Angelo Romagnoli

Notes on the three spaces of the actor

A research outline

Introduction

The research here outlined suggests that understanding performance in terms of the human neurophysiological processing of space may allow a systematisation of many concomitant or juxtaposed sets of methods and approaches to acting[1]. Indeed, acting encompasses complex and manifold sets of competences that every single actor appropriates and adapts according to their needs and experiences in a highly personal manner[2]. Moreover, I argue that spatiality allows a homogeneous tackling of issues such as listening, presence, posture, rhythm, that are present in all performative traditions.

There is a further advantage with space: it is a form of embodied nonconceptual content[3] that does not require further conceptualisation and can be deployed without risking infinite regress by founding theory on theory. In performer training, a spatial approach seems empirically clearer than overarching theories on performance referring to Dynamic Systems Theory[4], but, at the same time, both compat-

[1] This research has been presented on September 28th - 30th 2021 at the Contemporary Acting Techniques in Eurasian Theatre, Performance and Audiovisual Arts: Intercultural and Intermedia Perspective conference, orgainsed by the Faculty of Humanities of the Nicolaus Copernicus University, Toruń (Poland) and The Grotowski Institute, Wrocław, and on January 9th - 12th 2022 at the 8th conference of the International Platform for Performer Training, organised by The Estonian Academy of Music and Theatre, Tallinn (Estonia).

[2] Cfr. D. Krasner, *An actor's craft: the art and technique of acting*, London, Bloomsbury Publishing, 2017, p. 2.

[3] Cfr. A. L. Roskies, *A new argument for nonconceptual content*, in «Philosophy and Phenomenological Research», 76, 2008, n. 3, pp. 633-659; J. Toribio, *Nonconceptual content*, in «Philosophy Compass», 2, 2007, n. 3, pp. 445-460.

[4] Cfr. J. Lutterbie, *An Introduction to Theatre, Performance and the Cognitive Sciences*, London, Bloomsbury Publishing, 2019. Available at: https://www.perlego.com/book/1176779/an-introduction-to-theatre-performance-and-the-cognitive-sciences-pdf (last accessed: 5 August 2022).

ible with it and with a reframing of performer training according to material contexts as informed by Assemblage Theory[5].

This research shares the tenet of Eugenio Barba's Theatre Anthropology that there exists both a specific condition of the human being in performance[6] and a hierarchy between the principles underpinning theatre and the epiphenomenology of performance[7], but acts in ways that are somewhat contrary to Barba's provisions. If Theatre Anthropology «means the study of man in a performing situation on a biological and socio-cultural level»[8] it tries to underpin the «biological» and the «socio-cultural» within practical and experiential frameworks: firstly, it delves into contemporary research in Neurophysiology, which presents a nuanced and sometimes counterintuitive picture of space processing in terms of agency, enactment, embodied subjectivity[9]. Secondly, by seeing performative settings as material and spatially located assemblages and by stressing on the processual nature of the relations between its diverse components, it insists on the state of performance as emergent from the interactions of its very components, which includes primarily interplay and blockings. While semantic and logical oppositions such as 'inner/outer' are superseded[10], the simultaneity of scenic action is seen (artificially, although customarily in the practitioners' jargon) from three distinct spaces that the performer inhabits: the body's inner states, the space of pertinence of the body, and the space of shared action.

Finally, a spatial approach is particularly useful to grasp common traits between diverse and apparently distant insights into acting and theatre-making: Louis Jouvet's "listening friend"[11], Stella Adler's "circumstances"[12], Samuel Beckett's spatial provisions in his directorial notes[13], Thierry Salmon's "Neutral Circle" and the "Tri-

[5] Cfr. F. Camilleri, *Performer Training Reconfigured: Post-psychophysical perspectives for the twenty-first century*, London, Bloomsbury Publishing, 2019.

[6] Cfr. E. Barba, N. Savarese, *A dictionary of theatre anthropology: The secret art of the performer*, New York, Routledge, 2003, p. 8.

[7] Cfr. M. Schino, *Alchemists of the stage: Theatre laboratories in Europe*, New York, Routledge, 2020.

[8] Cfr. E. Barba, *Dancinq Questions*, in «Journal of Theatre Anthropology», 1, 2021, p. 10.

[9] Cfr. T. Buhrmann, E. Di Paolo, *The Sense of Agency. A Phenomenological Consequence of Enacting Sensorimotor Schemes*, in «Phenomenology and the Cognitive Sciences», 16, 2017, pp. 207-236.

[10] Cfr. C. Falletti, G. Sofia and V. Jacono (eds.), *Theatre and cognitive neuroscience*, London, Bloomsbury Publishing, 2016, p. 52.

[11] Cfr. L. Jouvet, *Écoute, mon ami*, Parigi, Flammarion Éditions, 1952.

[12] Cfr. H. Kissel, *Stella Adler: the art of acting*, Milwaukee, Hal Leonard Corporation, 2000, pp. 75-85.

[13] S. Beckett, *Happy days. The production notebook of Samuel Beckett*, edited by J. Knowlson, London, Faber & Faber, 1985; Id., *The Theatrical Notebooks of Samuel Beckett*, vol. I: *Waiting for Godot*, edited by J. Knowlson and D. McMillan, London, Faber & Faber, 1993; Id., *The Theatrical Notebooks of Samuel Beckett*, vol. II: *Endgame*, edited by S.E. Gontarski,

angles" exercises'[14], amongst others, all contain deep spatial implications that are worth a deeper analysis according to the three perspectives offered below. Let a brief account of an exercise led in the studio with an international group of young actors introduce us to the matter.

0. A 'nameless' exercise[15]

Two actors, a man and a woman, enter the empty stage for an improvisation according to a limited set of rules: actors take their turn in walking and change their previous positions in space: they can neither gesture, nor utter sounds, nor recur to facial expressions. They are instructed that communication between them must be conveyed solely by modifying their respective positions in space. No acting tricks or "shenanigans" are allowed.

A man (M) enters the stage (Figure 1), whose dimensions are is approximately 8x7 yards, and stops near the right back side looking outwards; from the audience we can only see his back. After M has come to a complete stop, a woman (W) enters the stage and places herself at approximately one yard from the front stage on the left, and stares at his back. The drawings sketch both the positions of M and W and the direction of the actors' gazes[16].

After a moment of stillness, M turns his back, starts gazing at W and walks towards the centre stage. The changed position seems to imply a change in space perception for both the audience and the actors. In Figure 2, M seems to engage W in some sort of discourse which calls for a reply by W.

In turn, W chooses to 'open up' the space and escape what looks like a relentless chase by M.

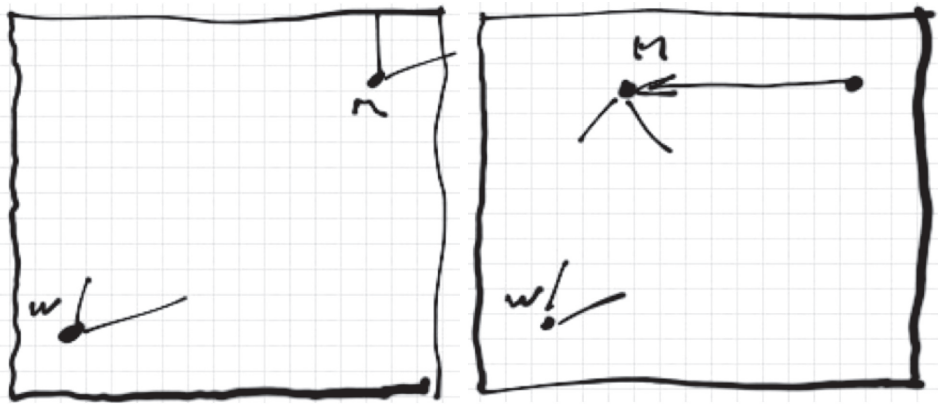
It now seems that W has avoided being cornered. W's move gives way to further possibilities in their silent dialogue which already starts offering elements for interpretation for us as an audience, despite the actors' absolute prohibition to utter words or sounds.

London, Faber & Faber, 1992; Id., *The Theatrical Notebooks of Samuel Beckett*, vol. III: *Krapp's Last Tape*, edited by J. Knowlson, London, Faber & Faber, 1992; Id., *The Theatrical Notebooks of Samuel Beckett*, vol. IV: *The Shorter Plays*, edited by S.E. Gontarski, London, Faber & Faber, 1995.

