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Towards a 20th Century History of Relationships between Theatre and Neuroscience

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ABSTRACT – Towards a 20th Century History of Relationships between Theatre and Neuroscience[1] **–** This article considers some preliminary reflections in view of a 20th century theatre-and-neuroscience history. Up to now, the history of the 20th century theatre has been too fragmentary and irregular, missing out on the subterranean links which, either directly or indirectly, bound different experiences. The article aims to put in evidence the recurrent problems of these encounters. The hypothesis of the essay concerns the possibility of gathering and grouping a great part of the relationships between theatre and neuroscience around four trajectories: the physiology of action, the physiology of emotions, ethology, and studies on the spectator's perception.
Keywords: **Theatre History. Neuroscience. Physiology. Ethology. Spectator.**

RÉSUMÉ – Vers une Histoire des Relations entre Théâtre et Neurosciences au XXe Siècle – L'objectif de l'article est de poser des hypothèses de départ et des réflexions en vue d'une histoire du théâtre et des neurosciences au XXe siècle. L'historiographie du théâtre du XXe siècle a considéré jusqu'ici que ces relations étaient trop fragmentées et hétérogènes et n'a pas su voir les liens souterrains, directs et indirects entre ces diverses expériences. Le but de l'article est de mettre en évidence les problèmes récurrents de ces rencontres. L'article réfléchit donc sur la possibilité de rassembler la plus part des rencontre entre théâtre and neurosciences autour de quatre thèmes principales: la physiologies de l'action, la physiologie des émotions, l'éthologie et les études sur la perception du spectateur.
Mots-clés: **Histoire du Théâtre. Neurosciences. Physiologie. Éthologie. Spectateur.**

RESUMO – Por uma História das Relações entre Teatro e Neurociência no Século XX – Este artigo aborda algumas reflexões preliminares referentes à história do teatro e da neurociência no século XX. Até agora, a história do teatro no século XX era demasiadamente fragmentada e irregular, perdendo-se nas conexões subterrâneas que, direta ou indiretamente, ligavam diferentes experiências. O artigo pretende colocar em evidência os problemas recorrentes desses encontros. A hipótese do ensaio refere-se à possibilidade de reunir e agrupar grande parte das relações entre teatro e neurociência em torno de quatro trajetórias: a fisiologia da ação, a fisiologia das emoções, a etologia e os estudos sobre a percepção do espectador.
Palavras-chave: **História do Teatro. Neurociência. Fisiologia. Etologia. Espectador.**

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In the 20th century, the exchange between theatre cultures and research into the nervous system – which for brevity's sake we shall refer to as neuroscience – has been as recurrent as scarcely investigated. To date the history of such transdisciplinary relationships remains full of lacunae. In fact, we lack a proper history of the relationships between theatre and neuroscience in the past century. Nevertheless, the increasingly frequent exchanges which contemporary theatre studies currently have with cognitive neuroscience highlights the necessity of filling such a gap – a challenging task indeed, when one considers the vast fragmentation and heterogeneity of the corpus under study[2].

The aim of the present essay is, therefore, that of positing some preliminary hypothesis and reflections in view of a 20th century theatre-and-neuroscience history.

Hypothesis and Methodology

The first hypothesis concerns the identification of the historical ruptures which would outline the beginning and the end of the historical corpus under study. My suggestion is that the history of relationships between theatre and neuroscience in the 20th century may have begun with the advent of the actor's pedagogy. That is, the moment in which the great directors started researching a whole series of practices and exercises aimed at producing new learning systems for the actor. The founding moment of the 20th century phase of such interdisciplinary relationships would thus coincide with what Fabrizio Cruciani and Ferdinando Taviani have defined as the first *scientific* enquiry of the actor:

> In an essay on the art of the actor and of the director, written for the Encyclopedia Britannica at the end of the 1920s, Stanislavski asks, 'Is it possible to identify the means which would enable that creative state which geniuses obtain by nature and without effort to be induced voluntarily and consciously?'. This is the first – and perhaps the only – scientific inquiry of the actor, the revolution takes place via a methodical, analytical investigation, fragment by fragment (Cruciani; Taviani, 1980, p. 92).

