

WHAT THE INNER SPEECH CAN TELL US ABOUT THE VERBAL AUDITORY HALLUCINATIONS

Chiara Rizzotto, Margherita Dahò,
Michele Rasco, Amelia Gangemi

Abstract

The «inner speech» experience refers typically to an internal silent dialogue. A wide number of studies showed that it influences several cognitive and behavioral functions, such as memory, thinking and reasoning and self-awareness (e.g. Utzl *et al.* 2011). Furthermore, clinical observations and many empirical studies found that it is related to Verbal Auditory Hallucinations (AVHs) (e.g. McCarthy-Jones, Fernyhough 2011). After having deepened the relationship between inner and open speech and its neural correlations, this paper wants to examine and clarify, its role in schizophrenia, and its relationship with AVHs.

Keywords: Inner Speech, Schizophrenia, Auditory Verbal Hallucinations.

1. INNER SPEECH AND OVERT SPEECH

According to Morin (2009), the phenomenon of inner speech is often taken for granted: it is present and central in every individual's daily life. However, it became a promising research object only since the early XIX century. For example, in 1986, Vygotsky defined it firstly, as a silently talking to oneself or as a speech for oneself. Recently, scholars described this phenomenon as an internal silent dialogue or as the ability to speak mutely in one's head (Uttl *et al.* 2011; Geva *et al.* 2011; Perrone-Bertolotti *et al.* 2014). Accordingly, inner speech is defined as an internalized verbal thought that can be consciously explored (Marvel, Desmond 2012) or, such as a particular personal experience of language that does not need the use of open and audible articulation (Alderson-Day, Fernyhough 2015). In addition, it has also been considered as a form of mental imagery (Oppenheim, Dell 2008).

In the last years, a wide number of empirical studies showed that the inner speech influences several cognitive and behavioral functions. For example, it plays a relevant role in several cognitive and behav-

ioral functions (Fernyhough 2018), such as in the self-regulation of thoughts and/or behaviors (Morin 1993), in the ability to plan future events (Uttl *et al.* 2011; Fernyhough 2018), in the verbal short-term and autobiographical memory (Baddeley, Hitch 1974; Larsen *et al.* 2002), in self-awareness (Morin 2009; Morin *et al.* 2007), in reading and writing tasks (Abramson, Goldinger 1997; Morin *et al.* 2018; Petkov *et al.* 2013), in those tasks that request switching abilities (Miyake *et al.* 2004).

However, as regards the language process, it is still unclear the relationship between the inner speech and the open speech or external language. This issue can be traced back to the behaviorist paradigm of verbal thought. For example, Watson (1982) associated the thought with the production of hidden language as a process of «motor habits in the larynx» (p. 174). In this sense, he suggests that the articulatory movements take place during inner speech. This view of «motor simulation» empathized the existence of a continuum between internal (i.e. inner speech) and external dialogue (i.e. open speech), showing a clear sharing of both mechanisms and neurophysiological correlates (Perrone-Bertolotti *et al.* 2014). Accordingly, the inner speech would be very similar to the overt speech, yet with one exception: the motor execution and the sound production are absent. This view has been questioned later by Smith, Brown, Toman and Goodman (1947) which argued that inner speech occurs in the absence of laryngeal movements. Even the «abstraction view», opposites to the motor simulation approach, claiming that the internal speech is not affected by articulatory details. More recently, Perrone-Bertolotti and colleagues (2014), maintained that the former spoken speech is a sort of «truncated external language» (p. 222) suggesting that the relationship between the two types of dialogue can be investigated through «language errors», or errors of a phonological or phonemic nature. If such errors also occur during the production of inner speech, as during the open speech, it is possible to conclude that the two types of dialogue are similar (Geva *et al.* 2011). Oppenheim and Dell (2008) investigated these so-called language errors through tongue-twisting recitation tasks. In particular, they focused on the phonological errors showing «the tendency for error in speech production to produce words more often than non-words during tongue-twister repetition», and on phonemic similarity effects or tendencies to replace phonemes with similar phonemes. The phonetic inner language indicates both types of errors.

