CoMe

Mediazione linguistica e culturale دراسات في الإتصال و الوساطة اللغوية الثقافية Estudios de comunicación
os de comunicación y Mediación lingüística y cultural **言語文化コミュニケーション学** Études en Com
语言学与语言文化中介 Studies on Communication and Linguistic and Cultural Mediation Исследо
ミュニケーション学 **Études en Communication et Médiation linguistique et culturelle** 语言学与语
Исследования в области коммуникации, языковое и межкультурное посредничество Estudos d
ество **Estudos de Comunicação e Mediação Linguística e Cultural** Zeitschrift für Kommunikations- u
urelle 语言学与语言文化中介 Studies on Communication and Linguistic and Cultural Mediation Ис
Mediação Linguística e Cultural **Zeitschrift für Kommunikations- und Translationswissenschaft**
Cultural Zeitschrift für Kommunikations- und Translationswissenschaft 言語文化コミュニケーション
e et culturelle **Studi di Comunicazione e Mediazione linguistica e culturale** و الوساطة اللغوية الثقافية
nicación y Mediación lingüística y cultural ケーション学 Études en Communication
e et culturelle 语言学与语言文化 and Linguistic and Cultural Medi
中介 Studies on Communication iation Исследования в области
ммуникации, языковое и межкул dos de Comunicação e Mediação L
e Comunicação e Mediação Lingu ommunikations- und Translationsw
ultural Zeitschrift für Kommunikat aft 言語文化コミュニケーション学
mmunication et Médiation linguis unicazione e Mediazione linguistic
Mediazione linguistica e culturale دراسات Estudios de comunicación
os de comunicación y Mediación l ミュニケーション学 Études en Com
语言学与语言文化中介 Studies on and Cultural Mediation Исследо
ミュニケーション学 Études en Co istique et culturelle 语言学与语言
mmunication and Linguistic and Cultural Med следования в области коммуникации, язык
ество Estudos de Comunicação e Mediação Linguística e Cultural Zeitschrift für Kommunikations- u
ção e Mediação Linguística e Cultural Zeitschrift für Kommunikations- und Translationswissenschaft
دراسات في الإتصال و الوساط **Estudios de comunicación y Mediación lingüística y cultural** 言語文化コミ
Cultural Zeitschrift für Kommunikations- und Translationswissenschaft 言語文化コミュニケーション
Comunicazione e Mediazione linguistica e culturale **دراسات في الإتصال و الوساطة اللغوية الثقافية** Estudios
nicación y Mediación lingüística y cultural 言語文化コミュニケーション学 Études en Communication
中介 **Studies on Communication and Linguistic and Cultural Mediation** Исследования в области
uistique et culturelle 语言学与语言文化中介 Studies on Communication and Linguistic and Cultural
ммуникации, языковое и межкультурное посредничество Estudos de Comunicação e Mediação L
e Comunicação e Mediação Linguística e Cultural Zeitschrift für Kommunikations- und Translationsw
inguistique et culturelle **语言学与语言文化中介** Studies on Communication and Linguistic and Cult
mmunication et Médiation linguistique et culturelle Studi di Comunicazione e Mediazione linguistic
Mediazione linguistica e culturale دراسات في الإتصال و الوساطة اللغوية الثقافية Estudios de comunicación
Исследования в области коммуникации, языковое и межкультурное посредничество
os de comunicación y Mediación lingüística y cultural 言語文化コミュニケーション学 Études en Com

Anno IV - Numero 1

CoMe
Studi di Comunicazione e Mediazione linguistica e culturale

Anno IV/2019

N. ISSN 2531-9809

In collaborazione con
la Scuola Superiore per Mediatori Linguistici di Pisa

SCUOLA SUPERIORE PER MEDIATORI LINGUISTICI
Istituto riconosciuto con decreto Ministeriale 31.07.2003
Diploma equipollente al Diploma di Laurea in Scienze della Mediazione Linguistica

Direzione

Monika Pelz
(Scuola Superiore per Mediatori Linguistici)

Vice-Direzione

Carlo Eugeni, Eleonora Romanò

Comitato Scientifico

Daniel Dejica-Carțiș, Politehnica University of Timișoara - Romania
Olga Egorova, Astrakhan State University - Russia
Najwa Hamaoui, Université de Mons - Belgio
John Milton, Universidade de São Paulo - Brasile
Pilar Orero, Universidat Autònoma de Barcelona - Spagna
Franca Orletti, Università degli Studi "Roma Tre" - Italia
Luca Serianni, Università degli Studi "La Sapienza" di Roma - Italia

Comitato Editoriale

Beth De Felici, Alessandra Carbone, Fabiana Mirella Garbosa,
Giulia Kado, Alina Kunusova, Shijie Mao, Issam Marjani,
Fiammetta Papi, Paolo Tomei, Silvia Velardi, Yukako Yoshida

www.comejournal.com
come@mediazionelinguistica.it

Copyright © 2019. CoMe. *Studi*. Tutti i diritti riservati.

MARIA LAURA MANCA[1*], MARTINA COSCI[2], MICHELANGELO MAESTRI[3],
GIULIA RICCI[1], GABRIELE SICILIANO[1], ENRICA BONANNI[1]

[1] Department of Experimental and Clinical Medicine, University of Pisa, Pisa
[2] Civica Scuola Interpreti e Traduttori "Altiero Spinelli", Fondazione Milano, Milan
[3] Section of Neurology, University Hospital of Pisa, Pisa
* Corresponding Author; e-mail: laura.manca@unipi.it

Neural aspects in simultaneous interpreting
The role of music in intralingual and interlingual activities

Abstract

The correlation of music with the brain state could be reflected in modifications of electrical activity recorded by electroencephalography (EEG). In this study, by recording EEG in three BA students in simultaneous interpreting, we have mapped the hemisphere activities of both shadowing and simultaneous interpreting, before and after brain stimulation provided by listening to Mozart's sonata K448. We have chosen K448 because this excerpt is associated to a short improvement in spatial-temporal task performance, in healthy subjects. We therefore wanted to check if there was a positive effect of Mozart's music also in shadowing and/or simultaneous interpreting.
Results show that brain activity was higher after listening to sonata K448 than after the shadowing exercise, and that simultaneous translation has generated a greater activity than the shadowing exercise. This means that listening to Mozart music does have a positive impact on brain activities, especially for those which make more use of the right hemisphere. Of such activities, simultaneous interpreting has demonstrated to be a harder mental activity than shadowing. In any case, the role played by music as a tool for training translators seems a good way to go, though further research is needed.