The outbreak of the actor's pedagogy, also defined as the "age of exercises" (Barba, 1997), has coincided with a renewal in the relationships between scientific inquiries on the human being and theatre studies, clearly directing the focus of such relationships onto

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the field of neuroscience[3]. The foundation of relationships between theatre and neuroscience in the 1900s cannot, therefore, be dated with precision, but it is to be identified with a gradual trend which took place between the last years of the nineteenth and the first twenty years of the 20th century.

On the opposite end, however, the final years of the century provide fairly clear chronological coordinates, since between 1994 and 1996 we can identify a precise leap of quality in the interdisciplinary collaborations between theatre and neuroscience. This was an important moment of transition which launched the contemporary phase. These are the years in which the first university courses in theatre and neuroscience began, both in Europe and in the United States[4]; years which see the birth of fields of studies and research projects that are purposefully programmed for interdisciplinarity[5]. But these are also the years which produce the first publications on the mirror neuron mechanism (Rizzolatti; Sinigaglia, 2008), a topic which would exercise a considerable influence on theatre cultures.

Once the outlines of the chronological period have been defined, it is possible to engage an analytic perspective which, on the contrary, will not follow a chronological criterion but will traverse the 20th century theatre along vertical trajectories, following *routes of interest* which have gathered around them dense constellations of encounters, seminars, conferences, experimental collaborations, and empirical studies. My hypothesis, in fact, concerns the possibility of gathering and grouping great part of the relationships between theatre and neuroscience around four trajectories: the physiology of action, the physiology of emotions, ethology, and studies on the spectator's perception.

In view of the obvious impossibility to furnish an exhaustive analysis of all the experiences nested around each trajectory, we shall here be focusing on only a few examples, privileging those examples which in certain ways are deemed more problematic or underestimated by traditional historiography, although these see the involvement of some of the greatest masters in the 20th century theatre.

Finally, only three out of these four trajectories will presently be discussed, since I have already presented a historical study focusing specifically on the spectator's perception in another recent publication (Sofia, 2013a).

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Theatre and the Physiology of Action

At a glance, the spectrum of interests which ties theatre cultures to studies in the physiology of action is definitely a broad one. Such concepts as reflex, impulse, intention, movement, pre-movement, reaction, and coordination span through the 20th century theatre, sprinkling its cosmos with references to equivalent physiological notions. Nevertheless, it is possible to see all of these interests converging to what Copeau defined as "achieved spontaneity" (1955), that is the skills which the actor has to develop and the conditioning which the actor has to get rid of in order to create an *effect* of naturalness or spontaneity in the spectator. The aim is to reconstruct, by means of technique, that everyday spontaneity which is inevitably compromised onstage[6]: "It is disconcerting how such a common thing, which is normally created spontaneously, disappears without a trace, as soon as the actor steps onto the stage, and much work, study and technique are required in order to restore it" (Stanislavski, 1956, p. 517).

The mechanisms which subtend such a spontaneity that "[...] disappears without leaving a trace" have aroused the curiosity of important theatre people, who from time to time have tried to describe such mechanisms via different concepts: habit, automatisms, reflexes etc. Nowadays we know that these complex mechanisms may be associated with the notion of body schema, or of body schematic process, as they have recently been proposed by the philosopher Shaun Gallagher[7].

The frequency with which Stanislavski questioned the relationship between everyday and stage habits induced scholars to imagine a possible influence upon the Russian master by the great American psychologist and philosopher William James. A hypothesis which gains some support with regards to concept of "second nature" used by Stanislavski but actually introduced in the field of science by James (Whyman, 2007). Moreover, even when we take more evident and better documented scientific influences under examination, such as those of Secenov, the Russian physiologist, or of the French psychologist Theodule Ribot, again we find a particular attention paid by Stanislavski to matters which were dear to James, such matters as those regarding habits or the relationship between will and action. All matters which conceal an even greater dilemma, related to the

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continuity or discontinuity between body and mind. In the light of the fact that not all motor processes are controlled by a deliberate cognitive effort (because they are organized by the body schema), the reconstruction of such processes onstage cannot take place via conscious work only. The actor's pedagogy in the 20th century in fact distinguished itself for having created a whole series of *contraintes* aimed at breaking up the actor's everyday habits in order to construct a different type of control on action that would be sophisticated to the point of becoming truly *second nature*: a scenic body.

