

A little bit of nature, a big influence



*"By limiting their contact with nature,
people fail to maximize the advantages
it offers for cognition and well-being"*

Elizabeth K. Nisbet and John M. Zelenski in Psychological Science.

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Trees, gardens and parks are indispensable in urbanised areas. A house with a green view is much preferred to one without it. Why? What is nature's influence on the human brain? IVN (Institute for Nature Education and Sustainability) asked science journalist Mark Mieras to put all the research together, and a little bit of nature appears to have a surprisingly large influence. It acts as a refuge for the mind.

With a population density of 490 citizens (2010) per square kilometre, The Netherlands is one of the most densely populated countries in the world. Only Bangladesh, Taiwan and South Korea are populated more densely. Two-thirds of Dutch citizens live in urbanised areas, where together they are squeezed onto only 14 percent of the Dutch ground surface. That density means that less tarmac is needed per citizen, that fewer kilometres are driven and that public transportation can be used more often. Urbanisation is a blessing for nature and the environment.

There also are disadvantages. People who live in the city are 21 percent more likely to suffer from anxiety disorder and 39 percent more likely to suffer from depression. On top of that, urban people are 50 percent more likely to suffer from schizophrenia. Even when economic and social differences between the city and the countryside are taken into consideration, the increased chance of having psychiatric disorders remains.^{1,2} Apparently, that is what an urban habitat does to humans. It is significant that children who move to the city after their 15th birthday do not have an increased chance of developing schizophrenia; schizophrenia is a developmental disorder.

Thus citizens pay a price for urbanisation. Growing up and living in an 'urbanised' environment imposes a heavy burden on people's vitality. How is that possible? What are the effects of the city and nature on our brains? These questions will be answered in this literature study.



City children develop different brains

Children's brains are significantly shaped by activities and circumstances. For example, playing a musical instrument has a great influence on how the brainstem processes sound.^{3, 4} It has also been established that habitat is an influential factor for humans and animals. An example of this is that blackbirds in the city sing louder than blackbirds in the forest⁵ due to the background noise. Their aural and vocal centres develop differently. People who grow up in urbanised cultures, such as Japanese or British people, trust their eyes more than people from rural cultures, such as the Himba in the barely urbanised North Namibia. British and Japanese people take a 'global view' that is sensitive to context. The Himba are better at judging details.⁶

What is more, the emotional systems of city dwellers work differently. They handle social stress differently than people from the countryside. German researchers had test subjects perform a difficult task and then criticised them. The aim of the research was to measure how their brains would react to the social pressure. One might expect that the city dwellers, who are used to getting in each other's way, would find it easy to let the criticism go. However, that was not the case. Those who were exposed to the social pressure of the city at a young age seemed to be extra sensitive to this when they grew up. Or, at least, more sensitive than children who grew up in villages. And villagers were more sensitive than people who spent their childhood in the countryside.^{7, 8}

When experiencing criticism, the city dwellers had the most brain activity in the front of the cingularis. This is where the 'oops-centre' is located. This centre warns an individual when something goes wrong, for example standing on somebody's toe or forgetting to give way. This part of the brain also plays a part in processing emotions related to rewards and punishment. The researchers found that the people who lived in the city had increased activity in the amygdala when they were criticised. This emotional centre is involved in reactions such as fear, threat or processing facial expressions. It also plays an important part in anxiety disorders and depression.

Urbanisation makes us city dwellers who can live without a lot of space. The downside is that we then struggle more with social stress. If this becomes chronic stress, it can have a profound impact on our health. Stress changes eating patterns, which can easily cause obesity. Furthermore, it can damage the immune system, increase the chance of having heart and vascular diseases and even negatively affect people's brains. Social stress is involved in developing burnouts, anxiety, depression and schizophrenia.



People who grow up in the city exhibit a greater visible increase in activity of the frontal part of the cingulate when they experience social stress than people who grow up in a village or the countryside. This part of the brain detects mistakes and processes emotions related to rewards and punishments.

