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Improving attention behaviour in primary and secondary school children with a Computer Assisted Instruction procedure

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Attention disorders are one of the major sources of poor school performance. This research project was designed to examine whether a Computer Assisted Instruction (CAI) approach would be successful in achieving higher rates of attention. In order to increase attention behaviour during school time, psychologically-designed software was developed. The software, called "How to improve your mental skills," consists of three games based on multimedia perception tasks. First, 155 elementary school children with an average age of 12.4 years, from Cadiz (Spain) School District, were evaluated with two attention tests, the Perception Differences Test (PDT), and the subtest Spatial of Primary Mental Aptitude (S-PMA). Students were divided and balanced into one experimental and two control groups, according to their scores on the PDT. Then, 10 training sessions, of 25 minutes each, with the software "How to improve your mental skills", were administered to the experimental group. Children from control group 1 played with a well-known computer game during the same period of time, whereas children from control group 2 remained in the classroom with nonspecific training. Finally, after the experimental sessions, all the children were re-evaluated with standard attention tests. Analyses of data included: (1) pre- and post-training comparison of the experimental group scores on the PDT; (2) comparison of the experimental and control group 1 and 2 scores on the PDT and S-PMA tests after training; and (3) gender and grade interference effects on attention behaviour. Results suggest that children from the experimental group significantly improved their attention behaviour as assessed by the PDT and S-PMA tests after 10 training sessions with the specific computer software. No gender and grade interference effects on attention behaviour were found.

Les désordres d'attention sont une des sources majeures de pauvre performance scolaire. Ce projet de recherche fut conçu pour examiner comment une approche d'enseignement assisté par ordinateur peut être efficace pour obtenir de plus hauts niveaux d'attention. Afin d'augmenter le comportement d'attention en classe, un programme informatique intitulé « Comment améliorer vos habiletés mentales » fut développé. Ce programme, basé sur la psychologie de la peception, consiste en trois jeux multimédias interactifs. L'étude s'est déroulée en trois phases. Premièrement, 155 enfants de l'école primaire, âgés en moyenne de 12,4 ans et issus du district scolaire de Cadiz, en Espagne, furent évalués à partir de deux tests d'attention: le *Perception Differences Test* (PDT) et le sous-test *Spatial of Primary Mental Aptitude* (S-PMA). Les élèves furent divisés en trois groupes, un groupe expérimental et deux groupes contrôle, en fonction de leur score au PDT. En deuxième lieu, le groupe expérimental fut soumis à 10 sessions d'entraînement, chacune d'une durée de 25 minutes, lors desquelles le programme informatique « Comment améliorer vos habiletés mentales » fut administré. Les enfants du premier groupe contrôle ont joué avec un autre programme informatique bien connu durant ces mêmes sessions, tandis que les enfants du second groupe contrôle demeuraient en classe sans recevoir d'entraînement particulier. En troisième lieu, tous les enfants furent réévalués à l'aide de tests d'attention standardisés. Trois séries d'analyses furent menées. La première visait à comparer les scores obtenus au PDT, au pré-test et au post-test, pour le groupe expérimental. La seconde consistait à comparer les scores obtenus au PDT et au S-PMA, au post-test, par les trois groupes. La troisième série d'analyses visait à examiner les effets du genre et du niveau de scolarité sur le comportement d'attention. Les résultats

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suggèrent que les enfants du groupe expérimental ont significativement amélioré leur comportement d'attention suite aux sessions d'entraînement avec le programme informatique. De plus, aucune interférence du genre et du niveau de scolarité ne fut observée.