Keywords: *Neural aspects, simultaneous interpreting, intralingual activities, interlingual activities*

Introduction

The main goal of the present study was to study the activation of brain areas, after performing some specific linguistic mediation tasks, namely shadowing in French and Italian, and simultaneous interpreting from French into Italian and vice versa. In particular, we have tried to answer the following research questions:

i) which brain hemisphere is more active during some specific language mediation tasks?
ii) does listening to music have a positive impact on cortical activity?
iii) Are interlingual and intralingual forms of language mediation comparable in terms of mental activity?

Thanks to electroencephalography (EEG), we could map the hemisphere activities of both shadowing and simultaneous interpreting, before and after brain stimulation provided by listening to Mozart’s sonata K448.

Regarding simultaneous translation, the process consists of four phases: reception of the message in the source language, message processing (decoding), message re-elaboration (recoding) and finally, the delivery of that message in the target language (encoding). Interpreting implies the implementation of a set of cognitive processes at the same time, and for this reason it can be described as a type of abnormal communication, as the interpreter is submitted to a superposition of the listening and the speaking phase, as well as to a partial superposition of the reception and production of the message. The cognitive load of the brain is therefore very high (Eugeni 2008, Gile 1985).

Shadowing is the out loud repetition of a spoken message, in which one tries to repeat a message which is as close as possible to the original text (Gran 1992). Under optimal conditions, the shadowing exercise can be relatively easy, and the number of errors is generally minimal Gran 1992. However, difficulties may arise while shadowing, because of a strong regional accent of the speaker or particularly amplified background noise.

Generally speaking, shadowing has characteristics which are similar to those of simultaneous interpreting because both activities involve two simultaneous cognitive tasks: listening and speaking.

However, these two cognitive tasks also have some differences. First of all, the function of shadowing is not communicative, as in the case of simultaneous translation or of a similar intralingual activity: live subtitling through respeaking. In fact, shadowing aims essentially at enhancing the split attention ability of an interpreter. For this reason, shadowing has proven to be a useful tool in exploring the limits of information processing and the human capacity to perform several tasks simultaneously. This makes it an excellent technique for training interpreters, who must first learn to listen and speak another language simultaneously, and then move on to interpreting from one language to another (Eugeni 2008, Lambert 1989).

This means that it is an exercise and the addressee of the output is the teacher or the shadower himself/herself. Conversely, simultaneous interpreting and live subtitling through respeaking aim at producing a professional service, namely to translate a speech for a specific audience, as spoken text into another language or written text in the same language, respectively (Eugeni 2008). Moreover, from a technological point of view, shadowing is usually performed through headphones and a microphone, but it is not dependent on them. On the contrary, simultaneous interpreting and live subtitling through respeaking deeply depend on technology. Last but not least, the quality of a shadowed text must be phonetically the same as the text produced by a simultaneous interpreter: pronunciation must be pleasant to hear. In the case of respeakers, the message must be unambiguous for the machine, so that the software properly recognizes the voice of the respeaker (Gile 1985, Gran 1992).

Given the above-mentioned similarities between shadowing and live subtitling through respeaking and that both the addressee and technology where only simulated, the analysis cannot be carried on between two non-comparable activities (e.g. simultaneous interpreting and shadowing). On the contrary, it should be carried on comparable activities: either between interlingual interpretation and intralingual interpretation (or shadowing) or between simulated simultaneous

interpreting and simulated live subtitling through respeaking.
Given that the focus of this article is on the process and not on the product, interlingual interpretation and simultaneous interpreting will be used as synonyms, as well as intralingual interpretation, shadowing and respeaking. Through music we could learn much about the human brain, being music an effective means of accessing and/or stimulating specific cerebral circuits (Kučikienė & Praninskienė 2018, Trimble & Hesdorffer 2017). In the present study, we chose Mozart among the possible composers. The rationale to the exposure to K448 Sonata by Mozart is associated to a short improvement in spatial-temporal task performance in healthy subjects (Hetland 2000, Rauscher, Shaw & KY 1993), thanks to the listening to the first movement of this excerpt. The correlation of music with the brain state could be reflected in modifications of electrical activity recorded by EEG (Rideout & Laubach 1996). In particular, quantitative EEG is a sensitive tool to substantiate cortical function (Verrusio et al. 2015), and each frequency band power owns a functional significance.

Materials and Method

Three female students, 21 – 22 years old, right-handed, with no musical talents were recorded while performing interlingual and intralingual translation activities in French and Italian. All students have completed a BA in conference interpreting at the Faculty of Translation and Interpreting at SSML – Pisa. They performed a series of tasks:

- listening to a white noise,
- listening to the first movement of Mozart's K448 sonata,
- shadowing of a text in Italian,
- translating a text from French to Italian simultaneously.

These mental activities and the related brain signals were recorded thanks to EEG. The protocol was decided by the medical team[1], who also analyzed data. The experimental text was conducted at the Neurological Clinic – Sleep Laboratory of Pisa University Hospital.
When subjects entered the laboratory, they were asked to sit on a chair and rest for 5 minutes. Their brain signals were recorded using 19 collodion applied scalp electrodes, in line with the 10-20 International System (Silverman 1963), a standardized method used to describe the location of scalp electrodes[2]. Recording length was approximately 50 min, using an electroencephalograph (EB Neuro S.p.A., Florence) for signal acquisition and recording. Impedance was kept below 5 kOhm for all electrodes (an impedance over this level in any electrode should not be accepted as adequate by the American EEG Society and the American Medical EEG Association, two of largest organizations representing clinical EEG in the world). The sampling rate was set to 256 Hz, because sampling rates of 256 and 512 Hz are considered as optimal in normal individuals.

[1] EB and GS, neurologists, together with MLM, biomathematician.
[2] The 10-20 system is based on the relationship between the location of an electrode and the underlying area of cerebral cortex. Each site has a letter to identify the lobe, and a number or another letter to identify the hemisphere location.

EEG recording was performed by an expert technician, with subjects having their eyes closed, being seated on a comfortable armchair, in a quiet room at a controlled auditory intensity level. Table 1 describes the texts used for the experiment.

