Neurophilosophie

Neurophenomenology of Hearing: Relations to Intentionality and Time Consciousness

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Abstract:

The aim of my—admittedly rather programmatic—talk is to show some shortcomings in neurophenomenology, often related to its strong focus on vision. By the same token, I will illustrate the particular fruitfulness of considering auditory phenomena in improving our understanding of time consciousness and of intuition and intentionality. Because of this, the topic of my talk also has more general interest for the philosophy of mind, extending beyond inner-phenomenological issues and debates.

Main Text:

During the past decade, there has been an increasing amount of literature which relates results from neuroscience and psychology to insights from Husserlian phenomenology. In particular, Husserl's concept of a time halo (of an extended perceptual present) and his account of the constitution of time consciousness have been discussed intensively.[1] Here the underlying assumption is that the findings from neuroscience and phenomenology can mutually inform and enrich each other. Different approaches here have either (i) emphasized the role of phenomenological insights as a heuristic guide for experimental designs in cognitive science or (ii) put emphasis on the phenomenological training of the people participating in neuroscientific experiments and on the conceptual background of the methods for evaluating experimental data. The first (design-focused) approach was initially argued for by Shaun Gallagher and is usually called "front-loaded phenomenology". The second (conceptually and methodologically motivated) approach follows the work of Francesco Varela and is called "neurophenomenology". (I should add that, whenever this second approach is concerned, I will explicitly speak of "*Varela's* neurophenomenology" to distinguish it from my more broader usage of the term "neurophenomenology" as referring to all attempts trying to combine phenomenology and neuroscience.)

Besides, also from within a rather strict phenomenological tradition the importance of acquiring well-informed first-person data in cognitive science has been shown; especially, by the work of Eduard Marbach.[2]

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[1] Cf., e.g., Varela 1999, van Gelder 1999, Thompson 2007, Gallagher and Zahavi 2008.

[2] Marbach 2007.

For present purposes I will accept the general assumption of a possible mutual enrichment between phenomenology and neuroscience. However, as far as possible, I will refrain from further—one might say "deeper" or "metaphysical"—claims about a possible reductive relationship between the mental (or rather the perceptual, as I will call it from now on) and the physical. Admittedly, when treating Varela's neurophenomenology in some more detail below, I will briefly have to say something about a kind of "common core" of phenomenology and neuroscience; but I myself will not subscribe to such assumptions about a reductive relation between the perceptual and the physical in the sense of, say, standard forms of physicalism. I prefer to suggest that the following structural analogies between the neuroscientific and the phenomenological findings about hearing can (and should) be appreciated independently of whether one is some sort of a reductionist or not.—Note the term "structural" here. The analogies I mention do not suggest what is sometimes called "content matching".[3] For the claim that, say, a certain brain activity and a certain phenomenal (that is perceptual) state have the same content arguably relies on such aforementioned assumptions about a reductive relationship between the perceptual and the physical. In contrast, claims about structural analogies do not rely on such an assumption.

To be a little more precise, the term "structural analogies" here refers to statistical correlations between first-person and third-person data; that is, statistically significant co-variations between physical parameters and perceptual qualities accessible by means of physiology and psychophysics, respectively.—This is not meant to say that approaching first-person data is without its problems. Indeed there are huge debates about different methods built on interviews, on behavioural discriminative abilities, etc.[4] However, it should also be obvious that without using at least some form of first-person data psychophysics and indeed a lot of neuroscience would not be possible. Investigations on visual imagery, pitch perception, and the like all rely on data concerning perceptual qualities.[5] Similarly, phenomenological or first-person data are involved also in the present context, but only insofar as investigations are considered in which people are, for instance, presented with pairs of tones and are asked to judge which one was the higher one or the longer one.

As already mentioned, the kind of perception or the sensual modality which I think to be very important in this context—but unfortunately often neglected—is hearing. The main reason for this importance lies in the close and intriguing relation between hearing and

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[3] In favour of such a "structural" instead of a "content matching" cf. Thompson 2007, 298, 349-350, 358.

[4] Cf., e.g., Petitmengin 2006, Horst 2010; see also Thompson 2007, 338-341.

