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Neurocognitive bases of tool use

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Tool use is a defining feature of human species. So, the issue of the underlying neurocognitive bases should be at the heart of psychologists’ and neuroscientists’ concerns. Yet, since the beginning of scientific psychology in the late 20th century, this issue has received very little interest. One potential reason for this lack of interest is the profound belief that tool use is first and foremost based on sensorimotor knowledge about how to use tools, as if tool use did not require any intellectual or reasoning skills, but only the hands. This belief has inspired, and still does, the major neuropsychological models of apraxia of tool use. This talk aims to describe the main recent advances in psychology and cognitive neuroscience that have contributed to revise the idea that manipulation is central to tool use, and have led to the formulation of new theoretical models suggesting that specific reasoning skills are involved in tool use. I will present the theoretical framework useful for the two other talks of this session, which will be further concerned with the issue of how to assess tool use disorders in brain-damaged patients (e.g., stroke, Alzheimer’s disease).

Keywords Apraxia; Tool use; Gesture; Action

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Apraxia of tool use: Assessment strategies

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A substantial proportions of patients with brain damage and neurodegenerative diseases misuse common tools. However, this neuropsychological syndrome affecting everyday life is relatively unexplored in the field of experimental and clinical neuropsychology. Little is known about long-term evolution and specific evaluation and/or rehabilitation. This is partially due to the fact that apraxia of tool use faces the lack of an integrative theoretical framework taking into account all cognitive processes underlying gesture orientation, object selection or action sequencing. Indeed, apraxia of tool use goes far beyond the traditional, obsolete, distinction between ideational apraxia and ideomotor apraxia. This is a complex symptomatology requiring a conceptual and clinical differential analysis. After a brief overview of the theoretical principles underpinning our evaluation method, the purpose of this presentation is to describe the various types of tests, which are required to exhaustively assess tool use disorders. In that sense, we want to reemphasize the importance of preliminary neurological examination as well as the exploration of language, body schema (probably involved in imitation disorders) and motor sequences (unilateral, limb-kinetic apraxia). We will then focus on tool use assessment: types of object, basic knowledge related to them, presentation modalities, action planning. Finally, we illustrate our approach with studies in patients with left brain damage.

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Developmental dyspraxia: Symptom or real “dys” disorder?

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Just like all the others specific learning disorders, dyspraxia is a key issue for public health and school performance. “Developmental dyspraxia” qualifies specific disturbances of gesture, i.e. the ability to produce a finalized action (goal-directed movement) and to use the objects [1,2]. Even if dyspraxia was described for decades, the value of the concept for diagnosis raises some debates in the international literature. Since 1994, a consensus has been established on the diagnostic entity of Developmental Coordination Disorder (DCD) to describe all children who exhibit developmental deficits of “motor coordination”. Beyond the usual debate of terminology, both the theoretical and the clinical definitions of the gestural dysfunctions in children remain insufficient in various respects. This communication provides a review of current controversies regarding the field of dyspraxia and DCD. Understanding the two entities of dyspraxia and DCD proves problematic, both when defining the concepts of praxis/motor coordination and when providing a theoretical analysis of the deficits they cover. More specifically, we aim at exploring the arguments supporting the hypothesis of a specific deficit in praxis development. We discuss the respective contributions of different impairment levels highlighted by studies of developmental gestural impairment (e.g. knowledge, executive functions, perceptive abilities...). Such a deconstruction of the concept of a specific deficit in praxis development argues in favor of an analysis that does not confuse gestural problems with other deficits made apparent through gesture.

Keywords Developmental dyspraxia; Developmental coordination disorder; Gesture; Children
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Developmental dyspraxia: A psychiatrist’s point of view
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Developmental coordination disorders, which consist of developmental dyspraxia, are a frequent reason for consultations in child psychiatry, given their impact on learning. These motor impairments, associated with visuo-spatial difficulties, can also penalize the child in his imitative exchanges and have an impact on social integration. The diversity of the forms of dyspraxia and the polymorphism in clinical presentations require the implementation of a working, multidisciplinary collaboration. Indeed, assessment and understanding of such disorders are part of an approach that is both developmental and integrative, which must take into account the cognitive, linguistic and emotional dimensions inherent to the overall functioning of a child in interaction with their wider environment. This clinical approach must be at the barycenter in a position between psycho-affective (underpinned by a psychodynamic point of view) and a second, more recently nourished knowledge, provided by neurosciences and genetics. Results from this approach will be tailored therapeutic proposals that are adjusted to the singularity of clinical situations that have been encountered.

Keywords Learning; Dyspraxia; Developmental coordination disorder; Social integration; Dimensional approach; Integrative

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What type of support for children with disorders of motor skills?
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The difficulties of defining the concepts of praxies and coordination during the development of the child are linked with recent debates and consensus-building regarding the diagnostic criteria for the developmental coordination disorder (DCD), dyspraxia, disorders of motor skills. The relevance of the proposed therapeutic approach logically depends on the clarity of the identification of disorders; in the current state of knowledge, support for children “DD” or “DCD” is still not consolidated. We report the recommendations established by certain organizations or scientific societies (Economic and Social Research Council Leeds 2006, INSERM 2007, European Academy for Childhood Disability 2012, Réseau Régional de Rééducation et Réadaptation Pédiatrique 2012, Caisse Nationale de Solidarité pour l’Autonomie 2014) as well as the therapeutic proposals published by the clinicians and researchers particularly invested in this area (Albaret, Gerard, Mazeau...). Our service at the Hôpitaux de Saint-Maurice has developed experience in the diagnostic and therapeutic support for children with developmental dyspraxia and children with praxic disorders associated with early brain damage. This leads us today, in the light of the recent work on the difficult passage of the assessment to the rehabilitation. Which place to give to approaches oriented on the deficit or functional performance? Is it possible to codify criteria of indication of adaptations (including computer) and their learning? What therapeutic strategy in the event of co-morbidity?

Keywords Developmental dyspraxia; Developmental coordination disorder; Rehabilitation

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Developmental dyspraxia: Which future in the adulthood?
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Dyspraxia is defined as a neuro-cognitive developmental disorder mainly involving the development of the gesture. If it is now well recognized thanks to the consensus on diagnostic criteria [1] and extensively studied through an abundant literature [2], its physiopathological mechanisms, its neurobiological bases and its evolution still remain insufficiently explained. The heterogeneous symptomatology, the frequency of the associated motor and cognitive disorders primarily focusing on the language, the attention and the executive functions, the evolution of the symptomatology over time make it a complex pathology with little reliable prognosis in the adulthood. It is, however, a frequently raised question by the parents, as soon as the diagnosis is assessed during the childhood: “what future for her or him when growing?” In order to answer this question, it seems important to develop, in this domain, case studies with longitudinal follow up. It is probably a way to assess a neurocognitive developmental model of the function by studying several individual trajectories taking into account the change of the different components of the praxic function as well as other cognitive functions involved and their evolution as time goes on. Of course the effect of rehabilitations has to be taken into consideration as well as the difficulty in making a difference between natural evolution and what depends of the evolution modified by treatments. Currently, the reference hospital centers for language and learning disabilities since the promulgation in March, 2001 of the action plan for the children with specific language disorder can follow-up these children in partnership with the liberal professionals and/or establishments of the medical and social sector as well as the Education system. Today, it is, thus, possible to lean on their experience, their expertise and their capacity to coordinate care with their partners in order to carry on such studies. To illustrate this approach, we shall present, here, several clinical situations.

Keywords Developmental dyspraxia; Longitudinal follow-up; Adulthood; Different trajectories

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