

Nature exposure is associated with reduced smartphone use

Keywords: Nature, smartphones, attention, screentime, greenspace

Extended Abstract

Evidence indicates that in recent years nature exposure has fallen precipitously for youth and young adults^{1,2}, with potential consequences for human well-being and environmental stewardship³⁻⁵. This nature deficit has been attributed to factors ranging from urbanization to increased use of media such as television⁶, the internet⁷, and more recently mobile devices^{8,9}. Human experiences of nature increasingly transpire within or near highly connected urban settings, with potential implications for planetary health and human well-being¹⁰. Due to the documented benefits linked to time spent in natural environments⁵, these trends have been described as worrisome for human-nature interactions¹¹. Conversely, the recent rise of nature-based digital detox recommendations, regimens and retreats is indicative of an increasingly popular view that certain settings in the biosphere may provide refuge from the “always-on” social and informational demands of the cybersphere^{10,12}. Yet evidence in this setting is extremely sparse. Does nature exposure influence device-directed attention?

To review prior investigations of the relationship between natural environment exposure and electronic device use, we conducted a systematic review of the relevant psychological literature. Nearly all prior studies did not consider or control for the potentially confounding influence of device use in restorative encounters, few included device use as a variable of interest, and none included objectively logged measures of smartphone use (Fig. 1A). One cross-sectional survey study of 546 US adolescents found negative relationships between self-reported all-category media use (including computers and television) and both recalled time spent in nature and perceived nature connection⁹. In a separate experimental study, participants randomly assigned to spend a break in greenspace without a laptop showed significantly higher improvement on cognitive tests than participants in all other device and setting conditions, demonstrating that digital stimuli can disrupt the restorative attentional and cognitive benefits derived from green space¹³.

Unlike laptops, smartphones are designed to be accessed while mobile and may be a more salient source of digital stimuli for young adults – particularly in natural settings – a concern voiced by several authors^{12,14}, but not yet investigated with logged measures of coinciding smartphone and environmental exposures during daily living. Indeed, if the restorative benefits of nature contact – as currently theorized – depend on connecting with natural elements⁴ through soft fascination and low-level involuntary attention to environmental features¹¹, the lure of smartphone use may distract focal attention in natural spaces and plausibly prevent recovery of the inhibitory mechanism needed for directed-attention. However, it remains unclear how young adult smartphone screen-time compares to green-time, and whether smartphone use varies within-individuals by type and dose of greenspace exposure.

Here, we analyzed ~2.5 million minute-level observations of smartphone screen use, texting, calling, and environmental exposures for 701 young adults over two years. We employ a within-person fixed effects specification that enables us to estimate the relationship between environmental exposures and within-person changes in smartphone use while controlling for

unobserved individual factors and other time-varying confounding factors, including day of the study time trends and person-specific hour-of-the-week behavioral routines.

Participants' weekly smartphone screen-time was over double their green-time. The relationship between exposure to greenspace and smartphone activity differed by greenspace exposure dose, type, and mobility state. Virtual social activities such as calling and texting increased during short recreational greenspace visits while all smartphone use declined over the first three hours in nature areas, suggesting that visiting more wild nature may support digital impulse inhibition in-situ. Those with elevated baseline screen-time or green-time significantly reduced device use in nature, indicating that parts of the biosphere may provide a reprieve from the cybersphere for highly connected young adults. Urban areas and recreational green spaces may be characterized by not only a higher density of stimuli in the physical environment but also in the digital environment. By contrast, nature areas may provide respite from digital demands.

