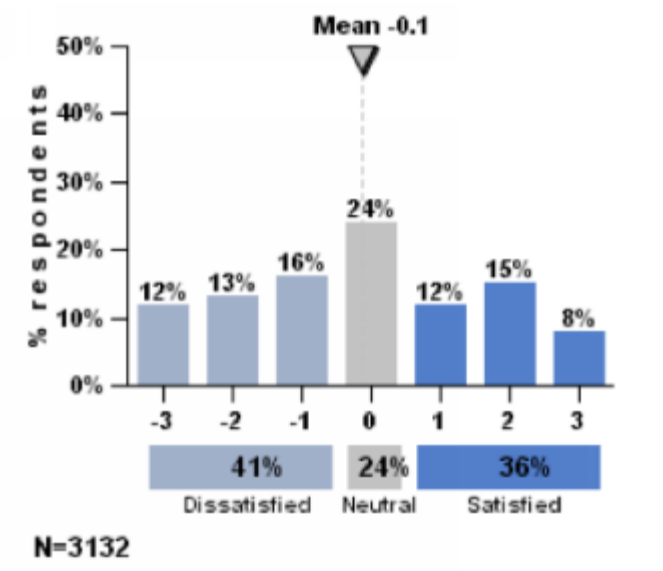
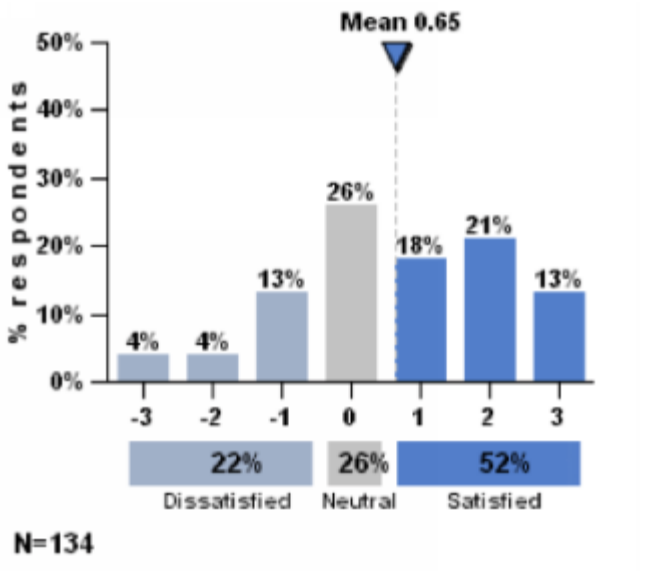
Potential Comfort Benefits with Radiant Systems (CBE Survey)

CBE occupant survey results – first comparison
Satisfaction with thermal comfort

CBE benchmark
(buildings with conventional HVAC since 2004)



Buildings with radiant systems
(since 2004)



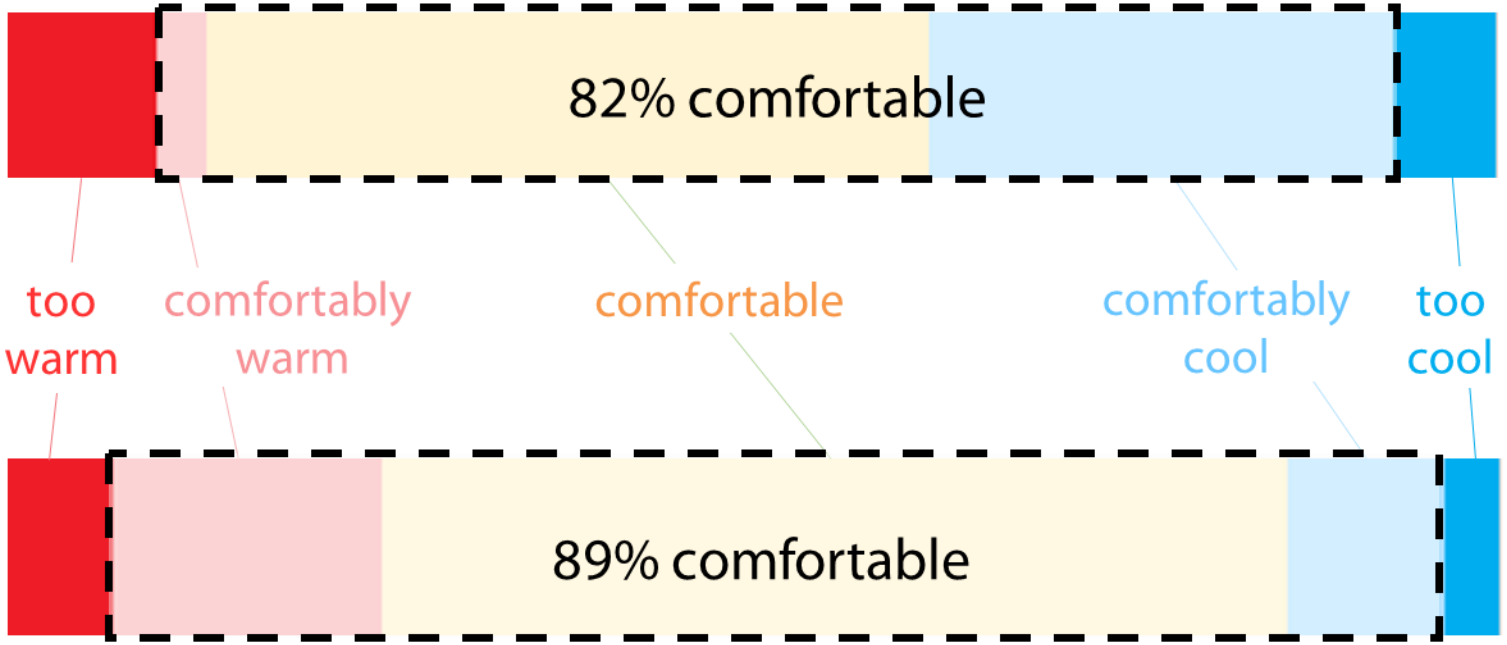
Ceiling Fan Comfort and Energy Benefits (CBE Survey)

