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Some children do not learn even while paying attention: Their focus is on winning

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ABSTRACT

Attention is a fundamental process that has been measured through performance in simple perception tests. The level of performance reached in those tests is often attributed exclusively to the attention paid to the task. However most tasks are relatively complex, and for successful execution require other cognitive processes in addition to attention. Our aim is to examine the role of attention in the performance of a learning task. We used the DiViSA, a visual discrimination test, to measure attention, and an experimental task designed to assess how efficiently the children learn (CLT: *Categories Learning Test*). A sample of 450 schoolchildren aged 7 to 12 years completed both tasks during school time. The results show that slowness and organization predict learning, whereas quickness, attention and organization predict the test scores, independently of the level of learning achieved. Discussion addresses the role played by attention and strategies, or personal styles, in solving category-learning tasks, as well as their implications for learning in school.

1. Introduction

Our aim is to study the role of attention in the performance of complex learning tasks, specifically those related to schoolwork. Learning performance that falls below school standards is usually attributed to either a stable general cognitive deficit in children or to maladjustment in children's affective-emotional and cognitive development. Both explanations are grounded on differences in biological development of a genetic or epigenetic nature or on biological developmental differences and inappropriate child-rearing patterns. Frequently, after conducting exhaustive assessments of a poorly performing child, the educational psychology school teams conclude that neither of those two explanations can be applied. This happens for almost 15% of the children. Educational psychology teams have often suggested that a child's poor performance at school could be due to an attention deficit and/or hyperactivity disorder (ADHD), (Bacete & Betoret, 2000; Castillo, 2009). From this point of view it can be inferred that the level of attention deployed by children (selective attention and attentional control) will influence their progress in learning school tasks. To study the influence of attentional processes in school learning experimentally, we must select a test of selective attention that involves the rapid and effective discrimination of stimuli from their context, and a complex learning task that represents the tasks usually faced in school. Let us examine first the characteristics of a selective attention test, secondly we will examine the relationship between general cognitive ability and attention, and finally we will present a category-learning task as representative of the essentials for most school learning tasks.

1.1. Measures of attention

Some tests or tasks are designed to measure different facets of attention (selective or focused, sustained, and attentional control). These tests estimate the attention levels of individuals from their overall performance in completing the task. Performance is the time the individual takes to make the responses and/or the accuracy in the responses, and is presented in the form of an attention index. As Cattell (1979) pointed out, regarding T-data (data obtained from tests which involve reactions to standardized experimental situations created in a lab where a subject's behavior can be objectively observed and measured), the task must be simple, new and without feedback during its execution, so that the differences in performance can be considered to be exclusive functions of attentional processes.

Therefore, attentional tests have been reduced to perception and discrimination of events in a simple lab context, in order to simplify the task. Morphological and functional characteristics of the stimuli (colour, form, relative position, meaning, movement, contrast, and configuration) that can influence the attentional process, both in children and adults (Boujon & Quaireau, 1999; Kruschke, 2000) have been identified. In this way researchers reduce the variability among stimuli to maintain the focus on voluntary and conscientious attentional process.

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Furthermore, preventing gradual adaptation to the attention test (by providing no feedback of the response consequences), leads to the assumption that each item of the test consistently assesses the current attentional level. Taking these considerations into account, diverse tests have been developed to measure attention from the performance that children show in solving the task. That is, the goal is to isolate the effect of attention from other basic processes.

Currently, there are a large number of objective tests aimed at assessing attention. Some of these tests have been derived from neurological and psychological assessment batteries (CAS: Naglieri, 1997 and NEPSY: Klenberg, Korkman, & Lahti-Nuuttila, 2001) while others have been developed from tasks used in experimental studies of attention in adults (Botella & Barriopedro, 1999; Hunt, 2005). Many classifications of attention tests associated are based on the types of attention mentioned above; i.e., selective or focused, sustained, and attentional control (see reviews by Ríos-Lago, Periáñez, & Rodríguez-Sánchez, 2011 and by Santacreu & Quiroga, 2015). According to Strauss, Sherman, and Spreen (2006) the objective assessment of attention in children has been conducted essentially through discrimination tests to estimate selective attention, or continuous performance tests (CPT) to assess vigilance or sustained attention. Here we are focusing only on selective attention tests due to their greater ecological validity (Wolfe et al., 2012). Discrimination tests are divided into two types: visual search tests and perceptual speed tests (cancellation tests). In visual search tests, a set of figures is presented simultaneously and the task consists of pointing to those that match the target, or those that meet a specific condition (e.g., figures that are large, those that are blue in colour or those that depict animals). In perceptual-speed tests, a set of stimuli is presented simultaneously, but usually arranged in rows, with instructions to complete the task (such as a cancellation task) within a specific time limit.