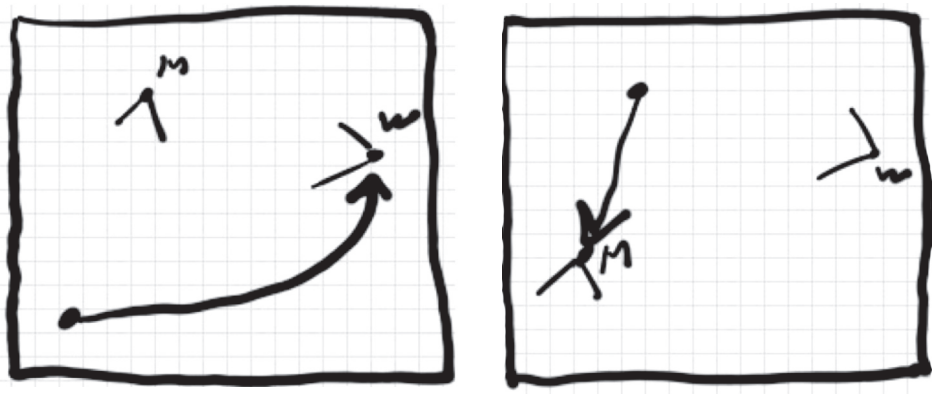
[14] R.M. Molinari, *Viaggio nel teatro di Thierry Salmon: attraverso* I demoni *di Fëdor Dostoevskij*, Roma, Ubulibri, 2008, p. 240.

[15] Workshop held during the Creative Europe Programme 'Playing Identities Performing Heritage: Theatre, Creolisation, Creation and the Commons': University of Siena, Italy, July 2016. http://www.playingidentities.eu/playing-1/performing-heritage-theatre-creolisation-creation-and-the-commons/ (last seen: 3 August 2022).

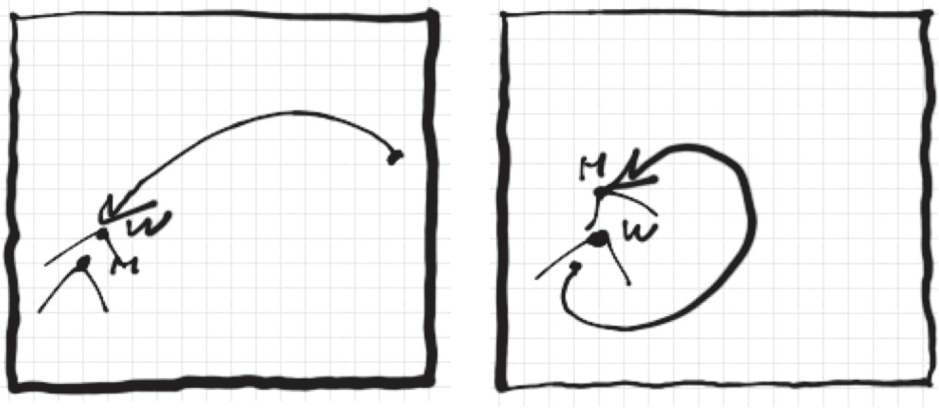
[16] The audience is placed on the lower side of the diagrams.



Figures 1 and 2.



Figures 3 and 4.



Figures 5 and 6.

After a short suspension, M moves towards the front stage. He seems to elude W's opening.

W is forced to change position if she intends to engage with M. W chases M as shown in Figure 5.

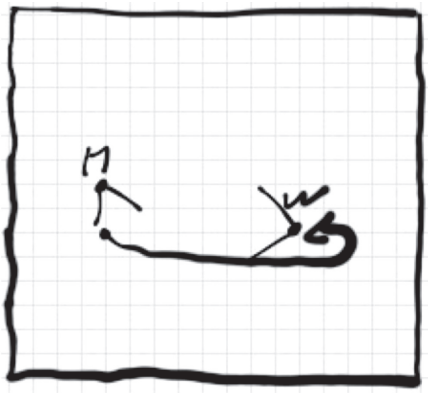
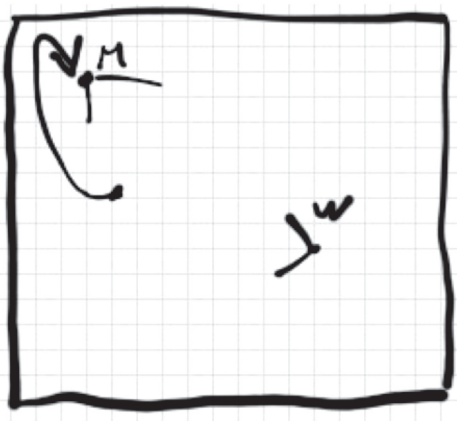


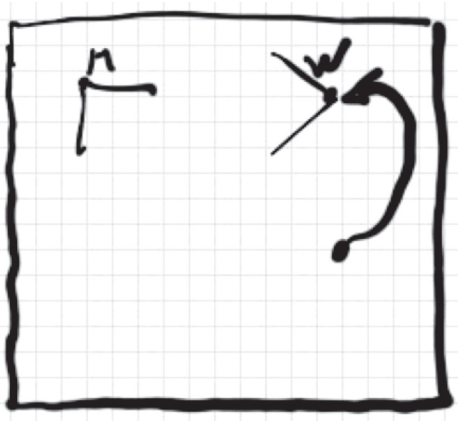
Figure 7.

This is a very challenging move as we can infer from M's reaction; W's move is highly invasive of M's space; it seems to hint to imposing a hovering presence while W's gaze seems entirely focused on M. Indeed, we can see in Figure 6 that M's response reproduces W's dominant posture with a significant difference: his gaze is directed towards the centre stage and seems to invite W to develop further actions in a wider perimeter. While an account for W's and M's intentions relies on the audience's personal interpretations, spatial changes seem to either imply or preclude specific developments in their relationships based on the actors' mere bodily attitudes.

While W disengages from M's physical proximity, she opens up at centre stage as if complying with M's suggestion (Figure 7). W awaits a countermove.

M then decides to move towards the left back of the stage on the back left-to-front right diagonal as to keep the entire stage under his own control. He is now quite in a domineering position whence he may be able to keep an eye on any further response from W. Which, in turn, decides to move on the same line and put herself on a par with M and the potential of his attitude (Figure 9). As a response, M turns his head towards W, and they have now another chance to further develop a relationship in space.





Figures 8 and 9.

Figure 10.

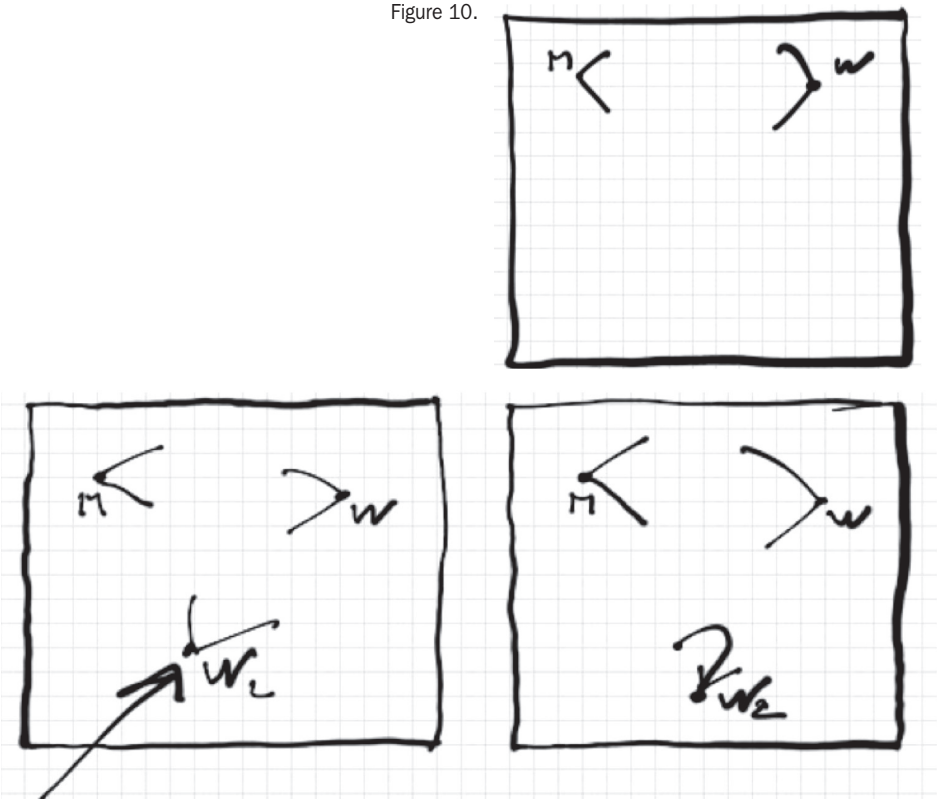


Figure 11.