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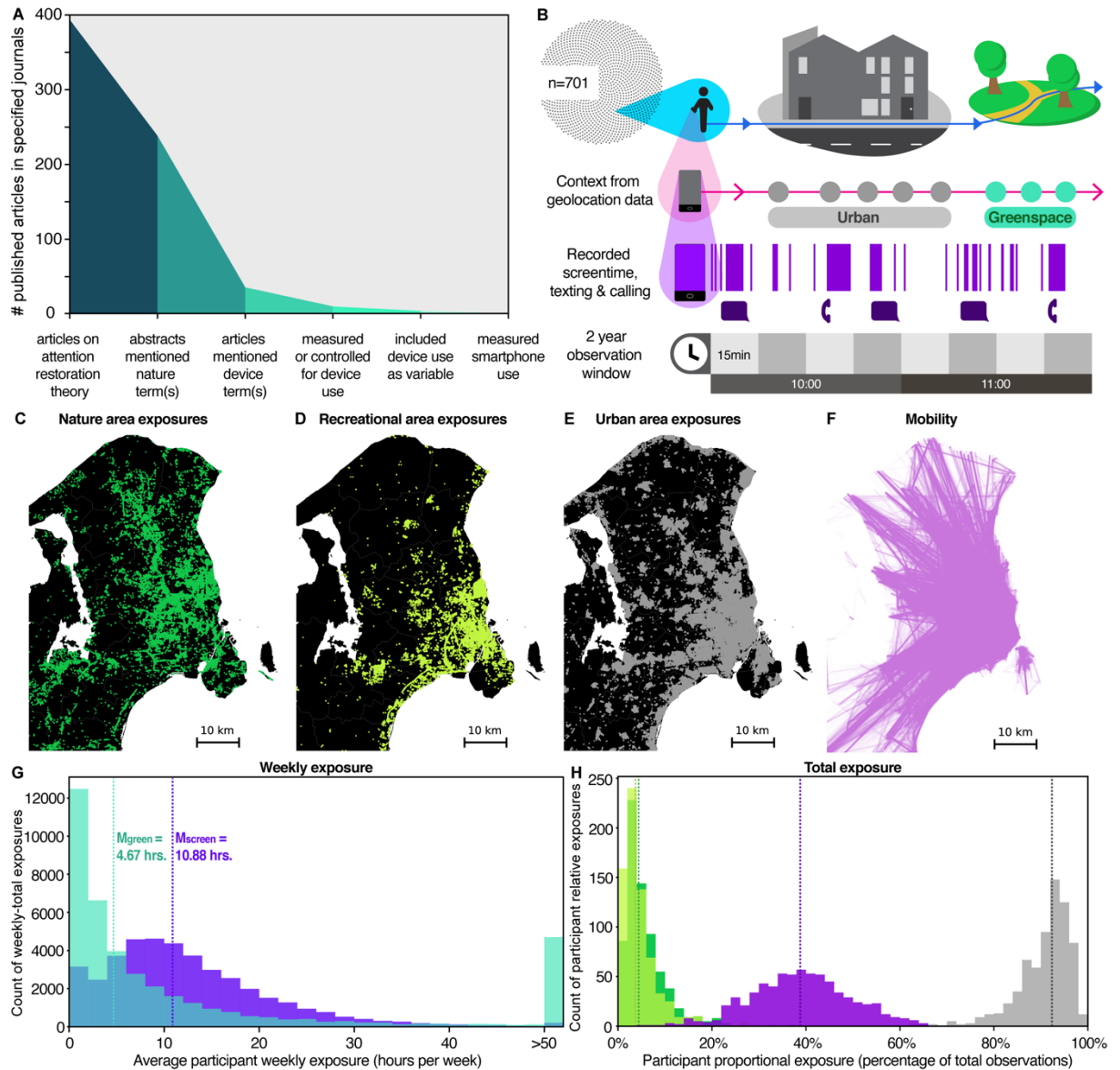


Figure 1. Measuring natural environmental and smartphone-based virtual exposures. (A) Visualization of the proportion of systematically reviewed articles investigating Attention Restoration Theory in natural settings while mentioning, controlling for and lastly measuring mobile device use. The present study is the first to measure smartphone use in natural contexts as a primary variable of interest. (B) Mobile sensing framework deploying smartphones as socioecological sensors to track overlapping physical and virtual environmental interactions. (C-F) Maps of nature, recreational and urban area exposures and functional mobility among the sample of 701 young adults for the month of September 2014. (G) Distributions of participant greenspace exposures (cyan) and smartphone use (purple) over the study period, extrapolated to the weekly level. Colored lines indicate the median exposure value for each distribution. (H) Distributions of the % of total participant-level observations spent in nature areas (dark green), recreational areas (yellow-green), urban settings (gray), and containing smartphone use (purple). Colored lines depict median values.