Los déficits de atención son una de las causas más frecuentes de fracaso escolar. La presente investigación se diseñó para someter a prueba si la Enseñanza Asistida por Ordenador (CAI) puede ser un procedimiento eficaz para conseguir mayores niveles de atención. Con el fin de conseguir una mejora de la atención en la escuela, se ha desarrollado un programa informático fundamentado en la psicología de la percepción que consiste en tres juegos interactivos multimedia. El estudio se realizó en tres fases. Primero, se evaluó a 155 niños de edad escolar del distrito de Cádiz (España) con dos pruebas estandarizadas de atención, Perception Differences Test (PDT), y sub-test Spatial of Primary Mental Aptitude (S-PMA). Tras ello, se formó un grupo experimental al que se realizaron 10 sesiones de entrenamiento de 25 minutos de duración cada una con el programa "Cómo mejorar tus habilidades mentales." Otro grupo de alumnos a los que se les denominó control-1 permanecieron jugando con un conocido juego informático durante el mismo período de tiempo. Los niños del grupo control-2 permanecieron en sus clases sin un entrenamiento específico. Tras las sesiones experimentales, se evaluó de nuevo a todos los niños con las pruebas estandarizadas de atención. Primero, se comparó las calificaciones del grupo experimental en la PDT antes del entrenamiento y después del entrenamiento; segundo, se comparó las calificaciones del grupo experimental y de los grupos control 1 y 2 en las pruebas PDT y S-PMA después del entrenamiento; y tercero, se analizó los efectos de interferencia del grado escolar y el género. Los resultados indican que los participantes del grupo experimental mejoraron su conducta atencional tras las sesiones de entrenamiento con el programa informático. No se encontraron efectos de interferencia del grado escolar o del género sobre la conducta de atención.

In the educational setting, it is important that children make use of different kinds of attention behaviour when they are involved in academic learning (Naglieri & Rojahn, 2001). These behaviours are closely related to three attention processes: selective, distributive, and continuous attention (Marlin & Foley, 1996). Continuous attention is the process of consciously focusing on a stimulus or stimuli. All additional processing depends on whether, and how well, learners attend to appropriate stimuli in their learning environment (Posner & DiGirolamo, 2000).

From this point of view, one of the main targets of the teacher is to capture and keep students' attention throughout the class (Kauchak & Eggen, 1998). However, one of the first problems is that students have lower attention skills than adults (Pascual-Leone & Baillargeon, 1994) and attention test validity for children is sometimes confusing, especially for those with attention deficits (Glutting, Robins, & de Lancey, 1997). In many school activities, expert students are better than beginners at paying attention to key information. Experts explore action faster and they are better at concentrating on significant information (Bard, Fleury, & Gonlet, 1994).

Low levels of attention behaviour may have implications for developmental and instrumental learning at school (Kail, 2000). The school setting demands that children remain seated, wait for turns or cues, pay attention, and keep on task. Their minds are full of learning capacity, but high activity and low attention skills make learning more difficult (Nervwirth, 1994).

In this situation, the Computer Assisted Instruction (CAI) approach could be noted as new technology, and a useful educational tool for improving students' attention behaviour (Alcalde, Navarro, Marchena, & Ruiz, 1998). The low cost and wider availability of computer software during the last decade have facilitated the spread of CAI in the educational setting. Technological advances have led to the development of complex and comprehensive educational software (Moreno & Mayer, 2000). Going beyond text plus pictures, today's new software harnesses the full potential of multimedia: animation, video, sound, and music (DuPaul & Eckert, 1998). Multimedia programming techniques may have the potential to improve the processes involved in children's attention behaviour (Howell & Navarro, 1997).

Recent studies report the effectiveness of a CAI approach in improving children's school learning (Tesauro, 1994). Lavely, Townsend, and Wilton (1998) achieved higher school performance with a group of students using a computer approach than in a control group instructed with standard methodology. Nicol and Anderson (1997) and Deborah, McGee, and Ungar (1998) report increasing self-confidence and attention in children with learning disabilities or low social skills using a computer-based training programme. CAI strategies have also been successfully tested with preschool children (Marchena, Alcalde, Navarro, & Ruiz, 1998) and children with special educational needs (Alcalde et al., 1998). Both groups achieved basic concepts of colour, shape, and body position.