According to the authors, the inner speech should be thus specified at a sub-phonemic level, since the inner speech can be produced in the same way as an open language. Therefore, it seems that inner speech has much in common with external language, being the lexical error quite frequent. Yet, at the same time, it distances itself from spoken language as it is poor and abstract. Furthermore, Oppenheim and Dell (2010) proposed to differentiate the self-talk experience in two different types of dialogue: the standard inner speech, without motor articulation, and the intermediate inner speech, characterized by silent articulation. Through other experiments, Oppenheim and Dell (2010) tried to demonstrate that the intermediate inner speech shows phonemic similarities exactly like spoken language, unlike the standard one. From their point of view, silent articulation increases the amount of activation of the articulatory (sub-phonemic) characteristics, consequently increasing the number of errors involving phonemes articulated similarly. Finally, a lack of phonemic similarity was observed in the inner speech standard. Thus, according to Oppenheim and Dell (2008), these results support another hypothesis called «flexible abstraction»: having the inner speech multiple facets, it could not involve some articulatory representations, but, on the opposite, may incorporate a level of articulatory planning lower when the speakers articulate silently. Further studies on inner speech led Fernyhough (2004) to propose the existence of four different types of inner speech entitled: 1) external dialogue; 2) private speech; 3) expanded inner speech, and 4) condensed inner speech. The external dialogue is considered such as a verbal mediated reciprocal exchange, while the private speech is defined as an overt self-directed speech. Then, the expanded inner speech is a deeper, extended private speech that has been internalized. Finally, the condensed inner speech is even deeper and it is similar to the Vygotsky's stage labeled: «thinking in pure meanings, syntactic and semantic abbreviation processes». According to Fernyhough, the inner speech has also a specific development in the child that is composed of four levels that go from an external dialogue to an internal one, as described in figure 1. Furthermore, he suggested that even during adulthood can occur shifts among these levels and that under particular conditions, such as under cognitive load or stress, there may be a transition from fully condensed inner speech to expanded inner speech and even private inner speech or external dialogue.



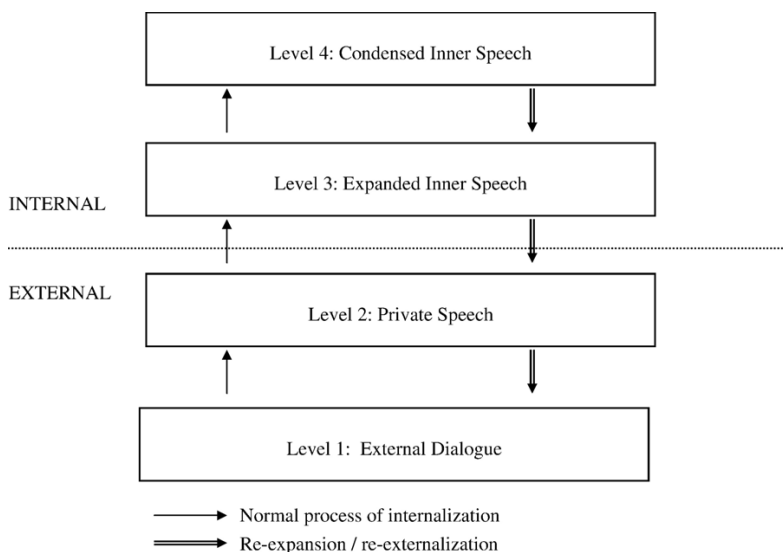


FIG. 1. Fernyhough's (2004) four-stage model of the development of inner speech.

Clinical observations and many empirical studies found that the inner speech can turn to be pathological under some conditions like, for example, in people suffering from autism spectrum, social anxiety, mood disorders and psychosis, such as **Schizophrenia**. In what follows we want to examine and clarify, the role of the inner speech in schizophrenia, and its relationship with a typical symptom of this disturb: the verbal auditory **hallucination** (AVHs).

2. INNER SPEECH AND AVHS

According to the DSM-V (2013), the schizophrenia spectrum is characterized by abnormalities in one or more of the following five domains: delusions, hallucinations, disorganized thinking (speech), grossly disorganized or abnormal motor behavior (including catatonia), and negative symptoms. Common symptoms of schizophrenia also involve a range of cognitive, behavioral, and emotional dysfunctions. Yet a single symptom is not pathognomonic of the disorder (cf. Cardelli, Gangemi 2019), given that it involves impairment in one or more major areas functioning (DSM-V, 2013). «Listening to other people's

voices» is an example of Auditory Verbal Hallucinations (AVHs), one of the most typical symptoms of patients suffering from schizophrenia. They are defined as sensory experiences that occur in the absence of external stimulation, despite there are some patients able to perceive a «silent voice» (no sound) with semantics that provides information (Jones, 2010). The content of the AVHs is commonly exaggerated, bizarre, repeated, and often involve unfamiliar topics (Leudar *et al.* 1997; Hoffman *et al.* 2008), and, according to Jones (2010), they have remarkable phenomenological parallels with inner speech. In what follows, we will see how this symptom is correlated with the inner speech phenomenon.

2.1. THE LINK BETWEEN AUDITORY VERBAL HALLUCINATIONS (AVHS) AND INNER SPEECH

While AVHs are usually considered a typical symptom of people affected by psychosis, hearing voices is something that can actually also occur to «normal» or healthy people (e.g., Cardella, Gangemi 2019). However, thanks to the presence of a *self-monitoring mechanism*, which they are equipped with, «normal» or healthy people can distinguish between the two types of voice. Recently, some scholars (Agnati *et al.* 2018, 2012) also added that inner speech can be a kind of «exaptation» activity, strongly connected to the evolution and development of the human brain (specifically, it can be derived following the acquisition of the language itself). Thus, it is involved in different cognitive processes and is useful for many cognitive operations (Loevenbruck 2018; Baldo *et al.* 2015; Morin 2005, 2009, 2012; Miyake *et al.* 2004). It is considered «exaptation» because, for example, it allows the individual to plan his behavior within the social environment (Agnati *et al.* 2012), like a «guide». On the contrary, it is sometimes considered an «exaptation error» (Agnati *et al.* 2012), a sort of «maladjustment», especially when it causes behavioral paralysis or when it occurs in people affected by autism, social anxiety, mood disorders (Allen *et al.* 2007; Beazley *et al.* 2001; Wallace *et al.* 2009), or when it becomes repetitive, negative and self-critical (Watkins 2008; Nalborczyk *et al.* 2017), giving rise to an episode of AVH (Loevenbruck 2018; Ford *et al.* 2012; Hugdahl 2009). In particular, AVHs appear to arise when an internal mental event is mistakenly attributed to external or