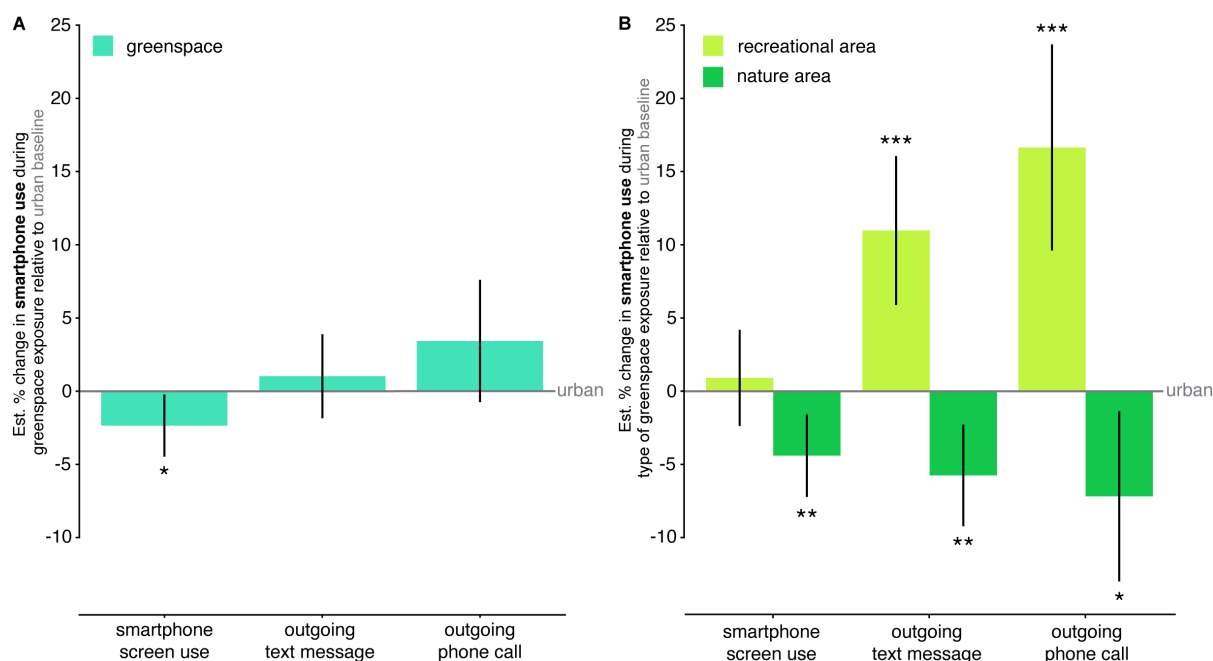


Figure 2. Within-person effects of greenspace exposures on smartphone use and communication. (A) The cyan bars show the estimated within-individual change (%) in smartphone use during general greenspace exposure compared to the person-specific urban setting baseline. From left to right, bars represent the response for total screen use, outgoing text messages sent, and outgoing phone calls made. Error bars represent 95% confidence intervals. (B) Estimated within-person change (%) in smartphone use by subtype of greenspace exposure, relative to the urban baseline (grey line). Colored bars show the marginal individual smartphone use responses for each smartphone activity measure in recreational areas (yellow green) and nature areas (dark green), relative to the urban baseline (grey line).