Enhanced Comfort At Higher Indoor Air Temperatures and more Controllability

Before fan install

Indoor temperature ~ 72 ^{0}F

(n = 29)

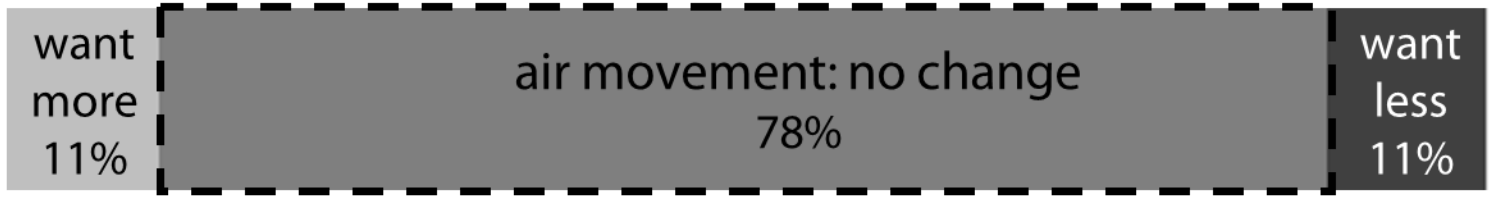


After fan install and air conditioning failure

Indoor temperature ~ 80 ^{0}F

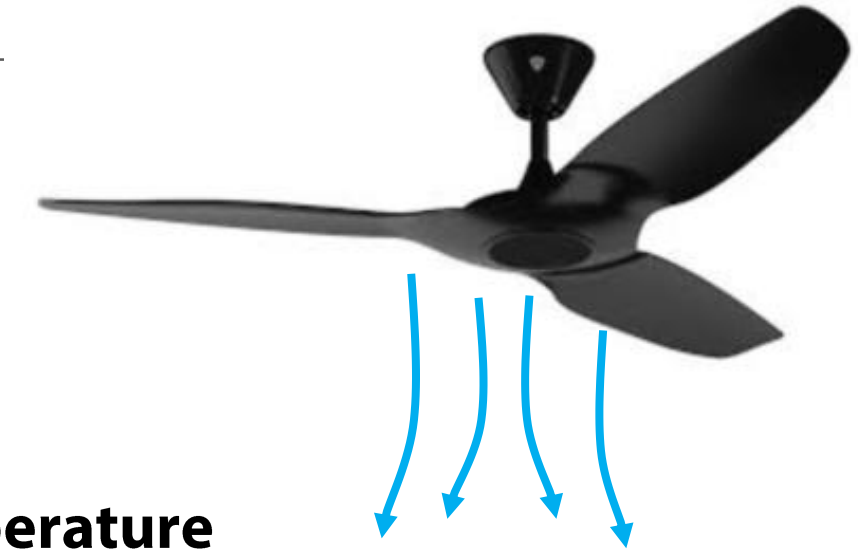
(n = 28)

Air speeds
~40 – 150 fpm



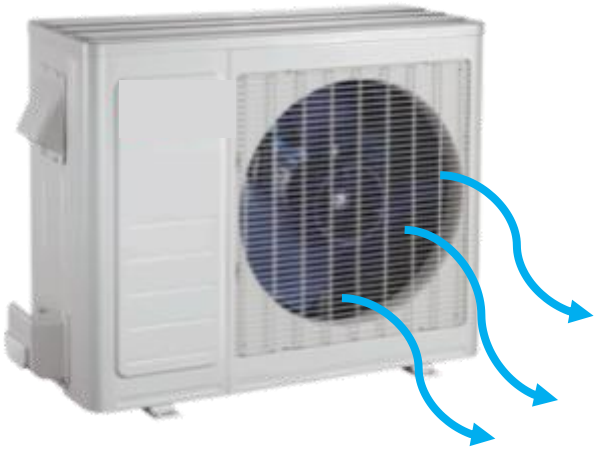
Ceiling Fan Comfort and Energy Benefits

Higher Setpoint Temperatures with Integrated Operation of AC and Ceiling Fans



Ambient temperature

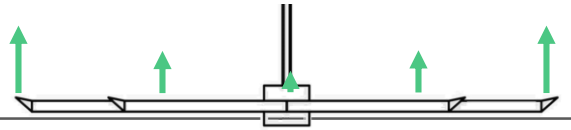
Cooling setpoint: 80 ^{0}F



More Uniform Airspeeds when Fans Blow Upwards (CBE Research)