The issue regarding the relationships between everyday nature and second nature is also what pushed Meyerhold to become interested in the notion of *reflex*. About Meyerhold, Beatrice Picon-Vallin writes:

> The director relates that he discovered the fundamental law of movement when he slipped on a sheet of ice in the street: having fallen on the left side, in order to get up, carry head and arms towards the right by way of counterweight and maintain equilibrium in this way. It is from such a spontaneous reflex of conserving equilibrium, from the awareness of its loss, which is common to any movement, that biomechanics start taking shape (Picon-Vallin, 1990, p. 106).

Meyerhold, in fact, uses the notion of reflex to describe that set of unconscious reactions which constantly regulate our posture, highlighting how our body possesses decision mechanisms – a veritably effective wisdom – which are autonomous from conscious control. Such mechanisms, which today can again be studied as functions of the body schema, normally act via minimal modifications to our posture and our limbs, but in a situation where equilibrium is suddenly destabilised (such as the case described by Meyerhold), these mechanisms become more evident precisely because they are engaged in an unusual task. Although Meyerhold's interest towards the brain sciences is explicit[8], one must nevertheless remember that the notion of reflex in the Soviet Union was by far broader than what we may understand by it nowadays. The extreme popularity which the Nobel prize had conferred upon Pavlov had allowed his model of cognition, which was essentially based on a series of reactions to the outside world, to become the regime's official doctrine. Whereby the notion of reflex was used reductively to describe mechanisms which were far more complex, such as those mechanisms associated with the sphere of emotions. Moreover, in the very years in which

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Meyerhold was shaping biomechanics in the theatre, again in Moscow the Russian physiologist Nikolai Bernstein was working to define the biomechanics of human movement, producing studies which remain of fundamental importance up to this day. There however remains little documentation of the contact between Meyerhold and Bernstein, since the latter was rapidly silenced by the Soviet regime precisely for having scientifically criticised the Pavlovian model[9]. Working on the so called *degrees of freedom* which better the efficacy of action in relation to a given goal, Bernstein declared purpose as being a central element in the organisation of action. Furthermore, in successive studies Bernstein highlighted how the *entire motor system* is organised in function of action's intentional process. It is no coincidence that these three elements – the organisation of action at different *levels*, the importance of the goal in the mechanical configuration of action, and the necessary coordination of the whole motor system in the execution of a single action – can be traced in Meyerhold's biomechanical training. Precisely in the light of such probable circulation of knowledge, the absence of Bernstein in Meyerhold's writings could, in my opinion, be explained also in terms of a measure of political caution on the part of the Russian director.

The importance of Bernstein's research in the context of studies on the actor's movement is all the more evident in the work of Meyerhold's most famous pupil: Sergei Eisenstein. As the scholar Ivanov points out, the system Eisenstein used to analyse the actor's action – composed of layered, interacting strata from the physiological to the subconscious level – is in part actually modelled on Bernstein's studies[10]. Even so, the scientific influences on Eisenstein's work were truly numerous: from the 19th century pioneers of physiology – such as the German Emile Du Bois-Reymond or the Finnish Robert Tigerstedt – to Gestalt studies[11]. If we were to add the passionate connections with psychophysiologists such as Leon Vygotsky[12] and Alexandr Luria[13], then we would better understand how during his artistic and theoretical career the great master had never given up his transdisciplinary approach.

Theatre and the Physiology of Emotions

The point of origin of the trajectory concerning the physiology of emotions could be identified in an 1898 article published by the famous French psychologist Alfred Binet entitled *Réflexions sur*

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le Paradoxe de Diderot. An expert in phenomena of hysteria and hypnosis, before embarking upon the writing of dramatic works himself, Binet had interviewed twelve actors on the famous *paradoxe*. These interviews induced the French psychologist to hypothesize that while acting performers undergo a kind of *doubling* of consciousness that is comparable to phenomena of hypnosis or hysteria: "To sum up, we think that there is no radical difference between the actor and the subject suggested, but simply a nuance[14]" (Binet, 1986, p. 295). Binet's conclusions were certainly not considered original in his time, but today they gain relative importance since one of his better known works, *On Double Consciousness* (1890) is present in Stanislavski's library (Whyman, 2007). It is therefore plausible to think that Stanislavski had in some way come across Binet's works, beyond the influences (which are evident by now) that Ribot clearly had upon his work[15].

