International Journal of Neuroscience, 2016; 126(3): 235–242

ISSN: 0020-7454 print / 1543-5245 online
DOI: 10.3109/00207454.2015.1010647

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ORIGINAL ARTICLE

Improvement of spontaneous language in stroke patients with chronic aphasia treated with music therapy: a randomized controlled trial

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Aim of the study: The aim of this research is to evaluate the effects of active music therapy (MT) based on free-improvisation (relational approach) in addition to speech language therapy (SLT) compared with SLT alone (communicative-pragmatic approach: Promoting Aphasic's Communicative Effectiveness) in stroke patients with chronic aphasia. *Materials and methods*: The experimental group ($n = 10$) was randomized to 30 MT individual sessions over 15 weeks in addition to 30 SLT individual sessions while the control group ($n = 10$) was randomized to only 30 SLT sessions during the same period. Psychological and speech language assessment were made before (T0) and after (T1) the treatments. *Results*: The study shows a significant improvement in spontaneous speech in the experimental group (Aachener Aphasie subtest: $p = 0.020$; Cohen's $d = 0.35$); the 50% of the experimental group showed also an improvement in vitality scores of Short Form Health Survey (chi-square test = 4.114; $p = 0.043$). *Conclusions*: The current trial highlights the possibility that the combined use of MT and SLT can lead to a better result in the rehabilitation of patients with aphasia than SLT alone.

KEYWORDS: music therapy, speech language therapy, aphasia, stroke, rehabilitation

Introduction

Stroke is one of the major causes of mortality, disability and cognitive decline. Among patients who experienced a stroke, approximately one-third develops aphasia, which can affect one or more areas of communication (speaking, understanding spoken words, reading and writing). An effective management and rehabilitation of language difficulties is of crucial importance. A recent review of randomized trials suggests that although there may be a benefit from speech and language therapy, the evidence is insufficient to indicate the best approach [1]. Moreover, it is not clear whether speech rehabilitation should also continue in the long term after the acute event. The primary aim of speech and language therapy is to increase patients' ability to communicate. It has been suggested that music and music therapy (MT) may be helpful in the improvement of communication in different clinical conditions [2,3]. Attempts in the past decades have been made to use music and MT in the treatment of aphasia. The MT treatment for aphasia rehabilitation was mostly based on a simple use of music during speech therapy [4–6]. These techniques have been defined as a specific approach named Melodic Intonation Therapy (MIT) [7–10]. Recently, rhythm, rather than singing, has been emphasized as a crucial component in speech and language rehabilitation [11, 12].

A recent review by Zumbansen et al. [13] summarizes the effects of music interventions based on singing in aphasia rehabilitation, including MIT programs. Another intervention program (SIPARI), including not only a specific rhythmic-melodic voice training but also instrumental and vocal rhythmic exercises and music

Received 11 July 2014; revised 13 January 2015; accepted 18 January 2015; publish online 16 December 2015

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improvisation, was described by Jungblut [14]. This program was proved effective in improving communication (articulation and prosody, speech repetitions and comprehension, and total speech profile).

We have recently developed an improvisational MT approach based on interaction between a qualified music therapist and a patient. This approach has been proved to be effective in the reduction of behavioral and psychological symptoms in patients affected by dementia [15–18]. We have hypothesized that the same approach of MT may improve the ability of communication in patients who have developed chronic aphasia after stroke. For this purpose, we conducted a randomized study in which we compared the effect of MT in addition to speech and language therapy with that of speech and language therapy alone in aphasic patients. Psychological and speech-language assessments were used to evaluate specific effects of MT on both language and psychological outcomes. We have hypothesized that this improvisational MT approach could improve spontaneous expression (including verbal speech) and psychological outcomes due to the impact of empathetic relationship and the increasing of motivation and compliance during the rehabilitative treatment.

Materials and Methods

Participants

The study was performed in 20 outpatients with previous stroke at the Division of Rehabilitation Medicine of the IRCCS Istituto Auxologico Italiano, Milan. The characteristics of the enrolled patients are summarized in the Tables 1 and 2.

Treatments

Both the MT group and the control group underwent speech and language therapy. A communicative-pragmatic approach (Promoting Aphasic's Communicative Effectiveness – PACE) for speech therapy was utilized [19,20]. The main concept of this approach is that language represents "a relationship between linguistic and non-verbal behaviors and the context and/or the purpose in/for they are used" [21].

