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THE USE OF MENTAL IMAGERY IN PAIR-ASSOCIATE LEARNING IN PERSONS WITH DOWN'S SYNDROME

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Introduction

Studies with associated pairs consist of presenting the subject with items in pairs, of which the second item of the pair has to be learned. At the moment of recall, subjects are presented with the first word of the pair, and must remember the second (Campos, 1988). For example, subjects may be presented with a list of pairs of words: car-table, paper-moon, etc. In the test period, the word 'car' is presented, and the subject has to remember 'table', and when the word 'paper' is presented, the subject has to remember 'moon'. By using mental images, the subjects join the two words in the pair together, so that on presenting them with part of the image, they will remember the other half (Paivio, 1979).

The use of mental imagery as a method for facilitating recall has been demonstrated in series of associated, verbal or pictorial pairs since the 1960s (Davidson, 1964; Levin and Kaplan, 1972; Reese, 1965). Studies carried out indicate that imagery is the preferred strategy for learning pairs associated with specific names, and that its use is associated with a high level of performance (Richardson, 1998). Other authors have confirmed the validity of this strategy, discovering that subjects who used imagery, both normal and unusual, obtained a higher level of recall than subjects who did not (Campos and Fernández, 1995).

It has also been indicated that images may improve memory, as not only the word is 'stored', but also the image of the object. Furthermore, it is possible to combine the images, leading to another storage method (Campos and González, 1988). Rather than using isolated images, it is more beneficial to use images in interaction for the learning of paired associates (Campos and González, 1988; Campos and Pérez, 1996). When images are used in learning, there is greater interest and at-

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tention during the process, meaning that it has a greater effect than when material is presented verbally without images (Campos and Pérez, 1996).

The use of mnemonic instruction in persons with learning difficulties and educable mental deficiencies has still not been studied in great detail. However, although this line of investigation is still in its early stages, it would appear that mnemonic instruction is a viable, versatile and powerful strategy in improving learning in handicapped students. The investigations that have been carried out reveal that mnemonic instruction is of benefit to handicapped students, meaning that it is important to continue investigating to discover suitable methods for special education.

In the 1980s, different authors carried out a considerable number of investigations into the use of mnemonic strategies in special populations. These investigations consisted of firstly exploiting the spontaneous use of strategies in gifted adolescents, and then applying them to students with learning difficulties and mental retardation (IQ between 60 and 80) (Scruggs and Mastropieri, 1990).

It was found that mnemonic strategies greatly facilitate learning in students with learning difficulties and mental retardation. Different laboratory investigations have discovered that mnemonic strategies lead to higher performance than instruction based on repetition routines, both with immediate and delayed recall.

Since the 1970s, studies have indicated the benefits of using mental images with students with mental retardation. The use of drawings facilitates the learning of paired associates (Kee and White, 1977). Students with mental retardation demonstrate improved learning of paired associates in conditions where interactive drawings are provided (Borkowski and Wanschura, 1974). It has also been observed that the learning of paired associates increases in persons with mental retardation when they are instructed to create interactive mental images of the objects or drawings (Lebrato and Ellis, 1974; Yarmey and Bowen, 1972). However, there are contrary opinions regarding the capacity to produce images. While authors such as Yarmey and Bowen (1972) indicated that children with mental retardation have practically the same capacity to produce images as children without deficiencies, studies by other authors have described important deficits in these subjects when working with images (Courbois, 1996).

Individuals with Down's syndrome are the subgroup with learning difficulties whose memory abilities have been most widely studied. Numerous studies have identified short-term memory deficits in subjects with trisomy 21 (Bilovsky and Share, 1965; Bower and Hayes, 1994; Broadley *et al.,* 1995; Das, 1985; Laws, 1995; Mackenzie and Hulme, 1987; Marcell and Armstrong, 1982; McDade and Adler; 1980; Varnhagen *et al.,* 1987; Marcell and Weeks, 1988).

Several studies have demonstrated that training improves the ability in individuals with trisomy 21 (Broadley and MacDonald, 1993; Broadley *et al.,* 1994, 1995). This means that to train their memories it is necessary to teach them learning strategies that improve recall.