The influence which the early 20th century physiology of emotions had on Meyerhold, instead, is of a more complex nature. In this case, in fact, the notion of reflex, which both James and Pavlov shared, if at all, on a terminological plane, was adopted to highlight the motoric dimension of emotive processes:

> We can quote James. He relates an astonishing case, which we have taken as an example and realized in practice. A man is running, pretending to be afraid of a dog that is chasing after him. There is no dog, but he has started running away as if there was a dog. When the man 'scared by the dog' started running away, he effectively got scared. Such is the nature of reflexes. A reflex activates yet another reflex. Such is the originality of the nervous system (Meyerhold, 1980a, p. 151).

If, on the one hand, Meyerhold uses the notion of reflex as a truncheon to break up the idea that emotion is only the result of cerebral or psychological mechanisms, on the other hand, it is precisely the identification of a necessarily motoric component in emotive experiences which provides Meyerhold with a way to motivate his having moved beyond the idea of an emotive isomorphism between the actor and the spectator. Since emotion is the result of a physical process, by reproducing biomechanical processes with precision the actor can induce the spectator (and not necessarily himself) to live a particular emotive experience.

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> Is there something psychological in our pause? Sometimes we are blamed of not doing psychology, and some among us get worried and dread this word. To the extent that we base ourselves on objective psychology, there definitely is some psychology present in our work. Only that we do not allow ourselves to be governed by relived experience, but by a constant faith in the precision of our technical acting. When I showed Zinaida Raikh the scene of Stefka in the third act, perhaps you might have noticed tears in my eyes, and yet, I promise you, the emotion Stefka felt did not correspond to my own at all. Simply, in explaining the scene, I took a shortcut which provoked the necessary reactions in me. A nerve was triggered, commanding my tear muscles, and I started producing tears. Exactly as in William James' example (Meyerhold, 1975, p. 156).

The use that Eisenstein makes of James' research follows the same line of thought:

> But the main field in which the phenomenon described by James is applied is, naturally, the spectator. In reconstructing what he sees, the spectator starts from states which are 'unmotivated' for him, which arise in him alone, via imitation, to reach a necessary emotive state. But the fact that within him imitation cannot give rise to the unfolding of its entire motoric wealth (as it does, however, in the actor), produces a further effect: it intensifies the intellectual side of emotive reception (Eisenstein, 1937, p. 172).

The Russians were, however, not the only ones to be interested in the scientific study of emotions. The French director André Villiers – he too was inspired by Binet's studies – realized one of the very first experiences of empirical measurement and analysis of actors' blood pressure during a performance. Again Villier's intentions were to attempt an empirical approach to Diderot's *paradoxe*. His attempt to correlate biological events such as blood pressure to the actor's performance can effectively be considered among the first attempts to put biological activity and emotive dynamics in a direct and causal relationship (Bonnichon, 1942). The points of reference which Villiers draws upon from the field of psychology are not too distant from those which influenced Stanislavski or Meyerhold; in fact we find various references to Ribot, some to James and a large amount of references to the work of the psychophysiologist Alfred Binet.

But the attempt to precisely define the physiological correlations of the actor's emotions would find its broadest experimental articulation only in the second half of the century, thanks to the experiments of the neurophysiologist Susana Bloch. In defining the *effector patterns of basic*

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emotions the scientist noted how the voluntary combinations of precise variables such as postural disposition, muscular tension, heartbeat, and respiratory rhythm could excite specific emotive experiences. According to Bloch, the voluntary recomposition of such variables could therefore help the actor to reconstruct the psychophysiological process which subtends the emergence of an emotion[16]:

> In Santiago de Chile in 1970, I started an interdisciplinary research project on the topic of emotions with Guy Santibáñez (neurophysiologist) and Pedro Orthous (theatre director). The aim of the study was to relate some of the physiological and expressive activations present during an emotion with the corresponding subjective experience. The study was not concerned neither with the causes which may produce an emotional state, nor with cultural implications or social consequences, but with the emotional state *per se.* What we did was to record in our laboratory at the Medical School physiological and expressive parameters in normal or neurotic subjects who were reliving strong emotional experiences related to basic emotions such as joy, anger, sadness, fear, eroticism, and tenderness. The recordings were done either in a clinical context or under deep hypnosis [...]. We observed in this first study that the emotional arousal was accompanied by an ensemble of specific respiratory, postural, and facial modifications that were characteristic for each emotion. In other words, we found that *specific emotional feelings were linked to specific patterns of breathing, facial expression, degree of muscular tension, and postural attitudes.* The respiratory component appeared to be the most vital element. [...] All these observations clearly suggest that during an emotional state there is a *unique interdependence between a specific breathing rhythm, a particular expressive attitude* (both facial and postural), *and a given subjective experience.* We have called this ensemble 'emotional effector pattern' (Bloch, 1993, p. 123-124, italics in the original text).

The studies of Susana Bloch eventually led to the creation of an acting method proper called *Alba Emoting*.

Finally, one must not forget how the study of the actor's and the spectator's emotions went through a veritable golden age in the 1980s, with multiplying conferences and publications which paved the way for the important afore mentioned advances which took place in the 1990s[17].

Theatre and Ethology

The 20th century is launched by Darwin's revolutionary research. With Darwin, the human being's position in nature

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changes. No longer situated at the centre of the cosmos, the human being is now seen as the product of a species' continuous evolution and adaptation to the environment. The mind, therefore, is not immaterial and absolute, but a constantly changing dynamic process apt at guaranteeing and improving the species' survival. As Jean-Marie Pradier highlights, Darwin's studies constitute "[...] the premise for an ethological approach to live performance" (Pradier, 2011, p. 61).

Although Darwin's observations have often been used to support the hypothetical *ritual origins of theatre* – a theory the veracity of which is far from being confirmed –, the most interesting cues concern the importance of spectacular rituals of animal *seduction* to the evolution of the species. As Pradier again points out, Darwin's studies have highlighted how the abilities to attract and maintain the attention of others, which are essential for the actor, have been fundamental also in the ambit of evolution. The power of live performance would therefore reside in translating such highly sophisticated human *needs* into artistic practice[18].

The idea that the observation of animal behaviour could furnish important information also on human performative behaviour connected a whole series of studies and interdisciplinary experiences in the second part of the 20th century: already in the 1960s, important ethologists such as Konrad Lorenz, Julian Huxley or, later, Irenäus Eibl-Eibesfeldt, highlighted dynamics which were common to both mating parades in the animal world and behaviours which humans rendered spectacular (Pradier, 2009). A key episode, however, for this kind of debate is probably the 1972 conference organised by Jean-Luis Barrault at the Théâtre des Nations. In the context of the *Journées Internationales du Théâtre des Nations*, the great French mime dedicated the closing day to a conference entitled *Biologie et Comportement Humain*, in which he personally intervened together with the biologist and ethologist Henri Laborit. The surprising outcome was an *orgy of protests*, which nowadays allows us to better understand how the comparison between human beings and animals still constituted as strong taboo at the time:

> What I retain of these disorderly days, is the constant efficacy of physical theatre, of sensual theatre, the biological particularity of the art of theatre. Presently, on our last day, we come to what I personally desire to tackle: human biology and behaviour. This is what was most instructive for me. For the majority it was an opportunity to manifest hysterical