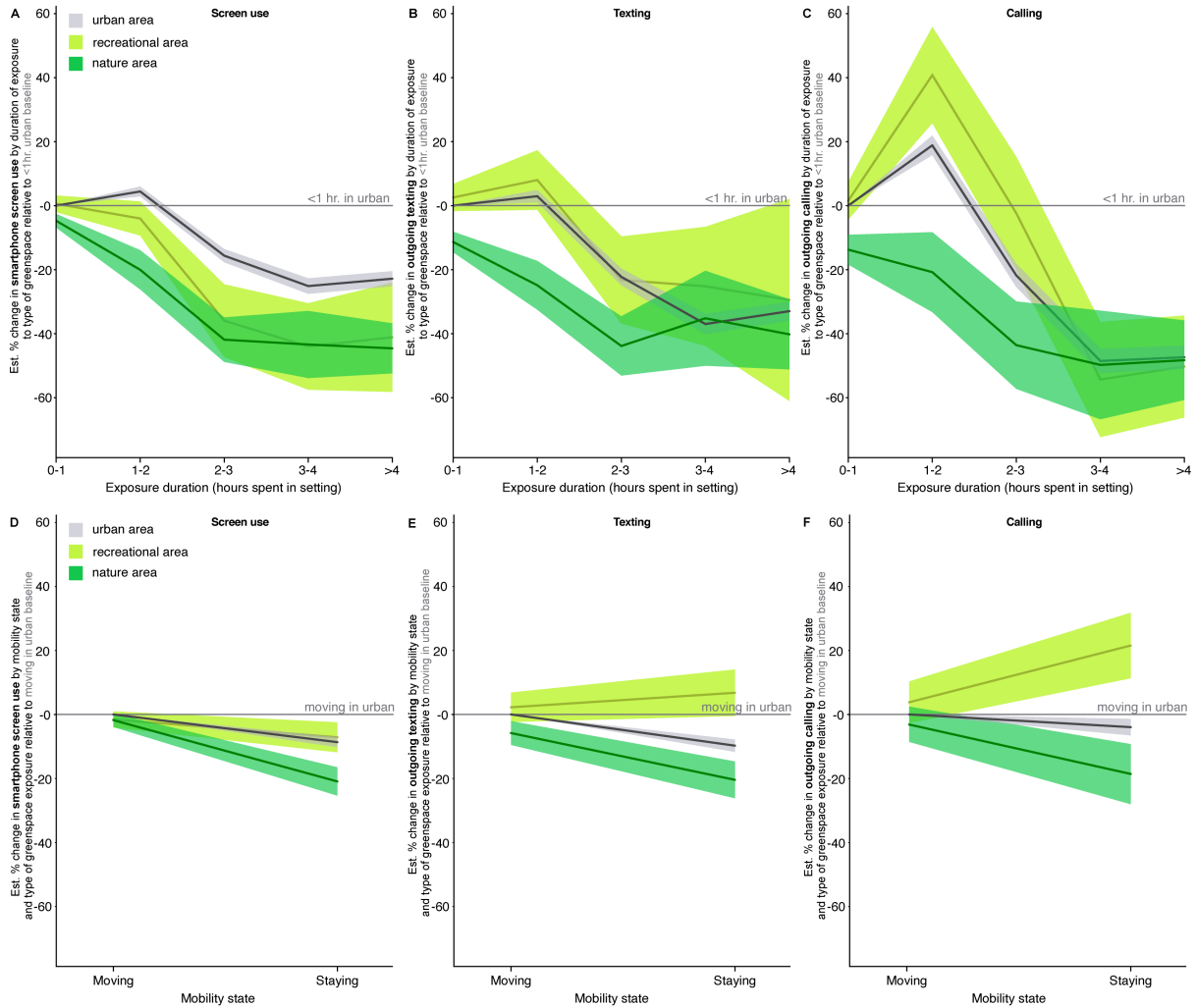


Figure 3. Setting Exposure Dose and Smartphone Use Response Relationships. (A-C) Colored lines depict the estimated smartphone use response by environmental exposure type and dose in 1 hour bins, compared to the <1hr urban exposure baseline. The relative smartphone response is shown for urban settings (dark grey line), recreational areas (yellow-green line) and nature areas (dark green line). Shaded intervals represent 95% CIs. (D-F) Lines show the estimated relative effect of environmental exposures on smartphone use by mobility state (actively moving vs. staying in place) in urban settings (grey), recreational areas (yellow-green) and nature areas (dark green) compared to the mobile urban baseline. Shaded intervals show 95% CIs.

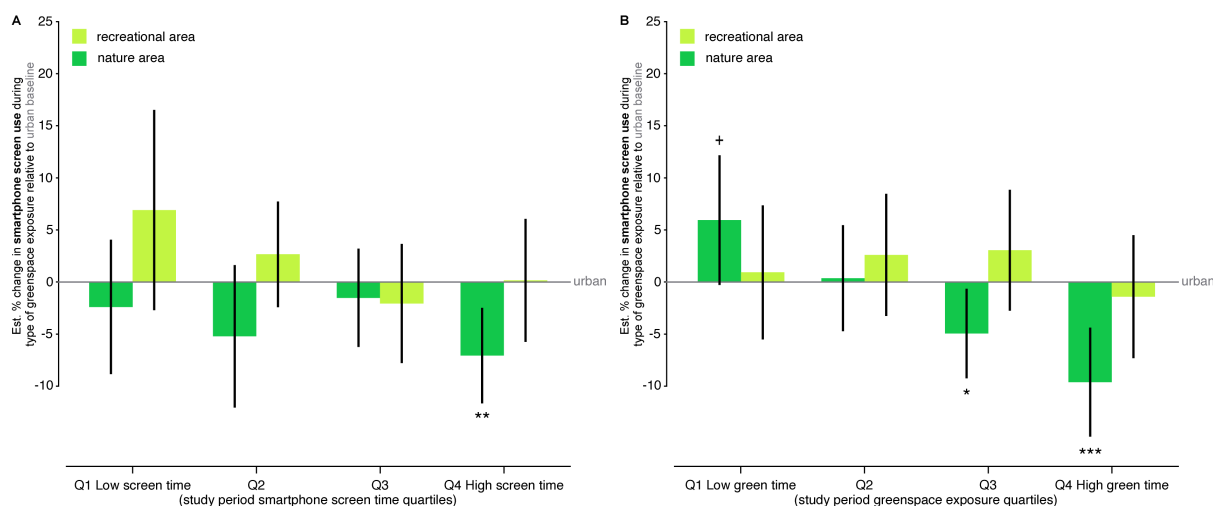


Figure 4. Subgroup plots of the estimated effects of greenspace exposures on smartphone use by quartiles of typical screen-time and green-time. A) Colored bars depict the estimated relative within-person smartphone use response to being in recreational areas (yellow-green) and natural areas (dark green) compared to the urban setting baseline (grey), by quartiles of smartphone usage, ranging from participants with light to heavy typical device usage over the study period. Error bars represent 95% confidence intervals. B) The estimated within-person smartphone use response to environmental exposures, relative to the urban baseline, across quartiles of greenspace use over the course of the study.