Teaching with computers is still a little-explored practice, and it is necessary to design new procedures that can achieve contrasted results. These procedures must be different from the traditional standard teaching programmes. Although both are able to obtain similar results, a CAI procedure has added benefits such as motivation, keeping on task, and lower time-consumption (Howell & Navarro, 1997). This last advantage seems particularly important because attention behaviour recovery with standard methodology is slow (Barkley, 1990). Considering the rapid pace of the schooling period, children with low attention can be trapped in poor academic performance, accumulating a pessimistic experience of failure year after year (Rief, 1993).

Considering this issue in the school setting, and the necessity of developing efficient tools to improve attention, multimedia software was designed to increase children's cognitive attention skills. The *How to improve your mental skills* software (Navarro, Ruiz, Alcalde, Marchena, & Amar, 1996) exhibits an applicable and original project to develop cognitive skills linked with self-control and attention behaviour. The software was designed by adjusting the continuous/sustain factor of Posner´s three attention network (Posner, 1992; Posner & Peterson, 1990).

This study had two goals: to contrast the efficacy and adequacy of the *How to improve your mental skills* computer program and the use of a CAI approach to increase the attention behaviour of primary and secondary students. In order to achieve these two targets, we designed a comparative study where students were trained either with the software or with a standard approach.

METHOD

Participants

A total of 155 children from the 6th, 7th, and 8th grade, 73 boys and 82 girls, with an average age of 12.4 years (*SD* = 0.93, range 10–15) for boys, and 12.2 years (*SD* = 1.02) for girls, from the public school district of Cadiz, Spain, participated in the study. Most of the students came from a lower middle-class background. The school is located in a lower middle-class neighbourhood. Students were divided into three groups: an experimental group (30 boys and 21 girls), control group 1 (22 boys and 31 girls), and control group 2 (21 boys and 30 girls). Students were balanced into their groups according to their scores on the Perception Differences Test (PDT) (Thurstone & Yela, 1985).

Materials

Students' attention was assessed with the Perception Differences Test (PDT; Thurstone & Yela, 1985), and subtest Spatial of Primary Mental Aptitude (S-PMA; Thurstone & Thurstone, 1996). The S-PMA was selected because it is able to evaluate continuous attention (Rosello, 1997). The PDT is a well-established attention assessment procedure, in which a total of 25 items are presented. Each item consists of three human faces: two of them are identical, and one is different just in one tiny detail (i.e., open vs. closed eyes). Participants must identify which stimulus is different.

Attention training materials included the *How to improve your mental skills* computer program (Navarro et al., 1996). This software has as its general goal the practice and development of relaxation, attention, and concentration skills, facilitating controlled behaviour in academic and personal contexts. *How to improve your mental skills* has two sections: relaxation practice, and attention and concentration training. The attention and concentration section presents three multimedia games and progressively teaches such skills. Game performance assessment is possible after each session. Each game has three difficulty levels (easy, moderate, and hard) and a range of 5 to 10 trials.

The ghost book game. The game features a full library. One of the books moves slightly, and the user must click on that book. The game requires the student to focus and maintain attention for a few seconds; it is also helpful in improving reaction time, since the computer asks for as fast a response as the user can give.

Match the lines task game. The game presents a vertical line with a horizontal crossing line. Both lines have different lengths and generate an illusion. The users have to increase or decrease the size of the vertical line until its length coincides with the horizontal one.

Line adjustment task game. The game presents a rectangular box with a line protruding from each side. Users are required to adjust the segment of the right-hand side of the box so that it lines up perfectly with the segment on the left-hand side to form a straight line. The result is a perfect straight line crossing through the rectangle.

Procedure

The study was developed in three phases: pre-test, treatment, and post-test. In the pre-test phase, each group of eight students was seated in a comfortable classroom environment and, after a period of adjustment, was informed that in order to determine their attention skills, they would be given a test. Then the PDT and the S-PMA tests were administered. Students were then assigned to the experimental or control groups according to their test scores; groups were organized as follows:

TABLE 1
Perception Differences Test (PDT) and subtest Spatial of Primary Mental Aptitude (S-PMA) tests pre- and post-phases ANOVA for experimental group, control group 1, and control group 2