Table 1

EEG Recording	**Time (min)**
At baseline	3
While listening to white noise	8:24
In silence	3
While listening to the first movement of K448	8:24
In silence	3
While listening to an Italian text (3 min), shadowing (7 min)	10
In silence	3
While listening to a French text (3 min), simultaneous translation from French to Italian (7 min)	10
In silence	3

The raw EEG traces were saved in ASCII format before being automatically processed by using the programming platform Matlab R2019, and its Signal Processing Toolbox (The MathWorks Inc, Natick, MA), for Mac Os X. Signals were first examined by an expert neurologist in order to eliminate EEG segments containing artifacts. Traces were pre-processed by using Butterworth passband filter, in order to filter the noise signals coming from eyes blinking (low-frequency noise) and muscle movement (high frequency noise). Then, Power Spectrum Density (PSD) was computed by Fourier transforming the estimated autocorrelation sequence (Manca & Murri 2006), which is found by Welch’s method (average of non-overlapped epochs of 2 seconds, over intervals lasting 120 seconds). Finally, we estimated the average alpha, beta, and gamma bandpowers (Klimesch 2012). Concerning brainwaves, alpha rhythm (8 - 13 Hz) represents the relaxed and comfortable awareness without special attention and concentration level. The higher the intensity of alpha waves, the less active the brain. Beta rhythm (13 - 30 Hz) is usually related to increased alertness, attention/concentration level, active thinking, solving concrete problems.

Finally, gamma rhythm (30 - 60 Hz) is generally associated with solving high mental tasks, such as the ones analyzed in this experiment. To obtain a measure of global activity, we averaged PSD measures of each channel, at baseline, and after each task. The procedure was separately repeated for the channels of the right and left hemispheres. The global activity was estimated by alpha / beta and alpha /gamma power ratios, aimed to detect an activation of the brain. In fact, a ratio below value 1 indicates a larger level in the beta or gamma frequency band, respectively, i.e. a greater activity in the brain. Then, we studied the differences between the two cerebral hemispheres (asymmetry). Hemisphere asymmetry (CACIOPPO, TASSINARY & BERNTSON 2007) was estimated by the natural logarithm (ln) of the right (R) alpha power / left (L) alpha power ratio:

$$ln(R\alpha power) - ln(L\alpha power) = ln\frac{R\alpha power}{L\alpha power}.$$

Because of EEG-correlated magnetic resonance imaging studies (NAKAMURA ET AL. 1999) have demonstrated that alpha power is inversely related to neural electrical activity, a ratio below the 0 value indicates a relatively greater activity in the right hemisphere. Following a similar process, for the R alpha power activity, we have also estimated the natural logarithm of the music / shadowing, music / simultaneous interpretation, and simultaneous interpretation / shadowing ratios. Similarly, a ratio below the 0 value indicates a relatively greater activity in the numerator (music vs. shadowing or simultaneous interpretation, and simultaneous interpretation vs. shadowing).

Results

As far as brain global activity is concerned, Figure 1a shows that mean alpha activity was at its highest after the shadowing task, while mean beta and gamma activities were at their highest after listening to music. Moreover, mean beta power (showing alertness) was larger than mean alpha power after music and white noise, and mean gamma power (indicating solution strategies) was greater than mean alpha power after listening to music. However, when we compared EEG rhythms after simultaneous interpretation with EEG rhythms at the baseline, we have found a slight increase in all considered frequencies (Figure 1b).

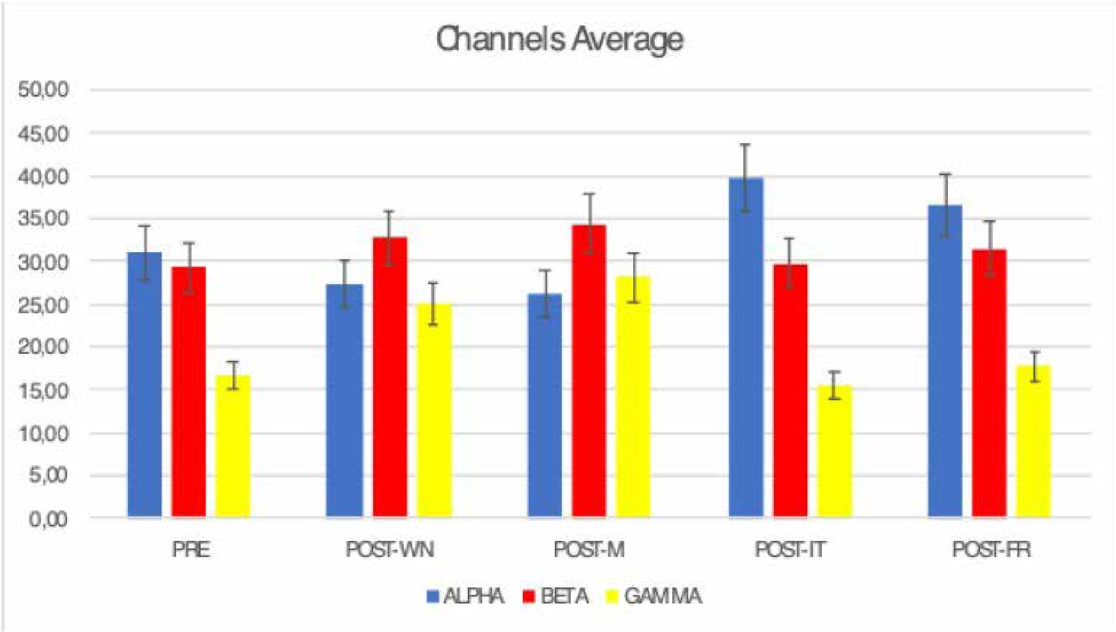


Figure 1a

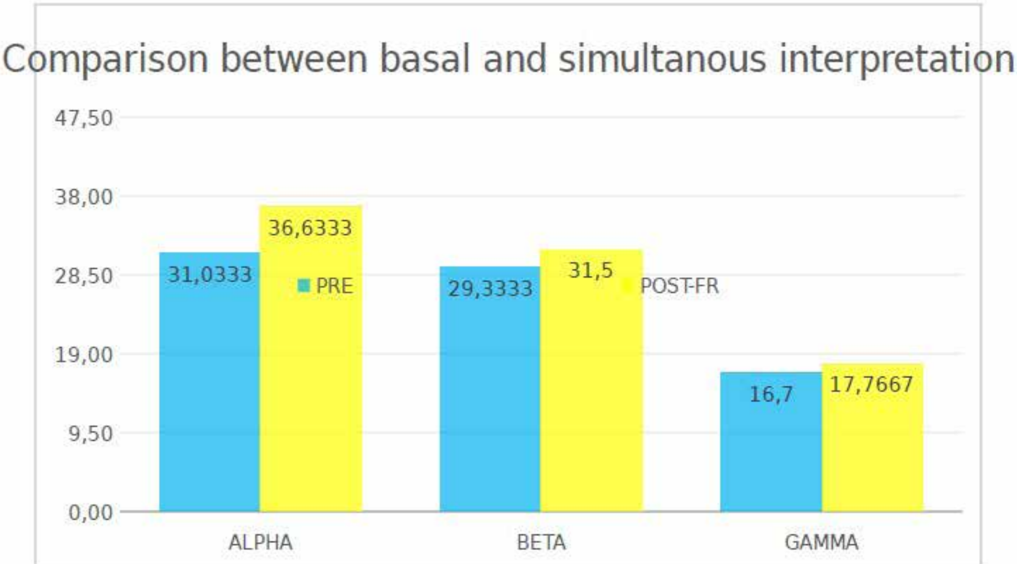


Figure 1b

Legend Figures 1a, 1b:
PRE: basal condition
POST-WN: after white noise
POST-M: after Mozart music
POST-IT: after shadowing
POST-FR: after simultaneous interpretation.