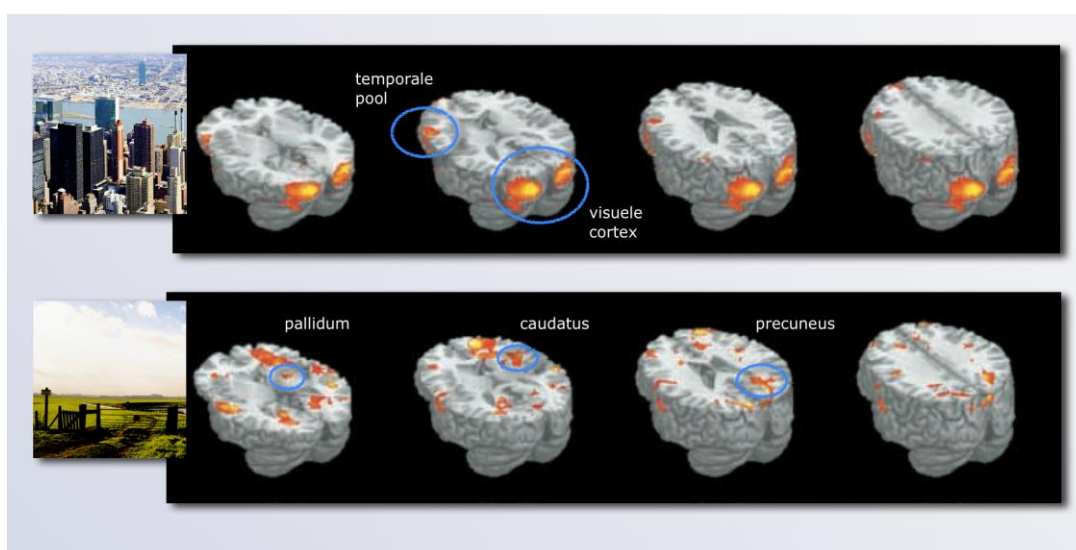
A low threshold for the effect of nature

Statistics show that having nature in the city helps to maintain our health. Researchers from the University of Glasgow analysed public health data from 268 urban areas in England and found a direct relationship between public health and the presence of parks and forests. More nature equalled a longer lifespan and fewer suicides. The bigger the nearby green area, the bigger the effect.⁹ A Japanese study found that elderly people seemed to live longer if they lived close to a park.¹⁰ And Danish and Canadian researchers found a negative relationship between the presence of parks and obesity.^{11, 12}

The threshold for the 'nature effect' appears to be surprisingly low: a little bit of nature makes a difference. In a study at the University of Cornwall, researchers mapped the amount of nature children could see from their windows. Even after taking social and economic differences into consideration, there still seemed to be a striking relationship between the two. The more nature the children could see, the better they could handle stressful life experiences.¹³

Even in an indoor laboratory there is a clear difference when test subjects, who are lying in a tight, noisy MRI scanner, look at pictures of the forest, mountains or meadows. The pictures of nature caused an increased activity in the aural cortex (listening), the pallidum (free movement), caudate (sense of value) and precuneus (consciousness and reflection). This combined activity can be seen as an 'inner experience'. Pictures of buildings that were used as a contrast activated externally focussed activities with high peaks in the visual cortex (seeing) and the temporal pole (consideration for others).¹⁴

A picture of nature or a view of a single treetop already makes a measurable difference. But the biggest effect is measured when test subjects are 'in nature' and unable to see any buildings or roads.¹⁵



When people look at pictures of the city, their visual centres are very active, as is their temporal pole (consideration of others). When they see pictures of nature, there is noticeable brain activity in the centres for self-consciousness, free movement and sense of value.¹

A refuge for attention

Trees and plants change the mindset of city dwellers: it shifts from watchfulness and a focus on the visual and social outside world to a focus on oneself and reflection. How is that possible? Scientists seem to agree that the attention system plays a key role.¹⁶ People can concentrate better – they have more control over their attention – after a walk through the park or a cup of tea in the garden. This is because their brains are no longer exposed to the overwhelming stimuli in urbanised areas. This Attention Restoration Theory has been tested extensively and confirmed in recent years.