non-autonomous sources (Mitropoulos 2020; Loevebruck 2018; McCarthy-Jones, Fernyhough 2011). Electromyography studies, committed to testing subvocalization (small laryngeal movements that occur during inner speech) while patients experience AVH, have confirmed that inner speech is the foundation on which AVHs are based (Gould 1948; Inouye *et al.* 1970). Therefore, according to what has been said so far, auditory voices may be self-generated. Studies have focused on investigating the relationship between self-monitoring mechanism and psychosis, yet not always achieving positive results. Jones (2010), for example, criticizes this theory adding that if voices were «*misidentified inner speeches*», schizophrenics should report less inner speeches than healthy individuals, but this fact does not occur. Versmissen and colleagues (2007) did not find a correlation between the two phenomena as well. Other scholars, like Wu (2012), tried instead to investigate the reason why psychotics consider inner speech and voices as something different when, in essence, they are the same thing.

2.2. THE DISTINCTION BETWEEN INNER SPEECH AND AVHS

It is important to underline that a distinction between inner speech and AVH exists. Voices are a complex phenomenon that can be sent back to gods or other spiritual entities, aliens, known people both living and deceased (Jones, Luhrmann 2015; Rosen *et al.* 2018;). Precisely these, in the most recent literature, are described as having «a mind of their own» or a distinct personality, like a developed interactive personification or a social role (Wilkinson, Bell 2016; Humpston 2017). Therefore, the distinction between inner speech and AVH occurs at the point of loss of «paternity» of the content and with which the listener gives meaning to the voice (Waters, Jardri 2015; Deamer, Wilkinson 2015; Bell *et al.* 2017). Furthermore, this hypothesis suggests that the hallucinations reported by psychotics are separated from the self, as they are experienced as extreme and completely unfamiliar. Thus, particular attention must be given to the interpersonal relationship between oneself and the voices, as the experience is always clearly distinct from the self.

3. CORTICAL AREAS ACTIVE DURING INNER SPEECH AND AVHS

In this paragraph, we will deepen the brain areas activated during the inner speech and if these are the same areas that are activated during the AVH. Most of the cognitive studies (Moseley *et al.* 2013; Nathou *et al.* 2019) that have investigated this point have confirmed the activation of the same areas.

In particular, for what regards the inner speech, the use of neuroimaging techniques, such as the positron emission tomography (PET), the electroencephalography (EEG), the transcranial magnetic stimulation (TMS), and the functional magnetic resonance imaging (fMRI), have allowed studying in deep the brain regions activated during an inner speech. Specifically, the use of neuroimaging techniques also made possible to scan the hemispheres of the participants, engaged in the silent reading of sentences expressed both directly and indirectly, finding that most of the subjects make use of this phenomenon (Yao *et al.* 2011; 2012; Geva *et al.* 2019). The results obtained so far, revealed the activation of several frontal brain areas included: left frontal inferior gyrus (IFG) (including the Broca area), the Wernicke area, the right temporal cortex, the supplementary motor area (SMA), the insula, the right superior parietal lobule (SPL) and the right superior cerebellar cortex (e.g. Geva *et al.* 2011; Jones *et al.* 2007; Marvel *et al.* 2012; Morin *et al.* 2007). Other studies in this direction have shown, in addition, the existence of projections between areas related to vocal production and the auditory cortex considered as a relevant process in verbal self-monitoring of inner speech (Jones *et al.* 2007). Finally, another investigation showed the activation of temporal vocal areas, or TVA, in the auditory cortex, during the perception of the human voice (Belin *et al.* 2000). In particular, it was founded a greater activity of inner speech during the silent reading of sentences expressed in the direct form. It also seems that the nature of the inner speech mentally simulates implications supra-segmental acoustic representations. Indeed, the neural correlates of these vocal simulation processes involved the anterior, central and posterior parts of the upper right temporal sulcus (STS) (Yao *et al.* 2012). Therefore, some areas in the auditory cortex, those along the part of the superior temporal sulcus (STS), are particularly sensitive to the auditory stimulation from the bottom up of the human voice (Belin *et al.* 2000). As regards the AVHs, it was possible to detect