As they stop in the position portrayed in Figure 10 below, I had instructed another female actress (W2) to go onstage and join the exercise.

As W2 assumes the posture sketched in Figure 11, she immediately breaks the rule of the exercise by taking another moving turn and pretending to have found something on the ground which will turn out to have been "an apple". The exercise is now over.

«What have we seen? », I ask the audience in the studio, which is composed by the other spectating actors. Answers are as disparate as captivating. «Can you remake it? », I ask the audience again. Volunteers step in with some enthusiasm. The exercise is successful when the new cast can recollect and *copy* the entire sequence with good approximation. In such a case, we say that *space has retained the memory* of the events. On the contrary, when the improvisation doesn't unfold according to congruous interplay, the copying cast wouldn't grasp the "whats" and "hows" of the original improvisation and the sequence will be much harder to remember and reproduce.

There are three main components within this exercise: the timing and quality of the

interplay, the distances, postures, and the succession of the blockings as shown in the pictures above from which the members of our audience draw their plots and narratives. Indeed, the stage space is "written" by the movements of the actors on stage for the fruition of the audience and performers alike: this is the *hodological space* or the «space that matters by virtue of connecting or separating people»[17] and it is a central feature of how space is cognitively organised. These three components are all spatial aspects of the stage experience as I try and show by delving into three strands of research at the crossroads between Neurophysiology and Cognitive Psychology: Interoception, Peri-personal space, and the Functions of the Hippocampus.

1. On Interoception

The term Interoception refers to the multidimensional processing of the afferent sensorial information arising from the varying states of the internal organs, tissues, and cells of the human body. This information includes both somatic inputs of proprioceptive and tactile nature and sensory information from internal organs and tissues plus olfactory and gustatory receptors. Such a wide set of sensory inputs suggests that we should think of Interoception as a composite framework related to internal events[18], which contributes to the homeostatic equilibria of the body and to its cognitive and emotional processes.

Visceral Interoception is made of two classes of afferent signals: the General Visceral Afferents (GVAs), which relay sensory information from the guts and organs present in the torso and in body muscles through cranial nerves, such as the Glossopharyngeal (CNIX) and the Vagus Nerve (CNX), and the Special Visceral Afferents (SVAs), which gather inputs from gustation and olfaction[19]. The visceral senses have common central projections to cell groups in the brainstem, including the nucleus tractus solitarius (NTS), midbrain, and thalamus, that link anatomically and functionally with a distinct set of central neural systems and processes[20] and share biochemical markers with GVAs and with autonomic neurons[21].

[17] Cfr. R. Rehm, *The Play of Space: Spatial Transformation in Greek Tragedy*, Princeton, Princeton University Press, 2009, p. 270.

[18] Cfr. O.G. Cameron, *Interoception. The inside story: a model for psychosomatic processes*, in «Psychosomatic Medicine», 63, 2001, n. 5, pp. 697-710.

[19] Cfr. P.D. MacLean, *Studies on limbic system (visceral brain) and their bearing on psychosomatic problems*, in E.D. Wittoker (ed.), *Recent developments in psychosomatic medicine*, London, Pitman, 1954, pp. 101-125.

[20] Cfr. A.D. Craig, *How do you feel? An interoceptive moment with your neurobiological self*, Princeton, Princeton University Press, 2014; C. Saper, *The Central Autonomic Nervous System: Conscious Visceral Perception and Autonomic Pattern Generation*, in «Annual review of neuroscience», 25, 2002, n. 1, pp. 433-469.

[21] Cfr. L. Squire, D. Berg, F. Bloom, D. Du Lac, A. Ghosh, N.C. Spitzer, *Fundamental Neuroscience*, Cambridge, Academic Press, 2012.

Quite interestingly, the Vestibular System, which is so deeply involved with bodily spatial orientation, posture, and navigation in gravitational space, is not to be considered amongst interoceptors: although entirely located inside the cranium[22], it is functionally connected with the somatic motor systems and therefore counted either within the class of proprioceptors or within the general class of exteroceptors.

Moreover, the insular cortex integrates visceral afference, to the point that anomalies in insular functions are associated with a wide range of cognitive, emotional, and behavioural disturbances[23] as interconnected with the prefrontal cortex, the cingulate cortex, and the amygdala that are involved in emotion and cognition[24]. Exteroceptive and interoceptive information and cognitive and emotional processes mutually influence each other: visceral afferents carrying interoceptive information are linked with central neural systems and therefore underlie and affect behavioural, cognitive, and emotional processes[25]. The insula mediates gustatory positive and negative reactions (*hedonics*) to taste, while insular cortex anomalies account for deviation from the norm[26]. On a similar pattern[27], smell is related to hedonics and affects mood, cognition, and behaviour[28]. Adding to the widespread opinion that Interoception cannot be studied in isolation from emotional, cognitive, and behavioural processes, fMRI meta-analyses indicate there are overlaps in systems

[22] Cfr. J.M. Goldberg, V.J. Wilson, K.E. Cullen, D.E. Angelaki, D.M. Broussard, J. Buttner-Ennever, K. Fukushima e L.B. Minor, *The vestibular system: a sixth sense*, Oxford, Oxford University Press, 2012.

[23] Cfr. P.G. Gasquoine, *Contributions of the insula to cognition and emotion*, in «Neuropsychology Review», 24, 2014, n. 2, 77-87.

[24] Cfr. G.V. Allen, C.B. Saper, K.M. Hurley, D.F. Cechetto, *Organization of visceral and limbic connections in the insular cortex of the rat*, in « Journal of Comparative Neurology», 311, 1991, n. 1, pp. 1-16; J. Augustine, *Circuitry and functional aspects of the insular lobe in primates including humans*, in «Brain research reviews», 22, 1996, n. 3, pp. 229-244; R. Nieuwenhuys, *The insular cortex: A review*, in «Progress in Brain Research», 195, 2012, pp. 123-163; X. Gu, P.R. Hof, K.J. Friston. J. Fan, Anterior insular cortex and emotional awareness, in « Journal of Comparative Neurology», 521, 2013, n. 15, pp. 3372-3388.

[25] Cfr. M. Tsakiris, H. Critchley, *Interoception beyond homeostasis: Affect, cognition and mental health*, in «Philosophical Transactions of the Royal Society B: Biological Sciences», 371, 2016, n. 1708.

[26] Cfr. S. Frank, S. Kullmann, R. Veit, *Food related processes in the insular cortex*, in «Frontiers in human neuroscience», 7, 2013, p. 499; A. Maffei, M. Haley, A. Fontanini, *Neural processing of gustatory information in insular circuits*, in «Current opinion in neurobiology», 22, 2012, n. 4, pp. 709-716.

[27] Cfr. E.T. Rolls, *Taste, olfactory, and food reward value processing in the brain*, in «Progress in Neurobiology», 127, 2015, pp. 64-90.