[5] Perhaps one might even say that the existence of statistical correlations between the perceptual and the physical is a presupposition for doing such research—whereas the assumption of a reductive relation between the two is not.

experiencing or perceiving time. Coming back to Husserl, it is striking that his own perfect example for introducing an account of time consciousness was hearing; or, to be more accurate, the perception of long enduring tones and short melodies (Husserl 1966a). Indeed the same is true for most of his contemporaries as, for example, Brentano, Stumpf, and James. However, within the recent neurophenomenologist literature, the discussion of the relation between perception and time consciousness has nearly exclusively focussed on vision.[6] Of course, one might argue that there are a lot of similarities between the visual and the auditory system and that, to give a concrete example, we do not need a separate discussion of deafhearing (in addition to the one we have of blindsight) if the philosophical issues involved are exactly the same. However, not every auditory phenomenon has such a visual counterpart; especially not those related to time. As neurophysiological and psychological studies have shown, the auditory modality plays a very specific role in the neural representation and in the perception of duration.[7] Besides, within phenomenology the structure of the time halo—that is, of the extended perceptual present which includes so-called retentions of the immediate past and rudimentary anticipations (or protentions) of what is just about to come—is assumed to be fundamental not only for the constitution of time consciousness but also provides the basis for the intentionality of all mental acts (Husserl 1966a, 1966b).

This does not imply that there is anything wrong with the recent discussion of vision in neurophenomenology and in the philosophy of mind more generally. But it suggests that a closer look at auditory research might lead to important insights concerning time consciousness and intentionality.

Hence, I will now have to acquaint you with some empirical findings for about the next three minutes, but shall then immediately return to philosophy; that is, to the philosophical significance of those findings.

Recent neurophysiological investigations demonstrate striking differences between the neural processing in the auditory and visual system. In a sense, the auditory cortex does what in vision the so-called "higher" cortical areas are needed for. (Key words are, for instance, scene analysis and identification of objects.)[8] Let me mention only two things or features here:

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6 See again Varela 1999 and Thompson 2007, especially 341-348 on binocular rivalry.

7 Accordingly, psychological and neurophysiological studies have claimed the auditory modality to be the "modality of time" (cf. Fraisse 1957, Sieroka 2004).

8 Cf. King and Nelken 2009. An important underlying reason for this is the fact that within the auditory system temporal regularities are processed *as such*. There are no "pre-processing" transformations involved unlike in the visual system where rods and cones immediately abrogate the original temporal regularities of the light

First, only the auditory system has a kind of extrapolating memory trace on the sensory level. The mismatch negativity (MMN) is a pre-attentive brain response elicited when one hears a sequence of similar tones interspersed with rare deviant tones; and it is "pre-attentive" in the sense that a mismatch negativity is also elicited when one is not paying attention to the sounds and even during sleep.[9] Comatose patients do not generally show mismatch negativities. However, if one does so, then this person is very likely to recover from coma within the next few days. Mismatch negativities occur on the scale of about a few seconds and not only in such "simple" cases where, say, a series of identical tones is modified from time to time by tones differing largely in pitch or timbre. Mismatch negativities are also elicited when rather abstract sound patterns are violated; patterns like "the higher the pitch the lower the intensity of the sound" or, to give another example, "short tones are followed by high-pitch tones, long tones are followed by low-pitch tones".[10] Indeed, mismatch negativities were also found to be correlated with the subliminal perceptions involved in priming.[11]

Second, in some cases pitch itself is a phenomenon of temporal integration and buffering. For instance, generating a temporal regularity on the millisecond scale by adding up one and the same noise sound with a constant delay leads to a perception of pitch, although the sound lacks a well-defined or any "preferred" frequency. In such a case one speaks of "temporal pitch".[12] Besides, the pitch saliency also of "normal" tones (like a complex harmonic tone) crucially depends on the duration of the tone itself. Taken together, these phenomena show a close interrelation between pitch and temporal structure and extension. And indeed physiological and modelled data are correlated with these findings.

So much for the empirical findings about the auditory system. I believe them to be philosophically relevant at least in relation to the following four issues or concerns, whereof the first two are primarily of inner-neurophenomenological concern, while the other two are of some more general interest:[13]

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frequencies. (Of course, this is only possible because the relevant time scale in hearing is that of the neural information processing itself; namely milliseconds instead of femtoseconds. Accordingly, most of the features and data I mention here have been assessed by means of electrophysiology; i.e. EEG and MEG. As compared to fMRI, these methods exhibit a much finer temporal resolution. Their spatial resolution, on the other hand, is based only on indirect methods.—These remarks are philosophically significant insofar as they suggest that the current focus on the visual system and on a content matching assumption is at least partially a consequence of a certain bias in the reception of neuroscientific methods and results.

[9] Cf. Näätänen et al. 2001.