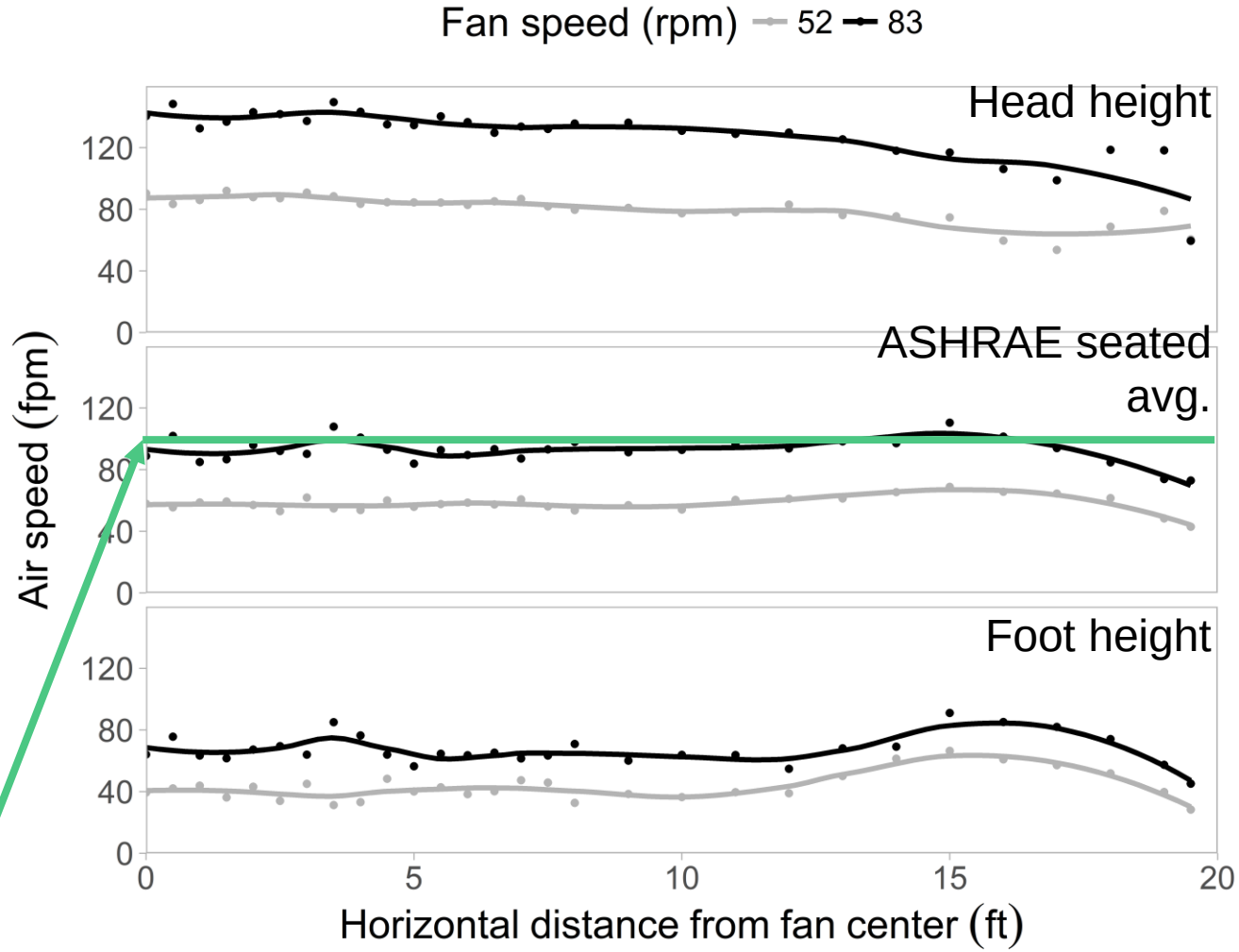
Ceiling Fan Benefits

- Much more uniform



40’ room, 10’ diameter fan, 14’ from floor, 18’5” ceiling

- Lower airspeeds than downwards, but still enough for significant cooling effect.
  - Upwards test results ranged from 40 - 250 fpm seated averages (2 – 7 °F temp increase)
- Higher airspeeds at head than feet
- Issues:
  - Fans not rated in reverse direction (no airflow data)
  - Blade design not optimized for up direction (roughly half the airflow for same rpm/power)



100 fpm design speed
~5 °F temp increase

Potential Comfort Benefits with Radiant Systems

Radiant systems

- Provide sensible load control with separate air system for ventilation and latent load control (e.g., dedicated outdoor air system, natural ventilation)
- Higher chilled water temperatures allow improved energy efficiency at plant
- Designed to maintain operative temperature within comfort range
- Remove heat using convection and radiation