Visual search tests used to assess selective attention provide valuable information about other variables, apart from the global attention efficiency. Using a software-based visual discrimination task (DiViSA, described in the instrument section in this article) Santacreu and Quiroga (2012) have assessed two large groups (schoolchildren displaying typical development $N = 1442$; and poorly performing schoolchildren $N = 1178$). They found that in all age groups, poorly performing schoolchildren were slower, and made more commission (CE) and omission errors (OE). Even more, commission errors were mainly due to hastiness. All these results apply to the group level. However, at the individual level, poor performance in the attention test could be due to a different combination of the main scores in the test, including lack of organization, hastiness, distraction or slowness.

General mental ability (GMA) is a strong predictor of performance in learning for schoolchildren (Spinath, Spinath, Harlaar, & Plomin, 2006). However, GMA includes diverse cognitive processes, and we need to know more specifically which measure of attention, independently determined, can explain performance in learning tasks such as spatial, memory or reasoning tasks. In the pioneering study by Jong and Das-Smaal (1995) on attention switching, fluid intelligence and working memory, with a sample of over 2000 children, the results showed correlations of 0.36 to 0.40 between attention and memory tests and of 0.31 to 0.53, between attention and fluid intelligence. However, little is known about the role of selective attention.

1.2. Learning of categories

In the context of human learning, one of the most elementary abilities is to discriminate among stimuli (objects or figures) with morphological differences (shape, colour, glossiness, size or position). Therefore, it is assumed that if children have developed the ability to discriminate the characteristics of stimuli, and if they pay attention to the task at hand, they will complete more complex learning tasks with less difficulty. Once sensorial or motivational differences between children have been, performance differences in a perceptual discrimination task will be exclusively the result of their attention level (Dodd & Flowers, 2012).

To study the effect of the attentional process in school learning tasks we have selected a category-learning task. Category learning is a complex task that demands, at least, the ability for perceptual discrimination and the ability for associative conditioning to enable the individual to classify or categorize stimuli. This goal is achieved experimentally by exposing the individual repeatedly, in several trials, to a set of stimuli (different objects, figures or words) either sequentially as in the continuous performance tests (CPTs) or simultaneously, inducing through the instructions the search and selection of a given set of objects or figures. Participants can classify the figures according to their morphological or conceptual characteristics (e.g. red coloured objects, large objects or figures of animals, fruit, mammals, plants) without the experimenter having specified the required characteristics in each class (Feldman, 2003; Hammer, Diesendruck, Weinshall, & Hochstein, 2009). These tasks have a long-standing tradition in psychological research, and, in some of their variants, participants are informed immediately after responding as to whether the selected item does belong or not to the prescribed category. For example, a sequence is displayed depicting a cow, an oak tree, a dog, a cypress, a table, an apple, a tiger, a cat, some cherries, a pine tree, a whale… and so on. After each picture the participant is asked to respond yes or no. If the chosen object belongs to the category, participants are told their choice was correct (e.g. they hear *CORRECT* on choosing oak tree, cypress and pine tree if the category is trees, and *INCORRECT* in all other cases). In this way the participant learns to identify the elements in a category that, in this example, would be *trees*. If the category to be learnt were *plants*, then *CORRECT* would be given also for the remainder of choices in this category (e.g. cherries), and all other choices announced as *INCORRECT*.

All school tasks are relatively complex and often include, among other processes, one of associative and category learning. The majority of school tasks are made up of sub-tasks that must be completed correctly and in a certain order requiring planning the sequence with which the whole set will be executed. Thus, performance in any task demands motivation and attention and, in complex tasks, planning and organizing the set of sub-tasks (Greiff et al., 2013; Schweizer, Wüstenberg, & Greiff, 2013). Additionally, some school tasks require other specific abilities: verbal, spatial, memory, reasoning, etc. (Dodd & Flowers, 2012; Unsworth, Redick, Heitz, Broadway, & Engle, 2009).

The objective in the present research is to assess the role of selective attention itself in a complex learning task. Our main hypothesis is that selective attention, measured with a visual search test, will predict a considerable part of the performance in a category-learning test. More specifically, learning will be measured through two different but related scores: total obtained points (a raw learning score) and a learning index computed as the number of hits/presses (representing learning efficiency). It is expected that both learning measures will be correlated with the attention level that the children display in the selective attention test.

2. Method and procedure

2.1. Participants

The sample was made up of 450 schoolchildren aged 7 to 12 years, at two schools in Madrid (225 girls and 225 boys). The group was divided into 5 school years: Primary year 2 ($N = 92$, *mean age* $= 7.20$; $SD = 0.54$); Primary year 3 ($N = 84$, *mean age* $= 8.12$; $SD = 0.33$); Primary year 4 ($N = 84$, *mean age* $= 9.17$; $SD = 0.41$); Primary year 5 ($N = 94$, *mean age* $= 10.16$; $SD = 0.39$) and Primary year 6 ($N = 96$, *mean age* $= 11.22$; $SD = 0.41$). The number of boys and girls per class was equivalent (Chi^2 $(4, N = 450) = 5.29$; $p = 0.259$) and girls and boys did not differ in age in any of the 5 school years studied ($F(4, 440) = 0.768$; $p = 0.547$). Table 1 shows the frequency of girls and boys, mean age and standard deviation per school year and sex.