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One century after Liepmann's work on apraxia: Where are we now?

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Running head: Introductory Editorial: Special Issue Apraxia

One century ago, Hugo Karl Liepmann carried out a series of famous works on patients with deficits in the execution of manual gestures (Liepmann, 1905, 1908, 1925). Since his works, deficits in the gesture production started being considered as an autonomous neuropsychological disorder called apraxia. One of Liepmann's main contributions was to characterize apraxia as a skilled movement disorder, independent from other cognitive defects like aphasia and agnosia (see Goldenberg, 2003). He further proposed a complex assessment of this deficit by means of different kinds of manual gestures (i.e., meaningless postures, real tool use, pantomime of tool use, symbolic/expressive gestures), each of them having a specific interest in the evaluation and understanding of the praxis disease. One century later, the question is: Where are we now?

Regardless of one century of history on the studies of apraxia, Liepmann's legacy is still present. Even the most recent definitions of apraxia define this disorder by default, maintaining that a diagnosis of apraxia has to be posited by ascertaining first that the deficit in the execution of gestures cannot be explained by other cognitive defects (Cubelli, 2017, Osiurak & Rossetti, 2017). However, the emergence of complex cognitive models for the understanding of apraxia together with the use of a more complete assessments bring to light that this independency from other disorders is far from being taken from granted. Several points of concerns leave the question of "apraxia" as an autonomous disorder still under debate.

Language and praxis rely on neural substrates in the left brain. Therefore, the hard job of Liepmann was to understand whether apraxia was an exaggeration of aphasia (see Goldenberg, 2003) or if the two disorders were independent. Results of his works have led him to affirm that apraxia and aphasia are two independent disorders, giving limb apraxia the authority to be included in the list of the neuropsychological deficits.

However, the several recent patients' and neuroimagery works carried out on the link between language and gesture processing reveal that the question is still an open issue (Bidula & Króliczak, 2015; Frey, 2008; Goldenberg, 2013; Goldenberg & Randerath, 2015; Króliczak, Piper, & Frey, 2011; Vingerhoets et al., 2013)

Apraxia is assessed by means of complex praxis assessments, basically including the evaluation of multiple gestures (i.e. pantomime, transitive, intransitive and meaningless) to be performed under different task conditions (i.e. verbal, visual, imitation etc.). Furthermore, since the hand with which the gesture is performed cannot be separated from the body toward which some gestures are executed (e.g. the distinction between hand and finger meaningless postures) and neither from the external environment where gestures are directed (i.e. to interact with other objects – object related actions – or with other individuals – expressive/symbolic gestures), a growing interest in the relationship between gestures and other aspects of cognition emerged. We list here some points of concern:

(a) Imitation of meaningless postures. A series of works initiated in the 1990's have proposed an alternative to the direct-matching hypothesis, demonstrating that difficulties in imitating meaningless postures (particularly hand meaningless postures) could be revealed by body schema/image deficits (Dafsari, Dovern, Fink, & Weiss, 2019; Goldenberg, 1995; Goldenberg & Hagmann, 1997).

(b) Real tool use. The classical approach to apraxia emphasizes the importance of motor memories (also called manipulation knowledge, action semantics, or visuo-kinesthetic engrams) for the real use of familiar tools (Buxbaum, 2001; Buxbaum & Kalénine, 2010; Cubelli, Marchetti, Boscolo, & Della Sala, 2000; Heilman, Rothi, & Valenstein, 1982; Rothi, Ochipa, & Heilman, 1991; van Elk, van Schie, & Bekkering, 2014). However, evidence indicates that tool-use disorders might also be explained by

impaired reasoning about physical object properties (also called mechanical-problem solving or technical-reasoning skills; Goldenberg & Hagmann, 1998; Goldenberg & Spatt, 2009; Jarry et al., 2013; Osiurak, Jarry, Lesourd, Baumard, & Le Gall, 2013; Osiurak et al., 2009; for review, see Osiurak, Lesourd, Navarro, & Reynaud, in press).

