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Guido Gainotti

Drawing and gesturing in aphasia 7

*Laura Angioletti - Claudia Spinosa - Maurizio Bossola - Sara Fadelli
Anna Maria Villa - Francesca Sabbatini - Michela Balconi*

Italians and immigrants' chronic patients' representation of health and medical care: a semantic and discourse analysis approach 23

*Aarushi Agarwal - Ajeet Patel - Tara Singh - Trayambak Tiwari
Anju Lata Singh*

Exploring relationship between attention and consciousness using Dual-Task paradigm 47

*Michela Balconi - Roberta Sebastiani - Annalisa Beatrice Galeone
Laura Angioletti*

Sustainability in the fashion luxury branding. Using neuroscience to understand consumers' intentions towards sustainable eco-luxury items 65

*Michela Balconi - Davide Crivelli - Federico Cassioli
Miguel Davide Sabogal Rueda - Marco Grassi*

The effect of centesimal prismatic lenses on attention orienting processes: neuroscientific evidence 75

Laura Angioletti - Michela Balconi

Interoceptive empathy and emotion regulation: the contribution of neuroscience 85

Drawing and gesturing in aphasia

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ABSTRACT

The aim of the present review will consist of surveying the role that non-verbal tasks based on gestures and free drawing can have on the assessment of defective representational activities and on the rehabilitation of aphasic patients. The relationships between verbal and non-verbal cognitive disorders of aphasic patients and the underlying mechanisms will be considered in the first part of this review. Then the contribution of gesture or drawing based tasks to the rehabilitation of aphasic patients will be discussed, taking separately into account: (a) the use of these tasks to compensate for a severe reduction of language abilities and (b) their use to improve naming ability in individuals with aphasia. The theoretical and clinical differences between the use of gesture or drawing-based tasks for rehabilitation purposes will subsequently be taken into account and, finally, the relationships between right hemisphere and non-verbal representational activities will be shortly discussed.

Keywords: drawing; gestures; aphasia rehabilitation; word retrieval; right hemisphere representations

1. INTRODUCTION

The role that non-verbal tasks based on gestures and free drawing can have on cognitive assessment and rehabilitation of aphasic patients has been the object of several studies in recent years. The common assumption underlying these investigations was that a relationship may exist between (at least some) linguistic and non-linguistic deficits in aphasic individuals and that disruption of pre-verbal conceptual networks may influence both lexical-semantic and non-verbal cognitive disorders of aphasic patients. A partly related assumption was that working on the non-verbal representations of actions (with gesture based tasks) or on pictorial aspects of objects (with drawing tasks) could help to improve the non-verbal communication of patients with severe language disorders and/or have facilitative effects on word retrieval.

The aim of the present review will consist of surveying some important aspects of these questions. First, I will overview some general points concerning the relationships between verbal and non-verbal cognitive disorders of aphasic patients and the mechanisms underlying these non domain-specific semantic disorders. Then I will pass to survey the contribution that gesture or drawing based tasks can give to the rehabilitation of aphasic individuals. This will be made by distinguishing the contribution that these tasks can give to improve the non-verbal communication of patients with severe expressive disorders from the facilitative effect that they can have to enhance speech production in patients with word retrieval difficulties. A comparison between the rationale underlying the use of gesture or drawing-based asks for rehabilitation purposes and the practical implications of the use of non-verbal tasks for rehabilitation of aphasia patients will then be proposed. A short discussion of the relationships between right hemisphere and non-verbal representational activities will conclude the present review.

2. RELATIONSHIPS BETWEEN VERBAL AND NON-VERBAL COGNITIVE DISORDERS OF APHASIC PATIENTS

This first general assumption concerning non domain-specific semantic/conceptual disorders in aphasia is based on converging evidence from different kinds of neuropsychological investigations. Old studies have, indeed, consistently shown that some aphasic patients show impairments in nonverbal cognitive tasks, such as understanding the meaning of simple symbolic gestures (Gainotti & Lemmo, 1976; Duffy & Duffy, 1981); drawing objects from memory (Gainotti et al., 1983; Kirk & Kertesz, 1989) associating pictures with corresponding objects (De Renzi et al., 1968) connecting black and white drawings with the corresponding colors (De Renzi et al., 1972), and associating environmental sounds with pictures (e.g.,

Spinnler & Vignolo, 1966; Saygin et al., 2003).