[10] Winkler 2007.

[11] Hasting et al. 2007.

[12] Cf. Patterson et al. 2002. (The frequency of the perceived pitch is given by the inverse of the constant delay.)

[13] For the following issues (especially the first, the second, and the fourth) see also Sieroka 2009.

First, the existence of an auditory memory trace and the automatic extraction of abstract sound patterns from ongoing stimuli can be interpreted in terms of "immediate memory" and "pre-attentive sound anticipation". So a closer look at the auditory processes might provide neurophenomenologists with suitable candidates for physiological counterparts of protentions and retentions ("counterparts" again meant in terms of structural features, not in terms of content matching). This would be of particular importance for the ongoing debates in phenomenology about the status and nature of protentions.[14]

On a more general level, brain responses like the mismatch negativity are important in the context of neurophenomenology because they open up a field of research often neglected in traditional phenomenology; namely subliminal or pre-conscious perceptions. To put it roughly: Since by definition Husserlian phenomenology is a general framework for the study of consciousness, it has kind of inherent problems with studying unconscious phenomena. At the same time, however, there is striking evidence for the existence of pre-conscious perception; and the perhaps most prominent example has already been mentioned: priming. Accordingly, from a neurophenomenologist standpoint the pairwise correlations between the strength of a brain response (like the mismatch negativity), the physical parameters of the presented tones, and the discriminative abilities above the perceptual threshold can provide solid guidance for the assessment of the structure of subliminal perception.

Second, Varela (and his followers) intend neurophenomenology to be a naturalized version of phenomenology.[15] This claim has been based on the following three assumptions:[16] First, living beings are autonomous agents. Second, nervous systems are autonomous dynamic systems. Third, the analysis of neural phase synchronies by means of dynamic systems theory provides the relevant tools for probing and investigating the relation between these patterns of autonomous agency and patterns of neural activity.

Let me only say something about the third claim here: The investigation of phase synchronies by means of dynamic approaches is just one method of data evaluation in electrophysiology and one which is dominant mainly in visual but not in auditory research—and arguably this is due to the differences in the set-up of the auditory and the visual system.[17] So the generalizing claims by Thompson and Gallagher-Varela to the effect that phase

[14] See, e.g., Ferrari 2001, 170.
[15] Varela 1999, van Gelder 1999, Thompson 2007.
[16] Cf. Thompson 2007, 11, 13-14.
[17] For instance, pace Thompson 2007, 421-42, also "traditional" approaches in EEG data analysis allow for modelling so-called top-down processes in the brain. (Moreover, Thompson's differentiation relies on a surely debatable implicit claim which identifies autonomy with decomposability of brain activity.) Besides, also systematic investigations on the relation between neurophysiological and first-person data can be conducted by other methods; cf., e.g., Overgaard and Timmermans 2010.

synchrony subserves "all aspects of a cognitive act"[18] and that it is "the explicit substrate of the living present"[19] are rather premature.

Besides, the same authors claim that the very reason for assuming such a reliance of Varela's neurophenomenology on dynamic systems theory is the fact that the latter provides a general formal account of activity, so that arguably dynamic systems theory is neutral with respect to the distinction between the physical and perceptual, while at the same time being applicable to both.[20] However, the question whether these claims about neutrality and applicability are accepted or not does not depend on dynamic systems theory in particular but on the general role or "ideality" of mathematics or of certain mathematical structures. So, what Varela's neurophenomenologist framework boils down to is a kind of reconciliation between a theory of subjectivity and a theory of nature on the basis of a common mathematical framework.[21] And I leave it up to you to decide whether, like Varela, one should call this a "naturalized phenomenology"—or rather a "mathematical structuralism".

My third issue now leads me to more general concerns in the philosophy of mind. The phenomenon of temporal pitch is, I think, of interest for discussions about the relation between different aspects of intuition. Remember Sellars's critique against Kant's distinction between pure forms of intuition and qualitative aspects of intuition; that is, against Kant's sharp differentiations especially in the treatment of extension and colour.[22] A standard illustration to motivate such a differentiation is the hint at black-and-white TV and at the use of filters in photography.[23] Apparently, nothing essential is taken away from an external object if one takes away its colour, whereas this is different as soon as the object's extension is concerned. Extension, so the claim goes, is somehow an essential feature of external objects, while colour is not.—I don't want to go into the question whether Sellars's critique really applies to Kant insofar as the distinction in Kant is meant to be a transcendental rather than a phenomenological one.[24]