In an activity involving non-verbal expression, both therapist and aphasic patient can contribute equally. The patient is allowed to develop communicative responses using non-verbal communication with the therapist so that he/she is able to utilize his/her communication resources. The therapist can adapt and modify the messages in a dynamic interchange with the patient. On the basis of the responses of the patient, he becomes a sort of "communication promoter."

The SLT treatment included a 45-min individual session twice a week for 15 weeks, with a total of 30 sessions.

The MT methodology utilized in this study is an active inter-subjective approach based on musical improvisation, which implies the prevalence of non-verbal musical aspects in the direct patient/music therapist relationship [22,23]. The subjects and the music therapist not only play rhythmic-melodic instruments (percussions, glockenspiels, xylophones, etc.) but also sing/vocalize together co-building a non-verbal communication through free sound–music improvisation: in such a relationship, the sound and the instruments become effective communicative channels. The sonorous-music attunement between the patient and the music therapist is strongly characterized by the sharing of the rhythm course. A certified and specifically trained music therapist conducted all the MT sessions. The MT treatment included a 30-min individual session twice a week for 15 weeks, with a total of 30 sessions.

Procedure

The inclusion criteria of the study were the presence of aphasia defined as an acquired loss or impairment of the language system following brain damage [24] with the exclusion of other communication difficulties attributed to sensory loss, confusion, dementia or speech difficulties due to muscular weakness or dysfunction such as dysarthria. Patients who had musical competence or underwent previous MT treatment were excluded from the study.

Patients were randomized to MT treatment in addition to Speech and Language Therapy (SLT) or SLT alone by using the randomization program, QuickCalcs (GraphPad software Inc.). The recruiters and evaluators were blinded to the patient treatment allocation.

All subjects participating in this study, or their legal representatives in case of inability, gave written informed consent. The local Ethical Committee approved the protocol of the study.

Disability was assessed with the modified Rankin scale, and strokes were classified according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria. The time from the onset of stroke was recorded.

All patients underwent language impairment, psychological and quality of life (QoL) assessment before the beginning (T0) and at the end (T1) of a course comprising 15-week MT+SLT or SLT alone sessions, twice a week.

Speech/language assessment was performed by using the Milan Protocol [25] and the Aachener Aphasie Test (AAT), Italian version [26]. Aphasia was classified as fluent and non-fluent, and different syndromes were

Table 1. Speech and language therapy patients' characteristics

SLT	Age	Gender	Education (years)	Handedness	Lesion site	Aphasia type	Aphasia severity	Apraxia	Dysarthria	Dysphagia
A.R.	63	Female	8	Right-handed	Left FP	Non-fluent	Severe	No	No	Yes
B.U.	65	Male	8	Right-handed	Left TP	Non-fluent	Severe	No	No	No
C.C.	64	Male	15	Right-handed	Left TP	Non-fluent	Mild	Mild	No	No
G.M.	71	Male	13	Right-handed	Left FT	Non-fluent	Severe	Severe	No	No
M.J.	81	Female	5	Right-handed	Left TP	Fluent	Moderate	No	No	No
R.R.	66	Male	10	Right-handed	Left FT	Global	Severe	Severe	No	Yes
G.A.	61	Male	13	Right-handed	Left FP	Non-fluent	Mild	No	No	No
K.E.	89	Male	17	Right-handed	Left TP	Fluent	Severe	No	No	No
T.R.	76	Female	2	Right-handed	Left FTP	Global	Severe	Severe	No	Yes
A.G.	73	Male	13	Right-handed	Left FT	Non-fluent	Mild	No	No	No

FP = frontal-parietal; TP = temporal-parietal; FT = frontal-temporal; TPO = frontal-parietal-occipital; FTP = frontal-temporo-parietal.

Table 2. Music therapy + speech and language therapy patients' characteristics.