[28] Cfr. A. Saive, J. Royet, J. Plailly, *A review on the neural bases of episodic odor memory: from laboratory-based to autobiographical approaches*, in «Frontiers in behavioral neuroscience», 8, 2014, p. 240; Y. Soudry, C. Lemogne, D. Malinvaud, S. Consoli, P. Bonfils, *Olfactory system and emotion: Common substrates*, in «European Annals of Otorhinolaryngology. Head and Neck Diseases», 128, 2011, n. 1, pp. 18-23.

co-activated by interoceptive signalling and emotional regulation[29]. This is relevant to performer training and suggests the existence of relatively unexplored approaches to sensory awareness and competence. One main example is the so-called *Proust phenomenon* where the recollection of autobiographical incidents through taste and odours proves its reliability when compared to other forms of memory and reminiscence[30]. This suggest that the actor's 'cheap' trick to sniff the place in performance possesses its empirical reliability when it comes to waking up to one's senses as it exploits the afference of the olfactive stimuli: on an empirical level, by associating the appreciation of the varying odours of the place with the task at hand, especially with uttering lines, a performer is supported in *not* pretending on the freshness and novelty of the sensory inputs for the very reason that the appreciation happens in the present moment and in an associative manner. On an entirely experiential level, actors are aware that the act of smelling implies a change in the breathing pace and in respiratory activity in general, with alleged recollection of autobiographical memory[31]. Although not completely neglected, olfaction has never been a central theme of performance studies, possibly because of lack of vocabulary in most spoken languages[32]. Scholars have documented the use of smells for the connotation of performance spaces and space awareness both in immersive theatre and in standard narrative performances[33], but it appears that more can be developed by practitioners given the wide, strong emotional and somehow unmediated response that odour gives rise to. Olfaction provides an example of how interoceptive afference may be related to spatiality and is modified by iterative interactions be-

[29] Cfr. F. Adolfi, B. Couto, F. Richter, J. Decety, J. Lopez, M. Sigman, F. Manes, A. Ibàñez, *Convergence of interoception, emotion, and social cognition: A twofold fMRI meta-analysis and lesion approach*, in «Cortex», 88, 2017, pp. 124-142.

[30] Cfr. R. Hackländer, S. Janssen, C. Bermeitinger, *An in-depth review of the methods, findings, and theories associated with odor-evoked autobiographical memory*, in «Psychonomic Bulletin & Review», 26, 2019, pp. 401-429; E.L. Cameron, E.P. Köster, P. Møller, *Is Novelty Detection Important in Long-Term Odor Memory?*, in «Brain Sciences, 11, 2021, n. 19: https://www.mdpi.com/2076-3425/11/9/1146 (last accessed: 1 May 2024).

[31] Cfr. Y. Masaoka, H. Sugiyama, A. Katayama, M. Kashiwagi, I. Homma, *Slow breathing and emotions associated with odor-induced autobiographical memories*, in «Chemical Senses», 37, 2012, n. 4, pp. 379-388; K. Watanabe, Y. Masaoka, M. Kawamura, M. Yoshida, N. Koiwa, A. Yoshikawa, S. Kubota, M. Ida, K. Ono, M. Izumizaki, *Left posterior orbitofrontal cortex is associated with odor-induced autobiographical memory: An fMRI study*, «Frontiers in Psychology», 9, 2018; Y. Masaoka, *Breathing rhythm, emotions and memories*, in «自律神経», 56, 2019, n. 1, pp. 19-22.

[32] Cfr. C. Sulmont-Rossé, S. Issanchou, E.P. Köster, *Odor Naming Methodology: Correct Identification with Multiple-choice versus Repeatable Identification in a Free Task*, in «Chemical Senses, 30, 2005, 1, pp. 23-27; A. Majid, N. Burenhult, *Odors are expressible in language, as long as you speak the right language*, in «Cognition», 130, 2014, n. 2, pp. 266-270.

[33] Cfr. *The senses in performance*, S. Banes, A. Lepecki (eds.), New York, Routledge, 2007; S.L. Feagin, *Olfaction and space in the theatre*, in «The British Journal of Aesthetics», 58, 2018, n. 2, pp. 131-146.

tween actors, audience, and the space itself. Such a general visceral afference, and the top-down and bottom-up integration of insular cortical systems underlie the cognitive-emotional processes that reflect the broad integrative contributions of the insula[34].

Moreover, there is wide evidence that awareness of interoceptive bodily sensations can be raised and one's capacity of understanding the states of self and others improved. Experiments on heartbeat count[35], respiration[36], or gastric sensitivity[37] have proven that individuals have varying degrees of knowledge of inner states associated with more intense emotional experience and competence[38]. The structural and functional organisation of the insular cortex can be changed through practice focused on body signals[39], e.g., in meditation practice[40] and singing[41], as well as after pathological processes when additional attention to body cues is placed involuntarily, e.g., chronic pain[42].

There is also evidence that the impairment of the insula affects the sense of self, agency, and consciousness[43], suggesting that insula activation is correlated with the sense of body ownership and agency[44]. Indeed, Interoception provides a promising

[34] Cfr. M. Tsakiris, H. Critchley, *Interoception*, cit.

[35] Cfr. R. Schandry, *Heartbeat perception and emotional experience*, in «Psychophysiology», 18, 1981, n. 4, pp. 483-488.

[36] Cfr. J. Daubenmier, J. Sze, C.E. Kerr, M.E. Kemeny, W. Mehling, *Follow your breath: Respiratory interoceptive accuracy in experienced meditators*, in «Psychophysiology», 50, 2013, n. 8, pp. 777-789.

[37] B.M. Herbert, E.R. Muth, O. Pollatos, C. Herbert, *Interoception across modalities: On the relationship between cardiac awareness and the sensitivity for gastric functions*, in «PloS One», 7, 2012, n. 5.

[38] Cfr. H.D. Critchley, N.A. Harrison, *Visceral influences on brain and behavior*, in «Neuron», 77, 2013 n. 4, pp. 624-638.

[39] Cfr. M. Kliuchko, E. Brattico, *Interoception in the sensory sensitivities: Evidence from the auditory domain*, in «Cognitive Neuroscience», 10, 2019, n. 3, pp. 166-168.

[40] Cfr. S.W. Lazar, C.E. Kerr, R.H. Wasserman, J.R. Gray, D.N. Greve, M.T. Treadway, *Meditation experience is associated with increased cortical thickness*, in «Neuroreport», 16, 2005, n. 17.

[41] Cfr. B. Kleber, A. Friberg, A. Zeitouni, R. Zatorre, *Experience-dependent modulation of right anterior insula and sensorimotor regions as a function of noise-masked auditory feedback in singers and nonsingers*, in Neuroimage, 147, 2017, pp. 97-110; B. Kleber, A.G. Zeitouni, A. Friberg, R.J. Zatorre, *Experience-dependent modulation of feedback integration during singing: role of the right anterior insula*, in «Journal of Neuroscience», 33, 2013, n. 14, pp. 6070-6080.

[42] Cfr. U. Blankstein, J. Chen, N.E. Diamant, K.D. Davis, *Altered brain structure in irritable bowel syndrome: potential contributions of pre-existing and disease-driven factors*, in «Gastroenterology», 138, 2010, 5, pp. 1783-1789.

[43] Cfr. A. Craig, *How do you feel?: an interoceptive moment with your neurobiological self*, Princeton, Princeton University Press, 2014; I.A. Strigo, A.D. Craig, *Interoception, homeostatic emotions and sympathovagal balance*, in «Philosophical Transactions of the Royal Society B: Biological Sciences», 371, 2016, n. 1708; M. Tsakiris, H. Critchley, *Interoception*, cit.

[44] Cfr. C. Farrer, N. Franck, N. Georgieff, C.D. Frith, J. Decety, M. Jeannerod, *Modulating the*

framework to integrate studies in Body Ownership, where research has mostly privileged exteroceptive approaches such as in the Rubber Hand Illusion (RHI) experiment[45]. A predictive index called Interoceptive Accuracy (IAcc)[46] integrates the heartbeat-counting task and multisensory stimulation and uses the RHI as a case of the exteroceptive self. Lower IAcc results and changes in homeostatic regulations in body ownership during RHI experiments appear to correlate[47]. Moreover, neuroimaging, neuropsychological and behavioural research hints that the perception of the body from the inside is interconnected with the perception of the body from the outside and with the representation of self in relation to others, self-awareness and awareness of others and with social cognition[48].

experience of agency: a positron emission tomography study, in «NeuroImage», 18, 2003, n. 2, pp. 324-333; M. Tsakiris, M.D. Hesse, C. Boy, P. Haggard, G.R. Fink, *Neural signatures of body ownership: A sensory network for bodily self-consciousness*, in «Cerebral Cortex», 17, 2007, n. 10, pp. 2235-2244; R. Cogliano, C. Crisci, M. Conson, D. Grossi, L. Trojano, *Chronic somatoparaphrenia: A follow-up study on two clinical cases*, in «Cortex», 48, 2016, n. 6, 758-767; M. Gandola, P. Invernizzi, A. Sedda, E.R. Ferrè, R. Sterzi, M. Sberna, E. Paulesu, G. Bottini, *An anatomical account of somatoparaphrenia*, «Cortex», 48, 2012, 9, pp. 1165-1178; H. Karnath, B. Baier, *Right insula for our sense of limb ownership and self-awareness of actions*, in «Brain Structure and Function», 214, 2010, nn. 5-6, pp. 411-417; V. Moro, S. Pernigo, M., Tsakiris, R. Avesani, N.M. J. Edelstyn, P.M. Jenkinson, *Motor versus body awareness: Voxel-based lesion analysis in anosognosia for hemiplegia and somatoparaphrenia following right hemisphere stroke*, in «Cortex», 83, 2016, pp. 62-77.