	Sum of square	*df*	*Mean of square*	*F*
Pre-test S-PMA				
Between-groups	81.23	2	40.61	0.302
Intra-groups	19740.76	147	134.29	
Total	9822.00	149		0.938
Post-test S-PMA				
Between-groups	288.39	2	144.19	
Intra-groups	22445.47	146	153.73	
Total	22733.86	148		
Pre-test PDT				
Between-groups	38.28	2	19.14	0.257
Intra-groups	11323.61	152	74.49	
Total	11361.89	154		
Post-test PDT				
Between-groups	1944.14	2	972.07	10.490**
Intra-groups	13433.93	145	92.64	
Total	15378.07	147		

** $p < .001$.

Experimental group. Fifty-one students received 10 daily training sessions, of 20 minutes each, with the *How to improve your mental skills* software. Experimental sessions were carried out in the computer lab, with students seated individually in front of the computer. They practised three trial games each. Then, their scores were recorded.

Control group 1. Fifty-three students received 10 daily training sessions, of 20 minutes each, with the *Tetris* software game. These sessions were carried out in the computer lab, and students were seated individually in front of the computer.

Control group 2. Fifty-one students did not receive any computer training. They remained in the class following the ordinary learning activities.

Finally, in the post-test phase, the PDT and S-PMA tests were administered to all students.

RESULTS

Data was analysed in three different ways: (1) pre- and post-training comparison of the experimental group scores on the PDT; (2) comparison of the experimental and control groups 1 and 2 scores on the PDT and S-PMA tests after training; and (3) gender and grade interference effects on attention behaviour. In order to examine intergroup homogeneity in attention scores, Levene ANOVA was calculated. Each group had the same variance, both in the PDT test, $F(2, 152) = 0.348$, $p < .707$, and the S-PMA test, $F(2, 147) = 2.004$, $p < .133$. No significant statistical differences were found, leading to the conclusion that the groups were homogeneous.

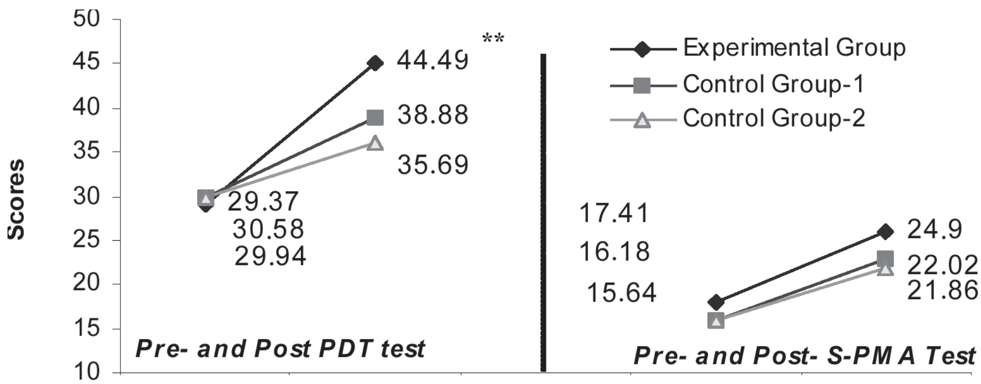

Figure 1. Pre-test and post-test experimental and control group mean scores for Perception Differences Test (PDT) and subtest Spatial of Primary Mental Aptitude (S-PMA). ** $p < .001$.

TABLE 2
Mean differences multiple comparisons for experimental group, control group 1 and control group 2 for pre- and post-phases of the Perception Differences Test (PDT) and subtest Spatial of Primary Mental Aptitude (S-PMA)