MT+SLT	Age	Gender	Education (years)	Handedness	Lesion site	Aphasia type	Severity	Apraxia	Dysarthria	Dysphagia
S.P.	59	Male	10	Right-handed	Left TPO	Non-fluent	Severe	Severe	No	No
D.A.	63	Female	12	Right-handed	Left FP	Non-fluent	Moderate	Mild	No	No
F.M.	42	Male	13	Right-handed	Left FP	Non-fluent	Mild	Mild	No	No
G.R.	55	Female	17	Right-handed	Left FTP	Non-fluent	Moderate	Mild	No	No
V.F.	67	Male	17	Right-handed	Left FTP	Non-fluent	Severe	Severe	No	Yes
K.J.	52	Male	15	Right-handed	Left FT	Non-fluent	Severe	Mild	No	Yes
M.P.	89	Male	5	Right-handed	Left TP	Fluent	Severe	No	No	No
C.G.	65	Male	18	Right-handed	Left FTP	Global	Severe	Severe	No	No
L.G.	69	Male	18	Right-handed	Left TP	Fluent	Mild	No	No	No
L.V.	52	female	8	Right-handed	Left FT	Non-fluent	Mild	No	No	No

FP = frontal-parietal; TP = temporal-parietal; FT = frontal-temporal; TPO = frontal-parietal-occipital; FTP = frontal-temporo-parietal.

subsequently defined (Wernicke's, transcortical sensory, transcortical motor, conduction, Broca's, global, anomic).

To assess speech language (primary outcome measures), the following tests were used: Token Test for the assessment of comprehension (score 0–34) [27]; Boston Naming Test (score 0–60) [28]; AAT Picture Description subtest (score 0–30); and AAT Spontaneous Speech subtest (score 0–30).

To evaluate psychological aspects (secondary outcome measures), the following tests were administered: Beck Depression Inventory (BDI) [29] for the assessment of depression symptoms, which includes 21 items (score 0–63); Big Five Observer (BFO) [30] for the evaluation of personality characteristics such as energy/extroversion (score 0–100), friendship (score 0–100), diligence, (score 0–100), emotional stability (score 0–100) and open-mindedness (score 0–100).

Quality of life assessment was done by using the Short Form Health Survey 36 (SF36) [31], which includes 36 items in the areas such as physical activity (score 0–100), physical health perception (score 0–100), physical pain perception (score 0–100), general health perception (score 0–100), vitality (score 0–100), social activity (score 0–100) and mental health perception (score 0–100).

Statistical analysis

Data are presented as median and interquartile range (IQR). Group comparisons were performed by means of the Mann–Whitney U Test for Group Comparisons. The Wilcoxon signed-rank test was used for comparisons within the groups. Frequency of improved language and psychological outcomes were analyzed with chi-–square test. p Values < 0.05 were considered significant.

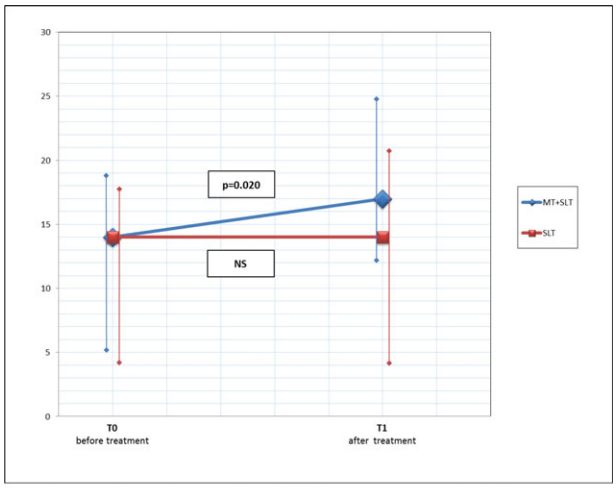
Results

Demographic and clinical characteristics of the patients who underwent MT+SLT or SLT alone rehabilitation sessions did not show significant differences.

Of note, there were no differences in the degree of disability between patients who underwent MT+SLT and those treated with SLT alone. In fact, 2/10 in both groups had a modified Rankin score ≤ 1 and the remaining 8 in both groups had a score of >1.

Time from the onset of acute stroke was the same in both groups: 3.4±4.1 years in the MT+SLT patients versus 3.8±3.3 years in the SLT alone patients.

Main results of the study are summarized in the Table 3.



MT = Music Therapy
SLT = Speech and Language Therapy
NS = Non-Significant

Figure 1. "Spontaneous speech" (subtest of Aachener Aphasie test [AAT]) improvement in MT+SLT and SLT alone groups. Data are expressed as median (IQR).