(c) Pantomime of use. The classical approach to apraxia stresses the importance of motor memories for pantomime of tool use. However, other hypotheses have been proposed such as the working-memory (Bartolo, Cubelli, Della Sala, & Drei, 2007) or the social-cognition hypotheses (Bartolo & Ham, 2016; Finkel, Hogrefe, Frey, Goldenberg, & Randerath, 2018). The latter has notably been supported by some studies indicating that pantomime production deficits are present in individuals with autism (Ham & Bartolo, 2012; Ham, Bartolo, Corely, Swanson, & Rajendran, 2010, Ham et al., 2011) or schizophrenia (Stegmayer et al., 2016; Viher et al., 2018; Walther et al., 2013), who are not initially considered as apraxic patients.

(d) Symbolic/expressive gestures. Deficits in producing symbolic and expressive gestures have been found in individuals with autism (e.g., Ham et al., 2011) or in right brain-damaged patients (see Lesourd et al., 2018). Therefore, to what extent social cognitive deficits contribute to difficulties in the production of symbolic/expressive gestures? Can the social cognitive deficits be at the basis of the difficulties in the production of these gestures or are praxis and social cognition still two independent disorders?

Such studies question on the independence of apraxia from other cognitive disorders. Thus, is apraxia a pure “gestural disorder” or is it the consequence of other cognitive dysfunctions that are expressed through gestures. This last possibility would suggest that apraxia may not be a unitary disorder with a unique neuropsychological

basis. In this special issue, most of the major authors on the topic address the above provoking questions with experimental data or review articles.

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References

- Bartolo, A., Cubelli, R., Della Sala, S., & Drei, S. (2003). Pantomimes are special gestures which rely on working memory. *Brain and Cognition*, *53*, 483–494.
- Bartolo, A., & Ham, H. S. (2016). A cognitive overview of limb apraxia. *Current Neurology and Neuroscience Reports*, *16*, 75.
- Bidula, S. P., & Króliczak, G. (2015). Structural asymmetry of the insula is linked to the lateralization of gesture and language. *European Journal of Neuroscience*, *41*, 1438–1447.
- Buxbaum, L. J. (2001). Ideomotor Apraxia: A call to action. *Neurocase*, *7*, 445–448.
- Buxbaum, L. J., & Kalénine, S. (2010). Action knowledge, visuomotor activation, and embodiment in the two action systems. *Annals of the New York Academy of Sciences*, *1191*, 201–218.
- Cubelli, R. (2017). Definition: Apraxia. *Cortex*, *93*, 227
- Cubelli, R., Marchetti, C., Boscolo, G., & Della Sala, S. (2000). Cognition in action: Testing a model of limb apraxia. *Brain and Cognition*, *44*, 144–165.
- Dafsari, H. S., Doovern, A., Fink, G. R., & Weiss, P. H. (2019). Deficient body structural description contributes to apraxic end-position errors in imitation. *Neuropsychologia*, *133*, 107150.
- Finkel, L., Hogrefe, K., Frey, S. H., Goldenberg, G., & Randerath, J. (2018). It takes two to pantomime: Communication meets motor cognition. *Neuroimage: Clinical*, *19*, 1008–1017.
- Frey, S. H. (2008). Tool use, communicative gesture and cerebral asymmetries in the modern human brain. *Philosophical Transactions of the Royal Society of London B*, *363*, 1951–1957.
- Goldenberg, G. (1995). Imitating gestures and manipulating a mannikin: The representation of the human body in ideomotor apraxia. *Neuropsychologia*, *33*, 63–72.
- Goldenberg, G. (2003). Apraxia and beyond: Life and work of Hugo Liepmann. *Cortex*, *39*, 509–524.
- Goldenberg, G. (2013). Apraxia in left-handers. *Brain*, *136*, 2592–2601.
- Goldenberg, G., & Hagmann, S. (1997). The meaning of meaningless gestures: A study of visuo-imitative apraxia. *Neuropsychologia*, *35*, 333–341.
- Goldenberg, G., & Hagmann, S. (1998). Tool use and mechanical problem solving in apraxia. *Neuropsychologia*, *36*, 581–589.
- Goldenberg, G., & Randerath, J. (2015). Shared neural substrates of apraxia and aphasia. *Neuropsychologia*, *75*, 40–49.
- Goldenberg, G., & Spatt, J. (2009). The neural basis of tool use. *Brain*, *132*, 1645–1655.
- Ham, H. S., & Bartolo, A. (2012). Exploring the relationship between gesture and language in ASD. *Perspectives on Language Learning and Education*, *19*, 56–65.

