



## The Impact of Heat Increases on Education: Theory and practice for climate-resilient schools

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Photo caption here. Photo by XXXXX.



# Heat and Schools

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# What do we know about heat and schools?

- Heat degrades cognition and productivity
- Students test worse on hot days
- Students learn less in hot years

# Heat degrades productivity and cognition

- Global labor productivity losses estimated at **1.4 – 4%** (mean 2.6%) of global GDP by 2100 if global mean temperature rises 3.7 °C (no mitigation scenario) (Zhao, 2021, *Climate Change*)
- Indonesia: worker productivity decreased **-8.22%** in sun vs. shade (Masuda, 2021, *Nature Communications*) and cognition also declined (Masuda, 2020, *Environmental Research*)
- Meta-analysis found negative cognitive effects from elevated temperature, especially for math and reading comprehension (Yeganeh, 2018, *Building and Environment*)

## Experimental evidence

Peccolo (1962): students learn classroom tasks faster under optimal thermal conditions

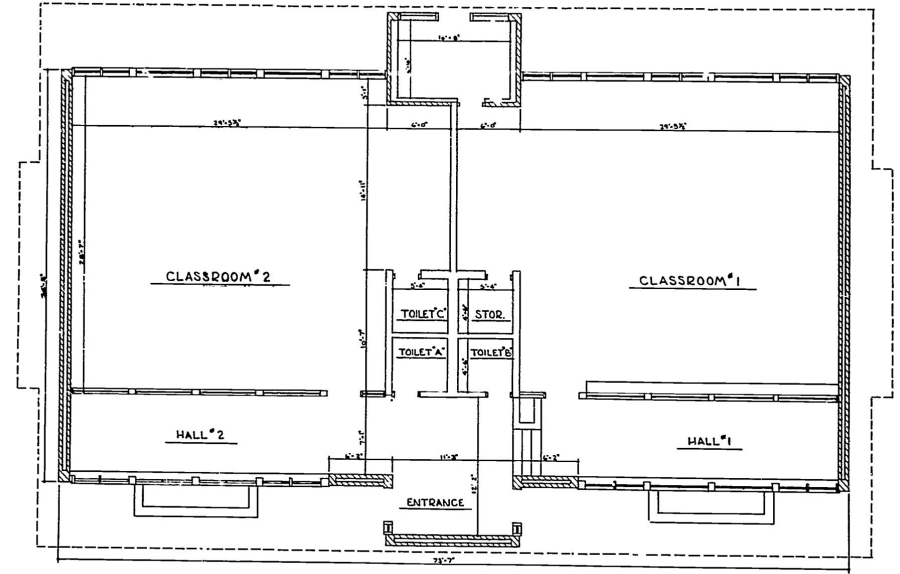


FIGURE 2 Floor Plan of Lennox Research School

# Students test worse on hot days

**United States:**  $+1^{\circ}\text{C}$  on test day  $\Rightarrow$  **-0.035 SD**  
(Graff Zivin et al, 2018, *Journal of the Association of Environmental and Resource Economists*)

**New York City:**  $+1^{\circ}\text{C}$  on test day  $\Rightarrow$  **-0.016 SD**  
(Park, 2022, *Journal of Human Resources*)