Attention is a gateway through which all experiences have to pass before we can assign meaning to them. To do so, information from the entire brain needs to be put together. It is a complicated process that asks a lot of the brain's capacity. That is why the 'gateway' is narrow and experiences need to squeeze themselves in.

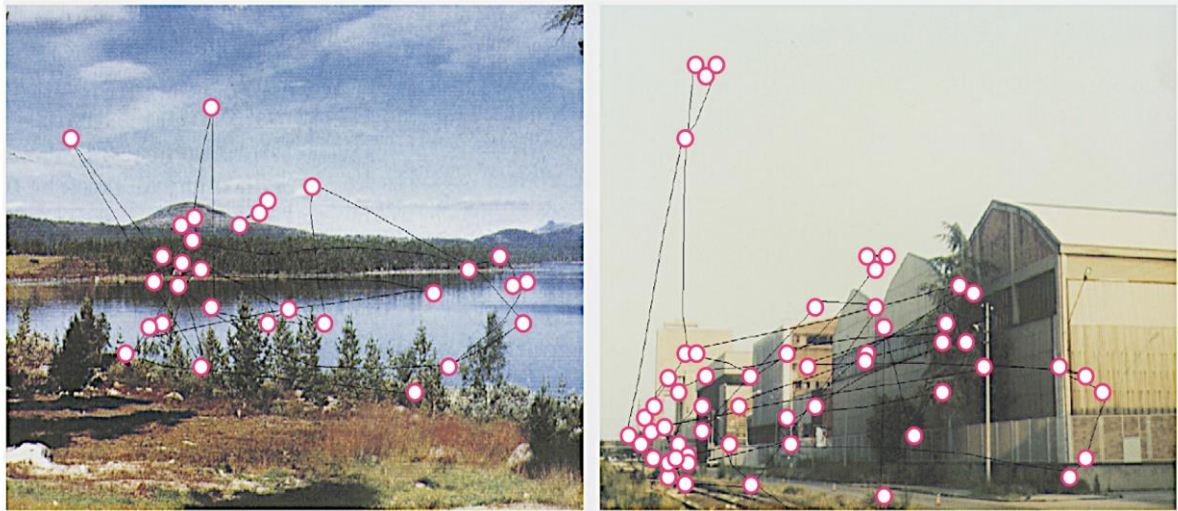
There are two attention systems that hinder each other. The first one is controlled by outside stimuli, by sounds, colours and movement. This 'involuntary attention' runs after everything we hear and see like a young puppy. The second system consists of 'focussed attention' (or executive attention) which shapes our inner plans and goals. This focussed attention plays an important part in learning.

City and nature have different influences on the two systems. Test subjects who are looking at pictures of urban areas move their eyes up and down more quickly and fixate on details more often than they do when they

look at pictures of nature. This fixation shows that involuntary attention is used more strongly in urban areas.¹⁷ The focussed attention has to work hard to get the attention back every time, which is not good for the reserves of the neurotransmitter dopamine. When the battery is empty, the focussed attention has to work even harder, which makes the working memory worse. This makes self-control more difficult, which makes it more difficult to resist the temptation to have a snack. The effect is comparable to being a little bit sleep deprived, which we know can lead to obesity.



Involuntary attention also compromises our ability to reflect. Thinking about oneself and others, combining new knowledge with existing knowledge: these are activities of the default mode network ('fall-back network'). This network gets its name from the fact that it is almost exclusively active when the brain has no other activity to give priority to. As long as involuntary attention keeps the mind busy, the reflection network is at a low ebb.¹⁹



Our eyes move differently when we look at an urban area than they do when we look at nature. Our eyes fixate more often at the same time, which shows that they zoom in and out on details. Attention seems to be strongly directed by external stimuli.¹⁷

Reflection plays a key role in dissolving stress.²⁰ That is probably why people who look at barren streets and buildings cannot handle social stress as well as people who have a tree or a patch of flowers in their sight. Their minds have less space to process experiences.