[45] Cfr. M. Botvinick, J. Cohen, *Rubber hands 'feel' touch that eyes see*, in «Nature», 391, 1998, n. 756.

[46] Cfr. M. Tsakiris, A. Tajadura-Jiménez, M. Costantini, *Just a heartbeat away from one's body: Interoceptive sensitivity predicts malleability of body-representations*, in «Proceedings of the Royal Society B: Biological Sciences», 278, 2011, n. 1717, pp. 2470-2476.

[47] Cfr. G.L. Moseley, N. Olthof, A.Venema, *Psychologically induced cooling of a specific body part caused by the illusory ownership of an artificial counterpart*, in «Proceedings of the National Academy of Sciences», 105, 2008, n. 35, pp. 13169-13173.

[48] Cfr. A. Fotopoulou, M. Tsakiris, *Mentalizing homeostasis: The social origins of interoceptive inferenc*e, in «Neuropsychoanalysis,19, 2017, n. 1, pp. 3-28; J. Aspell, L. Heydrich, G. Marillier, *Turning body and self inside out: visualized heartbeats alter bodily self-consciousness and tactile perception*, in «Psychological science», 24, 2013, n. 12. pp. 2445-2453; M.L. Blefari, R. Martuzzi, R. Salomon, J. Bello-Ruiz, B. Herbelin, A. Serino, O. Blanke, *Bilateral Rolandic operculum processing underlying heartbeat awareness reflects changes in bodily self-consciousness*, in «European Journal of Neuroscience», 45, 2017, n. 10, pp. 1300-1312; L. Crucianelli, C. Krahé, P. Jenkinson, A. Fotopoulou, *Interoceptive ingredients of body ownership: Affective touch and cardiac awareness in the rubber hand* illusion, in «Cortex», 104, 2017, pp. 180-192; H.-D. Park, F. Bernasconi, R. Salomon, C. Tallon-Baudry, L. Spinelli, M. Seeck, K. Schaller, O. Blanke, *Neural sources and underlying mechanisms of neural responses to heartbeats, and their role in bodily self-consciousness: an intracranial EEG study*, in «Cerebral Cortex», 28, 2018, n. 17, pp. 2351-2364; R. Ronchi, F. Bernasconi, C. Pfeiffer, J. Bello-Ruiz, M. Kaliuzhna, O. Blanke, *Interoceptive signals impact visual processing: Cardiac modulation of visual body perception*, in «Neuroimage», 158, 2017, pp. 176-185; K.B. Schauder, L.E. Mash, K.L. Bryant, C.J. Cascio, *Interoceptive ability and body awareness in autism spectrum disorder*, in «Journal of experimental child psychol-

1.1. Interoception, *Kairos* and Listening.

The connections between the anatomy and activity of the insular cortex, Interoception, Attention, and timing abilities have been spotted for the first time in 2004[49] with an experiment on heartbeat interoception and the perception of synchronous and asynchronous tones, proving that the right anterior insula is 'temporally fine-tuned' and integrates the heartbeat with exteroceptive signals in a temporal sense[50]. This entails that, in phenomenological analyses, self-consciousness and time consciousness cannot be separated.

In a phenomenal description, consciousness can be seen as a window of presence *taking place* in the continuous flow of time[51]. That is a spatiotemporal leap through which *Chronos*, the quantitative time measuring movement in space described by Aristotle in his *Physics* (IV. 10-14), gives way to *Kairos* as time not measured extensively, but enlivened *intensively*. The understanding and the experiential fine-tuning of the 'sense' of Kairos is a key aspect of stage work and it is relatively surprising that it is correlated with a broader competence of interoceptive signals.

The notion of Kairos (καιρός) has manifold nuances that include *timeliness*, *due measure*, *proportion*, *fitness*, *exact* or *critical time*, *season*, but also *opportunity*, *fruit*, *profit*, *wise moderation*[52]. It regards the proper timing in which inner states and

ogy», 131, 2015, pp. 193-200; A. Sel, R. Azevedo, M. Tsakiris, *Heartfelt self: cardio-visual integration affects self-face recognition and interoceptive cortical processing*, in «Cerebral Cortex», 27, 2017, n. 11, pp. 5144-5155; K. Suzuki, S. Garfinkel, H. Critchley, A. Seth, *Multisensory integration across exteroceptive and interoceptive domains modulates self-experience in the rubber-hand illusion*, in «Neuropsychologia», 51, 2013, n. 13, pp. 2909-2917; A. Tajadura-Jiménez, M. Tsakiris, *Balancing the "inner" and the "outer" self: Interoceptive sensitivity modulates self-other boundaries*, in «Journal of Experimental Psychology: General», 143, 2014, n. 2, p. 736; P. Shah, C. Catmur, G. Bird, *From heart to mind: Linking interoception, emotion, and theory of mind*, in «Cortex», 220, 2017, n. 93.

[49] Cfr. H. Critchley, S. Wiens, P.Rotshtein, A. Ohman, R.J. Dolan, *Neural systems supporting interoceptive awareness*, in «Nature Neuroscience», 7, 2004, pp. 189-195; cfr. Y. Tan, D. Wei, M. Zhang, J. Yang, V. Jelinčić, J. Qiu, *The role of mid-insula in the relationship between cardiac interoceptive attention and anxiety: evidence from an fMRI study*, in «Scientific Reports», 22 novembre 2018. https://www.nature.com/articles/s41598-018-35635-6.pdf (last accessed: 5 August 2022).

[50] Cfr. R. Salomon, R. Ronchi, J. Dönz, J. Bello-Ruiz, B. Herbelin, R. Martet, N. Faivre, K. Schaller, O. Blanke, *The insula mediates access to awareness of visual stimuli presented synchronously to the heartbeat*, in «Journal of Neuroscience», 36, 2016, n. 18, pp. 5115-5127.

[51] M. Wittmann, K. Meissner, *'The embodiment of time: How interoception shapes the perception of time*, in *The Interoceptive Mind: From Homeostasis to Awareness*, edited by M. Tsakiris and H. De Preester, Oxford, Oxford University Press, 2018, pp. 63-79. Cfr. T. Metzinger, *Being no one: The self-model theory of subjectivity*, Cambridge, The MIT Press, 2004; A. Revonsuo, *Inner presence: Consciousness as a biological phenomenon*, Cambridge, The MIT Press, 2006.

[52] https://outils.biblissima.fr/fr/eulexisweb/?lemma=%CE%BA%CE%B1%CE%B9%CF%81%CE%BF%CF%82&dict=LSJ (last accessed: 5 August 2022).

external circumstances are aligned. Quite interestingly, the variant καίριος appears in Homer's Iliad[53] *primarily with a spatial acceptance*, where «[...] it denotes a vital or lethal place in the body, one that is particularly susceptible to injury and therefore necessitates special protection; καιρός thus, initially, carries a spatial meaning»[54]. Therefore, the measured and timely delivery of the performer is supposed to be grounded in the objective features of the performance: «kairos depends on temporal frames that are independent of human action: [...] Kairos has an ontological "physical and metaphysical" dimension of his own»[55]. Being able to tackle gracefully these circumstances requires the fine-tuning of the actor's timeliness[56] and the congruity of delivery through dominion and knowledge of the actual emotional responses[57]. This entails that Kairos requires a high degree of 'frictionless' acceptance of both internal states and external circumstances, and it is more about what an actor meets in performance than what an actor has prepared in rehearsals. This resounds with Peter Brook's «deadly theatre»[58] where the British director nods to the dreadful displays of professionalism in certain mainstream theatre and the inherent dullness and deafness of 'pre-packaged' interplays. Ultimately, I argue, this is due to the superimposition of the preconceived over one's liveliness and openness, the over-writing of an idea over the physical states that are intertwined with the relations and the spaces where the action unfolds. This 'unavailability' to oneself and others builds on defensiveness and anticipation and is a very serious issue for the actor.