**Vietnam:**  $+1^{\circ}\text{C}$  on test day  $\Rightarrow$  **-0.011 SD**  
(Vu, 2022, *Asian Economic Journal*)

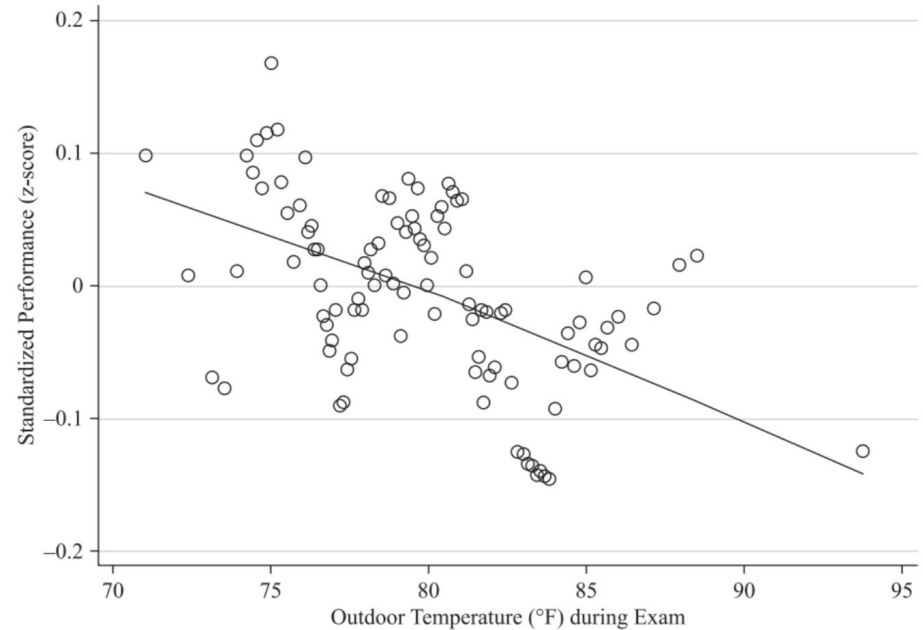
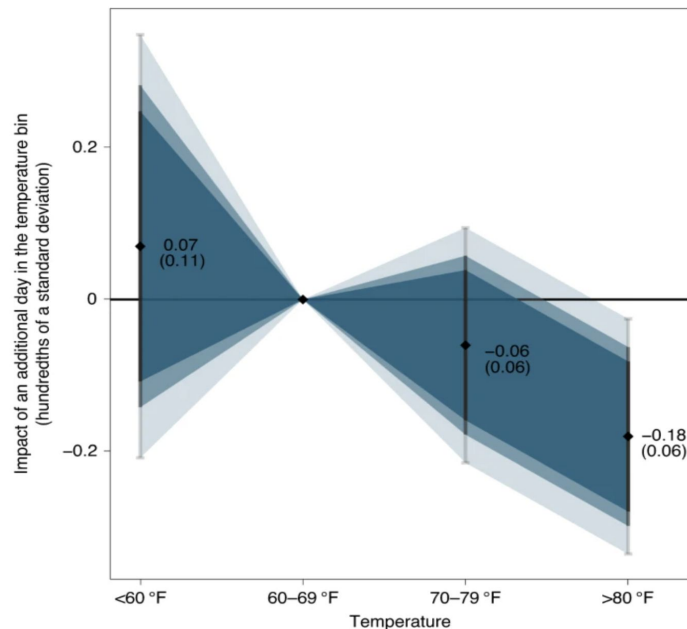
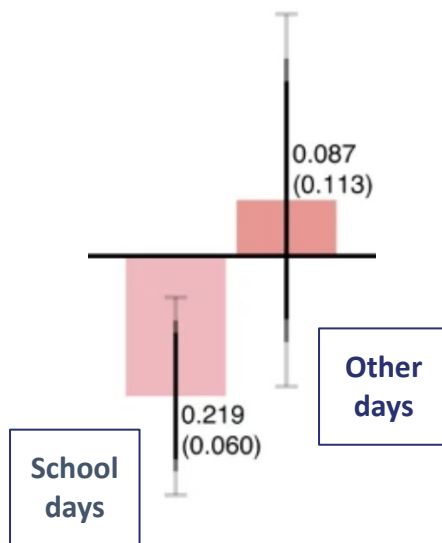


Figure from Park et al. (2020) *Journal of Human Resources*

# Students learn less in hot years

**Global:** +1 day > 80°F (27°C) **-0.002** SD (Park et al., 2018, *Nature Human Behavior*)

**India:** +10 days > 29°C → **-0.02 to -0.03** SD (Garg et al., 2020, *Journal of the Association of Environmental and Resource Economists*)