the activation of similar areas in the presence of AVHs to those of the inner speech. Neuroimaging studies (Nathou *et al.* 2019; Mondino *et al.* 2016; Moseley *et al.* 2013) also confirmed the activation of the same cortical areas of inner speech. Some studies were able to detect the morphological (Jardri *et al.* 2011; Ford *et al.* 2012) and the functional markers (Modinos *et al.* 2013) that manifest respective activations. In particular, the left temporo-parietal areas (Allen *et al.* 2012; Hoffman *et al.* 2000; Jardri *et al.* 2011), the middle and superior temporal gyri, the Wernicke's area, the left inferior frontal areas (Leroux *et al.* 2014; Jardri *et al.* 2007), the Broca's area, the frontal operculum, the anterior insula, the precentral gyrus, as well as the right homologues, as the supplementary motor area (SMA) and the insula (Shergill *et al.* 2010). These data are in line with previous other neuroimaging investigations (e.g., Friedman *et al.* 1998; McGuire *et al.* 1996b).

Specifically, in an fMRI study by Sommer and colleagues (2008), greater activity was highlighted during AVHs in the homologous Broca area of the right hemisphere (IFG), in the right superior temporal gyrus, as well as in the bilateral insula and the anterior cingulate gyrus. Being the AVH considered as an anomaly of the inner speech, and referring to the studies of Frith, Done (1988), it has been identified the cognitive capacity responsible for this verbal self-monitoring mechanism, (VSM). Indeed, the improper monitoring of the inner speech may cause those verbal thoughts not recognized as one's own and instead as someone else. The VSM appears to operate through a corollary discharge system in which the expulsions or discharges coming from the speech-producing motor areas in the frontal lobes may «advise» the auditory cortex about the fact that the self-produced speech is going to be said soon, dampening its response (Ford and Mathalon, 2005; Martikainen *et al.* 2005). In this regard, different neuroimaging studies (e.g, Jones *et al.* 2007) have been concerned with investigating the neural correlates, all agreeing that the correlates of inner speech are the same in subjects with AVH. The major activation in these regions can be linked to deficits in self-monitoring functions (Allen *et al.* 2007; Waters *et al.* 2012), to motor-sensory transformation functions (Ford, Mathalon, 2005; Tian, Poeppel, 2012), as well as to gating sensory (Bak *et al.* 2014). Therefore, the cause of AVH could be related to anomalies in these same functions.

Finally, other attempts have been made to evaluate the role of inner speech in schizophrenic subjects and with AVHs during an fMRI

session, before and after undergoing a rTMS therapeutic treatment. In an interesting study of Bais and collaborators (2017), it has been empathized the role of the changes affecting the neural networks involved in a mechanism capable of promoting not only inner speech but also AVHs. They found greater activation of the areas of the auditory-sensorimotor cortex in schizophrenic patients with AVHs, compared to the control group and subjects without AVHs. In a similar experiment (Fitzgerald *et al.* 2007), that included a word generation task, administered to a small group of schizophrenic subjects during an fMRI, and previously subjected to an rTMS treatment, findings showed an increased activity in the left temporoparietal cortex and in the cortex front lower part that falls within a network of processes involved in the generation of vocal intervention. Therefore, in light of the evidence collected so far, the scientific literature shares the common idea that both phenomena compete for the same neural responses.

5. CONCLUSION



The scientific literature of the past 50 years on the phenomenon of inner speech shows a rich growing literature with encouraging results. So far, it has been considered not only as evolutionary exaptation but rather also as an element present in various cognitive functions. As it has been said, inner speech, in its non-pathological condition, plays a key role in many cognitive processes, such as self-control of thoughts and changes, in autobiographical memory, in finding and reading etc. However, in its pathological form, it is associated with various mental disorders, including schizophrenia, social anxiety or mood disorders. These results have empathized the possible interaction between inner speech and AVH, a relevant phenomenon characterizing schizophrenia, and also described the boundary between these elements as indistinguishable. Several neuroimaging studies (e.g. Geva *et al.* 2011; Jones *et al.* 2007; Marvel *et al.* 2012; Morin *et al.* 2007) demonstrated that during the inner speech there is the activation of the temporal vocal area, or TVA, areas that are sensitive to the perception of the human voice (e.g. Belin *et al.* 2010). These results are intertwined with the findings reported about the brain areas of AVHs, confirming that both phenomena have in common the application of similar brain regions. It has also been founded that the relationship between AVH and



inner speech is specifically in the auditory modality and not in hallucinations in general (McCarthy-Jones, Fernyhough 2011).

In conclusion, the themes that fascinate scholars on inner speech are many, as well as the questions that still require to be answered. For example, the relationship between inner speech and AVH remains a field of investigation that still needs to be explored, considering the outline of the complexity of phenomena. In addition, further neuroimaging studies to elucidate the cognitive dynamics and neural mechanisms underlying this relationship are warranted.