Italian actor and director Claudio Morganti tackles the issue by offering a remarkable analogy with certain strands of radical «lowercase improvisation» and «minimal improvisation» in contemporary music when it comes to embrace a non-conservative, forward-looking attitude on stage[59]:

[53] The word does never appear in Homer and it's a *hapax legomenon* in Hesiod: καιρὸς δ΄ἐπὶ πᾶσιν ἄριστος "timing is best in all things" (Hesiod, *Theogony. Works and Days. Testimonia*, edited and translated by G.W. Most, Loeb Classical Library 57, Cambridge, Harvard University Press, 2018, p. 694). Pindar and tragedians have many instances of the notion: Pindar says 'I have lighted upon many themes, hitting the καιρός with no false word (καιρὸν οὐ ψεύδει βαλών)'.

[54] Cfr. P. Sipiora, J.S. Baumlin, *Rhetoric and kairos: Essays in history, theory, and praxis*, New York, SUNY Press, 2002.

[55] Cfr. J.E. Smith, *Time and qualitative time*, in «The Review of metaphysics», 49, 1986, n. 4 pp. 3-16.

[56] Cfr. M. Hashiguchi, T. Koike, T. Morita, T. Harada, D. Le Bihan, N. Sadato, *Neural substrates of accurate perception of time duration: A functional magnetic resonance imaging study*, in «Neuropsychologia», 166, 2022, pp. 108-145.

[57] Cfr. S. Davey, J. Halberstadt, E. Bell, *Where is emotional feeling felt in the body? An integrative review*, in «PloS One», 16, 2021, n. 12.

[58] Cfr. P. Brook, *The Empty Space*, London, MacGibbon & Kee, 1968, pp. 7-42.

[59] Cfr. C. Morganti, *La grazia non pensa*, Imola, Cue Press, 2018, pp. 21-24.

> Showing only what is known to us resembles the act of displaying a relic, it is indeed a profoundly conservative understanding of art. I understand that it can be a natural reaction to the volatility and fickleness, to the whim and mystery and vagueness of the theatre, but we shouldn't be afraid of it![60]

In Morganti's intuition, no matter how punctilious the script or how stringent the director's notes, there is always room for a subtler and fresher interplay based on true, deep mutual listening. There is a reference to the work ethic in the improvising player who selflessly gives away control of his own delivery and 'makes room' to the performance of other players: indeed, listening is not merely an attitude, but rather a repeated and concrete act carried out by every performer, that is iteratively modified and redefined in the unfolding of the performance. It is interesting to see that improvisers utilise spatial metaphors to describe both the outcome and the precondition for successful interplay. British inventor of the «situated friction» form of saxophone improvisation Seymour Wright describes such 'space-making' in this way:

> I try to create as much space and balance as possible in what's going on. [...] It's listening but it's also trying to generate as much space as possible in the music. [...] When I talk about space, I suppose I'm talking about a kind of sound or textural or sonic territory. It doesn't preclude the call and response; it's just one way of dealing with it. It's the idea of things happening at once independently and together. Part of the point of having all this space is to have the freedom that I think this music requires. I think improvised music should be fundamentally free music and about having different possibilities and I think you start with the space. [...] I'm interested in making a musical space as rich as possible. But, depending on who I'm playing with, that's more or less easy to do. So, the decisions I make are very much informed by the people I'm playing with[61].

Indeed, listening goes beyond the "shallowness" of language, as Adam Bohman, Clive Graham, Clive Hall and Michael Prime from British experimental music Morphogenesis claim:

> I think what we're trying to describe is that if you're thinking about it, it's not so successful. You should be feeling it, and perhaps what I mean by feeling it is non-verbal thought. Because that feeling is thought but if you're thinking of it in terms of words in your head, you're being so analytical that you're *missing the moment* (italics mine). Some people say there's no such thing as non-verbal thought. Anyone who plays music would probably accept that there is. You're

[60] Ivi, p. 23 (translation mine).
[61] Cfr. B. Denzler, J.L. Guionnet (eds.), *The practice of musical improvisation: Dialogues with contemporary musical improvisers*, London, Bloomsbury Publishing, 2020, p. 19.

> not analysing it in that verbal form. All of these things are factors which our brains analyse and again its non-verbal thought and that's precisely why it's interesting. [...][62]

Actors face the same kind of challenges when they dive into reflection during performance, committing, in the words of Scottish BAFTA award winner actor Alan Cumming, the «biggest crime in acting: over-thinking»[63]. The issue of trying to superimpose one's ideas on the immediacy of the interplay is a misuse of analytical capabilities which erodes the quality of the performance as we tamper with our automatic responses. The trust in one's interoceptive abilities, as developed through practice, may positively reflect on the rigidities of over-thinking.

2. On Peri-personal Space

The peri-personal space (PPS) is a compound system in the brain which represents the space surrounding the body, and that adaptively estimates the probability of interaction with objects in the environment: it is a profoundly self-centred representation of space that, as a set of graded fields[64], traces distances and boundaries between what might interact with the body and what won't. The integrate multisensory information of PPS is mapped in a fronto-parietal network through the integration of tactile stimuli on the body with visual and auditory information from external objects at a distance. Intriguingly, PPS is a peculiar sort of 'bubble': different neurons map different section of the space around the body, and can be accounted for as the combination of the spaces of affordance around the head, the trunk, and the back of the hands[65]. The representation of PPS is of multisensory-motor and not merely of multisensory nature[66]: the pioneering studies of Giacomo Rizzolatti and his team on mirror neurons in nonhuman primates had already reported on specialised multisensory neurons in intraparietal and premotor cortices which respond both when a body part is touched, and when a visual or audito-

[62] Ivi, p. 14.
[63] https://www.youtube.com/watch?v=jCmLpcesG4s (last accessed: 1 May 2024).
[64] Cfr. C.F. Sambo, B. Forster, S.C. Williams, G.D. Iannetti, *To blink or not to blink: Fine cognitive tuning of the defensive peripersonal space*, in «Journal of Neuroscience», 32, 2012, n. 37, pp. 12921-12927.
[65] Cfr. M.S.A. Graziano, D.F. Cooke, *Parieto-frontal interactions, personal space, and defensive behavior*, in «Neuropsychologia», 44, 2006, n. 6, pp. 845-859; J.P. Noel, C. Pfeiffer, O. Blanke, A. Serino, *Peripersonal space as the space of the bodily self*, in «Cognition», 144, 2015, pp. 49-57; E. Gherri, A. Xu, E. Ambron, A. Sedda, *Peripersonal space around the upper and the lower limbs*, in «Experimental Brain Research», 240, 2022, nn. 7-8, pp. 2039-2050.
[66] Cfr. A. Serino, *Peripersonal space (PPS) as a multisensory interface between the individual and the environment, defining the space of the self*, in «Neuroscience & Biobehavioral Review», 99, 2019, pp. 138-159.

ry stimulus occurs near the same body part[67]. Therefore, how we deal with people and things, what posture we adopt, how we startle when alarmed, all leak information on us for the world out there. Our interactions with our whereabouts are revelatory to the observer that empathically understands the unmediated responses and 'reads' the quality of movements[68].

PPS is shaped by both experience and circumstances: the adaptive nature of the system will plastically encompass farther portions of space after interaction and use of tools such as sticks or props or will shrink because of external or body/brain constraints. And, just as experience with tools extends PPS representation, it will also respond to changes in the surrounding environment and will "introject" exteroceptive signals from interactions[69].