Furthermore, other investigations have shown that impairment in linguistic and non-linguistic processes go hand-in hand in aphasic patients. Thus, some authors showed that within these patients the inability to understand the meaning of symbolic gestures (Gainotti & Lemmo, 1976) or to draw objects from memory (Gainotti et al., 1983) are related to the number of semantic errors obtained on a verbal comprehension test. Other authors (e.g., Saygin et al., 2003) examined the ability of aphasic patients to match environmental sounds and linguistic phrases to corresponding pictures and observed correlated behavioural deficits across the two domains. Still other authors (e.g., Saygin et al., 2004) examined comprehension of visually presented action stimuli in both linguistic and non-linguistic modalities and showed that aphasic patients' comprehension is dramatically affected by semantic distracters across both the verbal and nonverbal domains. All these data suggest that semantic/conceptual disorders can underlie verbal and non-verbal processing deficits in aphasia.

3. MECHANISMS UNDERLYING VERBAL AND NON-VERBAL SEMANTIC DISORDERS OF APHASIC PATIENTS

The implicit assumption made by most authors who first described the non-verbal cognitive disorders of aphasic individuals was that both verbal and non-verbal semantic disorders shown by these patients were due to a defect of the underlying non-verbal conceptual representations. A different hypothesis was, however, advanced by Bay (1962 and 1964), who made a distinction between poor differentiation and actualization of concepts, thus anticipating the distinction between disorders of access and disorders of knowledge (see McNeil & Pratt, 2001 for review).

This distinction between semantic representation and semantic retrieval disorders has been more recently developed by Jefferies & Lambon Ralph (2006), who have clinically distinguished 'semantic dementia' from 'semantic aphasia'. According to these authors, 'semantic dementia' (SD) is due to a bilateral atrophy of the anterior temporal lobes, which progressively degrades a set of amodal representations (Patterson et al., 2007; Lambon-Ralph & Patterson, 2008), whereas 'semantic aphasia' (SA) is caused by left prefrontal or temporal-parietal infarcts, that do not allow executive processes to direct and control semantic activation in a task-appropriate fashion. In SD the verbal and non-verbal semantic defect should, therefore, be due to a loss or degradation of semantic representations, whereas in SA they should reflect an 'access' disorder, linked to a defect of the corresponding semantic control mechanisms.

4. CONTRIBUTION OF GESTURE OR DRAWING BASED TASKS TO THE REHABILITATION OF APHASIC PATIENTS

Two main goals have been pursued using gesture or drawing based tasks to rehabilitate aphasic patients. The first goal consisted in increasing the communication abilities of patients with severe language disorders, whereas the second goal consisted in evaluating if these tasks, combined with residual forms of language, have the potential to enhance speech production in individuals with aphasia.

4.1 Use of non-verbal (gesture or drawing based) tasks to increase the communication abilities of aphasic patients with severe expressive disorders

The first authors who tried to use non-verbal (gestural or iconic) material to increase the communicative abilities of global aphasic patients were Glass et al. (1973) and Gardner et al. (1976), who hypothesized that these visual symbols could be processed by the intact right hemisphere. These attempts were developed by Davis & Wilcox, (1985) who, in their 'Promoting Aphasics' Communicative Effectiveness' (PACE) rehabilitation procedure, focused on developing non-verbal channels of communication, such as gesturing and drawing, to compensate for a severe reduction of language abilities.

Clinical experience (e.g., Herrmann et al., 1988; Hogrefe et al., 2012 and Caute et al., 2013) indicated that some patients used these non-verbal communication strategies very efficiently whereas others failed to transmit semantic content by non-verbal means, but it was not clear which patients are able to do this through these modalities. Investigations studying the compensatory use of gestures and of drawing in patients with aphasia showed, however, that both for gesturing (e.g., Behrmann & Penn, 1984; van Nispen et al., 2016; Murteira & Nickels, 2020) and for drawing (e.g., Lyon, 1995; Kinney et al., 2020) this compensatory effect is not linked to the severity of aphasia, but to the presence of a nonfluent output, with relatively intact semantic comprehension. This suggest that intactness of internal representations is needed to communicate by means of an expressive pictorial system. In any case, Daumüller & Goldenberg (2010), Marshall et al. (2012) and Roper et al. (2016) have shown that there is little generalization of improvement from practiced to unpracticed items.

