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Influence of green vegetation on children's capacity of attention: a case study in Florence, Italy

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Abstract: **In the present study we compared the effects on primary school children's capacity of attention of a garden dominated by green vegetation with those of a classroom lacking natural elements. Eighty pupils, eight and 10 years of age of similar education and intellectual faculties, were chosen to solve the so-called "Trail making test". Results showed that garden exposure significantly improved the attention of children. Implications of this finding are discussed in terms of guiding school policy and design.**

1. Introduction

Life in an urban setting can be both physically and mentally stressful. Under these conditions a substantial amount of vegetation is of paramount importance not just to improve environmental conditions, but also for human health and well-being. A body of research has emphasised the relationship between the presence of plants in urban areas and stress reduction. Bennett and Swasey (1996) proved that urban residents visit public gardens to relax, reduce stress and for a sense of restoration. Honeyman (1991) measured, by means of physiologic parameters, the sense of relaxation and calm coming from looking at plants, even in pictures. Patients spending their convalescence in rooms facing a garden recover more quickly than those sheltered in rooms with windows looking out on buildings (Ulrich, 1984).

In the last year special attention on the positive effects of plants on children and teen-agers has been posed. Horticultural and gardening programs in the primary schools teach children to know and respect natural rhythms, to finish a labour with care, to work together to realize and maintain their project. Moreover, theoretical and empirical work in landscape architecture and environmental psychology has addressed numerous possible other benefits of nature for children, including providing privacy (Nabhan and Trimble, 1994; Trancik and Evans, 1995), mental stimulation (Faber Taylor *et al.*, 1998), sensory stimulation (Strinisteand Moore, 1989) and supporting important developmental activities such as play (Miller, 1972; Moore, 1986 a, 1989), creative forms of play (Jansson, 1984), and exploratory and divergent thinking (Heseltine and Holborn, 1987; Kirkby, 1989; Senda, 1992). Nevertheless, among this plethora of studies, only a few papers have raised the question of nature's potential impact on children's attention (Trancik and Evans, 1995; Wells, 2000; Faber Taylor *et al.*, 2001).

The study described here evaluates the effectiveness of the presence of plants in improving children's and students'learning ability. The specific objective was to determine whether exposure of primary school children to nature could influence their capacity to direct attention, defined as the capacity to inhibit or block distractions during purposeful activity, such as noise in the external environment or worries in the internal one (Posner and Snyder, 1975; Kaplan and Kaplan, 1982 a).

The present study compared the attention-improving effects of a garden dominated by green vegetation with those of a classroom lacking natural elements. Findings showed that garden exposure significantly improved the attention of primary school children engaged in the simple task of taking an easy test.

2. Materials and Methods

This research was conducted at the primary school "Andrea del Sarto" in Florence housed in ancient building in the area of the urban park of "San Salvi" (about

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10 ha area) and surrounded by a large garden planted with trees where children can meet and play.

A total of 80 pupils, with similar education and intellectual faculties, participated in this study. They were chosen to solve the so-called "Trail making test" (TMT). TMT was standardized by Partington and Leiter (1949) who found the test to be a good predictor of general mental ability. The test is used to point out skill in perceiving visual and spatial stimuli and in changing from a numerical stimulus to an alphabetical one. Around 1944 the test became part of the Army Individual Test of General Ability, and is now part of the Halstead-Reitan Test Battery. It consists of two parts (Fig. 1): A) in as little time as possible the subject has to connect, with a stroke of a pen, the numbers from 1 to 25 according to increasing order. The encircled numbers are randomly spread across a sheet of paper (210 x 297 mm); B) on a sheet of paper are written the numbers from 1 to 10 and the letters from A to L; the subject has to connect every letter to the corresponding number (1-A; 2-B; 3-C, etc.) in as little time as possible.

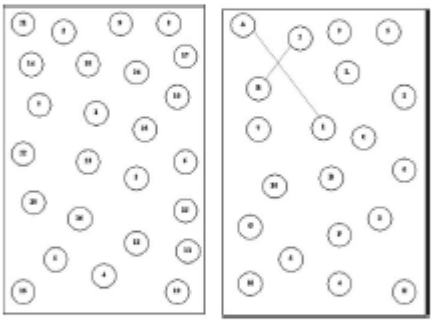

Fig. 1 - Trail making test. Trial A (left): in the shortest time you have to connect, with a stroke of a pen, the numbers from 1 to 25 according to an increasing order. Trial B (right): you have to connect every letter (from A to L) to the corresponding number (from 1 to 10) in the shortest time.

Normally, the entire test can be completed in 5 to 10 minutes. TMT evaluates numerous processes (Kay, 1984), such as:

1) Spatial organization, graphomotor speed, recognition of numbers, visual pursuit, vigilance and number sequences.
2) Part A evaluates the process of rote memory.
3) Part B is associated with distinguishing between numbers and letters, integration of two independent series, ability to learn an organizing principle and apply it systematically, serial retention and integration, verbal problem solving, and planning.

Both parts are simple and anonymous; they are preceded by an example to aid understanding. The example is exactly like the test and helps to understand and solve it in the best way. TMT does not violate privacy and does not upset the performer; an especially important aspect when working with children.

Children were divided into two groups (40 each): one composed of fourth year students (ten-year-old pupils); the other of second year students (eight year olds). The same-aged children had normal intellectual faculties and they were prepared in a similar way. Ten-year-old pupils were subjected to both tests (A and B), whereas the younger ones did only test A.