However, what I like to suggest is that, if we restricted ourselves to the phenomenological level, Sellars seems to be correct: Perceptual qualities are interwoven in a

[18] Thompson 2007, 333.
[19] Gallagher and Varela 2003, 123; similarly Varela 1999, 283.
[20] Thompson 2007, 357; Varela 1999.
[21] Thompson 2007, 164. A similar framework can also be found, for instance, in the later works of Carl Friedrich von Weizsäcker. His "theory of ur-alternatives" (although it originated from a different background) also assumes a common mathematical framework for providing both, a re-construction or even re-constitution of subjectivity and of nature (including matter and hence brains). Cf. von Weizsäcker 1988.
[22] Kant 1974, B207f.; Sellars 1968, 58; cf. Haag 2007, 131-134.
[23] Cf., e.g., Lowe 1996.
[24] See Kant 1974, A28f.; cf. Haag 2007, 144-149, 436-438.

sense that such a distinction between different aspects of intuition is a mistaken abstraction; at least if the underlying assumption or picture is that of two separate spaces: the pure forms of intuition spanning, so to speak, one vector space, and the qualitative aspects spanning a separate one.[25] Such an assumption is strongly opposed by the phenomenology and psychophysics of hearing (and much more clearly so than by the case of vision). Auditory perceptual qualities—including duration—are not generally independent of each other. They, so to speak, do not form an orthogonal basis of perceived sound. In particular, the aforementioned examples of pitch saliency and temporal pitch suggest that duration, allegedly being a pure form of intuition, and pitch do not belong to different aspects or spaces of intuition. They are rather non-orthogonal dimensions spanning one and the same space of intuition. Like loudness and timbre they are what one might call "dependent parts" in the perception of sounds. That is, every perception of a tone necessarily involves hearing a certain pitch, hearing it for some time, etc.[26]

I now turn to my last issue, but only very briefly as I am running out of time and also because it is a kind of generalized version of the first issue I mentioned:

Fourth, a more detailed description and analysis of the interrelationship between perceptual auditory qualities, especially as involving experienced duration and immediate memory, might help to gain a more satisfying account of time consciousness.[27] Fruitful heuristic guidance here might be taken from empirical research on pre-attentional sound feature abstraction and temporal pitch. It suggests that a tensed temporal character is indeed a very basic feature to perceptual states; and—but this has to remain speculation at this stage—this might lead to a general account of what might be called the inner structure of intentionality.[28] For the directedness of a perceptual or mental act would then be accounted for (at least partially) by means of its tense, of its integration or buffering of what has just happened and its pre-attentive anticipation of what is to come next.

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[25] Sellars 1981, 33-34; deVries 2005, 231.

[26] Of course, if the perceived pitch is simulated by some physiological model, then time or temporal integration is treated differently from the spectral features accounting for loudness and timbre, and the pitch itself is then represented by ridges in time. However, this whole modelling is done in terms of physical parameters and the ridges as represented refer to external, physical time. Of course, as suggested above, one would expect some structural analogies between perceptual time and physical time, but one should not simply take over all the mereological relations and interdependencies between different perceptual and physical parameters or moments.

[27] Important work towards a general phenomenology of sound has recently been provided by Schmicking 2003.

[28] Cf., e.g., Crane 2003.

Conclusion:

Just to end up and to emphasize it again: This rather programmatic discussion was not meant to suggest that brain responses are dependent parts of perception like loudness, timbre, and pitch or that mismatch negativities have an experiential character. However, what is striking about the examples from auditory research are the co-variations and the continuities in the physical parameters, especially when on the correlated perceptual level the border between conscious and unconscious phenomena is reached. This is why the structural features of brain responses like the mismatch negativity can be taken as heuristic guides towards structurally analogous phenomena and interrelationships on the side of pre-conscious and conscious perceptual states. Also think of neurofeedback as a further illustration here: recorded brain activity can be used for operant conditioning. Hence, although brain activity itself does not have an experiential character, it can make a difference for what will happen perceptually whether one sees and knows about one's brain responses or not. So ignoring the mutual interrelations between phenomenological and physiological insights and data arguably will result in both, theoretical and practical, shortcomings.

Literature:

Crane, T. 2003. The Intentional Structure of Consciousness. In: Jokic, A. and Smith, Q. (eds.). *New Philosophical Perspectives*. Oxford: Oxford University Press, pp. 33-56.

DeVries, W. 2005. *Wilfrid Sellars (Philosophy Now)*. Montreal: McGill-Queen's University Press.