The results obtained from the studies carried out reveal that short-term memory performance may be improved in subjects with Down's Syndrome by memory strategy instruction (Comblain, 1994; Farb and Throne, 1978; Laws, 1995; Laws *et al.,* 1996). The analyses demonstrated a significant effect from training in strategies such as repetition, categorisation, organisation and images, in order to develop short-

term memory capacity in persons with Down's Syndrome.

It is true to say that young and older children with Down's Syndrome do not appear to use memory strategies in incidental learning. They are not used to learning and memorising using these techniques to facilitate recall (Broadley and MacDonald, 1993). However, one of the special needs of persons with Down's Syndrome consists of exercising the memory with motivated repetitions or strategies (Miñán-Espiagers, 1999). Most subjects with Down's Syndrome do not tend to spontaneously adopt learning strategies that help them to recall events more easily; however, they do use them if they are taught to do so (Laws, 1995). Today, mnemonic techniques with images have a potential that has yet to be exploited by educators of subjects with special needs.

In this investigation, we attempted to discover if there was a difference in the recall of paired associates by using images, drawings and repetition in children (Experiment 1), and in adults (Experiment 2).

Method

Experiment 1

Participants

Twenty two children with Down's Syndrome took part in the experiment (14 boys and 8 girls) taken from state schools in Galicia, Spain (n=16), the Early Health care Units (n=3) and Down Syndrome Associations (n=3). The chronological mean age of the sample was 9.20 years (SD=1.57), (range between 7 and 12 years of age). The mean IQ was calculated using Kaufman's Brief Intelligence Test (Kaufman, Spanish adaptation by Cordero and Calonge, 1997). The mean IQ obtained was 53.13 (SD=10.28), (range 40 to 73).

Materials

Kaufman Brief Intelligence Test. The shortened version of this test was used (Kaufman and Kaufman, Spanish adaptation by Cordero and Calonge, 1997) that gave measurements for verbal and non-verbal intelligence. The test is valid for participants between the ages of 4 and 90. This test is subdivided into two parts, covering vocabulary and matrices. The vocabulary sub-test consists of 82 items that measure verbal abilities. The sub-test for matrices evaluates non-verbal abilities using figurative and abstract visual stimuli, presented in 48 items. It gives measurements for these two sub-sets, and a composite IQ of between 40 and 160.

Three lists of 20 words. The words were chosen considering the vividness of their imagery (higher than 5.20, corresponding to the mean plus 2/5 of sigma, which means that these words are highly imaginable), (Valle-Arroyo, 1998). We also considered frequency of use using the Frequency Dictionary of Spanish Words (Alameda and Cuetos, 1995). The words selected were those of frequency between 40 and 200, this being the range including common words which would surely be known to the participants of this study. We also considered that the number of letters in the words contained in the list were the same. The following inclusion criteria were also established namely: that the word was a noun, and that it had a specific nature.

In order to check if the lists were the same with regard to variables for vividness, frequency and number of letters, a comparison was made between them. TABLE I shows the means and standard

deviations. We carried out a Multivariate Analysis of Variance (MANOVA) to check if there were differences between the lists in the three variables. No significant differences were found between the lists in any of the analyses (Pillais = 1.13), indicating that they were the same.

Interactive drawings of each of the paired associates. These were drawings of the interacting pair, for example a lion wearing a dress (lion-dress))see FIGURE 1), and **answer sheets** to make note of free recall and recall of paired associates, immediately after learning them, and one week later.

TABLE I
Means and standard deviations from the three lists of paired associates by frequency, vividness and number of letters

	Frequency		Vividness		Number of letters	
	M	SD	M	SD	M	SD
List 1	86,1	45,539	6,208	0,423	5,55	1,538
List 2	104,35	50,323	6,473	0,418	5,35	1,461
List 3	89,7	43,118	6,413	0,409	5,4	1,489

FIGURE 1
Interactive drawing of paired-associate - lion-dress

Procedure

Each subject listened to a series of words recorded on a cassette tape, that they had to learn using different strategies. The sample was previously divided into three groups. The first group started learning list 1 using the repetition strategy. The subjects listened to the list twice, with a cadence of 15 seconds between pairs; they were then asked to repeat the words they remembered from what they had heard. The person carrying out the experiment then said a word and asked the subject to say the word that went with it. An evaluation was then made one week later for free recall and recall of paired associates.