Figure 2 shows that mean alpha / beta ratio was below value 1 after white noise and music, while mean gamma / beta ratio was below value 1 only after music. Finally, both highest were reached after shadowing.

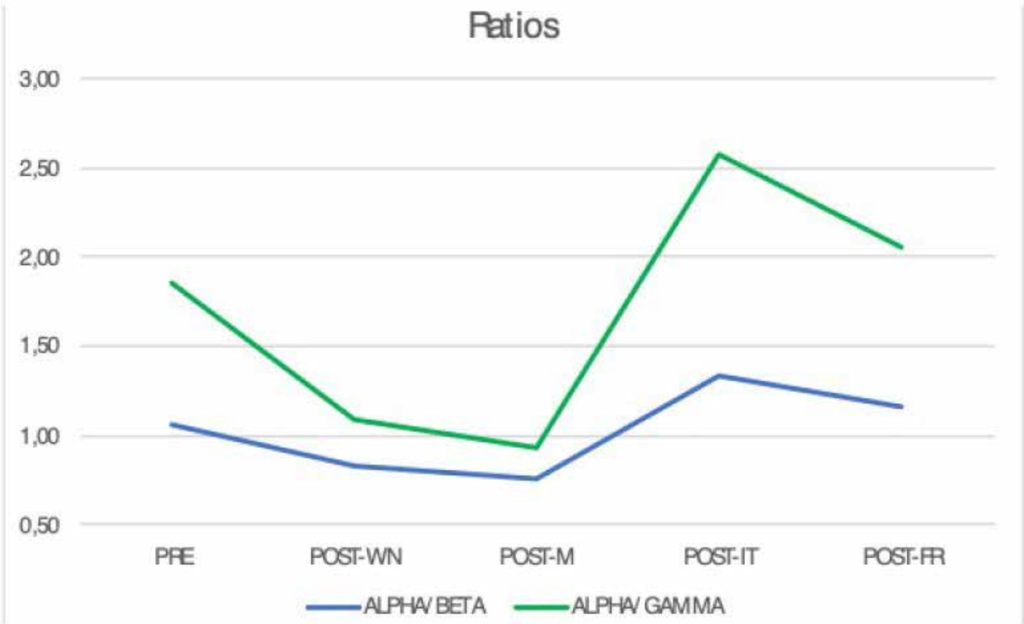


Figure 2

Legend Figure 2:
PRE: basal condition
POST-WN: after white noise
POST-M: after Mozart music
POST-IT: after shadowing
POST-FR: after simultaneous interpretation.

Then we studied asymmetry, in order to understand which brain hemisphere is more active during specific tasks. Figure 3 displayed results in terms of natural logarithms of the right / left alpha power ratio. Logarithms were negative numbers for all tasks, suggesting a relatively greater activity in the right hemisphere.

Figure 3

Furthermore, both the right and left alpha / beta ratios were below 1 after listening to music (Figure 4).

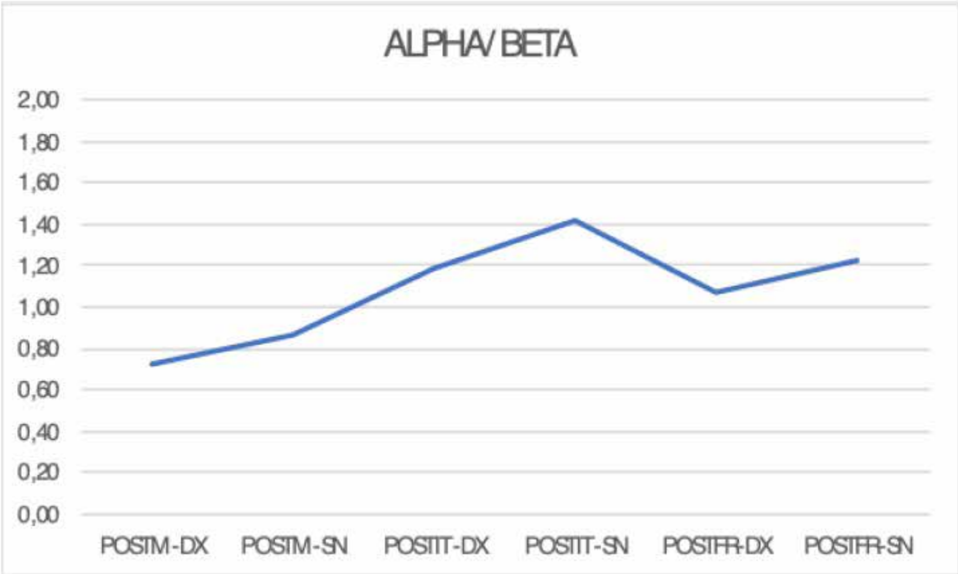


Figure 4)

Legend Figure 4:
POSTM: after Mozart music
POSTIT: after shadowing
POSTFR: after simultaneous interpretation
DX: right
SN: left.

Finally, mean right beta power was higher than left beta power after K448, almost overlapping post shadowing and simultaneous translation statuses (Figures 5a, 5b).