Ferrari, D. 2001. *Consciousness in Time*. Heidelberg: Winter.

Fraisse, P. 1957. *Psychologie du Temps*. Paris: Presses Universitaires de France.

Gallagher, S. and Schmicking, D. (eds.). 2010. *Handbook of Phenomenology and Cognitive Science*. Dordrecht: Springer.

Gallagher, S. and F. Varela. 2003. Redrawing the Map and Resetting the Time: Phenomenology and the Cognitive Sciences. *Canadian Journal of Philosophy*, Supplementary Volume 29: 93-132.

Gallagher, S. and Zahavi, D. 2008. *The Phenomenological Mind*. London/New York: Routledge.

Haag, J. 2007. *Erfahrung und Gegenstand*. Frankfurt: Klostermann.

Hasting, A. S. , Kotz, S. A., und Friederici, A. D. 2007. Setting the Stage for Automatic Syntax Processing: the Mismatch Negativity as an Indicator of Syntactic Priming. *Journal of Cognitive Neuroscience* 19: 386-400.

Horst, S. 2010. The Role of Phenomenology in Psychophysics. In: Gallagher and Schmicking 2010, pp. 447-469.

Husserl. E. 1966a. *Zur Phänomenologie des Inneren Zeitbewußtseins (=Husserliana X)*. Den Haag: Nijhoff.

Husserl. E. 1966b. *Analysen zur passiven Synthesis (=Husserliana XI)*. Den Haag: Nijhoff.

Kant, I. 1974. *Kritik der reinen Vernunft*. Frankfurt: Suhrkamp.

King, A. J. and Nelken, I. 2009. Unraveling the Principles of Auditory Cortical Processing: Can we Learn from the Visual System? *Nature Neuroscience* 12: 698-701.

Lowe, E. J. 1996. *Subjects of Experience*. Cambridge: Cambridge University Press.

Marbach, E. 2007. Towards Integrating Husserlian Phenomenology with Cognitive Neuroscience of Consciousness. *Synthesis Philosophica* 44: 385-400.

Näätänen, R., Tervaniemi, M., Sussman, E., Paavilainen, P. and Winkler, I. 2001. "Primitive Intelligence" in the Auditory Cortex. *Trends in Neurosciences* 24: 283-288.

Overgaard, M. and Timmermans, B. 2010. How Unconscious is Subliminal Perception? In: Gallagher and Schmicking 2010, pp. 501-518.

Patterson, R. D., Uppenkamp, S., Johnsrude, I. and Griffiths, T. D. 2002. The Processing of Temporal Pitch and Melody Information in Auditory Cortex. *Neuron* 36: 767-776.

Petitmengin, C. 2006. Describing One's Subjective Experience in the Second Person: An Interview Method for the Science of Consciousness. *Phenomenology and the Cognitive Sciences* 5: 229-269.

Petitot, J., Varela, F. J., Pachoud, B. and Roy, J.-M. (eds.). 1999. *Naturalizing Phenomenology*. Stanford: Stanford University Press.

Schmicking, D. A. 2003. *Hören und Klang: Empirisch phänomenologische Untersuchungen.* Würzburg: Königshausen & Neumann.

Sellars, W. 1968. *Science and Metaphysics*. London: Routledge.

Sellars, W. 1981. Foundations for a Metaphysics of Pure Process. *The Monist* 64: 3-90.

Sieroka, N. 2004. *Neurophysiological Aspects of Time Perception*. Dissertation, Universität Heidelberg.

Sieroka, N. 2009. Ist *ein* Zeithof schon genug? – Neurophänomenologische Überlegungen zum Zeitbewusstsein und zur Rolle des Auditiven. *Philosophia Naturalis* 46: 213-249.

Thompson, E. 2007. *Mind in Life: Biology, Phenomenology, and the Sciences of the Mind*. Cambridge (Mass.): Harvard University Press.

van Gelder, T. 1999. Wooden Iron? Husserlian Phenomenology Meets Cognitive Science. In: Petitot et al. 1999, pp. 245-265.

von Weizsäcker, C. F. 1988. *Aufbau der Physik*. München: Deutscher Taschenbuch Verlag.

Varela, F. J. 1999. The Specious Present: A Neurophenomenology of Time Consciousness. In: Petitot et al. 1999, pp. 266-314.

Winkler, I. 2007. Interpreting the Mismatch Negativity. *Journal of Psychophysiology* 21: 147-163.