- Ham, H. S., Bartolo, A., Corley, M., Rajendran, G., Szabo, A., & Swanson, S. (2011). Exploring the relationship between gestural recognition and imitation: Evidence of dyspraxia in autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *41*, 1–12.
- Ham, H. S., Bartolo, A., Corley, M., Swanson, S., & Rajendran, G. (2010). Case report: Selective deficit in the production of intransitive gestures in an individual with autism. *Cortex*, *46*, 407–409.
- Heilman, K. M., Rothi, L. J., & Valenstein, E. (1982). Two forms of ideomotor apraxia. *Neurology*, *32*, 342–346.
- Jarry, C., Osiurak, F., Delafuys, D., Chauviré, V., Etcharry-Bouyx, F., & Le Gall, D. (2013). Apraxia of tool use: More evidence for the technical reasoning hypothesis. *Cortex*, *49*, 2322–2333.
- Króliczak, G., Piper, B. J., & Frey, S. H. (2011). Atypical lateralization of language predicts cerebral asymmetries in parietal gesture representations. *Neuropsychologia*, *49*, 1698–1702.
- Lesourd, M., Osiurak, F., Baumard, J., Bartolo, A., Vanbellingen, T., & Reynaud, E. (2018). Cerebral correlates of imitation of intransitive gestures: An integrative review of neuroimaging data and brain lesion studies. *Neuroscience & BioBehavioral Reviews*, *95*, 44–60.
- Liepmann, H. (1905). Die linke Hemisphere und das Handeln. *Münchener Medizinische Wochenschrift*, *49*, 2322–2326.
- Liepmann, H. (1908). *Drei Aufsätze aus dem Apraxiegebiet*. Berlin: Karger.
- Liepmann, H. (1925). Apraktische Störungen. In H. Curschmann & F. Kramer (Eds.), *Lehrbuch der Nervenkrankheiten* (pp. 408–416). Berlin: Springer.
- Osiurak, F., Jarry, C., Allain, P., Aubin, G., Etcharry-Bouyx, F., Richard, I., Bernard, I., & Le Gall, D. (2009). Unusual use of objects after unilateral brain damage: The technical reasoning model. *Cortex*, *45*, 769–783.
- Osiurak, F., Jarry, C., Lesourd, M., Baumard, J., & Le Gall, D. (2013). Mechanical problem-solving strategies in left-brain damaged patients and apraxia of tool use. *Neuropsychologia*, *51*, 1964–1972.
- Osiurak, F., Lesourd, M., Navarro, J., & Reynaud, E. (in press). Technition: When tools come out of the closet. *Perspectives on Psychological Science*.
- Osiurak, F., & Rossetti, Y. (2017). Definition: Limb apraxia. *Cortex*, *93*, 228.
- Rothi, L. J. G., Ochipa, C., & Heilman, K. M. (1991). A cognitive neuropsychological model of limb praxis. *Cognitive Neuropsychology*, *8*, 443–458.
- Stegmayer, K., Bohlhalter, S., Vanbellingen, T., Federspiel, A., Moor, J., Wiest, R., Müri, R., Strik, W., & Walther, S. (2016). Structural brain correlates of defective gesture performance in schizophrenia. *Cortex*, *78*, 125–137.
- van Elk, M., van Schie, H., & Bekkering, H. (2014). Action semantics: A unifying conceptual framework for the selective use of multimodal and modality-specific object knowledge. *Physics of Life Reviews*, *11*, 220–250.
- Viher, P. V., Stegmayer, K., Kubicki, M., Karmacharya, S., Lyall, A. E., Federspiel, A., Vanbellingen, T., Bohlhalter, S., Wiest, R., Strik, W., & Walther, S. (2018). The cortical signature of impaired gesturing: Findings from schizophrenia. *NeuroImage: Clinical*, *17*, 213–221.
- Vingerhoets, G., Alderweireldt, A. S., Vandemaele, P., Cai, Q., Van der Haegen, L., Brysbaert, M., & Achten, E. (2013). Praxis and language are linked: evidence from co-lateralization in individuals with atypical language dominance. *Cortex*, *49*, 172–183.
- Walther, S., Vanbellingen, T., Muri, R., Strik, W., & Bohlhalter, S. (2013). Impaired gesture performance in schizophrenia: Particular vulnerability of meaningless pantomimes. *Neuropsychologia*, *51*, 2674–2678.