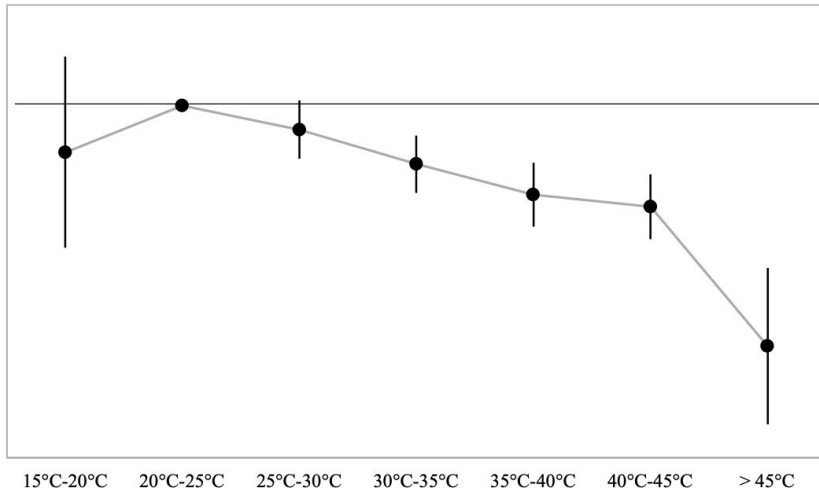
Figures from Park et al. (2021) *Nature Human Behavior*

# Not just cognition...

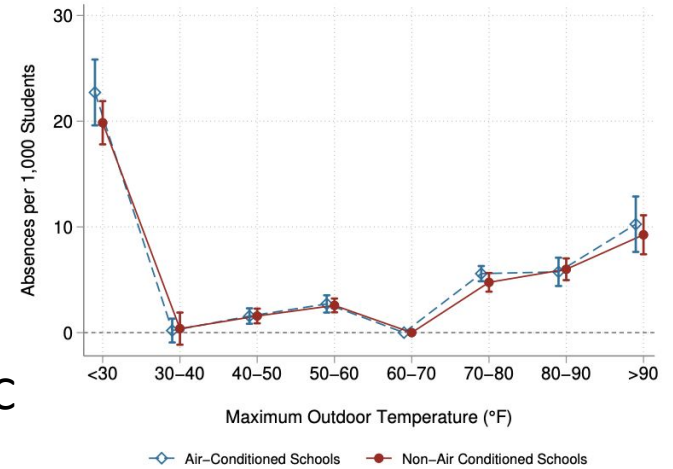
→ **US:** Heat increases **disciplinary issues & student absences** (McCormack, 2023, *working paper*)

→ **India:** Heat increases **teacher absences** by 8% per 1°C (Léonard & Heyes, 2021, *working paper*)

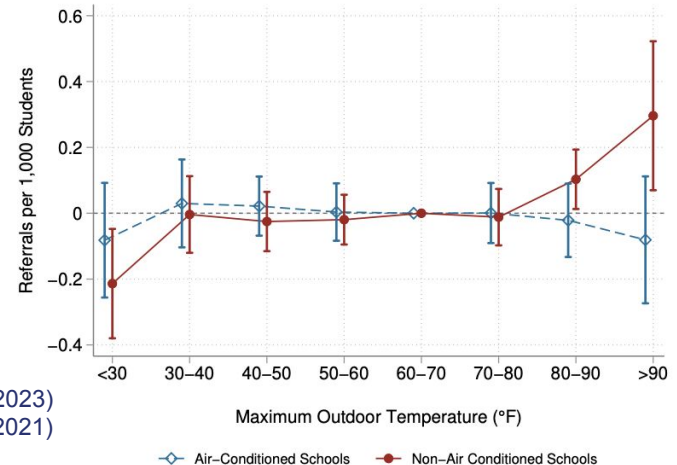
Teacher presence reg. coef.



Right: McCormack (2023)  
Left: Léonard & Heyes (2021)



(A) Absences





# What don't we know?

1. Many schools are *much* hotter than those formally studied – what happens “beyond the graph”?



2. What about heat exposure *outside* of school?



3. What can we do, at scale, to mitigate heat's impact on learning?





# **GREEN is a network – Let's connect!**

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