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> rejection. Marxists and Freudians (I speak neither of Marx nor of Freud) made me think of the possessed whom, in the Middle Ages, one had to exorcise. They leapt about like goats. A nothing would make them jump out of themselves. Yet the matter is simple: 'Biology being the science investigating the behaviour of living beings, does the human being nowadays behave according to the natural laws documented by biological science, or is he, by his behaviour, in disaccord with its laws?'. Like mad monkeys, some jumped onto the bleachers. This took place at the Théâtre Récamier which, besides, for the past ten days remained full from eleven in the morning till two at night. 'An animal's behaviour is generally concerned with the need to survive, the conservation of the species. It is incessantly solicited by reproduction, hunger, fight, it has discovered the reoriented act, diverted agressivity: the bases of civilisations proper'. The human being's behaviour at present, on the contrary, tends to be turned against himself. He orients himself towards the destruction of his species, and more generally, to the destruction of all life, etc. Writings by Konrad Lorenz, Jaques Monod, François Jacob, Lévi-Strauss, Edgar Morin, and Henri Laborit supported these ideas. It was all in vain. Men are willing to play among themselves, but they refuse to be judged by geese and chimpanzees. The truth is, they would not allow anyone to put his nose in their plate. Nevertheless I believe that the treasures discovered by Marx and by Freud would in our time have to be classified within the most precious compartments of our acquired knowledge. That is not to ignore them, but on the contrary to absorb them, then to attempt to go beyond with the aim of moving closer to the equilibrium of life. Because life in our time is in a state of legitimate defence. However, the human being, this strange animal, does not want to use the power of his conscience if not to persevere in distancing himself precisely from the animal's equilibrium. This last day, therefore, crowned the feast with a veritable orgy of protests. But the seed had been sown; today I am convinced of that (Barrault, 1975, p. 166-168).

Nevertheless, Barrault's impression was absolutely correct: a seed had been sown. The proof of this resides in the fact that between the late seventies and the early eighties Henri Laborit became perhaps the most committed scientist in search of an interdisciplinary debate with theatre studies, to the point of tackling reflections on theatre and ethology himself (Laborit, 1980).

For instance, a lecture by Laborit inaugurated what can be considered as the first real international encounter on theatre and science, that is the *Colloque sur les Aspects Scientifiques du Theatre*, organized by Jean-Marie Pradier and Alina Obidniak in the small Polish town of Karpacz. The scientific committee of the conference

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was actually chaired by the ethologist and acoustic biology specialist René Guy Busnel[19]. The influence of the Karpacz Conference – which among others saw the participation of Jerzy Grotowski, Eugenio Barba, Roy Hart Theatre, and Kristian Lupa – was clearly evident in the first two International School of Theatre Anthropology (ISTA) editions (Bonn, 1980; Volterra, 1981), when Henri Laborit was invited to hold public lectures. These two ISTA editions, as it is well known, were in fact particularly characterized both by explicit references to science and by the actual presence of scientists themselves (Barba; Savarese, 1991; Bijeljac-Babic, 1981). In parallel to European studies, the emergence of Performance Studies in the United States facilitated the first reflections on ethology and theatre, as Schechner's article on *Ethology and Theatre* (1976) stands to show.

The period between the late 1970s and the early 1980s, therefore, saw the creation of a fruitful triangle between ethology, anthropology, and theatre which generated new interests towards brain sciences. The most clear example is that of Victor Turner, one among those anthropologists who had shown a major interest in live performance, and who, right at the beginning of the 1980s, declared the need to combine the cultural approach with the study of the biological basis of behaviour, documented in the essay *Body, Brain and Culture* (Turner, 1986), published posthumously after the anthropologist's sudden passing away in 1983.

Besides, those were the years which saw the revamping of a theory formulated by the neurobiologist Paul McLean in the 1950s, i.e. the theory of the *triune brain*[20], which envisaged a three-level subdivision of the human brain: a deep level, called *reptile* brain, devoted to the management of primary functions; a limbic brain, devoted to the management of emotions; and the neocortex, which is characteristic of human activities proper. Even if it is now challenged by contemporary neuroscience, such a theory offered numerous cues on theatre cultures, as shown in the article *Tu es le Fils de Quelq'un*, in which Grotowski evokes the image of a *reptile* brain a number of times:

> An expert of the brain might possibly be able to discover the 'reptile brain', an antique brain that goes down through the back of the head, along the backbone, and he might even find the connection, or extension, of this backbone brain in the solar plexus, which is called the 'little mind' in some traditions (Grotowski, 1986, p. 35).

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It is interesting to note that Grotowski imagined the reptile brain as being directly linked to the solar plexus, thus anticipating what would become, at the turn of the 21st century, yet another shared subject of interest between theatre and neuroscience, i.e. the concept of a *second brain*[21].