Chiara Rizzotto
Department of Cognitive Science
University of Messina
Via Concezione, 6/8, 98121 Messina, Italy
chiara.rizzotto@unime.it

Margherita Dahò
Department of Cognitive Science
University of Messina
Via Concezione, 6/8, 98121 Messina, Italy
margherita.daho@unime.it

Michele Raso
Department of Cognitive Science
University of Messina
Via Concezione, 6/8, 98121 Messina, Italy
michele.raso@unime.it

Amelia Gangemi
Department of Cognitive Science
University of Messina
Via Concezione, 6/8, 98121 Messina, Italy
gangemia@unime.it



REFERENCES

- Abramson M., Goldinger S.D. (1997), *What the Reader's Eye Tells the Mind's Ear: Silent Reading Activates Inner Speech*, in «Perception, Psychophysics», 59, 1059-1068.

- Agnati L.F., Barlow P., Ghidoni R., Borroto-Escuela D.O., Guidolin D., Fuxe K. (2012), *Possible Genetic and Epigenetic Links Between Human Inner Speech, Schizophrenia and Altruism*, in «Brain research», 1476, 38-57.
- Agnati L.F., Guidolin D., Marcoli M., Maura G. (2018), *Inner Speech Mis-Exaptation Can Cause the «Hubris» that Speeds Up Ecosystem Over-Exploitation*, in «Neurology, Psychiatry and Brain Research», 30, 62-73.
- Alderson-Day B., Fernyhough C. (2015), *Inner Speech: Development, Cognitive Functions, Phenomenology, and Neurobiology*, in «Psychological bulletin», 141 (5), 931.
- Alderson-Day B., Weis S., McCarthy-Jones S., Moseley P., Smailes D., Fernyhough C. (2016), *The Brain's Conversation with Itself: Neural Substrates of Dialogic Inner Speech*, in «Social Cognitive and Affective Neuroscience», 11(1), 110-120.
- Allen P., Modinos G. (2012), *Structural Neuroimaging in Psychotic Patients with Auditory Verbal Hallucinations*, in *Hallucinations* (pp. 251-265), Springer, New York, NY.
- Allen P., Aleman A., McGuire P.K. (2007). *Inner Speech Models of Auditory Verbal Hallucinations: Evidence from Behavioural and Neuroimaging Studies*, in «International Review of Psychiatry», 19(4), 407-415.
- American Psychiatric Association (2013), *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®)*, American Psychiatric Pub.
- Baddeley A.D., Hitch G. (1974), *Working Memory*, in G.H. Bower (ed.), *The Psychology of Learning and Motivation: Advances in Research and Theory* (vol 8, pp. 47-89), New York, Academic Press.
- Bak N., Rostrup E., Larsson H.B., Glenthøj B.Y., Oranje B. (2014), *Concurrent Functional Magnetic Resonance Imaging and Electroencephalography Assessment of Sensory Gating in Schizophrenia*, in «Human brain mapping», 35(8), 3578-3587.
- Bais L., Liemburg E., Vercammen A., Bruggeman R., Knegtering H., Aleman A. (2017), *Effects of Low Frequency Rtms Treatment on Brain Networks for Inner Speech in Patients with Schizophrenia and Auditory Verbal Hallucinations*, in «Progress in Neuro-Psychopharmacology and Biological Psychiatry», 78, 105-113.
- Baldo J.V., Paulraj S.R., Curran B.C., Dronkers N.F. (2015), *Impaired Reasoning and Problem-Solving in Individuals with Language Impairment Due to Aphasia or Language Delay*, in «Frontiers in Psychology», 6, 1523.
- Beazley M.B., Glass C.R., Chambless D.L., Arnkoff D.B. (2001), *Cognitive Self-Statements in Social Phobia: A Comparison Across Three Types of Social Situations*, in «Cognitive therapy and Research», 25(6), 781-799.
- Belin P., Zatorre R.J., Lafaille P., Ahad P., Pike B. (2000), *Voice-Selective Areas in Human Auditory Cortex*, in «Nature», 403(6767), 309-312.
- Bell V., Mills K.L., Modinos G., Wilkinson S. (2017), *Rethinking Social Cognition in Light of Psychosis: Reciprocal Implications for Cognition and Psychopathology*, in «Clinical Psychological Science», 5(3), 537-550.