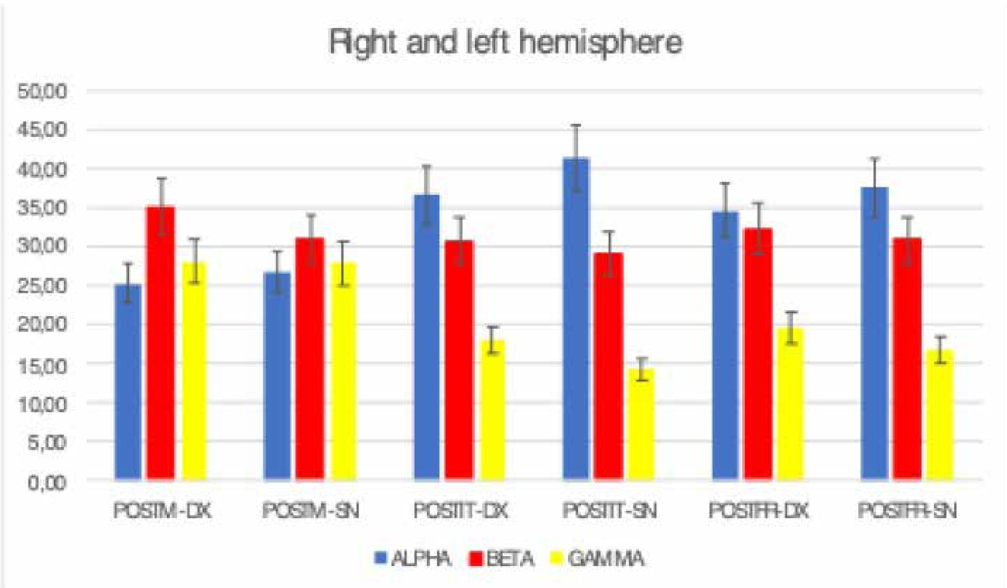


Figure 5a

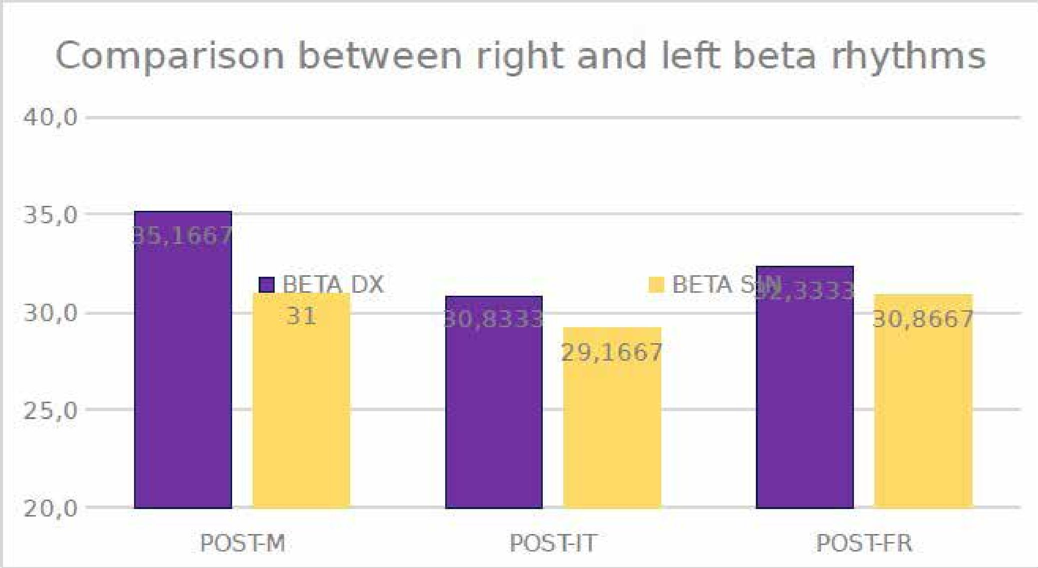


Figure 5b

Legend Figures 5a, 5b:
POSTM: after Mozart music
POSTIT: after shadowing
POSTFR: after simultaneous interpretation
DX: right
SN: left.

Comparing the different tasks, all natural logarithms of the ratios considered were negative (Figure 6). This suggests a relatively greater activity in the numerator, that is, listening to music produces cortical activity superior to both shadowing and simultaneous translation. Likewise, simultaneous interpretation causes more activity than shadowing.