Conclusions

Although the present essay has presented them separately, these three trajectories can be seen as intersecting or even coinciding with one another at several points. It is, for instance, impossible to draw a neat distinction at times between arguments related to the physiology of action and those regarding emotion. Sometimes it is precisely the discourse on the biological correlates of emotions which crosses into the field of ethology and vice-versa. In general, speaking of the actor's pedagogy always results insufficient if the other side of the relationship in theatre, that is the spectator and his perceptive processes, is not taken into consideration.

Moreover, the use which theatre cultures made of neuroscience differed, even in a radical way, from one artist to another. For some neuroscience provided a particularly refined instrument to study the human being; for others it constituted a model, a metaphor, "[…] the opposite of a superstition" (Barba, 2013, p. 11).

Not to forget the other side of the relationship, which was left a little in the background in this article, that is the interest which neuroscientific studies have shown towards theatre and towards the techniques of the actor, as a model for the investigation of emotions, as a particular locus in which to observe the human being.

Finally, one cannot leave out all those studies dedicated to pedagogy or therapy which, in search of fertile convergences, have sought to relate with theatre and neuroscientific disciplines.

The discussion is, therefore, vast and ever more heterogeneous. Up to now, the history of the 20th century theatre has considered such relations as being too fragmentary and irregular, missing out on the subterranean links which, either directly or indirectly, bound different experiences. A new approach, starting precisely from tackling the recurrent problems, could not only inaugurate a new outlook onto the history of the 20th century theatre, but above all it could provide contemporary interdisciplinary perspectives with solid roots.

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Notes

[1] The author wants to thank Victor Jacono for the translation he made from the Italian (unpublished) version of this article.

[2] A first attempt at a historical reconstruction was made by Rhonda Blair in the chapter *The Twentieth-Century Heritage* of her book *The Actor, Image, and Action: Acting and Cognitive Neuroscience* (2008). The first part (103 pages) of my doctoral thesis (Sofia, 2011) is totally dedicated to a historical reconnaissance. In a way, such doctoral research could be regarded as a *preparation* to the observations and hypothesis which will be put forward in the present article.

[3] Although not always present, such relationships have frequently influenced theatre theory and practice in equal measure (Mariti, 1993; Pradier, 1997).

[4] In fact, the first courses on theatre and neuroscience are held in 1994 by John Emigh at Brown University's Department of Performance Studies (Emigh, 2002). In the same year, at the University of Malta, theatre director and scholar John Schranz and neuroscientist Richard Muscat started joint lectures entitled *Neuroscience, Bodymind and the Actor*.

[5] For instance, I am referring to the birth of Ethnoscenology (Pradier, 1996) or the launching of the xHCA programme (Schranz, 2001; 2007).

[6] Everyday spontaneity, as it is known, is compromised onstage because the actor cannot simply perform his score of actions, but also has to stimulate, hold, and sustain the spectator's attention. Such double intention, or "dilated intention" (Sofia, 2013b), requires neuro-motor routines which are different from those engaged in everyday life.

[7] Gallagher has defined body schema as "A non-conscious system of processes which constantly regulate posture and movement – a system of sensory-motor capacities functioning below the threshold of awareness and not in need of perceptive monitoring" (2005, p. 234). On the relevance of research into body schema for studies on the actor see Sofia (2013c).

[8] "In all the other art forms, the material is exterior to the creator, and in a way a certain struggle between subject and object is produced. On the contrary, in the art of theatre, the actor works upon a material which resides inside him. This kind of split requires that a particular attention is brought to the centre, that is to the actor's brain" (Meyerchol'd, 1980a, p. 93).

[9] For an account of Bernstein's personal and scientific vicissitudes, see the essay *N.A. Bernstein: The Reformer of Neuroscience* (Feigenberg; Latash, 1996).