4.2 Use of non-verbal tasks to improve naming ability in individuals with aphasia

The study of the contribution that gesture or drawing based tasks can give to enhance speech production in individuals with aphasia was prompted by the Luria's (1970) construct of intersystemic reorganization, in which an intact

modality is paired with an impaired one to facilitate improvement of the impaired modality. Following Luria's approach, several authors reported improved naming ability in conjunction with gesticulation or after gestural training (e.g., Pashek, 1998; Rose & Douglas, 2001; Rodriguez et al., 2007). Furthermore, Raymer et al. (2006) showed that gesture plus verbal training (GVT) has the potential to improve communication by increasing spoken word retrieval of trained nouns and verbs and by promoting use of gesture to communicate when word retrieval fails. Similar results were obtained with drawing based tasks by Farias and colleagues (2006), Taylor & Strauss Hough (2013), Hough & Taylor (2014), Hung & Ostergren (2019) and Kinney et al. (2020). Farias et al. (2006) assessed object naming during a baseline confrontation naming task, a drawing condition and a writing condition. They showed that drawing have a facilitative effect on picture naming task when compared to writing and similar results were obtained by Hung & Ostergren (2019). On the other hand, Taylor & Strauss Hough (2013) and Hough & Taylor (2014) treated patients asking them to name pictures of objects and to draw answers to related semantic feature analysis (SFA) cueing scripts. They found that drawing the answers to the SFA questions led to an increase in the accuracy of naming for treated pictures, as well as some generalization to untreated pictures. Finally, Kinney et al. (2020) examined the relationship among naming, drawing, and semantic feature generation asking 10 participants with chronic aphasia to complete a series of sequenced tasks measuring confrontation naming accuracy before and after drawing and a semantic feature cueing task for target nouns. Participants significantly increased confrontation naming accuracy when they named targets after completing semantic feature cueing then drawing, suggesting that a more accurate naming is obtained when drawing (the element with fewer language demands), is completed directly before naming.

Furthermore, in line with results obtained using non-verbal tasks to increase the communication abilities of aphasic patients with severe expressive disorders, Rose & Douglas (2001) and Rodriguez et al. (2007) showed that even in studies aiming to improve naming ability in individuals with aphasia, the presence of an underlying semantic disorder impedes the facilitatory effect of non-verbal tasks. Individuals with phonologically based anomia responded, indeed, better in treatment than patients whose naming impairments were associated with semantic dysfunction.

5. THEORETICAL AND CLINICAL DIFFERENCES BETWEEN THE USE OF GESTURE OR DRAWING-BASED TASKS FOR REHABILITATION PURPOSES

5.1 Theoretical differences between tasks based on gestures or on drawing activities

The main theoretical difference between the use of gestures and drawing tasks consists of the fact that gestures mainly concern actions (or manipulable objects) and should therefore be mainly used to improve verb retrieval, whereas drawing tasks mainly concern objects, and should therefore be used to improve nouns retrieval. This distinction is in line with the proposal by Martin et al. (2000) that the semantic representation of a concept may be composed not only of stored information about the perceptual features defining that concept (such as its typical form, color and motion) but also of the actions associated with its use.

The authors who have observed an improvement in word (verb) finding after gesture comprehension (e.g., Saygin et al., 2004), gesture observation (e.g., Marangolo et al., 2010; Bonifazi et al., 2013; Gili et al., 2017; Murteira & Nickels, 2020) or gesture training (e.g., Pashek, 1998; Raymer et al., 2006) have, often attributed this effect to a mechanism related to the “mirror neuron system” (e.g., Rizzolatti and Craighero 2004) from the neurophysiological point of view and to the Embodied Cognition Framework (Barsalou, 1999) from the cognitive viewpoint, because in both these models actions are on the foreground. However, Murteira & Nickels (2020), who examined the potential mechanisms underlying the effects of gesture observation on action picture naming in aphasic patients, concluded that gesture observation may facilitate verb retrieval at either gestural semantic or lexical levels.

On the other hand, drawing from memory requires retrieval and reproduction of distinctive visual features that allow the identification of objects. For this reason, Farias et al. (2006) have suggested, in line with the spreading activation theory of semantic processing (Collins & Loftus, 1975), that drawing an object could activate the corresponding neural network. This assumption is consistent with the observation that the Semantic Feature Analysis (SFA), which activate the semantic network, improves confrontation naming, because it assists aphasic patients with lexical access impairments to retrieve words more effectively (Boyle & Coelho, 1995; Boyle, 2004). Following this line of thought, Hung & Ostergren (2019) have suggested that the act of drawing may facilitate word retrieval by stimulating the semantic network associated with the word and involving the right cerebral hemisphere in the word retrieval process.