						95% confidence interval of the difference	
Dependent variable	*(I) group*	*(J) group*	*Mean differences (I–J)*	*SE*	*p*	*Higher limit*	*Lower limit*
Pre-test S-PMA	Experimental group	Control group 1	1.23	2.318	.868	–4.50	6.96
		Control group 2	1.77	2.329	.750	–3.99	7.53
	Control group 1	Experimental group	–1.23	2.318	.868	–6.96	4.50
		Control group 2	0.54	2.306	.973	–5.17	6.24
	Control group 2	Experimental group	–1.77	2.329	.750	–7.53	3.99
		Control group 1	–0.54	2.306	.973	–6.24	5.17
Post-test S-PMA	Experimental group	Control group 1	2.88	2.480	.512	–3.26	9.01
		Control group 2	3.04	2.505	.480	–3.15	9.24
	Control group 1	Experimental group	–2.88	2.480	.512	–9.01	3.26
		Control group 2	0.16	2.480	.998	–5.97	6.30
	Control group 2	Experimental group	–3.04	2.505	.480	–9.24	3.15
		Control group 1	–0.16	2.480	.998	–6.30	5.97
Pre-test PDT	Experimental group	Control group 1	–1.21	1.693	.774	–5.40	2.97
		Control group 2	–0.57	1.709	.946	–4.79	3.66
	Control group 1	Experimental group	1.21	1.693	.774	–2.97	5.40
		Control group 2	0.64	1.693	.930	–3.54	4.83
	Control group 2	Experimental group	0.57	1.709	.946	–3.66	4.79
		Control group 1	–0.64	1.693	.930	–4.83	3.54
Post-test PDT	Experimental group	Control group 1	5.61	1.935	.017*	0.82	10.40
		Control group 2	8.80	1.945	.000**	3.99	13.61
	Control group 1	Experimental group	–5.61	1.935	.017*	–10.40	–0.82
		Control group 2	3.19	1.935	.261	–1.60	7.97
	Control group 2	Experimental group	–8.80	1.945	.000**	–13.61	–3.99
		Control group 1	–3.19	1.935	.261	–7.97	1.60

* $p < .05$; ** $p < .001$.

According to descriptive statistical data (Figure 1), the post-test per-group-scores-increases in the S-PMA were 7.94 for the experimental group, 5.84 for control group 1, and 6.22 for control group 2.

Statistical differences between all groups means in the PDT post-test scores were found, $F(2, 145) = 10.492$, $p < .001$ (Table 1). An a posteriori ANOVA was calculated to show which groups demonstrated significant differences. Data revealed that comparisons between the experimental group and control group 1 (mean differences = 5.61, $p < .017$), and experimental group and control group 2 (mean differences = 8.80, $p < .001$) were statistically different (see Table 2).

A deeper analysis of the *a posteriori* ANOVA confirmed significant differences in the PDT post-test, $F(2, 145) = 10.492$, $p < .001$. Similar differences were found between the experimental group and control group 2. Mean differences between both groups was 8.80 ($p < .001$). Finally, nonsignificant differences were found between control group 1 and control group 2 (means = 16.18 and 15.64, respectively).

In order to compare data for the experimental group, both test scores (PDT and S-PMA tests), and pre-test and post-test period, a Student *t* for related samples was calculated (see Table 3). Both measurements exhibited significant differences, S-PMA $t(46) = –6.42$, $p < .001$; PDT $t(48) = –11.89$, $p < .001$.

PDT test values were more significant than S-PMA test values. Also, pre-test and post-test, significant

TABLE 3
Student *t* of the experimental group after the pre- and post-Perception Differences Test (PDT) and subtest Spatial of Primary Mental Aptitude (S-PMA) scores

	Pair 1 Pre S-PMA - Post S-PMA	*Pair 2 Pre PDT Post PDT*
Paired differences		
Mean	–7.83	–15.06
SE	8.60	8.86
Standard error	1.25	1.27
95% CI of the difference		
Lower	–10.35	–17.61
Higher	–5.31	–12.52
t	–6.24 **	–11.89**
df	46	48

** $p > .001$.

differences for control group 1, $t(49) = -7.1415$, $p < .001$, and control group 2, $t(43) = -3.215$, $p < .002$, were found. This data suggests that nonsystematic experience with computer games, the passing of time, and the learning effect itself would also improve students' attention behaviour. But the data also suggest specific effects of the CAI training procedure, considering the experimental design used. Although the experimental and control groups improved their attention behaviour, the independent variable used with the experimental group was training with a piece of software, in contrast with the nonspecific training used for control group 1, and no computer training at all for control group 2.

