empirical knowledge, were rather neglected in the present account. The present 'neurophenomenological hypothesis' must consequently be considered as preliminary and should be developed further for the different modalities of qualia with their specific 'contents'.

One may, for example, hypothesize a similar involvement of the ventral prefrontal cortex in auditory, visual and emotional qualia. These different 'contents' of qualia may differ from each other with respect to the involvement of other cortical and subcortical regions. One may thus suppose neural interaction between the ventral prefrontal cortex and these other regions by means of a so-called bottom–up and top–down modulation (Northoff, 2003b). These neural interactions have yet to be explored in full detail.

Third, one should be aware of the limited scope of our 'neurophenomenological hypothesis' with regard to both neuroscience and philosophy.

While they link particular neurophysiological mechanisms of the brain with specific phenomenological and epistemological mechanisms of qualia, they remain unable to reveal the underlying neurophysiological details (i.e., neural transmission, modulation of synapses, cells, circuits, etc.) by themselves. The 'neurophenomenological hypothesis' therefore remains limited with regard to neuroscience.

The 'neurophenomenological hypothesis' necessarily relies on natural conditions since otherwise it could not refer to empirical, i.e., neuroscientific, data — the natural conditions of qualia are thus revealed. However, philosophical investigations rather focus on the logical conditions of qualia: while these conditions overlap, they are not identical with natural conditions. 'Neurophenomenological hypotheses' therefore remain limited with regard to philosophy.

On one hand, the 'neurophenomenological hypothesis' may guide the focus of a neurophysiological investigation. For example, the hypothesis of linkage between 'double dissociation' in VMPFC/VLPFC and the integration of 'heterogenous' stimuli into 'homogenous' events (see above) may focus on the exact neurophysiological mechanisms, which might account for reciprocal modulations in the ventral prefrontal cortex.

On the other hand, the 'neurophenomenological hypothesis' could also serve as a starting point for the philosophical investigations of logical conditions. For example, the natural conditions themselves may be varied in imaginative thought experiments that in turn may serve as the first step towards the elucidation of logical conditions in philosophy (see Northoff, 2003a).

2. *Neurophilosophical implications*

First, we demonstrated various linkages between the phenomenal mechanisms of qualia and the neural mechanisms of the ventral prefrontal cortical brain function. These 'neurophenomenological hypotheses' may provide a first step towards further neurophysiological investigations of qualia with the consecutive development of a neuroscience of qualia. The better we understand the phenomenal and epistemic mechanisms of qualia in neuroscientific terms the more we may be able to reveal the nature of qualia, which in turn could enable us to account for the neurophilosophy of qualia. Accordingly, the present 'neurophenomenological hypothesis' may be considered as a node point for future neurophysiological and neurophilosophical investigations of qualia.

Second, we demonstrated that the linkage between qualia and the function of the brain presupposes the distinction between mechanisms, i.e., the 'How', and nature, i.e., the 'What', with respect to both brain and qualia. Linkage between brain and qualia remains possible only if either their mechanisms, i.e., the 'What', or nature, i.e., the 'How', are related with each other. In contrast, cross-linkage between mechanisms, i.e., the 'What', and nature, i.e., the 'How', must necessarily fail because mechanisms and nature describe different characteristics. Unlike many other neuroscientific accounts of qualia, the 'neurophenomenological hypotheses' avoid such cross-linkage and are thus not due to failure *a priori*. Accordingly, the 'neurophenomenological hypothesis' may serve as a paradigmatic example for the future development of appropriate methodological strategies for the linkage between qualia and the brain.

Third, we revealed the epistemic implications of our 'neurophenomenological hypothesis'. The different epistemic perspectives were, as a result, characterized by specific epistemic abilities and inabilities respectively. These different

epistemic abilities and inabilities may then be related with particular neural mechanisms of the functional organization of the brain with the consecutive development of 'neuroepistemological hypotheses'. Accordingly, the present 'neurophenomenological hypothesis' may be regarded as a starting point for the development of 'neuroepistemology' as an 'epistemology on a neurological basis' (Kuhlenbeck, 1965, p. 137) in the future.

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