- Cardella V., Gangemi A. (2019), *From the Categorical to the Dimensional Approach in Psychopathology: The Case of Auditory Hallucinations*, in «Mediterranean Journal of Clinical Psychology», 7(3).
- Deamer F., Wilkinson S. (2015), *The Speaker Behind the Voice: Therapeutic Practice from the Perspective of Pragmatic Theory*, in «Frontiers in psychology», 6, 817.
- Dierks T., Linden D.E., Jandl M., Formisano E., Goebel R., Lanfermann H., Singer W. (1999), *Activation of Heschl's Gyrus During Auditory Hallucinations*, in «Neuron», 22(3), 615-621.
- Fernyhough C. (2004), *Alien Voices and Inner Dialogue: Towards a Development Account of Auditory Verbal Hallucinations*, in «New Ideas in Psychology», 22, 49-68.
- Fernyhough C. (2018), *Le voci dentro. Storia e Scienza del dialogo interiore*, Milano, Raffaello Cortina.
- Ferreira C., Direito B., Sayal A., Simões M. et al. (2018), *Functional Mapping of Inner Speech Areas: A Preliminary Study with Portuguese Speakers*, in *International Conference on Speech and Computer* (pp. 166-176), Cham, Springer.
- Ford J.M., Mathalon D.H. (2005), *Corollary Discharge Dysfunction in Schizophrenia: Can It Explain Auditory Hallucinations?*, in «International Journal of Psychophysiology», 58(2-3), 179-189.
- Ford J.M., Dierks T., Fisher D.J., Herrmann C.S., Hubl D., et al. (2012), *Neurophysiological Studies of Auditory Verbal Hallucinations*, in «Schizophrenia Bulletin», 38(4), 715-723.
- Friedman L., Kenny J.T., Wise A.L., Wu D., Stuve T.A., Miller D.A., et al. (1998), *Brain Activation During Silent Word Generation Evaluated with Functional MRI*, in «Brain and Language», 64, 231-256.
- Frith C.D., Done D.J. (1989), *Experiences of Alien Control in Schizophrenia Reflect a Disorder in the Central Monitoring of Action*, in «Psychological Medicine», 19, 359-363.
- Geva S., Fernyhough C. (2019), *A Penny for Your Thoughts: Children's Inner Speech and Its Neuro-Development*, in «Frontiers in Psychology», 10.
- Geva S., Warburton E.A. (2019), *A Test Battery for Inner Speech Functions*, in «Archives of Clinical Neuropsychology», 34(1), 97-113.
- Geva S., Jones P.S., Crinion J.T., Price C.J., Baron J.C., Warburton E.A. (2011), *The Neural Correlates of Inner Speech Defined by Voxel-Based Lesion-Symptom Mapping*, in «Brain», 134(10), 3071-3082.
- Gould L.N. (1948), *Verbal Hallucinations and Activity of Vocal Musculature: An Electromyographic Study*, in «American Journal of Psychiatry», 105(5), 367-372.
- Hoffman R.E., Varanko M., Gilmore J., Mishara A.L. (2008), *Experiential Features Used by Patients with Schizophrenia to Differentiate «voices» from Ordinary Verbal Thought*, in «Psychological medicine», 38(8), 1167.
- Hugdahl K. (2009), «Hearing Voices»: *Auditory Hallucinations as Failure of Top Down Control of Bottom-Up Perceptual Processes*, in «Scandinavian Journal of Psychology», 50(6), 553-560.

- Humpston C.S., Linden D.E., Evans L.H. (2017), *Deficits in Reality and Internal Source Monitoring of Actions Are Associated with the Positive Dimension of Schizotypy*, in «Psychiatry Research», 250, 44-49.
- Inouye T., Shimizu A. (1970), *The Electromyographic Study of Verbal Hallucination*, in «Journal of Nervous and Mental Diseases».
- Invernizzi G., Bressi C. (2012), *Manuale di psichiatria e psicologia clinica*, McGraw Hill.
- Jardri R., Pins D., Delmaire C., Goeb J.L., Thomas P. (2007), *Activation of Bilateral Auditory Cortex During Verbal Hallucinations in a Child with Schizophrenia*, in «Molecular psychiatry», 12(4), 319.
- Jardri R., Pouchet A., Pins D., Thomas P. (2011), *Cortical Activations During Auditory Verbal Hallucinations in Schizophrenia: A Coordinate-Based Meta-Analysis*, in «American Journal of Psychiatry», 168(1), 73-81.
- Jones S.R. (2010), *Do We Need Multiple Models of Auditory Verbal Hallucinations? Examining the Phenomenological Fit of Cognitive and Neurological Models*, in «Schizophrenia Bulletin», 36, 3, 566-575.
- Jones N., Luhrmann T.M. (2016), *Beyond the Sensory: Findings from an In-Depth Analysis of the Phenomenology of «Auditory Hallucinations» in Schizophrenia*, in «Psychosis», 8(3), 191-202.
- Jones S.R., Fernyhough C. (2007), *Neural Correlates of Inner Speech and Auditory Verbal Hallucinations: A Critical Review and Theoretical Integration*, in «Clinical Psychology Review», 27(2), 140-154.
- Kljajevic V., Gómez E.U., López C., Bandeira Y.B., Vicente A. (2017), *Inner Speech in Post-Stroke Motor Aphasia*, in «Cog Sci».
- Larsen S.F., Robert W., Schrauf R.W., Fromholt P., Rubin D.C. (2002), *Inner Speech and Bilingual Autobiographical Memory: A Polish- Danish Cross-Cultural Study*, in «Memory», 10, 45-54.
- Lennox B.R., Bert S., Park G., Jones P.B., Morris P.G. (1999), *Spatial and Temporal Mapping of Neural Activity Associated with Auditory Hallucinations*, in «The Lancet», 353 (9153), 644.
- Leroux E., Delcroix N., Dollfus S. (2014), *Left Fronto-Temporal Dysconnectivity Within the Language Network in Schizophrenia: An Fmri and DTI Study*, in «Psychiatry Research: Neuroimaging», 223(3), 261-267.
- Leudar I., Thomas P., McNally D., Glinski A. (1997), *What Voices Can Do with Words: Pragmatics of Verbal Hallucinations*, in «Psychological medicine», 27(4), 885-898.
- Loevenbruck H. (2018), *What the Neurocognitive Study of Inner Language Reveals about Our Inner Space*, in «Epistémocritique, épistémocritique: littérature et savoirs, Langage intérieur - Espaces intérieurs/ Inner Speech – Inner Space», 18.
- Maïza O., Hervé P.Y., Etard O., Razafimandimby A., Montagne-Larmurier A., Dollfus S. (2013), *Impact of Repetitive Transcranial Magnetic Stimulation (Rtms) on Brain Functional Marker of Auditory Hallucinations in Schizophrenia Patients*, in «Brain sciences», 3(2), 728-743.