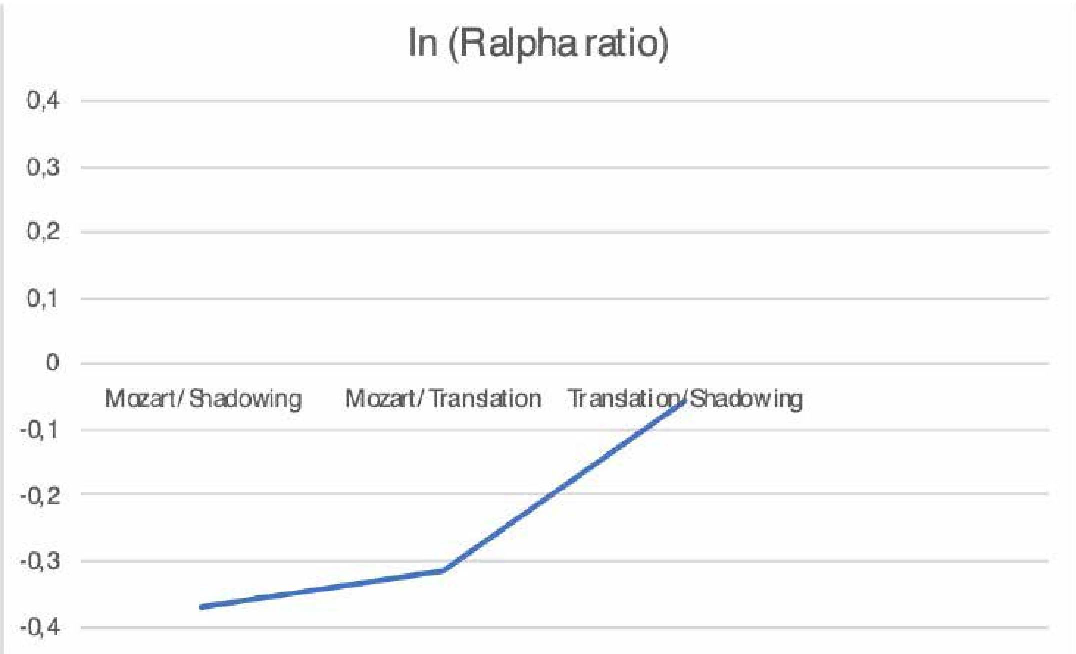


Figure 6

Discussion

Our preliminary results on a small but homogenous sample suggest that a relatively greater activity in the right hemisphere was observed after K448. These data are in line with the functional lateralization as a principle of brain's organization (Hervé et al. 2013). Today, however, theories based on neuroimaging findings suggest a less radical division and hypothesizes that the two hemispheres are in balance (Karolis et al. 2019). We found that the asymmetry on the right hemisphere was less evident after shadowing and simultaneous interpreting compared to music, probably because of the familiarity subjects have with the tasks required by the experiment, given their BA training into both activities. Furthermore, we found that listening to music increases beta and gamma waves and decreases alpha power, thus confirming previous research in the field (Jenni et al. 2017, Rauschecker 2001, Rauscher et al. 1994, Rauscher et al. 1995). In this case, of particular interest is the effect the K448 sonata has on linguistic tasks, though the effect is not substantial, especially on shadowing. This may be related to the previous issue, which
correlates beta and gamma waves to the perception of music. If K448 sonata stimulates the brainwaves which are more at stake in the intralingual and interlingual translation tasks, the activity which intuitively requires more effort, namely simultaneous interpreting, is more positively influenced by listening to music. Overall, the main results show that brain activity was higher after listening to Mozart than after the shadowing exercise, and that simultaneous interpretation has generated a greater activity than the shadowing exercise. As a consequence, the shadowing activity has turned out to be the one which involved the least mental effort. This relates to Daniel Gile's model for simultaneous interpreting (Hervé et al. 2013), according to which this activity implies a much greater effort than shadowing activity. In particular, this model describes simultaneous translation as an activity based on some specific "efforts", or mental activities, aimed at perceiving and understanding a speech. The first effort of listening and analyzing the speech increases in a non-optimal context, as the one in which interpreters perform their job. While information must be reproduced in the target language, interpreters make a production effort which varies according to situations: in case of strategic hesitations or pauses, aimed at choosing the words and structure of a sentence, these efforts increase, whereas when a verbal automatism is triggered, these efforts decrease. Finally, specific interpretation strategies determine a delay in the delivery of information, which leads to a memory effort. In an optimal situation, the efforts are distriduted homogeneously among the three phases of interpretation. The sum of the efforts
mentioned (listening, production and memory) cannot exceed a given threshold, called processinf capacity. During the shadowing activity, the subjects of the study did not need to put so much effort into producing a new message, so the whole process becomes much easier. That is why shadowing is the less difficult activity to perform.

In our study, even if the beta rhythm was not significantly evident after linguistic tasks, a slight growth of all three EEG rhythms was observed after simultaneous interpretation in comparison to baseline values. This result could be interpreted with a more widespread neuronal activation, correlated to the fact that the brain has to make the effort of processing many data simultaneously.

he hypothesis should be confirmed with functional magnetic resonance imaging studies in association with EEG.

Finally, a little specific effect of Mozart music on linguistic exercises is not surprising, considering that mechanisms producing beneficial results on spatial-temporal tasks are presumably different. Mechanisms activated during spatial-temporal reasoning, in which Rauscher et al. firstly found K448 Sonata to be effective (Rauscher et al. 1993) are predominantly visual, and very different from those present during simultaneous interpretation, in which the brain perceives and processes language through hearing, stores previously heard information in memory, and, finally, generates an equivalent message in the target language.

From a linguistic point of view, it is interesting to draw on the results of a parallel study carried out by Zunino (Zunino 2019), with a comparable experimental test (but in English and without music), on a group of subjects having the same characteristics of our study. What emerged from the analysis of both target texts is that shadowing proves to be less difficult than simultaneous interpreting as it does not imply interlingual translation problems. The main strategy adopted by subjects to correctly shadow the source text were omission of secondary information when the cognitive load was too high so as to carry out the activity. Concerning simultaneous interpreting, instead, subjects reacted positively to the main difficulties, managing, in most cases, to find good solutions to get around the various obstacles introduced in the source text, by means of strategies like reformulations, compressions, summaries, or even improvisation strategies and strategies based on the intensive use of décalage and echoic memory. Overall this has brought to an increase in the memory effort to recover specific information. And when the workload was too demanding (mainly high speech rate, technical terminology, morpho-syntactic difficulties, and in one case physiological factors), errors and omissions also occurred, thus compromising the quality of the target text.

Compared to our study, where subjects were required to interpret from French into Italian, subjects found it simpler to interpret mainly because French is morphologically and syntactically closer to the Italian language and the main difficulties have been linked to the very specific terminology and to numbers. As a consequence, many calques were found resulting either in false friends or nonwords.

Generally speaking, the two experiments have led to two different EEG results, with simultaneous interpreting from English into Italian showing a higher involvement of gamma waves, responsible for problem-solving activities. This means that shadowing into one's native

language can be considered as a point in the continuum that goes from easier to harder without clear-cut boundaries between interlingual and intralingual simultaneous activities and professions.

Conclusions

Overall, in this proof-of-principle study, our research questions have been answered. Concerning research question number 1 (which brain hemisphere is more active during some specific language mediation tasks?) we have found a relatively greater activity in the right hemisphere. As for research question number 2 (does listening to music have a positive impact on cortical activity?) listening to Mozart music does have a positive impact on brain activity, which is more concentrated in the right hemisphere. In this context, simultaneous simultaneous interpreting has shown to be a harder mental activity than shadowing, with the English-Italian pair proving more challenging than the French-Italian one. In light of these preliminary results, further inter-disciplinary studies with quantitative EEG analysis should be carried out, with more subjects and of both genders, with a control group that performs the same tasks without music, and including an objective measurement of linguistic performances of these subjects, possibly in various language pairs. Finally, concerning research question number 3 (are interlingual and intralingual forms of language mediation comparable in terms of mental activity?), some considerations are to be done when discussing the data above. If we focus on the profession of live subtitling through respeaking, we need to bear in mind that it does not only consist of shadowing, but also of interfacing with a speech recognition software, which uses the audio input to generate captions (Eugeni 2008). Moreover, verbal component is not the only features of the source text to report. Punctuation and other formatting need to be considered too, so that the final result makes sense to the user, which means that words like "comma" and "new line" have to be pronounced out loud (ibidem). Finally, voice commands are to be used to indicate a change of speaker or song lyrics, in order to provide the best replication of the hearing experience for a deaf or hard-of-hearing user (ibidem). All these extra efforts mean that respeakers often need to have a faster voice pace than the speaker they are captioning. Given the similarities between respeaking and shadowing mentioned above, a stimulation of the same brain areas during these two tasks seem plausible (ibidem). However, respeaking presents a number of cognitive challenges that are not required during the shadowing process. In order to better understand the relationship between them, it would be interesting to carry out further research by comparing these two activities. Intuitively the hypothesis is that respeaking and similar reporting or captioning activities imply the same concentration and intensity of brainwaves that are evident in simultaneous interpreting.

References

Cacioppo, J.T., Tassinary, L.G., & G. Berntson (2007) "Handbook of Psychophysiology". in *Cambrdge University Press.*

Eugeni, C. (2008)"A Sociolinguistic Approach to Real-Time: Respeaking vs. Shadowing and Simultaneous Interpreting", in Kellett Bidoli, C. J. & E. Ochse (edds.) *English in International Deaf Communication*, Linguistic Insights series, 72, Berna: Peter Lang.