A natural habitat forms a refuge for the overloaded mind. Trees and plants are not only low in stimuli, but they also evoke mild fascination.²¹ Fascination dims involuntary attention, creating peace and allowing focussed attention, working memory and self-control to recover.

Many studies have confirmed the refuge-effect. A study involving 169 urban children in Chicago found a relationship between scenery filled with trees and characteristics such as self-control, self-discipline and delayed gratification.²²

Another study, this one conducted in the American city of Ann Arbor, tested the attention of 38 subjects. Afterwards, the subjects were asked to take a 50-minute walk. One-half of the group had to take this walk downtown and the other half was allowed to go to the Arbor Arboretum, a park next to the University of Michigan. When both groups

returned to the task, the group that had walked in the park had considerably better results.²³ The study also found that looking at photographs of nature or a city had a significant effect on focussed attention. This also occurred when test subjects watched a black and white nature film.²⁴

Another experiment asked subjects to watch camera footage of a park on a high-quality television screen. The effect on focussed attention was measurable, but was much less than when subjects looked at the same view through a window.

Stimuli-finding strategies

Children with ADHD are especially sensitive to the sensory overwhelming urban habitat. That is why they benefit even more from trees and plants. After children with ADHD took a 20-minute walk in a park, researchers found an increase in focussed attention that was greater than when they walked in a residential area or city centre. Researchers advocate for 'a daily dose of nature' as an integral part of guiding this group of children.

People with ADHD are influenced by their surroundings. Their attention jumps involuntarily from stimulus to stimulus, like a puppy. Almost everyone can recognise this behaviour in their own activities, such as watching television, surfing the internet or checking e-mail. Many people have a hard time controlling this type of behaviour.²⁸



The symptoms of ADHD look like a magnified version of the stimuli-finding strategy that the brains of all city dwellers develop. Research conducted on Himba people who moved from a natural habitat to urbanised areas is a fine example of this.²⁹ To survive in their new,

unclear, fragmented habitat, their brains quickly got used to letting their attention be guided by their surroundings. Cognitive tests found that this negatively affected their active control over attention. The urbanised Himba were less attentive and more quickly distracted than their family in the fields under the same circumstances. This change was not connected to age.

The brains of city dwellers often fall into the trap of underestimating consequences. An experiment at the University of Ottawa instructed test subjects to walk outdoors along the Rideau Canal, a green belt in the city. A control group walked through underground tunnels. Before the walk, the subjects were asked to complete a questionnaire that asked what they thought the influence of the walk would be on their sense of relaxation and pleasure. This was significantly overestimated by the tunnel walkers and underestimated by the nature walkers.

City dwellers prefer to overburden their attention system, which is not odd. After all, people who are used to being guided by external stimuli in their surroundings are naturally more attracted to a stimulus-rich environment than to a low-stimulus environment, like a park. The same phenomenon has been studied in switching between media. People who find it difficult to flexibly focus their attention more often use multiple media simultaneously. Precisely the fact that they cannot focus their attention as well as others causes them to attempt to do everything at once, which overburdens their attention even more.³¹ This is a vicious circle: we turn our backs on nature because we feel alienated from it.

Nature makes playing outside appealing

Alienation from nature has broader consequences for our children. Dutch children who grow up in a habitat without nature play outside less often, even when the data is corrected for social and economic differences.³² Apparently, pavement is not as appealing for playing outside as nature is.

Playing outside less often is a trend that has been rising in recent decades.^{33, 34} The rise of iPads and game consoles seems to have sped up this process. The discussion on this mainly focuses on the physical consequences. Children have to play to expend their energy; otherwise, they gain too much weight and are too energetic. Playing outside is also important for their emotional and cognitive development, a fact supported by numerous studies.

