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Social spaces as necessity: a neuro-cognitive perspective

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Abstract. Every scientific institution is also a social space. To have worked in different institutions on different continents is both a challenge and a gift. In this personal report, a few experiences and observations are sketched which have been made in China, Russia, the United States, and Germany. The journey begins in Germany, to be exposed to research in ethology and biological rhythms. From there, it goes to the United States, where neuropsychology and neuroanatomy opened a new window. Early on, several doors opened to Russia, and the open doors were used for decades, enjoying interdisciplinary cognitive science. In China, intense cooperation started in the new millennium with the focus on visual attention, temporal processing, and neuroaesthetics. In spite of all the diversity in research topics, in spite of cultural differences, political systems, historical trajectories, there was always one strong belief that never should be given up: Scientists are natural ambassadors.

Keywords: blindsight, circadian rhythms, neuroaesthetics, oscillations, time perception

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Социальные пространства как необходимость: нейрокогнитивный подход

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Аннотация. Каждое научное учреждение является еще и социальным пространством. Работать в разных учреждениях на разных континентах – это и вызов, и подарок. В этом описании личного опыта освещен ряд научных контактов и наблюдений, полученных в ходе этих контактов в Китае, России, США и Германии. Путешествие начинается в Германии, где я приобрел опыт исследования в области этологии и биологических ритмов. Из Германии мой путь пролег в Соединенные Штаты, где нейропсихология и нейроанатомия открыли новые горизонты. Еще до этого открылись двери в Россию, и эти двери оставались открытыми несколько десятилетий, позволяя сотрудничать в области междисциплинарных когнитивных исследований. В Китае интенсивное сотрудничество началось в новом тысячелетии с упором на визуальное внимание, временнУю обработку информации и нейроэстетику. Несмотря на все разнообразие тем исследований, несмотря на различия в культуре, политических системах, траекториях исторического развития, для меня всегда существовало одно твердое убеждение, от которого никогда нельзя отказываться: ученые, по сути, являются послами своих государств.

Ключевые слова: ложная слепота, циркадные ритмы, нейроэстетика, осциллограммы, восприятие времени

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This is a very personal report. I will make myself an “experimental subject” in this report who had important personal experiences in different “social spaces”. In this journey I raise some scientific issues, in fact more questions than answers. The overriding motto is “scientists are natural ambassadors”.

The journey begins in Germany in the Max-Planck-Institute of Behavioral Physiology. An important person in this “social space” was Konrad Lorenz, one of the founders of modern ethology, the discoverer of “imprinting” who actually was once a professor in Königsberg, or Ka-

liningrad now. With Lorenz, I learned about anthropological universals, or innate releasing patterns [Lorenz 1943], i. e., behavioral patterns that unite all humans, in a complementary way to cultural specifics. What makes us different, what unites us?

The other person in this social space was Jürgen Aschoff, who discovered circadian rhythms in humans [Aschoff 1965]. It was shown that the 24-hour rhythm is self-sustained when subjects spend weeks in complete isolation; I was one of the subjects. This "internal clock" has become an important topic in cognitive science. We can use the 24-hour rhythm as an experimental tool. Yan Bao from Peking University has discovered that we have a morning system that is different from the evening system when paying attention. The "phase differences" of attentional control are a crucial indicator; they indicate that we are dealing with different cognitive systems. This attentional phenomenon can be explained by distinct projection systems of the retina towards central areas of the brain. Thus, neuroanatomy helps to understand cognitive phenomena [Bao, Pöppel 2012].

Now I move to the MIT (Massachuesetts Institute of Technology in Cambridge). When I still was at the Max-Planck-Institute of Behavioral Physiology there came as a visitor the provost of MIT and he asked what everybody was doing. I said that I studied the diurnal rhythm of time perception. He said that at MIT somebody had already solved the problem: the diurnal rhythm of time perception is determined by the diurnal rhythm of body temperature, as predicted by chemical laws; the warmer, the faster. I said that this was wrong; he looked surprised. The phases of the maxima do not coincide; the maxima of the two functions are many hours apart. He said, "Do you want to come to MIT?" I said yes.

At MIT, I entered a new social space of high interdisciplinarity. The director was Hans-Lukas Teuber, who got some special "imprinting" from Alexander Luria in Moscow [Luria 1973]; being now Teuber's student, I suddenly became the scientific grandson of Luria. Research at MIT was dedicated to the visual system, in particular the early visual pathway [Teuber 1960]. I was lucky to discover a phenomenon that was later named "blindsight". This observation opened the eyes to different knowledge systems, i.e., in addition to explicit knowledge (usually represented in language), we also have to deal with the system of implicit or tacit knowledge [Pöppel, Held, Frost 1973]. When we navigate through the world, we rely mainly on the implicit knowledge system; without consciously "seeing", we know where we are.