Gile, D., (1985) "Le modèle d'efforts et l'équilibre d'interprétation en interprétation simultanée", in *Université Lyon* 2, Lyon, France, Meta, 30.

Gran, L., (1992) "Aspetti dell'organizzazione cerebrale del linguaggio: dal monolinguismo all'interpretazione simultanea", in *Campanotto.*

Hervé, P.Y., Zago, L., Petit, L., Mazoyer, B. & N. Tzourio-Mazoyer (2013) "Revisiting human hemispheric specialization with neuroimaging", in *Trends Cogn Sci*. 17, pp. 69-80.

Jenni, R., Oechslin, M.S. & C.E. James (2017) "Impact of major and minor mode on EEG frequency range activities of music processing as a function of expertise", in *Neurosci Lett*. 647, pp. 159-164.

Karolis, V.R., Corbetta, M. & M. Thiebaut De Schotten (2019) "The architecture of functional lateralisation and its relationship to callosal connectivity in the human brain", in *Nat Commun*. 10, pp. 1417.

Klimesch, W. (2012) "α-band oscillations, attention, and controlled access to stored information", in *Trends Cogn Sci*. 16, pp. 606-617.

Kučikienė, D. & R. Praninskienė (2018) "The impact of music on the bioelectrical oscillations of the brain", in *Acta Med Litu*. 25, pp. 101–106.

Lambert, S. (1989) "La formation d'interprètes : la méthode cognitive", in *Montréal University press.*

Manca, M.L., & L. Murri (2006) "Fourier ed il ruolo della sua trasformata nella ricerca neurologica", in *Quaderni Dipartimento di Matematica,* Università di Pisa.

Nakamura, S., Sadato, N., Oohashi, T., Nishina, E., Fuwamoto, Y. & Y. Yonekura (1999) "Analysis of music-brain interaction with simultaneous measurement of regional cerebral blood flow and electroencephalogram beta rhythm in human subjects", in *Neurosci Lett*. 275, pp. 222-226.

Rauschecker, J.P. (2001) "Cortical plasticity and music", in *Ann* N Y Ac. Sci. 930, pp. 330-336.

RAUSCHER, F.H., SHAW, G.L. & C.N. KY (1993) "Music and spatial task performance", in *Nature*, 365, pp. 611.

RAUSCHER, F.H., SHAW, G.L., LEVINE, L.J., KY, K.N. & E.L. WRIGHT (1994) "Music and spatial task performance: a causal relationship", presented at the *American Psychological Association Annual Meeting*, Los Angeles, CA.

RAUSCHER, F.H., SHAW, G.L., & C.N. KY (1995) "Listening to Mozart enhances spatial-temporal reasoning: towards a neurophysiological basis", in *Neurosci Lett.* 185, pp. 44-47.

RICCARDI, A., (2003) "Dalla traduzione all'interpretazione, Studi d'interpretazione simultanea", in *Edizioni Universitarie di Lettere Economia Diritto,* Milano.

RIDEOUT, B.E. & C.M. LAUBACH (1996) "EEG correlates of enhanced spatial performance following exposure to music", in *Percept Mot Skills*. 82, pp. 427-432.

RONDAL, J.A. & X. SERON (2003) "Troubles du langage. Bases théoriques, diagnostic et rééducation", in *Pierre Mardaga*, Hayen, Sprimont (Belgium).

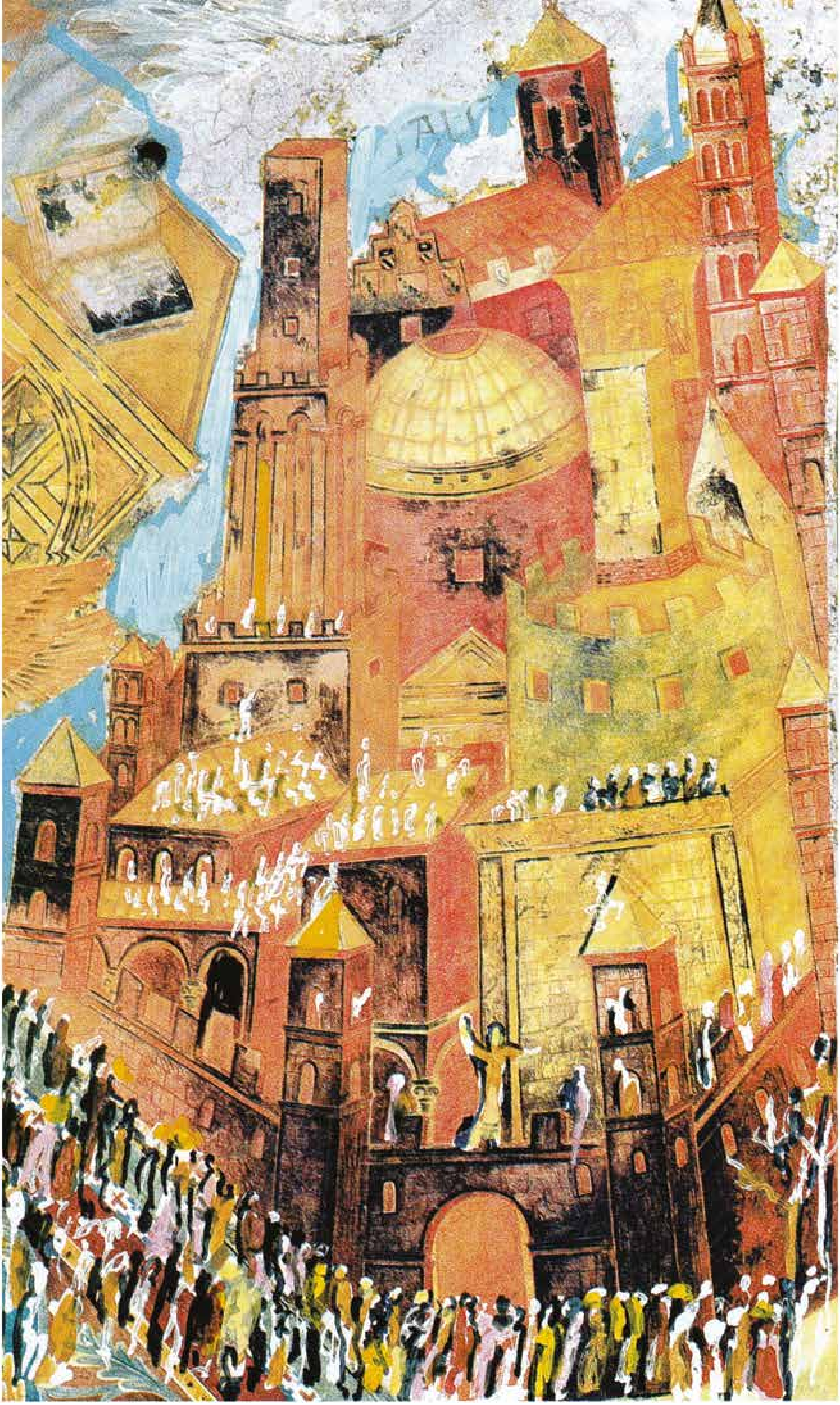
SALMON, L. & M. MARIANI (2008) "Bilinguismo e traduzione. Dalla neurolinguistica alla didattica delle lingue", in *Franco Angeli* s.r.l., Milano.