After one week, and having compiled the information from the previous list, a new list of words was presented which the subject had to learn using the imagery strategy. The subject was asked to imagine the words in interaction when hearing them, and several 'rehearsals' were made using the three pairs of words; for example, when the subject heard the words 'skirt-paper', they were asked to imagine a skirt made of paper covered in writing. The cassette with the pairs was then played, with the subject listening to each pair and then being told the situation they should imagine. Free recall and recall of paired associates was evaluated immediately afterwards, and then again one week later.

Finally, the subject was presented with a third list of words that they had to learn using the drawing strategy. The cassette was played, and as they listened to the pairs of words, they were shown a drawing of the pair in interaction. An evaluation was made of immediate and delayed recall (free and paired associates).

The second group learned the lists by first using the imagery strategy, then the drawing strategy, and finally the repetition strategy. The third group used the drawing strategy first, then repetition, and finally the image strategy.

Experiment 2

Participants

The sample used for this experiment comprised 29 adults with Down's Syndrome (19 men and 10 women), aged between 18 and 57 (mean = 29.76; SD = 8.68). All of the subjects came from occupational workshops in Galicia, Spain. A mean IQ of 43.02 (SD = 5.01) was detected using the Kaufman Brief Intelligence Test. The highest IQ was 57, and the lowest was 40.

Materials

The materials used for this experiment were the same as those used and described for Experiment 1.

Procedure

The experiment was carried out in the same way as the first. The lists of paired associates were presented and learned using the same learning strategies (drawing, mental image and repetition). An evaluation was made of free recall and of paired associates immediately after learning. After one week, the evaluation was repeated.

Results

Experiment 1

A series of Repeated-Measures ANOVAs were made, using the type of

strategy for learning the lists as the independent variable (drawing, image or repetition). As dependent variables, we used immediate and delayed recall, and the immediate and delayed recall of paired associates.

The strategy used for learning paired associates had a significant influence on immediate free recall F (2,42) = 11.783; $p \leq .001$. Comparisons of pairs based on estimated marginal means of the least significant difference - LSD - that were then carried out revealed the existence of significant differences between the strategies of image and repetition, and those of drawing and repetition. Mean recall obtained by subjects using the drawing, mental image and repetition strategies is shown in TABLE II.

Delayed free recall was also influenced significantly by the strategy used for learning F (2,42) = 3.494; $p < .05$. In the subsequent comparison by pairs, it was seen that there were significant differences between the strategies of repetition and image, and between repetition and drawing.

The learning strategy used significantly influenced the recall of paired associates, both with immediate recall F (2,42) = 57.897; $p \leq .001$ and delayed recall F (2,42) = 34.920; $p \leq .001$. In both cases, comparison by pairs revealed significant differences between the strategies of repetition and image, and repetition and drawing.

In all of the cases of recall analysed, it was observed that the highest level of recall derives from learning using drawings, shortly followed by learning using images, which differs considerably from the recall obtained from learning by repetition.

Experiment 2

The results for free recall and paired associates were analysed using a Repeated-Measures ANOVA. The results revealed that the strategy used for learning the lists had a significant influence on immediate free recall F (2,56) = 23.13; $p \leq .001$). The comparison of pairs, based on the marginal means estimated using the LSD (Least Significant Difference), revealed significant differences between the total number of strategies used for learning (see means in TABLE III). Significant differences were found between the strategies of repetition and image. The same is apparent between the strategies of repetition and drawing, and image and drawing.

TABLE II
Means for recall and standard deviations obtained using learning with the different strategies in children with Down's Syndrome

	Drawing		Image		Repetition	
	M	SD	M	SD	M	SD
Immediate free recall	5.22	1.90	4.72	2.35	2.68	1.98
Immediate recall of paired associates	6.27	2.14	5.22	2.09	0.95	1.04
Delayed free recall	1.04	1.21	1.00	1.57	0.27	0.63
Delayed recall of paired associates	3.13	1.58	2.81	1.36	0.40	0.66

The differences found regarding delayed free recall were also significant (F (2, 56) = 7.29; $p \leq .01$). Subsequent analysis revealed that the level of recall obtained after learning by repetition was significantly different from that obtained using images or drawings. Similarly, there was a significant difference in the level of recall between the image and drawing strategies.

The immediate recall of paired associates was also significantly influenced by the learning strategy used (F (2, 56) = 38.15; $p \leq .001$). The subsequent comparison of pairs revealed significant differences between the recall obtained by learning using images, and by repetition. Similarly, there were significant differences between the strategies of drawing and repetition, and image and drawing.