British director Declan Donnellan is a prominent theatre practitioner that has thoroughly elaborated on the neurophysiological features of the peri-personal space. His thinking of acting as an actor/target tension immediately conveys the inherent alertness of peri-personal space with the need of being alive on stage. The idea of the target is strongly ostensive and quintessentially spatial: the target is «neither an objective, nor a want, nor a plan, nor a reason»[70], but rather stems from the givens of the spatial relations with the target itself. For an actor, says Donnellan, there is always a target, and it always exists *outside* of them, at a measurable and visible distance. Donnellan's approach to acting seems empirically akin to the fundamental features of PPS mechanisms. I believe it is fair to say that the main contribution of the actor/target duality is to free the actor from "meddling" with introspection in favour of active responsiveness towards imaginative spatial tensions. But is there any room for connecting Donnellan's work with the interoceptive mechanisms that we have seen above? The response should be positive. Already in 2017, Michael Graziano regretted that his team hadn't tackled peri-personal space from the perspectives of smell and of the vestibular system, so relevant for the interconnections between balance and vision[71]. In-

[67] Cfr. G. Rizzolatti, C. Scandolara, M. Matelli, M. Gentilucci, *Afferent properties of periarcuate neurons in macaque monkeys. I. Somatosensory responses* e Iid., *Afferent properties of periarcuate neurons in macaque monkeys. II. Visual responses*, in «Behavioral Brain Research», 2, 1981, pp. 125-146; 147-163.

[68] Cfr. M.S.A. Graziano, D. F. Cooke, *Parieto-frontal interactions*, cit.; M.S. Graziano, C.S. Taylor, T. Moore, *Complex movements evoked by microstimulation of precentral cortex*, in «Neuron», 34, 2002, n. 5, pp. 841-851.

[69] Cfr. O.V. Bogdanova, V.B. Bogdanov, A. Dureux, A. Farnè, F. Hadj-Bouziane, *The Peripersonal Space in a social world*, in «Cortex», 142, 2021, pp. 28-46; C. Teneggi, E. Canzoneri, G.D. Pellegrino, A. Serino, *Social modulation of peripersonal space boundaries*, in «Current Biology», 23, 2013, n. 5, pp. 406-411.

[70] D. Donnellan, *The actor and the target*, London, Nick Hern Books, 2005, p. 31.

[71] M. Graziano, *The spaces between us: a story of neuroscience, evolution, and human nature*, Oxford, Oxford University Press, 2017, p. 49.

deed, relevant research appeared already in 2018, confirming that audio-vestibular motion stimuli (as in whirling) expanded the PPS boundary further away from the body as compared to no spinning[72]. This is evidence that «vestibular inputs dynamically update the multisensory delineation of PPS and far space, which may serve to maintain accurate tracking of objects [...] and to update spatial self-representations»[73].

3. The hippocampus and the making of the hardwired stage

The "inside-outside" juxtaposition is a recurrent theme in most acting traditions and, as the wording might suggest, it hints to a difference between the internal psychophysiological states of the actor in performance and the capability of watching their own performance as if sitting in the audience. A closer analysis of the spatial and mnemonic features of the hippocampal formation informs us on the viability of an account for stage space as *a shared cognitive space* between the actors and the audience.

The story of the hippocampal area and of its involvement with space, learning and memory is linked to the renowned case of patient H.M.[74] and the surgical operation that removed his hippocampus and medial temporal lobes in 1953[75]. From the day of his operation at age 27 to his demise in 2008, no new memory could be established, although procedural memory had remained fully functional, and his IQ even grew over time. His case has been of utmost relevance as it proved that declarative memory is only one aspect of the mnemonic capabilities of humans and that entails that different neuronal configurations are responsible for different forms of memory.

The connection between impairments in declarative memory and in the sense of spatiality due to hippocampal dysfunctions was not actually acknowledged before the '70s when an animal model of amnesia based on the removal of the hippocam-

[72] This is empirically tangible in the practice and teachings of contemporary Turkish Sufi dancer and choreographer Ziya Azazi. Cfr. E. Çizmeci, *World as sacred stage for Sufi ritual: Performance, mobilization and making space with the act of whirling*, in «Dance, Movement & Spiritualities», 3, 2016, n. 3, pp. 199-215. For other intersections between Sufi teachings and performer training see Ş. Sözer Özdemir. *Ayn and the Actor: The Immanent Truth in the Works of Ideogram Théâtre*, in «TDR: The Drama Review», Cambridge, Cambridge University Press, 66, 2022, n. 1, pp. 119-136.

[73] Cfr. C. Pfeiffer, J.P. Noel, A. Serino, O. Blanke, *Vestibular modulation of peripersonal space boundaries*, in «European Journal of Neuroscience», 47, 2018, 7, p. 800.

[74] Cfr. W.B. Scoville, B. Milner, *Loss of recent memory after bilateral hippocampal lesions*, in «Journal of Neurology, Neurosurgery, and Psychiatry», 20, 1957, n. 1, p. 11. See also L.R. Squire, *The legacy of patient HM for neuroscience*, in «Neuron», 61, 2009, n. 1, pp. 6-9.

[75] Cfr. W.B. Scoville, *The limbic lobe in man*, in «Journal of Neurosurgery», 11, 1954, n. 1, pp. 64-66.

pus revealed that spatial memory in rodents relies on the latter[76]. Indeed, the seminal works of O'Keefe and Dostrovsky[77] gathered preliminary evidence of the encoding of space through "place cells", neuron sets that fire according to the specific locations occupied by the rodent, and that were later proved to be ubiquitous throughout the entire hippocampus[78]. Further studies proved that lesions or hippocampus removal in rats or monkeys diminish space-navigation capabilities in memory tasks[79]. In those same years, it appeared more clearly that the neural activity of the hippocampal area constitutes a cognitive map of space in which individual place cells map the location of the animal in a specific environment[80].

But how do cells in the brain represent specific memories? The hippocampus receives cortical input from two major pathways: the medial entorhinal cortex (MEC) and the lateral entorhinal cortex (LEC). Area CA1 of the hippocampus mainly receives signals from area CA3, entorhinal cortex layer III (EC3), and area CA2. The so-called *trisynaptic pathway*, which includes signals from CA3, connects entorhinal cortex layer II (EC2) to the dentate gyrus (DG) to CA3, and then CA1 (EC2-DG-CA3-CA1 circuit). The *monosynaptic pathway* leads signals to CA1 from EC3, besides two "minor" hippocampal circuits to CA1[81]. The generation of place cells through CA3 and EC3 and the modalities of inhibition of their activities have raised a wide debate on experimental procedures[82]. To our ends, it is important to

[76] Cfr. P. Andersen, R. Morris, D. Amaral, T. Bliss, J. O'Keefe, *The hippocampus book*, Oxford, Oxford University Press, 2006; T. Danjo, *Allocentric representations of space in the hippocampus*, in «Neuroscience Research», 153, 2020, pp. 1-7; C.T. Johnson, D.S. Olton, F.H. Gage, P.G. Jenko, *Damage to hippocampus and hippocampal connections: Effects on DRL and spontaneous alternation*, in «Journal of Comparative and Physiological Psychology», 91, 1977, n. 3, p. 508; R. G.M. Morris, P. Garrud, J.N.P. Rawlins, J. O'Keefe, *Place navigation impaired in rats with hippocampal lesions*, in «Nature», 297, 1982, n. 5868, pp. 681-683; R. Morris, *Developments of a water-maze procedure for studying spatial learning in the rat*, in «Journal of Neuroscience Methods», 11, 1984, n. 1, pp. 47-60.

[77] Cfr. J. O'Keefe, J. Dostrovsky, *The hippocampus as a spatial map: Preliminary evidence from unit activity in the freely-moving rat*, in «Brain Research», 34, 1971, n. 1, pp. 171-175.

[78] Cfr. R.U. Muller, J.L. Kubie, *The effects of changes in the environment on the spatial firing of hippocampal complex-spike cells*, in «Journal of Neuroscience», 7, 1987, n. 7, pp. 1951-1968; M.W. Jung, B.L. McNaughton, *Spatial selectivity of unit activity in the hippocampal granular layer*, in «Hippocampus», 3, 1993, n. 2, pp. 165-182; J. O'Keefe, *Place units in the hippocampus of the freely moving rat*, in «Experimental Neurology», 51, 1976, n. 1, pp. 78-109.

