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Implicit and explicit memory: a functional dissociation in persons with Down syndrome

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Abstract

This study aimed at investigating implicit and explicit long-term memory functioning in subjects with Down syndrome (DS) compared to Mental-Age (MA) matched normal children. For this purpose, tests of verbal and visuo-perceptual explicit memory, verbal and visual repetition priming and procedural learning tasks were administered to 14 DS and 20 MA subjects. Our results document comparable implicit memory abilities in the two groups. In contrast, regarding explicit memory, normal children performed better than DS individuals. These results reveal a functional dissociation between implicit and explicit memory in subjects with DS. Theoretical and rehabilitative implications are discussed. © 2000 Elsevier Science Ltd. All rights reserved.

1. Introduction

Mental retardation (MR) is a clinical condition characterized by a cognitive deficit that can present widely differing features. In particular, neuropsychological research has permitted defining different cognitive profiles among subjects with MR of different etiology. For example, numerous authors have stressed that the typical language profile for persons with Down syndrome consists of poor production with greater compromission of morphosyntax than of lexical abilities [5,7,13,14,46], but relatively preserved comprehension [28,29]. In contrast, children with Williams syndrome (another genetic condition, less frequent but equally characterized by MR) often show marked impairment in certain visual-spatial abilities (especially praxic-constructive) and relative preservation of both productive and receptive language, at least concerning the phonological elements [32,42,44,45,47,48]. Also different cognitive profiles were described in subjects with comparable intellectual deficits [41] or even with the same etiopathological picture [33]. All these observations seem to support a theoretical approach that considers intellectual disability in subjects with mental retardation not as a mere slowing of normal cognitive development, but as distinct, individual profiles, that can be qualitatively specified [41]. In line with this theoretical point of view (which also suggests the need for strongly individualized rehabilitation treatment protocols), many recent studies emphasized the need to better define not only the impaired cognitive abilities in each subject, but just as importantly, the respective strengths, or relatively preserved abilities in children with MR. The importance of this approach was evidenced in several recent studies of memory, especially implicit memory in subjects with MR [4,40,51].

It should be recalled that memory, which is generally defined as the capacity to acquire, retain and recall experiences and/or information, is no longer considered a unitary function. Functional dissociation in healthy subjects and neuropsychological dissociation in brain-damaged patients suggest the memory is fragmented into a series of functionally independent, but clearly interacting, systems and subsystems. A cognitive model of the mnesic function which proved to be

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theoretically and practically useful was presented by Squire [36]. The first distinction made by this author is between short-term memory (STM) and long-term memory (LTM). The two types of memory are characterized by differences in retention capacity (limited to only a few items for STM, practically unlimited for LTM), in information coding (mainly phonological coding in the first case, based on semantic processing of stimuli in the second), in the mnesic trace deterioration rate (a few seconds without reiteration for STM, variable but still slow for LTM). The functional independence of the two memory systems is further confirmed by the description of a neuropsychological double dissociation. Reports were made of patients with severe impairment of episodic LTM, but essentially normal STM performance [1] and, in contrast, of patients with severe verbal span reduction and nearly normal performance in episodic LTM tests [2].

Within LTM, Squire's model distinguishes between explicit, or declarative, memory and implicit, or procedural memory. Explicit memory is involved in intentional and/or conscious recalling and intentional and/or conscious recognition of experiences and information, while implicit memory is manifested as a facilitation (that is, an improvement in performance) in perceptual, cognitive and motor tasks, without any conscious reference to previous experiences (for a review, see [39]). The mnesic impairment profile observed in patients with pure amnesia is the strongest element supporting the dichotomy between implicit and explicit memory systems. It has often been reported that these patients, although seriously deficient in intentionally recalling previously acquired information, show normal procedure learning and have a normal repetition priming level [34]. Further, Squire suggests that additional subsystems can be distinguished within implicit memory. These subdivisions are involved in the processing associated with so-called repetition priming, in learning visual-motor procedures and in operant conditioning. This additional fragmentation is supported above all by neuropsychological investigations showing that some brain disorders (i.e. Alzheimer's disease) impair repetition priming without affecting procedural learning, while other pathological conditions (i.e. Huntington's disease) compromise procedural learning but leave repetition priming intact [17].

The neuropsychological studies reported in the literature suggest insufficient development of the mnesic function in MR at different levels of articulation. Though with some exceptions (for example, children with Williams syndrome), [44,45], multiple deficits have been identified in STM functioning. The peripheral systems of articulatory reiteration as well as the central systems that direct information processing seem to be deficient in these subjects [18,43]. Explicit memory deficits in persons with MR have also been extensively documented [4,35,49].

According to recent studies, due to this diffuse impairment of mnesic abilities, persons with MR should show a relative preservation of implicit memory. In particular, by using a repetition priming test, such as completing word fragments, Komatsu et al. [20] observed similar performances in subjects with or without MR for those words which, during the study phase, had been the object of mainly perceptual processing (read the target word within the sentence). On the other hand, during the study phase, when it was necessary to name a word from its definition or description (therefore with semantic processing of the target), the performance of persons with MR was worse than the performance of those without MR. The authors concluded that implicit memory has two different components: a perceptual one, that does not change with age and intellectual level, and another, which evolves with age and is influenced by the intellectual level, having to do with conceptual processing of stimulation. Takegata and Furutuka [38] and later Perrig and Perrig [31], again using a repetition priming test reported similar levels of performance in persons with MR and in mental age matched controls. However, some questions were raised about the methodology used in these two studies [51]. The repetition priming test used by Takegata and Furutuka was marked by constant explicit recall to the target, therefore raising some doubts about the specific involvement of implicit memory. On the other hand, Perrig and Perrig did not report any difference in performance between persons with and without MR in implicit and explicit memory tests, and, hence, could not identify any dissociation between these two different cognitive abilities. More recent studies seem to provide equally contradictory conclusions. Using tests for evaluating procedural learning and tests for evaluating explicit learning, Vakil et al. [40] reported initial difficulty in both procedural and declarative learning in persons with MR, compared with controls of similar mental age. However, in a repetition priming test for visual material, Wyatt and Conners [51] reported a dissociation between implicit (preserved) and explicit (impaired) memory performances in persons with MR; but the controls in this study were matched for chronological age, and thus were poorly matched for mental age.

In a recent study [4], we described LTM abilities in persons with Down syndrome and in others with MR of unknown etiology, comparing them with normal subjects of similar mental age. Although the performance of the normal subjects in explicit memory tests was significantly better than the children with MR of unknown etiology, and the latter were better than those with Down syndrome, the performances of the