Feeling that age, gender, and grade would produce the same interference effect on the children's attention, an intersubject factorial analysis was calculated. Nonsignificant differences for grade, $F(2, 142) = 0.398$, $p < .673$, and gender were found: PDT post-test, $F(1, 142) = 0.183$, $p < .669$; S-PMA post-test, $F(1, 142) = 1.394$, $p < .24$. We did not detect interaction differences in either variable. Similar results were found with the age variable: PDT, $r = .058$; S-PMA, $r = .118$.

DISCUSSION

Data suggest that children from the experimental group significantly improved their attention behaviour, assessed by PDT and S-PMA tests, after 10 training sessions with the *How to improve your mental skills* computer software. A more qualitative analysis verified that gain was primarily obtained in the PDT rather than the S-PMA test. S-PMA is a test in which not only attention, but also spatial reasoning, is necessary for performance, whereas the PDT test specifically assesses attention. Given this, it would be reasonable to consider that the better scores obtained by students in the PDT test (and after 10 training sessions), represented a continuous attention gain. Therefore, specific and systematic computer software, designed to improve attention, would be effective in maintaining attention behaviour.

In that sense, a CAI approach would also be considered effective in improving attention (DuPaul & Eckert, 1998). The related practical impact of this effect would be substantial, since consolidation of attention resources during childhood would reduce future low school performance and other school adjustment troubles (Roznowski, Dickter, Hong, Sawin, & Shute, 2000).

It was noted that, after CAI training, students improved their attention scores. Results also suggest that control groups1 and 2 improved their attention behaviour, although it was meaningfully lower than in the experimental group (Figure 1). Since learning and the running time effects were controlled by control group 2, PDT and S-PMA test score differences found in the post-test phase cannot be functions of those variables. Students from control group 2 remained in the classroom all the time, following standard school activities.

On the other hand, the specific effect produced by CAI was neutralized by control group 1 receiving 10 training sessions with an unspecific computer game. Comparison between the experimental group and control group 1 is essential for this study. Alcalde et al. (1998) and Marchena et al. (1998) suggested that CAI is not a substitute for the teacher, but it could help as an efficient teaching tool. The CAI approach involves users maintaining visual and aural attention to displayed stimuli (Sweeters, 1994). This is an efficient strategy to improve continuous attention behaviour. So, pre- and post- PDT test differences for the experimental group were significant. In fact, the comparison of data between all three groups showed better results for the experimental group than for the control groups (Table 2). Students playing with the *Tetris* computer game (control group 1) and students remaining in the classroom (control group 2) improved post- attention tests scores, but they did so to a lesser degree than the experimental group.

These results suggest a positive perspective for improving attention behaviour in children. So, multimedia computer design constitutes another teaching support. Its versatility and easy use (Howell & Navarro, 1997; Lajoie & Derry, 1993) would establish CAI as an additional teaching approach. In order to assess this new procedure appropriately, more specific and contrasted software is required.

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REFERENCES

Alcalde, C., Navarro, J. I., Marchena, E., & Ruiz, G. (1998). Acquisition of basic concepts by children with intellectual disabilities using a computer assisted learning approach. *Psychological Reports, 82,* 1051–1056.

Bard, C., Fleury, M., & Gonlet, C. (1994). The relationship between perceptual strategies and response adequacy in sports situations. *International Journal of Sport Psychologists*, *25*, 266–281.

Barkley, R. (1990). *Attention Deficit Hyperactivity Disorder*. New York: Guilford Press.

Deborah, L., McGee, A., & Ungar, S. (1998). Issues in the development of a computer-based safety program for children with severe learning difficulties. *Child Abuse Review*, *7*, 343–354.

DuPaul, G. J., & Eckert, T. L. (1998). Academic interventions for students with attention-deficit/hyperactivity disorder: A review of literature. *Reading and Writing Quarterly: Overcoming Learning Difficulties*, *14*, 59–82.