- Martikainen M.H., Kaneko K.I., Hari R. (2005), *Suppressed Responses to Self-Trig-gered Sounds in the Human Auditory Cortex*, in «Cerebral cortex», 15(3), 299-302.
- Marvel C.L., Desmond J.E. (2012), *From Storage to Manipulation: How the Neu-ral Correlates of Verbal Working Memory Reflect Varying Demands on In-ner Speech*, in «Brain, Language», 120, 42-51.
- McCarthy-Jones S., Fernyhough C. (2011), *The Varieties of Inner Speech: Links Between Quality of Inner Speech and Psychopathological Variables in A Sample of Young Adults*, in «Consciousness and cognition», 20(4), 1586-1593.
- McGuire P.K., Murray R.M., Shah G.M.S. (1993), *Increased Blood Flow in Bro-ca's Area During Auditory Hallucinations in Schizophrenia*, in «The Lan-cet», 342(8873), 703-706.
- Meacham J.A. (1979), *The Role of Verbal Activity in Remembering the Goals of Actions*, in G. Zivin (ed.), *The Development of Self-Regulation Through Private Speech* (pp. 237-323), New York, Wiley.
- Mitropoulos G.B. (2020), *Auditory Verbal Hallucinations in Psychosis: Abnormal Perceptions or Symptoms of Disordered Thought?*, in «The Journal of Ner-vous and Mental Disease», 208(1), 81-84.
- Miyake A., Emerson M.J., Padilla F., Ahn J.-C. (2004), *Inner Speech as a Retrieval Aid for Task Goals: The Effects of Cue Type and Articulatory Suppression in the Random Task Cuing Paradigm*, in «Acta Psychologica», 115, 123-142.
- Modinos G., Costafreda S.G., van Tol M.J., McGuire P.K., Aleman A., Allen P. (2013), *Neuroanatomy of Auditory Verbal Hallucinations in Schizophre-nia: A Quantitative Meta-Analysis of Voxel-Based Morphometry Studies*, in «Cortex», 49(4), 1046-1055.
- Mondino M., Jardri R., Saoud-Chagny M.F., Saoud M., Poulet E., Brunelin J. (2016), *Effects of Fronto-Temporal Transcranial Direct Current Stimulation on Auditory Verbal Hallucinations and Resting-State Functional Connectiv-ity of the Left Temporo-Parietal Junction in Patients with Schizophrenia*, in «Schizophrenia Bulletin», 42(2), 318-326.
- Morin A. (1993), *Self-Talk and Self-Awareness: On the Nature of the Relation*, in «Journal of Mind and Behavior», 14, 223-234.
- Morin A. (2005), *Possible Links Between Self-Awareness and Inner Speech The-oretical Background, Underlying Mechanisms, and Empirical Evidence*, in «Journal of Consciousness Studies», 12(4-5), 115-134.
- Morin A., Michaud J. (2007), *Self-Awareness and the Left Inferior Frontal Gyrus: Inner Speech Use During Self-Related Processing*, in «Brain Research Bul-letin», 74(6), 387-396.
- Morin A., (2009), *Inner Speech and Conscious Experience*, in Banks W. (ed.), *En-cyclopedia of Consciousness*, San Diego, Elsevier.
- Morin A. (2012), *Inner Speech*, in *Encyclopedia of Human Behavior*, 436-443.
- Morin A., Duhnych C., Racy F. (2018), *Self-Reported Inner Speech Use in Univer-sity Students*, in «Applied Cognitive Psychology», 32(3), 376-382.