Overall, patients enrolled in the study showed a severe impairment in every area of communication without significant differences at baseline in the two treatment groups. The degree of comprehension and communication impairment at baseline in patients randomized to MT was similar to that in patients randomized to speech/language therapy alone. The scores of AAT Picture Description and Spontaneous Speech subtests did not differ before treatment ($p = 0.370$ and 0.771, respectively). In addition, the scores of other speech/language tests were similar at baseline in both groups. The interventions did not lead to any improvement in language speech test apart from spontaneous speech. In fact, at variance with the results of other tests, we found a significant effect on spontaneous speech (AAT subtest) in patients treated with MT+SLT that was not observed in the patients treated with SLT alone. The scores of spontaneous speech subtest were identical before treatment in both groups [T0 = 14 (5–19) in the MT+SLT group, and 14 (4–18) in the SLT alone group], but while it remained unchanged in the SLT alone group [T1 = 14 (4–21); $p = 0.369$], it significantly increased in the MT+SLT group [T1 = 17 (12–25); $p = 0.020$; Cohen's $d = 0.35$] (Figure 1).

The vitality score (SF 36 subtest) was similar in both groups at baseline [T0 = 63 (43–76) and 70 (53–73) in MT+SLT and SLT groups, respectively, $p = 0.459$]. After treatment, we observed a slight decrease in scores in both groups [T1 = 55 (45–78) in the MT+SLT group and 62 (25–75) in the SLT group; $p = 0.470$ and 0.089 vs. T0, respectively]. However, when we analyzed individual changes that occurred after

Table 3. Clinical assessment results: median (IQR) and significance within groups (p).

	MT+SLT group		p Value	SLT group		p Value
Test	T0	T1	T1 vs. T0	T0	T1	T1 vs. T0
TT	14 (10–28)	16 (12–29)	0.262	13 (11–25)	15 (13–26)	0.110
BNT	18 (2–34)	19 (3–38)	0.069	18 (1–34)	17 (1–34)	0.849
AAT – PD	14 (5–24)	19 (4–23)	0.556	16 (5–19)	16 (7–21)	0.133
AAT – SS	14 (5–19)	17 (12–25)	0.020	14 (4–18)	14 (4–21)	0.369
BDI	7 (5–14)	8 (4–14)	0.879	8 (3–11)	9 (5–12)	0.849
BFO – EE	45 (37–58)	51 (41–62)	0.293	60 (51–65)	66 (52–69)	0.311
BFO – F	54 (43–66)	54 (39–66)	0.583	50 (41–64)	52 (46–65)	0.259
BFO – D	48 (44–55)	43 (38–53)	0.254	60 (44–65)	53 (46–69)	0.348
BFO – ES	55 (46–65)	54 (42–62)	0.110	61 (53–64)	61 (41–68)	0.899
BFO – OM	49 (36–56)	46 (34–60)	0.962	59 (44–64)	62 (50–64)	0.287
SF36 – GH	72 (60–76)	77 (50–80)	0.632	70 (62–75)	70 (62–85)	0.410
SF36 – PH	62 (1–100)	41 (12–75)	0.282	75 (25–100)	50 (13–100)	0.170
SF36 – MH	72 (51–84)	54 (46–74)	0.226	84 (74–87)	76 (38–92)	0.265
SF36 – PA	45 (25–79)	55 (33–85)	0.427	20 (1–75)	30 (7–90)	0.138
SF36 – SA	81 (50–100)	56 (34–81)	0.172	75 (50–94)	50 (31–87)	0.421
SF36 – PP	75 (40–90)	80 (58–90)	0.288	80 (55–90)	72 (45–90)	0.185
SF36 – V	63 (43–76)	55 (45–78)	0.470	70 (53–73)	62 (25–75)	0.089

IQR = Interquartile range; MT = music therapy; SLT = speech language therapy; TT = token test; BNT = Boston Naming Test; AAT – PD = Aachener Aphasie Test – Picture Description; AAT – SS = Aachener Aphasie Test – Spontaneous Speech; BDI = Beck Depression Inventory; BFO – EE = Big Five Observer – Energy/Extroversion; BFO – F = Big Five Observer – Friendship; BFO – D = Big Five Observer – Diligence; BFO – ES = Big Five Observer – Emotional Stability; BFO – OM = Big Five Observer – Open Mindness; SF36 – GH = Health Survey – General Health; SF36 – PH = Health Survey – Physical Health; SF36 – MH = Health Survey – Mental Health; SF36 – PA = Health Survey – Physical Activity; SF36 – SA = Health Survey – Social Activity; SF36 – PP = Health Survey – Physical Pain; SF36 – V = Health Survey – Vitality.