5.2 Clinical indications and limitations of language rehabilitation based on gestures or on drawing activities

The main difference between the clinical use for rehabilitation purposes of tasks based on gestures or on drawing activities probably resides in the fact that the former were frequently used to improve the retrieval of both nouns corresponding to manipulable objects and action verbs (e.g., Raymer et al., 2006, Rodriguez et al., 2007; Marangolo et al., 2010; Bonifazi et al., 2013) whereas the latter were almost only used to improve object naming. A second difference consists of the fact that spontaneously generated arm and hand gestures are often used during word retrieval difficulty in people with aphasia (e.g., Herrmann et al., 1988; De Ruiter, 2006; Hogrefe et al., 2012) and that these patients experience facilitation from gesture production (e.g., Lanyon & Rose, 2009). On the contrary, a spontaneous use of drawing to increase communication or improve word retrieval has been rarely reported in the literature and only in patients with previous personal familiarity with visual arts and drawing techniques.

At least three clinical cases illustrative of this condition have, however, been described. The first case, reported by Gourevitch (1967), concerned a retired art professor, who, after developing Wernicke's aphasia, communicated with drawings and strip cartoons. The second case was a caricaturist graphic illustrator, reported by Pillon et al. (1980), who developed a severe aphasia after a stroke with right hemiplegia. Shortly after the stroke this patient began to spontaneously draw objects he could not name and, during the rehabilitation, progressed to draw detailed stories and to refine his drawings, to the point of being able to illustrate a book about his experience. The last case, more recently reported by Cervoni (2011), concerned an old person with severe aphasia who found drawing to be a profound healing tool, which not only provided a way of expression, but also improved self-esteem and self-worth while decreasing depression.

A limitation of tasks based on drawing activities is that, due to various defects concomitant with aphasia, such as right-sided hemiplegia or limb apraxia, these patients are unlikely to use drawing spontaneously, whereas the main advantage is that drawing, having a stable static form, provides a permanent record of individuals' communication intent. (Lyon, 1995). A further advantage is that drawing can serve as a type of art therapy to address the psychological and emotional trauma that is common following strokes, aiding patients to express ideas and emotions that have been disrupted by the disorder of language and, therefore, improving their quality of life.

6. PRACTICAL IMPLICATIONS OF THE USE OF NON-VERBAL TASKS FOR REHABILITATION OF APHASIA PATIENTS

In the discussion of this subject it is probably useful to distinguish the use of non verbal tasks to increase the communication abilities of aphasic patients with severe language disorders from the use of the same tasks to improve their naming abilities.

As for the first issue, Daumüller & Goldenberg (2010) have noticed that there are two major limitations in gesture training studies. The first is that the ecological validity of these studies is limited by the little generalization of improvement from practised to unpractised items. The second is that generalization is usually assessed from practised to unpractised items but not from the therapeutic setting to communication in other situations. In fact, when confronted with their inability to verbally express their needs, these patients often persevere in fruitless attempts of verbal expressions rather than switching the communication channel and employing the gestural skills acquired during therapy. For these reasons, Daumüller & Goldenberg (2010) have claimed that the therapy should concentrate on gestures that are of practical relevance for daily living of the patients. In agreement with these conclusions, Marshall et al. (2012) and Roper et al. (2016) also acknowledged that in their studies gains were item specific and there was no evidence of cross-modality cueing, preventing them from strongly advocate the use of gesture in therapy for people with severe aphasia.

More satisfactory results have been obtained by investigations which have checked the contribution that non-verbal tasks can give to improve word retrieval skills of aphasic patients. Several studies have, indeed, shown that both gesture (e.g., Raymer et al., 2006; Marangolo et al., 2010; Marshall et al., 2012; Bonifazi et al., 2013; Murteira & Nickels 2020) and drawing based tasks (e.g., Farias et al., 2006; Attard et al., 2013; Hough & Taylor, 2014; Hung & Ostergren, 2019 and Kinney et al., 2020) have a facilitative effect on picture naming. It must, however, be acknowledged that a great variability exists in the extent to which the participants benefit from non-verbal cueing (e.g., van Nispen et al., 2016; Murteira & Nickels, 2020) and that gains are often item-specific (e.g., Marshall et al., 2012; Attard et al., 2013; Hough & Taylor (2014). Furthermore, the rehabilitative efficacy of tasks based on gestures or on drawing activities is rather limited. In fact, several authors (e.g., Raymer et al., 2006; Crosson et al., 2007) have shown that treatments that include a gestural component improve word retrieval in aphasia, but the independent contribution of gesture to the treatment effect is difficult to determine. Rose et al. (2013), who conducted a systematic review of gesture treatments for post-stroke aphasia, indeed showed that gesture plus verbal training paradigms has

limited advantage over those with verbal training alone. The same can be said of tasks based on drawing activities, because the rehabilitative efficacy of these tasks has generally been studied in single cases or in small groups of aphasic patients and no systematic review of these investigations is currently available.