It was observed that the strategy used for learning the lists had a significant influence on the delayed recall of paired associates (F (2, 56) = 17.35; $p \leq .001$). Subsequent analysis revealed the presence of significant differences between recall after learning with images, and learning by repetition. Significant differences were also found between the strategies of drawing and repetition.

Discussion

The results indicate that the highest level of recall of paired associates occurs after learning with drawings, followed by that obtained by learning with mental images. Learning by repetition is one of the most widely investigated areas in subjects with Down's Syndrome (Comblain, 1994; Mackenzie and Hulme, 1987), with which a lower level of recall was obtained.

We discovered that in the case of immediate free recall, immediate recall of paired associates, delayed free recall and delayed recall of paired associates, children with Down's Syndrome who used drawings for learning paired associates obtained a higher level of recall than subjects who used the repetition method. These results found in children with Down's Syndrome coincide with those found in adults with the same pathology (Experiment 2) in previous studies with subjects with learning difficulties (Mastropieri *et al.,* 1990; Mastropieri *et al.,* 1985) and with subjects with diverse types of mental deficiency (Pearlman, 1990; Scruggs *et al.,* 1985).

The most important finding of this investigation is the fact that persons with

TABLE III
Means for recall and typical standard deviation obtained by learning with the different strategies in adults with Down's Syndrome

	Drawing		Image		Repetition	
	M	SD	M	SD	M	SD
Immediate free recall	8.10	2.62	6.20	3.02	4.58	2.92
Immediate recall of paired associates	6.00	2.77	4.00	2.37	2.27	2.50
Delayed free recall	2.10	2.74	1.34	1.91	0.44	1.05
Delayed recall of paired associates	2.86	2.55	1.58	1.63	0.68	1.10

Down's Syndrome, both children and adults, are able to follow verbally given instructions in order to form mental images of paired associates that have to be learned (Lebrato and Ellis, 1974). The data resulting from our investigation indicate that the image strategy produced a level of recall that was significantly higher than that obtained using the repetition strategy. This coincides with the investigations of McLoone *et al.* (1986), who concluded that learning using images was more effective than using repetition in the case of adolescents with learning difficulties. In the case of adult subjects, the difference found between the image strategy and the repetition strategy was also important, as a higher level of recall is obtained in learning using mental images. These findings coincide with those from studies carried out with normal subjects (Richardson, 2000; Woollen and Lowry, 1971).

In the case of children with trisomy 21, we did not find significant differences between image strategy and drawing strategy in immediate free recall and of paired associates, and delayed recall of paired associates, although the mean figures for recall were higher in the case of learning with drawings (5.22 vs. 4.72, 6.27 vs. 5.22, and 3.11 vs. 2.81). Nor in the case of delayed free recall did we find any significant differences between the results obtained using the image and drawing strategies. Furthermore, there was hardly any difference between the mean recall obtained using these strategies (1.04 for the drawing strategy, compared to 1.00 for the image strategy). These results indicate that children with Down's Syndrome at these ages were capable of generating mental images when they were provided for them at the start of the experiment.

By comparing the results obtained from the different strategies, it may be seen that the image and drawing strategies have shown to produce a higher level of recall than the repetition strategy, which indicates that both strategies must be useful instruments in the design of teaching and learning situations for adults with Down's Syndrome.

The results of applying mnemonic instruction to subjects with Down's Syndrome are promising, although there are still numerous areas to be investigated. More specific information has to be provided about the adaptations of procedure that are required for gifted students, and to check if these advantages persist with time, and in different areas of knowledge.

Summary

An evaluation is made of the efficiency of the use of mental images in pair-associate learning by individuals with trisomy 21 (Down's Syndrome), using two experiments. In the first, the sample comprised 22 children with Down's Syndrome between 7 and 12 years of age. The subjects learned 10 pairs of words using three different learning strategies: pair repetition, seeing drawings that represented each pair, and visualising the images of each pair in interaction once they had been given them. In the second experiment, the sample comprised 29 adults with Down's Syndrome who performed the same tasks as the first group. In both experiments we observed that the use of mental imagery for pair-associate learning led to a higher level of recall than learning by repetition. These results would suggest that mental imagery should be considered in the designing of learning tasks for subjects with trisomy 21.

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