[79] Cfr. M. Mishkin, *Memory in monkeys severely impaired by combined but not by separate removal of amygdala and hippocampus*, in «Nature», 273, 1978, pp. 297-298; D.S. Olton, B.C. Paras, *Spatial memory and hippocampal function*, in «Neuropsychologia», 17, 1979, n. 6, pp. 669-682; R.G.M. Morris, P. Garrud, J.N.P. Rawlins, J. O'Keefe, *Place navigation*, cit.

[80] Cfr. J. O'Keefe, L. Nadel, *The hippocampus as a cognitive map*, Oxford, Clarendon Press, 1978.

[81] Cfr. K. Kohara, M. Pignatelli, A.J. Rivest, H.Y. Jung, T. Kitamura, J. Suh, D. Frank, K. Kajikawa, N. Mise, Y. Obata, I.R. Wickersham, *Cell type-specific genetic and optogenetic tools reveal hippocampal CA2 circuits*, in «Nature neuroscience», 17, 2014, n. 2, pp. 269-279.

[82] Cfr. V.H. Brun, M.K. Otnæss, S. Molden, H. Steffenach, M.P., Witter, M.B. Moser, *Place cells*

notice that a growing body of evidence suggests that memories are stored in the hippocampus through the integration of spatial information from specialized cell types in the MEC with nonspatial information from cells in the LEC. The latter cells bring forth interesting experimental information: rodents display a minimal spatial modulation in LEC neurons in open-field environments but *fire in the proximity of objects*. This suggests that LEC neurons signal on the specific contents of the spatial environment and distinguish between the presence of the object and the memory of the object in the space[83].

Moreover, brief spikes of activity in the entorhinal cortex correlated with position in space provide evidence about the existence of "grid cells", a set of neurons firing in proximity of specific areas of the experimental space. The firing signals coming from the rat foraging around the space would define a series of hexagonal or triangular hotspots that are identifiable in a visual representation of the experiment[84]. The mapping of the experimental space is then stored in the memory of the subject for future spatial navigations; the pharmacological inhibition of the neural firings shows indeed a drastic deficit in the capability of the rodents to perform tasks in space. This is hardwired evidence of construction and retention of the memory of a space by the constitution of "conspicuous points", which are first established during the foraging performance time and then later retrieved. As inherited from a common ancestor[85], grid-like neuronal activity appears in bats, rats, and monkeys[86], as for the representation of position, direction, and velocity in entorhinal cortex[87] and as for the visual space in primates[88], and the

and place recognition maintained by direct entorhinal-hippocampal circuitry, in «Science», 296, 2002, n. 5576, pp. 2243-2246; V.H. Brun, T. Solstad, K.B. Kjelstrup, M. Fyhn, M.P. Witter, E.I. Moser, M.B. Moser, *Progressive increase in grid scale from dorsal to ventral medial entorhinal cortex*, in «Hippocampus», 18, 2008, n. 12, pp. 1200-12; R. Boehringer, D. Polygalov, A.J.Y. Huang, S.J. Middleton, V. Robert, M.E. Wintzer, *Chronic loss of CA2 transmission leads to hippocampal hyperexcitability*, in «Neuron», 94, 2017, n. 3, pp. 642-655.

[83] Cfr. A. Tsao, M.B. Moser, E.I. Moser, *Traces of experience in the lateral entorhinal cortex*, in «Current Biology», 23, 2015, n. 5, pp. 399-405.

[84] Cfr. T. Solstad, C.N. Boccara, E. Kropff, M.B. Moser, E.I. Moser, *Representation of geometric borders in the entorhinal cortex*, in «Science», 322, 2008, n. 5909, pp. 1865-1868.

[85] L. Krubitzer, D.M. Kahn, *Nature versus nurture revisited: an old idea with a new twist*, in «Progress in Neurobiology», 70, 2003, n. 1, pp. 33-52.

[86] Cfr. J. Jacobs, C.T. Weidemann, J.F. Miller, A. Solway, J.F. Burke, X. Wei, N. Suthana, M.R. Sperling, A.D. Sharan, I. Fried, M.J. Kahana, *Direct recordings of grid-like neuronal activity in human spatial* navigation, in «Nature Neuroscience», 16, 2013, 9, pp. 1188-1190; M.M. Yartsev, M.P. Witter, N. Ulanovsky, *Grid cells without theta oscillations in the entorhinal cortex of bats*, in «Nature», 479, 2011, pp. 103-107.

[87] Cfr. M. Fyhn, T. Hafting, M.P. Witter, E.I. Moser, M.B. Moser, *Grid cells in mice*, in «Hippocampus», 18, 2008, n. 12, pp. 1230-1238.

[88] Cfr. N.J. Killian, M.J. Jutras, E.A. Buffalo, *A map of visual space in the primate entorhinal cortex*, in «Nature», 491, 2012, n. 7426, pp. 761-764.

evolution of distributed networks in the human brain[89]. In the adult brain, space and orientation are represented by an elaborate hippocampal-parahippocampal circuit consisting of head-direction cells, place cells, and grid cells; in the developing brain, there is evidence of a primitive spatial map in the brain of a 2½-week-old rat pup exploring an open environment for the first time, that shows innate capabilities in the pre- and in the parasubiculum, and, later, a development of place and grid cells[90]. Finally, there is evidence that orientation is built upon both environmental experience and innate constructs and that the hippocampal formation constructs allocentric representations of space[91]. Indeed, the mammalian brain appears to be capable of transforming egocentric signals in allocentric ones[92] and of supporting the coexistence of allocentric and egocentric representations of space[93]. This entails that the same space can be seen by a subject as a combination of their self-centred representations and their understanding of the outstanding spatial relationships of objects and agents in that very space. In the latter case, the subject understands that they are *also* an element of the space setting and that there are alleged implications with being located in different positions in the very space.

Making sense of space seems to be hardwired in the spatial processing of mammals in such a twofold manner. This hints to Brook's notorious definition of the essence of theatre as «a man who walks across an empty space whilst someone else is watching him»[94]. There is a twofold egocentric and allocentric shared cognitive labour on the stage space that is a form of spatially organised knowledge[95] that informs and regards performers and audience members in the same way. The evidence gathered on the functions of the hippocampus seems to suggest that meanings and information generated on a space used and referred to by a composite group of 'makers' and 'watchers' derive from a hardwired property of species.

[89] Cfr. R.L. Buckner, F.M. Krienen, *The evolution of distributed association networks in the human brain*, in «Trends in Cognitive Sciences», 17, 2013, n. 12, pp. 648-665.
[90] Cfr. R.F. Langston, J.A. Ainge, J.J. Couey, C.B. Canto, T.L. Bjerknes, M.P. Witter, E.I. Moser, M.B. Moser, *Development of the spatial representation system in the rat*, in «Science», 328, 2010, n. 5985, pp. 1576-80.
[91] Cfr. T.J. Wills, F. Cacucci, N. Burgess, J. O'Keefe, *Development of the hippocampal cognitive map in preweaning rats*, in «Science», 328, 2010, n. 5985, p. 1573; T. Danjo, *Allocentric representations of space* cit.
[92] Cfr. C. Wang, X. Chen, J.J. Knierim, *Egocentric and allocentric representations of space in the rodent brain*, in «Current opinion in neurobiology», 60, 2020, pp. 12-20.
[93] Cfr. N. Burgess, *Spatial memory: how egocentric and allocentric combine*., in «Trends in Cognitive Sciences», 10, 2006, n. 12, pp. 551-557.
[94] Cfr. P. Brook, *The empty space*, cit.
[95] Cfr. D. Turnbull, *Maps narratives and trails: performativity, hodology and distributed knowledges in complex adaptive systems – an approach to emergent mapping*, in «Geographical research», 45, 2007, n. 2, pp. 140-149.

Conclusions

The research outline presented in this paper aims to point out on how the neural workings of our being in space as human beings serve us as artists and performer trainers. Indeed, evidence from studies in Interoception, Peri-personal space, and the functions of the hippocampus provide us with a compelling picture of spatial meaning-making that serves as an encompassing framework for accommodating and re-reading the works of relevant practitioners, and for the re-discovery of neglected theatrical experiences from both western and non-western traditions. Finally, a spatial approach may foster the emergence of diverse auto-ethnographical accounts on acting and performing based on more intuitive albeit solid premisses and might constitute an intersubjective element for comparing qualitative analyses.