NEWS RELEASE

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Vertical greenery can act as a stress buffer, NTU Singapore study finds

Vertical greenery 'planted' on the exterior of buildings may help to buffer people against stress, a **Nanyang Technological University, Singapore (NTU Singapore)** study has found.

The benefits of nature on mental health and for wellbeing have long been recognised, and now a team of NTU Singapore psychologists has used Virtual Reality (VR) to examine whether vertical greenery has a stress buffering effect (ability to moderate the detrimental consequences of stress) in an urban environment.

Using VR headsets, 111 participants were asked to walk down a virtual street for five minutes. Participants were randomly assigned to either a street that featured rows of planted greenery (e.g., on balconies, walls, and pillars of buildings), or one with only buildings that had green painted walls in place of green plants. The virtual environments used in the study was developed by the NTU research team.

To match a real-world experience, heavy traffic noise was played as the participants walked through the virtual street. Heart rate variability, which is a physiological indicator of stress, was continuously monitored using a portable electrocardiogram (ECG) device.

The study found that those who viewed buildings which only had green paint experienced a significant increase in stress as recorded by one measure of heart rate variability, while those who viewed the buildings with the green plants did not experience any change in stress.

Following the experiment, participants answered a questionnaire that assessed their positive (e.g., interested, excited) and negative emotions (e.g., upset, hostile), and the level of anxiety they were feeling.

Participants reported feeling less positive when walking through the street with buildings covered by only green walls, while those walking through the street with buildings covered by plants did not report feeling either more or less positive.

The findings published in the peer-reviewed academic journal *Landscape and Urban Planning*, have implications for the well-being of people living in urban areas and can guide greening efforts in cities, say the researchers.

Walls of greenery can help lower ambient temperature, which reduces energy consumption from cooling systems. They can also reduce carbon emissions and lessen the effect of 'urban heat island' – a phenomenon where city centres experience much warmer temperatures than less populated areas because of limited greenery and a high concentration of built structures.

While vertical greenery is often planted for these sustainability benefits, the NTU study is one of the first to explore its contribution to mental health, and the authors say that it provides additional impetus for city planners to adopt a 'biophilic design' concept – an approach to architecture that seeks to connect people more closely to nature – which is favoured in cities such as Singapore, Wellington (NZ), and San Francisco.

Principal investigator of the study, **Associate Professor Lin Qiu from the Psychology programme at the NTU School of Social Sciences** said, "With urbanisation, more people are expected to be living in urban areas globally in future. It is thus important for urban city planners and architects to understand factors that can contribute to healthy living, as urban planning can have a direct impact on quality of life for the population. Our work can guide efforts to green cities, by providing evidence of how vertical greenery can be a viable way to integrate nature into our built environment and promote mental health."

Co-lead author of the research, **Sarah Chan, a Ph.D. candidate from the Interdisciplinary Graduate Programme at NTU** said, "Our findings have important practical implications for city planning and design, especially for high density urban areas that face land constraints. It provides evidence that vertical greenery systems, which make use of vertical structures above-ground, may help moderate the detrimental consequences of stress.

"While previous studies looked at effects of green vegetation, the fact that the colour green could simply be a primitive visual feature, resulting in positive effects, was not considered. Thanks to emerging technology like VR, we overcame this limitation and were able to use a control condition, matching vertical greenery with the colour green in our study."

Moving forward, the NTU research team plans to use VR to investigate the psychological impact of using nature in architecture, for instance, using natural materials like wood compared to concrete.

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Note to Editors:

Paper titled *"Vertical greenery buffers against stress: Evidence from psychophysiological responses in virtual reality",* published online in *Landscape and Urban Planning* online, 5 May 2021.

Virtual reality environments used in the NTU study:

a. Street with buildings whose facade had parts covered in green plants.
b. Street with buildings whose facade only had green painted walls.

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About Nanyang Technological University, Singapore

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 33,000 undergraduate and postgraduate students in the Engineering, Business, Science, Humanities, Arts, & Social Sciences, and Graduate colleges. It also has a medical school, the Lee Kong Chian School of Medicine, set up jointly with Imperial College London.

NTU is also home to world-class autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies, Earth Observatory of Singapore, and Singapore Centre for Environmental Life Sciences Engineering – and various leading research centres such as the Nanyang Environment & Water Research Institute (NEWRI) and Energy Research Institute @ NTU (ERI@N).

Ranked amongst the world's top universities by QS, NTU has also been named the world's top young university for the past seven years. The University's main campus is frequently listed among the Top 15 most beautiful university campuses in the world, and it has 57 Green Mark-certified (equivalent to LEED-certified) building projects, of which 95% are certified Green Mark Platinum. Apart from its main campus, NTU also has a campus in Singapore's healthcare district.

Under the NTU Smart Campus vision, the University harnesses the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.

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