SILVERMAN, D. (1963) "The Rationale and History of the 10-20 System of the International Federation", in Am. J. EEG *Technol.* 3, pp. 17–2.

TRIMBLE, M. & D. HESDORFFER (2017) "Music and the brain: the neuroscience of music and musical appreciation", in *B J Psych Int.* 14, pp. 28–31.

VERRUSIO, W., ETTORRE, E., VICENZINI, E., VANACORE, N., CACCIAFESTA M. & O. MECARELLI (2015) "The Mozart Effect: A quantitative EEG study", in *Conscious Cogn*. 35, pp. 150-155.

ZUNINO, F. (2019) "Interpretazione simultanea e processi cognitivi. Quando le neuroscienze incontrano l'interpretazione: analisi del cervello dell'interprete durante l'interpretazione simultanea", in Pisa – SSML unpublished BA thesis.



“La concione a Bologna” (Dario Fo, 1999) per gentile concessione dell’archivio Rame - Fo *www.archivio.francarame.it*
progetto grafico **ADVERTO ITALIA** | Adverto.Italia - impaginazione **UGLY AGENCY** | *www.uglyagency.com*

nicación y Mediación lingüística y cultural 言語文化コミュニケーション学 Études en Communicatio
化中介 **Studies on Communication and Linguistic and Cultural Mediation** Исследования в области
uistique et culturelle 语言学与语言文化中介 Studies on Communication and Linguistic and Cultura
оммуникации, языковое и межкультурное посредничество **Estudos de Comunicação e Mediação**
e Comunicação e Mediação Linguística e Cultural Zeitschrift für Kommunikations- und Translations
linguistique et culturelle **语言学与语言文化中介** Studies on Communication and Linguistic and Cul
ommunication et Médiation linguistique et culturelle Studi di Comunicazione e Mediazione linguisti
e Mediazione linguistica e culturale دراسات في الإتصال و الوساطة اللغوية الثقافية Estudios de comunicación
Исследования в области коммуникации, языковое и межкультурное посредничество
ios de comunicación y Mediación lingüística y cultural 言語文化コミュニケーション学 Études en Co
Mediazione linguistica e culturale دراسات في الإتصال و الوساطة اللغوية الثقافية Estudios de comunicación
os de comunicación y Mediación lingüística y cultural **言語文化コミュニケーション学** Études en Co
语言学与语言文化中介 Studies on Communication and Linguistic and Cultural Mediation Исследо
コミュニケーション学 **Études en Communication et Médiation linguistique et culturelle** 语言学与语
Исследования в области коммуникации, языковое и межкультурное посредничество Estudos d
ество **Estudos de Comunicação e Mediação Linguística e Cultural** Zeitschrift für Kommunikations- u
urelle 语言学与语言文化中介 Studies on Communication and Linguistic and Cultural Mediation Ис
Mediação Linguística e Cultural **Zeitschrift für Kommunikations- und Translationswissenschaft**
Cultural Zeitschrift für Kommunikations- und Translationswissenschaft 言語文化コミュニケーション
e et culturelle **Studi di Comunicazione e Mediazione linguistica e culturale** و الوساطة اللغوية الثقافية
nicación y Mediación lingüística y cultural 言語文化コミュニケーション学 Études en Communicatio
e et culturelle **语言学与语言文化中介** Studies on Communication and Linguistic and Cultural Medi
化中介 Studies on Communication and Linguistic and Cultural Mediation Исследования в области
оммуникации, языковое и межкультурное посредничество **Estudos de Comunicação e Mediação L**
ación lingüística y cultural 言語文化コミュニケーション学 Études en Communication et Médiation li
ultural **Zeitschrift für Kommunikations- und Translationswissenschaft** 言語文化コミュニケーション
mmunication et Médiation linguistique et culturelle Studi di Comunicazione e Mediazione linguisti
Mediazione linguistica e culturale **دراسات في الإتصال و الوساطة اللغوية الثقافية** Estudios de comunicación
os de comunicación y Mediación lingüística y cultural 言語文化コミュニケーション学 Études en Co
言文化中介 **Studies on Communication and Linguistic and Cultural Mediation** Исследования в обла
コミュニケーション学 Études en Communication et Médiation linguistique et culturelle 语言学与语言
mmunication and Linguistic and Cultural Mediation **Исследования в области коммуникации,**
ação e Mediação Linguística e Cultural** Zeitschrift für Kommunikations- und Translationswissenscha
s en Communication et Médiation linguistique et culturelle 语言学与语言文化中介 Studies on Com
دراسات في الإتصال و الوساط **Estudios de comunicación y Mediación lingüística y cultural** 言語文化コミ
Cultural Zeitschrift für Kommunikations- und Translationswissenschaft 言語文化コミュニケーション
Comunicazione e Mediazione linguistica e culturale **دراسات في الإتصال و الوساطة اللغوية الثقافية** Estudios d
nicación y Mediación lingüística y cultural 言語文化コミュニケーション学 Études en Communicatio
化中介 **Studies on Communication and Linguistic and Cultural Mediation** Исследования в области
uistique et culturelle 语言学与语言文化中介 Studies on Communication and Linguistic and Cultural
оммуникации, языковое и межкультурное посредничество **Estudos de Comunicação e Mediação L**
e Comunicação e Mediação Linguística e Cultural Zeitschrift für Kommunikations- und Translations
inguistique et culturelle **语言学与语言文化中介** Studies on Communication and Linguistic and Cult
mmunication et Médiation linguistique et culturelle Studi di Comunicazione e Mediazione linguisti
Mediazione linguistica e culturale دراسات في الإتصال و الوساطة اللغوية الثقافية Estudios de comunicación