[10] "Eisenstein relates to conclusions on biomechanics in the yet unpublished writings on expressive movement, a theory he had worked upon in the 1920s in relation to questions on the actor's movement onstage. Adopting them only in part, he rounded up such conclusions with his own idea that movement was organised according to different strata. Bernstein had also reached an analogous conclusion on the basis of experimental data. Starting from studies on biomechanics, he had subsequently elaborated a theory on the structure of movement, based above all on the presence of a multiplicity of levels, also linked to the

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various evolutionary chronological stages of nervous centres; it is the same 'multiplicity of strata' which Eisenstein hinted at in his writings on the theory of expressive movement" (Ivanov, 1982, p. 322).

[11] Exactly in 1929 Eisenstein was invited by Wolfgang Köhler to hold a cycle of lectures for the Psychology Institute at the University of Berlin. Moreover, in the famous essay on *Expressive Movement*, written jointly with the director Tretiakov (Eisenstein; Tretiakov, 1981) Eisenstein refers a number of times to the French physiologist Benjamin Duchenne and to his famous phrase "[...] there are no isolated muscular actions in nature" (Duchenne, 1885), once again echoing one of Bernstein's (and Meyerhold's) fundamental lessons, i.e. the need for the whole body to cooperate synergetically even in the realization of the smallest movement.

[12] Vygotsky in particular attempted to study the actor's creative mechanisms starting from an opposite point of view to that of reflexology (Vygotsky, 1932).

[13] Eisenstein, for instance, was intrigued by the case of Solomon Shereshevsky, a patient on whom Luria had written a book (1968). In fact, Shereshevsky became famous for his extraordinary mnemonic abilities based on synesthetic mechanisms of *visualization* of numbers and words. As Ivanov recalls: "While tackling the problem of syncretic art, which in the 1930s and 1940s had interested him in relation to the issues of sound and colours in cinema, Eisenstein, together with two friends of his, the psychologists Vygotsky and Luria, studied the phenomena of synesthetic perception, drawing upon the example of a unique personality, Solomon Shereshevsky. Such observations of a psychological nature would later serve him to resolve other aesthetic problems" (1982, p. 237). In 1998, the story of Solomon Shereshevski and the book by Luria became the subject of Peter Brook's play *Je suis en Phénomène*.

[14] Binet would further his studies and publish essays on the psychology of playwrights (1903).

[15] See Autant-Mathieu (2005; 2007a; 2007b); Hamos-Siréjols (2007); Benedetti (1982); Carnike (2009); and Blair (2008).

[16] Bloch et al (1972) and Bloch et al (1973).

[17] 1985, for instance, is the year in which Joseph Roach published *The Player's Passion* (1985). In that same period in France, Jean-Marie Pradier first organizes the conference on *Théâtre et Sciences de la Vie* (1984) and then the summer seminars entitled *Pratiques Spectaculaires et Sciences de la Vie* (1989) and *Emotions et Complexité* (1991), which saw the participation, among others, of Eugenio Barba, Henri Laborit, Susana Bloch, and John Emigh (Pradier, 1990; 1993).

[18] The observations which Darwin proposed on natural selection have shown that in the majority of species, the *struggle* for survival does not take place between different species but among members of the same species, generally among members of the same sex intending to seduce members of the opposite sex. Consequently, it is not necessarily the *strongest* who win, but those who are more able to exhibit the most *effective* techniques of *seduction*, that is those techniques which better attain a determined *effect* on the specimen to attract for mating. Hence the obvious importance, at a biological-evolutionistic level, of an element

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that is intimately related to the work of the actor: seduction. It is not by chance that the third part of Darwin's book focuses precisely on the processes of sexual selection (and therefore also on the necessity of seduction) in humans (Pradier, 2009). Darwin's studies inspired another important Russian director, Nicolai Evreinov, in the formulation of what he defined as the "principle of theatricality" articulated in the essay *Apologija Teatral'nosti* (published in *Utro* in St. Petersburg on 8th of September 1908) and later in the book entitled *The Theatre in Life* (Evreinov, 1929; Carnicke, 1981).

[19] For further information on the conference see Pradier (1979).

[20] The model of the triune brain became fashionable again in the 1980s thanks to Carl Segan's best-seller *The Dragons of Eden: speculations on the evolution of human intelligence* (1977).

[21] See Gershon (1999). Schechner used Gershon's studies in relation to his notion of *rasaesthetic* (Schechner, 2001). For further information about the relation between Grotowski and the sciences see Pradier (2013).

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