The social space at MIT was characterized by another deep experience. Every Tuesday evening Walle Nauta, a leading neuroanatomist, working however in an institute of psychology, gave lectures which

were attended not only by students but also professors of different faculties [Nauta, Feirtag 1986]. One important message sticks forever in the mind; let us call it "Nauta's law": Every nerve cell is not farther away from any other in the brain than 4 intermediate steps. Thus, we have amazing interconnectivity. How to prevent neural chaos because of this high connectivity? The answer is: by neuronal inhibition. Inhibition and disinhibition are essential, for instance, in attentional control.

Now I find myself on my journey between social spaces in Russia. I got to know Victor Shklovsky, who has set up the "Center for Speech Pathology and Neurorehabilitation" in Moscow. This is, in my view, the best center in the world to deal with brain-injured patients. I had several opportunities over the years to present ideas about "blindsight" and temporal processing. This center is a unique "social space" for taking care of patients, also in their personal environment.

It was in the early seventies last century when I worked in the Max-Planck-Institute of Psychiatry in Munich when a visitor came from the Pawlow-Institute near St. Petersburg. It was Nikita Podvigin who discovered neural oscillations in the visual pathway with periods of some 30 milliseconds [Podvigin et al. 2004]. There was only one "mistake": he published in Russian, and others did not know about it. Years later, after his publications, neural oscillations were "re-discovered" and reported in another language. Now it has become a fashion to work on oscillations in different frequency domains. What are these oscillations described by Podvigin good for? They can serve the purpose of complexity reduction for visual input that is physically ill-defined in the temporal domain. The concept is that one period defines a system state within which the before-after relationship of sensory input is not defined; thus, temporal integration for ill-defined stimuli is made possible [Pöppel 1970].

Many years ago I was visiting Kaliningrad and also Svetlogorsk (formerly Rauschen) at the Baltic Sea. At the university in Kaliningrad, Vera Zabotkina organized within less than a day a lecture for me, and I was impressed that students spoke German. I suddenly found myself in a different social space. The German novelist Thomas Mann stayed for some time in Svetlogorsk before he moved to a house in Nidden. Having dinner at the Baltic Sea, we experienced a physical social space, the sound of the water, and an interdisciplinary social space bringing art and science together. Now Vera Zabotkina, together with colleagues from China and Spain and myself, works on a manuscript about a "taxonomy of cognitive functions", which is based on evolutionary principles and neuropsychological observations [Zhao et al. 2022]. We have a taxonomy in chemistry, as developed by Mendeleyev and Meyer, or in biology, as developed by Linné and substantiated by Darwin, and we need one in cognitive science.

In Moscow, I see myself in episodic memory standing in front of the picture "The Black Square" by Kasimir Malevich in the Tretyakov Gallery. This picture can be used to characterize the deep link between art and science [Bao et al. 2022]. When we ask ourselves what is represented on the retina, the background of the eye, the answer is: only edges and surfaces with different brightness or color [Pöppel 1986]. There are no lines on the retina; lines are a theoretical construct as in Euclidian geometry. This brings me now to China. The Chinese cognitive scientist Lin Chen made a fundamental discovery about the genesis of visual percepts [Chen 2005]. His point is that prior to a local feature analysis, the visual brain extracts topological invariants like edges, surfaces, or holes. As is normal in scientific debates, colleagues have problems with that concept and argue about it; people do not necessarily like new paradigms. Years ago I walked along the Charles River in Cambridge (the river being another social space) with Thomas Kuhn from MIT, discussing with him the concept of "scientific paradigms" in his book "The Structure of Scientific Revolutions", a book highly recommended [Kuhn 1962]. The data that Lin Chen presents are convincing, but when will they reach others? His discovery is indeed fundamental in cognitive science but beyond the border of the paradigmatic dogma.

Being in the Chinese social space now I experience and have experienced another scientific paradigm we have to deal with. It has been shown that cognitive processes are embedded in a pre-semantic time window of a few seconds; Yan Bao has called this "the magic seconds of 3". Both behavioral data and brain imaging results indicate that perceptual processes, aesthetic evaluations, and many other phenomena are embedded in a temporal window of a few seconds. What is important: this time window is not created BY the information processed, but FOR information processing in neural systems; thus, it is pre-semantic. This time window serves the purpose to create and maintain perceptual and conceptual identity – for some time; after this time segment a new percept or concept can enter consciousness, or the previous one is confirmed.

The journey between these personal social spaces has come to an end; it has brought me from Germany to the US, to Russia, to China [Pöppel 2018]. Many scientific questions remain open. What remains, however, is that on the basis of personal trust and friendship, we work together; in the ideal case, we follow one goal, which is a better understanding of the nature within us and the nature around us, and we enhance our understanding of being embedded in a cultural environment, being part of social spaces that may be different on the surface but are connected below the surface. Science itself is a social space. Scientists are natural ambassadors living in this space.

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