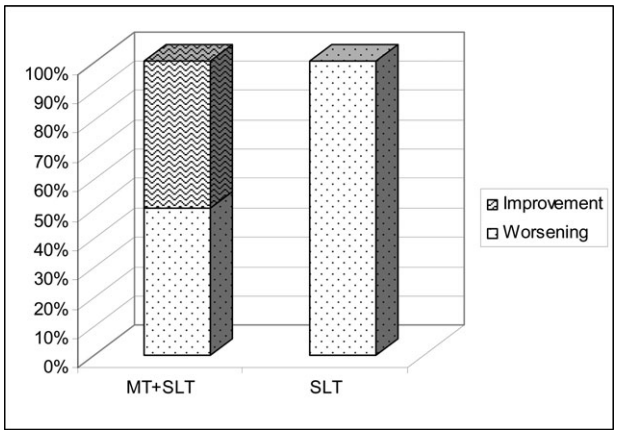


Figure 2. "Vitality" (SF 36 Health Survey sub-item) improvement in patients of MT and control groups (%).

treatment, we found that 50% of the patients who underwent MT+SLT showed improvement in the vitality score (increase $\geq$10%). By contrast, none of the patients who underwent SLT alone therapy improved after treatment (chi-square test = 4.114; $p = 0.043$) (Figure 2).

Discussion

The present randomized study did not show a significant improvement in communication difficulties, psychological symptoms or quality of life with a rehabilitation treatment based on speech and language therapy alone. By contrast, when speech and language therapy was associated with MT, an improvement was observed in spontaneous language and vitality score (SF36 subtest).

It has to be noted that the results of this study were obtained in patients who suffered the stroke one to three years before the beginning of the experimental rehabilitation treatment. Accordingly, spontaneous recovery was unlikely to occur in the current trial, as the patients received treatment in the chronic stage.

Compared with previous study (in which music techniques were mixed with speech therapy), the MT approach employed in the present study mainly used rhythmic component, separated from the SLT sessions. As a matter of fact, it is known that rhythm has a fundamental role in organizing movement at different levels [11,32]. We believe that, in view of the similarity/overlap of the music and speech areas in the brain [33], rhythm may organize/synchronize actions and behaviors (and also articulation where speech is concerned), thus facilitating their fluency. We can hypothesize that speech-motor planning can be influenced by the use of rhythm and singing or by their perception and/or imagery [34,35]. It has been shown that actions, speech and music share the same sensory-motor code, which organizes their syntactic processing [36–38]. In this

respect, the influence of rhythm on the cerebellum could also play a crucial role. Therefore, musical rhythm may coordinate the prosodic rhythm and create a greater regularity and fluency in expression and speech. We believe that rhythmic stimulation, even if separated from SLT, may have facilitated mental representation/organization of speech production, thereby leading to a more spontaneous and fluent verbal expression.

The relational component of active MT approach and the possibility to achieve meeting moments between the patient and the music therapist could have produced significant changes at the activation level, and consequently in the vitality sub-item scores. Thus, MT and SLT may have exerted a positive synergistic effect.

The approach described in this study may have a significant influence on patients' participation and motivation during the rehabilitation process. In fact, the patient was not asked to carry out any particular performance but was free to express himself/herself by choosing ways and time of interaction. The music therapist tried to modulate and adjust the intervention by introducing gradual variations or changes in response to what was expressed by the patient. During the sessions, the empathetic relationship between the patient and the music therapist enabled a greater tendency of verbal expression and communication. Thus, this approach may be considered a support to conventional treatments (e.g. speech therapy, and neuromotor rehabilitation) by increasing the efficacy of rehabilitative intervention.

Limitations

The first limitation is the small sample size that does not allow subgroup analysis based on the type of aphasia. An additional limitation may be represented by the lack of a group treated with MT alone. Moreover, although the effect size of MT treatment on spontaneous language was significant, the absolute change was relatively small.

Conclusions

The results of our study suggest that the active MT approach may improve vitality and spontaneous speech production, and can be proposed as a component of rehabilitation after stroke for the treatment of stroke-related aphasia in addition to SLT.

Larger studies on the use of MT in different phases of rehabilitation in patients who suffered a stroke and had significant impairment of speech and language are warranted to confirm these promising results.

Acknowledgements

The authors thank Elena Rossomanno for her contribution to music therapy sessions.

Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

No funding was received for this research.

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