Half of the students in each group (20 elements) took the trails individually, in the presence of a teacher and an operator, in a room without vegetation (the linguistic lab); the other half did the same in the school garden (Fig. 2). Trials were timed by an operator. He began timing when a child started solving the test and stopped when he completed it correctly; if the child made a mistake, the operator corrected him and then let him continue while the clock remained running.

Fig. 2 - Places where children took the trials: linguistic lab (above) and garden (below).

All the data derived from the tests were subjected to ANOVA using the program Statistica version 4.0 (Statsoft, Inc.).

3. Results and Discussion

Significant correlations were found between the time needed to solve the test and the place where the test was taken (Table 1). The second year pupils took an average time of 178 s to solve test A in the lab (maximum 260 and minimum 122 s) and 142 s in the garden (maximum 190 and minimum 102 s). These data put in evidence a significant average difference of 36 s in favour of the children who took the trial outdoors in the presence of vegetation.

Table 1 - Impact of different environments on the time needed by children of different ages to solve the *trail making test*

Class	Place	Test	Mean time (s)	s.d.	P value	Minimum (s)	Maximum (s)
Second	Lab	TMT-A	178	9	*	122	260
Second	Garden	TMT-A	142	6	*	102	190
Fourth	Lab	TMT-A	145	7	***	85	220
Fourth	Garden	TMT-A	99	8	***	64	178
Fourth	Lab	TMT-B	118	11	***	64	290
Fourth	Garden	TMT-B	65	4	***	42	101

In the lab the fourth year pupils took an average time of 145 s (maximum 220, minimum 85 s) to solve test A and 118 s for test B (maximum 290, minimum 64 s). In the garden the average time fell to 99 s (maximum 178, minimum 64 s) for the first trial and 66 s (maximum 101, minimum 42 s) for the second one. Also in this case, being surrounded by vegetation helped to save time: on average, 45 s for test A and 52 s for test B (Table 1).

Even if we exclude the extreme values from the results (maximum and minimum times from each group), we obtain significant differences (Table 1).

It is important to emphasise that the linguistic lab is a quiet room, whereas in the garden, pupils involved in the trials were exposed to noise from the street close by and to other "disturbing" factors like wind and excessive warm temperature. However, pupils of the "Andrea del Sarto" primary school usually spend much time in the garden, studying or just walking with their teachers. As a result they are inured to staying outdoors in contact with nature and they did not mind the windy and hot weather of the test day.

The notion that exposure to the natural environment positively affects human well-being has been discussed in many papers showing measured cognitive, psychological, and physiological benefits. Among these, numerous studies have documented children's preference for natural green spaces. According with Wells and Evans (2003) children's preference for green natural spaces is a direct corollary of human evolution. Preferred environments are likely to afford long-term survival and are likely to be the settings in which humans are more likely to function effectively (Kaplan and Kaplan, 1982 b; Ulrich, 1983; Zube *et al.*, 1983; Kaplan and Kaplan, 1989; Parsons *et al.*, 1998). Numerous studies have documented that children's preferred environments include a predominance of natural elements (Korpela, 2002). For example, Moore (1986 b) reported that when urban children aged 9 to 12 were asked to make a map or drawing of all their favourite places, 96% of the illustrations were of outdoor places. The children's most frequently drawn favourite places were lawns, playgrounds and schoolyards, their own home, local parks, and single trees. Sebba (1991) reported that when asked to describe the most important or preferred place of their childhood, a large part of adults indicated outdoor places. When examining both British and Caribbean children, Sobel (1993) found that children generally preferred natural play spaces. In his study on the experience of growing up in cities, Lynch discovered a general appreciation for vegetation: younger people frequently suggested that more trees should be planted in the urban environment. "The hunger for trees is outspoken and seemingly universal… Landscaping should be as essential a part of the basic infrastructure of a settlement as electricity, water, sewer, and paving" (Lynch, 1977). Given the evidence, it is reasonable to expect that green natural settings, preferred by children, would also have a beneficial effect on children's well-being. More recently, Faber Taylor and co-workers (2001) documented that activities in green settings tend to reduce symptoms in children who struggle with a chronic attention deficit due to Attention Deficit Disorder (ADD).

The results of our research are consistent with previous studies confirming that the environment plays an important role in children's development. Children spend as many as 40-50 hr per week in institutional and out-of-home care situations; so the play yards associated with these settings become one of the most important places where they have experiences with nature (Herrington and Studtmann, 1998). Landscape designers have to realize that the plan of an outdoor play space can influence the different aspects of children development, i.e. social, cognitive, and emotional (Whiteouse *et al.*, 2001); they have to create interesting and stimulating places, especially around schools, where children spend so much time. Since the pioneering work of Jean Piaget, Rudolf Steiner and Maria

Montessori, a lot of scientists and educators have recognized that a rich, multi-sensory learning environment is essential for the cognitive and emotional development of a child. A school garden, with its shapes and textures, colours, smells and sounds, can be beneficial for the development of the growing child and the school community.

4. Conclusions

Results of this study confirm that even a brief exposure to the natural environment may have some beneficial effects on children's capacity to direct attention. The green environment at school may play a far more significant role in the well-being of children than has previously been recognized. The notion that nature plays a positive role in improving children's performance at school has a number of implications, mainly for policy and for the design of school children's environments. Green schoolyards, enhancing the children's attentional capacity, could play a central role in the improvement of pupils'academic performance. Access to vegetation and natural areas can help in the attenuation of adverse affects of stressors often encountered by children in the first years of school. However, further research to explore the features of the nature-attention relationship, and with regard also to the effects of different types of green areas, are needed.

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