A part of this research focussed on the cognitive effects of physical exertion. Children who move a lot study better afterwards. That does not even have to involve going outside; you can achieve the same result by walking on a treadmill. At the University of Illinois, researchers asked 20 nine-year-olds to walk on a treadmill for 20 minutes. Before and directly after the exercise, the children had to complete a cognitive task. The second measurement found considerably more activity.³⁵

Results on reading tests were also better under these circumstances. The effect was not found for the next part of the programme: mathematical exercises. Researchers say that this is because the children's brain activity had already decreased again. Ideally, children should be able to run a little every hour. The more physical exercise they get, the better their results. A paved playground with goalposts and basketball hoops is sufficient,

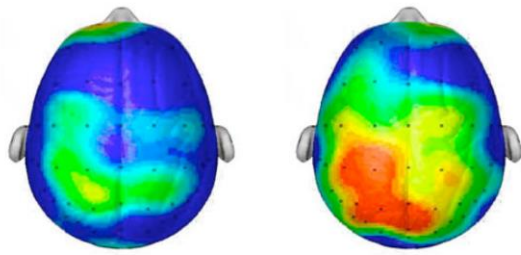
preferably with a PE teacher to make sure all the children are taking part. In some areas of the US, this is already a trend: breaks are organised like a PE class.

The growing research field 'embodied cognition' is establishing a link between cognitive and physical activity. Children who feel good in their bodies perform better in class.³⁶ Children who make gestures when they are solving problems understand them better afterwards. And children who imagine operations physically remember them better. So it is not only about physical effort, but also about being attentive to the body.

Finally, the research into play behaviour has found clues that support the cognitive importance of what happens on the schoolyard. Children who play a lot develop into better divergent thinkers.³⁹ Playing also contributes to good behaviour during class.⁴⁰ Play fascinates and helps to recharge the focussed attention so the student can concentrate on the content of the next lesson once they are back in the classroom.⁴¹

Altogether, playing outside is valuable to the development of a child. This involves physical and social skills, but also reading and calculating.⁴² Psychologists warn that unstructured playtime is different from structured, physically active playtime: both are valuable, but they are not interchangeable.⁴³ Different studies have found that an open, unstructured play environment encourages exploratory discovery.⁴⁴ This type of game requires a play environment that is safe and helps to reduce stress, an environment that fascinates and tempts the child to explore, reflect and daydream. A varied natural environment with

plants and trees provides better conditions for this than a flat paved area.



Walking for twenty minutes increases the brain activity of nine-year-old children. See the EEG pattern before the walk (left) and afterwards (right).³⁵

Conclusion

Nature reserves, parks, trees and gardens are a refuge for the mind. There is robust scientific support for this presumption. Even little bits and pieces of nature contribute to our focussing system and help us endure social stress. A short walk or a view of a leafy canopy helps people restore cognitive functions and enables them to function socially.

However, city dwellers have a complex relationship with nature. People who grow up in an urbanised area are more sensitive to stimuli from their surroundings and stress. Therefore, these people have a higher need for nature. But they are less inclined to go into nature. Due to the influence of all the stimuli, their brains develop a stimuli-finding strategy that operates at the expense of their active control over their attention and self-control. This lack of self-control leads them to fall into life patterns filled with pressure and stress.

The gradual decrease in time spent playing outside strengthens this vicious circle. Urban children tend to be cut off from three coping strategies: experiences in nature, physical exercise and experimental discovery. This is why it is logical to assume that education about nature, natural play opportunities and green schoolyards contribute to health and a good learning environment. Acclimating and interesting children in nature is valuable. It is a basic tool for living a healthy life and becoming successful in an urbanised area.

Mark Mieras is a physicist, science journalist and book author specialised in brain development. He wrote 'Is that me?' (*Ben ik dat?*) and 'Love' (*Liefde*) among other books. An abbreviated version of this study about the effects of nature can be found (*in Dutch*) at www.ivn.nl

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