- Moseley P., Fernyhough C., Ellison A. (2013), *Auditory Verbal Hallucinations as Atypical Inner Speech Monitoring, and the Potential of Neurostimulation as a Treatment Option*, in «Neuroscience, Biobehavioral Reviews», 37(10), 2794-2805.
- Nalborczyk L., Perrone-Bertolotti M., Baeyens C., Grandchamp R., Polosan M., Spinelli E., ... Løevenbruck H. (2017), *Orofacial Electromyographic Correlates of Induced Verbal Rumination*, in «Biological Psychology», 127, 53-63.
- Nathou C., Etard O., Dollfus S. (2019), *Auditory Verbal Hallucinations in Schizophrenia: Current Perspectives in Brain Stimulation Treatments*, in «Neuropsychiatric Disease and Treatment», 15, 2105.
- Oppenheim G.M., Dell G.S. (2008), *Inner Speech Slips Exhibit Lexical Bias, But Not the Phonemic Similarity Effect*, in «Cognition», 106(1), 528-537.
- Oppenheim G.M., Dell G.S. (2010), *Motor Movement Matters: The Flexible Abstractness of Inner Speech*, in «Memory, cognition», 38(8), 1147-1160.
- Perrone-Bertolotti M., Rapin L., Lachaux J.P., Baciú M., Løevenbruck H. (2014), *What Is That Little Voice Inside My Head? Inner Speech Phenomenology, Its Role in Cognitive Performance, and Its Relation to Self-Monitoring*, in «Behavioural Brain Research», 261, 220-239.
- Petkov C.I., Belin P. (2013), *Silent Reading: Does the Brain 'Hear' both Speech and Voices?*, in «Current Biology», 23(4), R155-R156.
- Rosen C., McCarthy-Jones S., Chase K.A., Humpston C.S., Melbourne J.K., Kling L., Sharma R.P. (2018), *The Tangled Roots of Inner Speech, Voices and Delusions*, in «Psychiatry Research», 264, 281-289.
- Shergill S.S., Bullmore E.T., Brammer M.J., Williams S.C., Murray R.M., McGuire P.K. (2001), *A Functional Study of Auditory Verbal Imagery*, in «Psychological Medicine», 31(2), 241-253.
- Smith S.M., Brown H.O. (1947), *The Lack of Cerebral Effects of D-tubocurarine*, in «Anesthesiology», 8(1), 1-14.
- Sommer I.E., Diederer K.M., Blom J.D., Willems A., Kushan L., Slotema K., Boks M.P., Daalman K., Hoek H.W., Nèggers S.F., Kahn R.S. (2008), *Auditory Verbal Hallucinations Predominantly Activate the Right Inferior Frontal area*, in «Brain», 131, 3169-77.
- Steinmann S., Leicht G., Mulert C. (2014), *Interhemispheric Auditory Connectivity: Structure and Function Related to Auditory Verbal Hallucinations*, in «Frontiers in Human Neuroscience», 8, 55.
- Stinson K., Valmaggia L.R., Antley A., Slater M., Freeman D. (2010), *Cognitive Triggers of Auditory Hallucinations: An Experimental Investigation*, in «Journal of Behavior Therapy, Experimental Psychiatry», 41, 179-184.
- Uttl B., Morin A., Hamper B. (2011), *Are Inner Speech Self-Report Questionnaires Reliable and Valid?*, in «Procedia-Social and Behavioral Sciences», 30, 1719-1723.
- Versmissen D., Janssen I., Johns L., McGuire P., Drukker M., Campo J. (2007), *Verbal Self-Monitoring in Psychosis: A Non-Replication*, in «Psychological Medicine», 7(4), 569-576.
- Vygotsky L. (1986), *Thought and Language*, Cambridge, MA, The MIT Press.

- Wallace G.L., Silvers J.A., Martin A., Kenworthy L.E. (2009), *Brief report: Further Evidence for Inner Speech Deficits in Autism Spectrum Disorders*, in «Journal of autism and developmental disorders», 39(12), 1735.
- Waters F., Jardri R. (2015), *Auditory Hallucinations: Debunking the Myth of Language Supremacy*, 533-534.
- Waters F., Allen P., Aleman A., Fernyhough C., Woodward T.S., Badcock J.C., ..., Vercammen A. (2012), *Auditory Hallucinations in Schizophrenia and Nonschizophrenia Populations: A Review and Integrated Model of Cognitive Mechanisms*, in «Schizophrenia bulletin», 38(4), 683-693.
- Watkins E.R. (2008), *Constructive and Unconstructive Repetitive Thought*, in «Psychological Bulletin», 134(2), 163-206, doi: 10.1037/0033-2909.134.2.163.
- Watson B.U., Sullivan P.M., Moeller M.P., Jensen J.K. (1982), *Nonverbal Intelligence and English Language Ability in Deaf Children*, in «Journal of Speech and Hearing Disorders», 47(2), 199-204.
- Watson J.B. (1913), *Psychology as the Behaviorist Views It*, in «Psychological Review», 20(2), 158.
- Weiss A.P., Heckers S. (1999), *Neuroimaging of Hallucinations: A Review of the Literature*, in «Psychiatry Research: Neuroimaging», 92(2-3), 61-74.
- Wilkinson S., Bell V. (2016), *The Representation of Agents in Auditory Verbal Hallucinations*, in «Mind, Language», 31(1), 104-126.
- Wu W. (2012), *Explaining Schizophrenia: Auditory Verbal Hallucination and Self-Monitoring*, in «Mind and Language», 27 (1), 86-107.
- Yao B., Scheepers C. (2011), *Contextual Modulation of Reading Rate for Direct Versus Indirect Speech Quotations*, in «Cognition», 121 (3), 447-453.