Glutting, J. J., Robins, P. M., & de Lancey, E. (1997). Discriminant validity of test observations for children with attention deficits/hyperactivity. *Journal of School Psychology, 35,* 391–401.

Howell, R., & Navarro, J. I. (1997). Ayudas tecnológicas en las aulas de integración de alumnos con necesidades educativas especiales. [Technological support in the special education setting for children with special educational needs]. *Revista de Educacion, 313*, 313–324.

Kail, R. (2000). Speed of information processing. Developmental change and links to intelligence. *Journal of School Psychology, 38*, 51–61.

Kauchak, D., & Eggen, P. (1998). *Learning and teaching: Research based methods* (3rd ed.). Needham Heights, MA: Allyn & Bacon.

Lajoie, S. P., & Derry, S. J. (Eds.). (1993). *Computers as cognitive tools*. Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Lavely, L., Townsend, M., & Wilton, K. (1998). Computer-assisted instruction in teaching literacy skills to adults not in paid employment. *Journal of Educational Studies*, *2*, 181–192.

Marchena, E., Alcalde, C., Navarro, J. I., & Ruiz, G. (1998). Formación de conceptos en alumnos de educación infantil mediante instrucción asistida por ordenador. [Training pre-school children in basic concepts with a CAI]. *Psicothema*, *10*, 75–83.

Marlin, M. W., & Foley, H. J. (1996). *Sensation and perception*. New York: Allyn & Bacon.

Moreno, R., & Mayer, R.E. (2000). Engaging students in active learning: The case for personalized multimedia messages. *Journal of Educational Psychology*, *92*, 724–733.

Naglieri, J. A., & Rojahn, J. (2001). Gender differences in planning, attention, simultaneous, and successive (PASS) cognitive processes and achievement. *Journal of Educational Psychology*, *93*, 430–437.

Navarro, J. I., Ruiz, G., Alcalde, C., Marchena, E., & Amar, J. (1996). *How to improve your mental skills. Educative software.* Cadiz, Spain: University of Cadiz, Department of Psychology.

Nervwirth, S. (1994). *Attention deficit disorders*. Washington DC: NIMH.

Nicol, M. M., & Anderson, A. (1997). Computer-assisted versus teacher-directed teaching of community living skills in people with a mild learning disability. *Journal of Occupational Therapy*, *60*, 498–502.

Pascual-Leone, J., & Baillargeon, R. (1994). Developmental measurement of mental attention. *International Journal of Behavioral Development, 17*, 161–200.

Posner, M. I. (1992). Attention as a cognitive and neural system. *Current Directions in Cognitive Science*, 1, 11–14.

Posner, M. I., & DiGirolamo, G. J. (2000). Cognitive neuroscience: Origins and promise. *Psychological Bulletin*, *126*, 873–889.

Posner, M. I., & Peterson, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience*, 13, 25–42.

Rief, S. F. (1993). *How to reach and teach ADD/ADHD children*. New York: Prentice Hall.

Rosello, J. (1997). *Psicología de la Atención. Introducción al estudio del mecanismo atencional*. [Psychology of attention. Introduction to attentional processing]. Madrid: Eudema.

Roznowski, M., Dickter, D. N., Hong, S., Sawin, L., & Shute, V. (2000). Validity of measures of cognitive processes and general ability for learning and performance on highly complex computerized tutors: Is the *g* factor of intelligence even more general? *Journal of Applied Psychology*, *85*, 940–955.

Sweeters, W. (1994). Multimedia electronic tools for learning. *Educational Technology, 4*, 47–52.

Tesauro, M. (1994). Necesidad de crear programas informáticos de calidad para mejorar el rendimiento intelectual. [It is necessary to create quality software in order to improve intellectual performance]. *Comunicación, Lenguaje y Educación*. *22*, 97–102.

Thurstone, L. L., & Thurstone, Th. G. (1996). *Primary Aptitude Test.* Madrid: TEA.

Thurstone, L. L., & Yela, M. (1985). *Perception Differences Test*. Madrid: TEA.