7. RELATIONSHIPS BETWEEN RIGHT HEMISPHERE AND NON-VERBAL ACTIVITIES BASED ON GESTURAL OR DRAWING TASKS

We have seen in section 4.1 of this survey that Glass et al. (1973) and Gardner et al. (1976), who first used non-verbal (gestural or pictorial) material to increase the communicative abilities of global aphasic patients, had thought that these visual symbols could be processed by the intact right hemisphere (RH). A similar assumption was made by many ensuing authors who proposed the use of tasks based on gestural or drawing activities for the rehabilitation of aphasic patients. Thus, the RH seemed to play an important role in studies based on word retrieval recovery after production (e.g., Crosson et al., 2009) or observation of gestures (e.g., Gili et al., 2017). Similar results were obtained by Farias et al. (2006) in a fMRI experiment, conducted to examine the neural correlates of drawing and writing in healthy subjects. These authors showed, in fact, that drawing, which improves more than writing naming accuracy in aphasic patients, produces stronger RH activation, when compared to writing, and that this asymmetry is particularly relevant in the right frontal areas BA 44/45. Farias et al. (2006) therefore concluded that drawing contributes to naming by activating semantic networks in the RH of aphasic patients. Data consistent with the hypothesis assuming that the RH may play a role in enhancing speech production in individuals with aphasia have also been obtained by Grossman (1988) who examined errors made by right and left brain damaged patients (BDP) in their attempts to produce free drawings of common objects in response to linguistic targets. This author analyzed pictures according to their features (color, shape and relative size) and to characteristic details which help distinguishing between similar items and showed that subjects with RH lesions were significantly more impaired overall than left BDPs on free drawings of common objects. The hypothesis assuming that the activation produced by gestural and drawing tasks may be particularly strong in RH structures, subsuming the non-verbal representations of objects, is consistent with the model proposed by Gainotti (2012 and 2015) of a different format of conceptual representations subsumed by the right and left anterior temporal lobes (ATLs). This model objects to the original version of the 'hub-and-spokes' model (Patterson et al., 2007; Lambon Ralph and Patterson,

2008), in which conceptual representations were considered to be ‘stored’ in the same unitary ‘amodal’ format in the right and left ATLs and assumes that these representations may be mainly stored in a verbal format in the left ATL and in a non-verbal (pictorial) format in the right ATL. According to this model it is possible to assume that different right-sided components of this network may contribute to improve the word retrieval processes bypassing the language expression defects, subsumed by the impaired left hemisphere and providing a different neural pathway from the intact RH to the lexical-semantic system. An objection that could be raised to this ‘right hemisphere’ model is that it might be inconsistent with the distinction proposed by Jefferies & Lambon Ralph (2006), between SD (in which conceptual representations are lost) and SA (in which only their controlled retrieval is affected). The distinction between semantic knowledge and semantic access disorders has been, however, recently criticized by Chapman et al (2020), who compared SA and SD patients on several phenomena previously used to support this distinction. Chapman et al (2020) found, in fact, that evidence from SA and SD patients does not differentiate representations and access mechanisms in the semantic system, as Jefferies & Lambon Ralph (2006) had previously suggested.

8. CONCLUDING REMARKS

Increasing attention has been paid in recent years to the contribution that non-verbal (gesture and drawing based) tasks can give to the rehabilitation of aphasic patients, improving their general communicative or their specific word-finding abilities. It has been suggested that gesture based therapies, concerning actions, may mainly facilitate verb retrieval, whereas drawing tasks, concerning objects, may improve noun retrieval. It is also been speculated that activation produced by non verbal tasks may be particularly important in RH structures, providing an alternative pathway from this hemisphere to the semantic-lexical system.

Clinical and research data gathered up to date are, however, too limited not only to evaluate the appropriateness of these theoretical interpretations, but also to identify the patterns of aphasic impairment that could predict the greater benefit from gesture and drawing based forms of rehabilitation.

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