
Preliminary Study Results
on the
Safety of Singing

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Olivia Lerwick

Soprano

Olivia Lerwick has attended such institutions as Interlochen Arts Academy, Rice University and currently attends the University of Colorado Boulder where she will complete her M.M. in 2021. She currently studies with Jennifer Bird-Arvidsson and has also studied extensively with Julie Simson. During her summers she has attended programs such as SongFest and the Up North Vocal Institute while also dedicating two summers to learning French and German with the six-week Rice in Country program. In 2015 she returned to her hometown of Midland, TX to perform in Midland Opera Theater's "Standing Ovation" concert alongside fellow Midlander Susan Graham.

UNIVERSITY OF MARYLAND

Dr. Jelena Srebric

Professor, University of Maryland

Dr. Jelena Srebric has been a professor of mechanical engineering and architecture at the University of Maryland for almost seven years and has collaborated with UMD in founding the Center for Sustainability in the Built Environment. Their work informs and serves campus Facility Management, the Sustainability Council, and the President's Energy Task Force by providing analytical tools and devices capable of managing environmental quality at scale. Srebric is featured in the "Sustainability Seven" not only because of her passion for sustainability but also for the work she's done to make this information accessible to the community and campus and to empower student engineers to make sustainable choices.

MUSC
Medical University of South Carolina

Dr. Lucinda Halstead

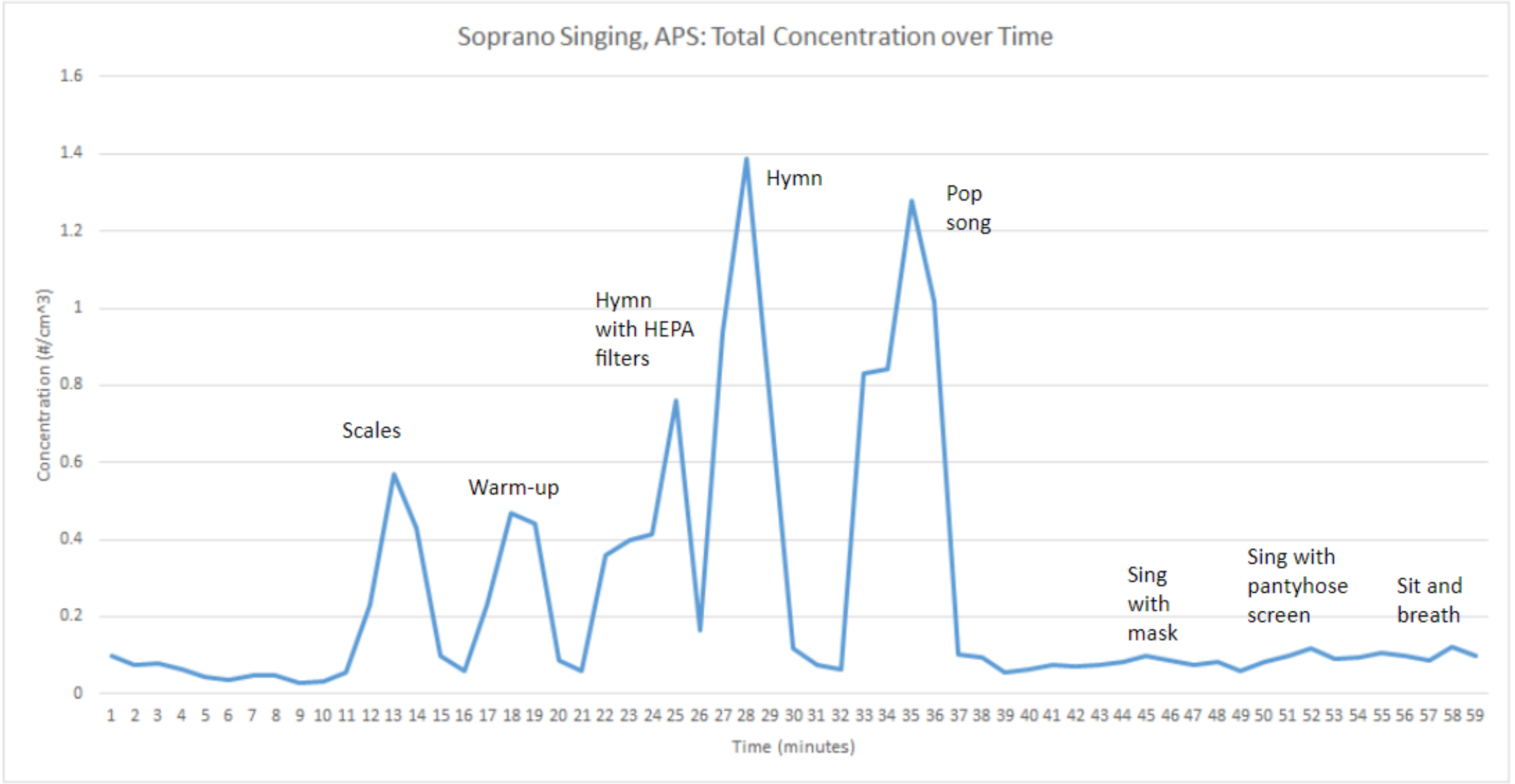
Associate Professor, Departments of Otolaryngology, Medical University of South Carolina

Otolaryngologist **Dr. Lucinda Halstead** is founder and medical director of the Evelyn Trammell Institute for Voice and Swallowing at the Medical University of South Carolina.

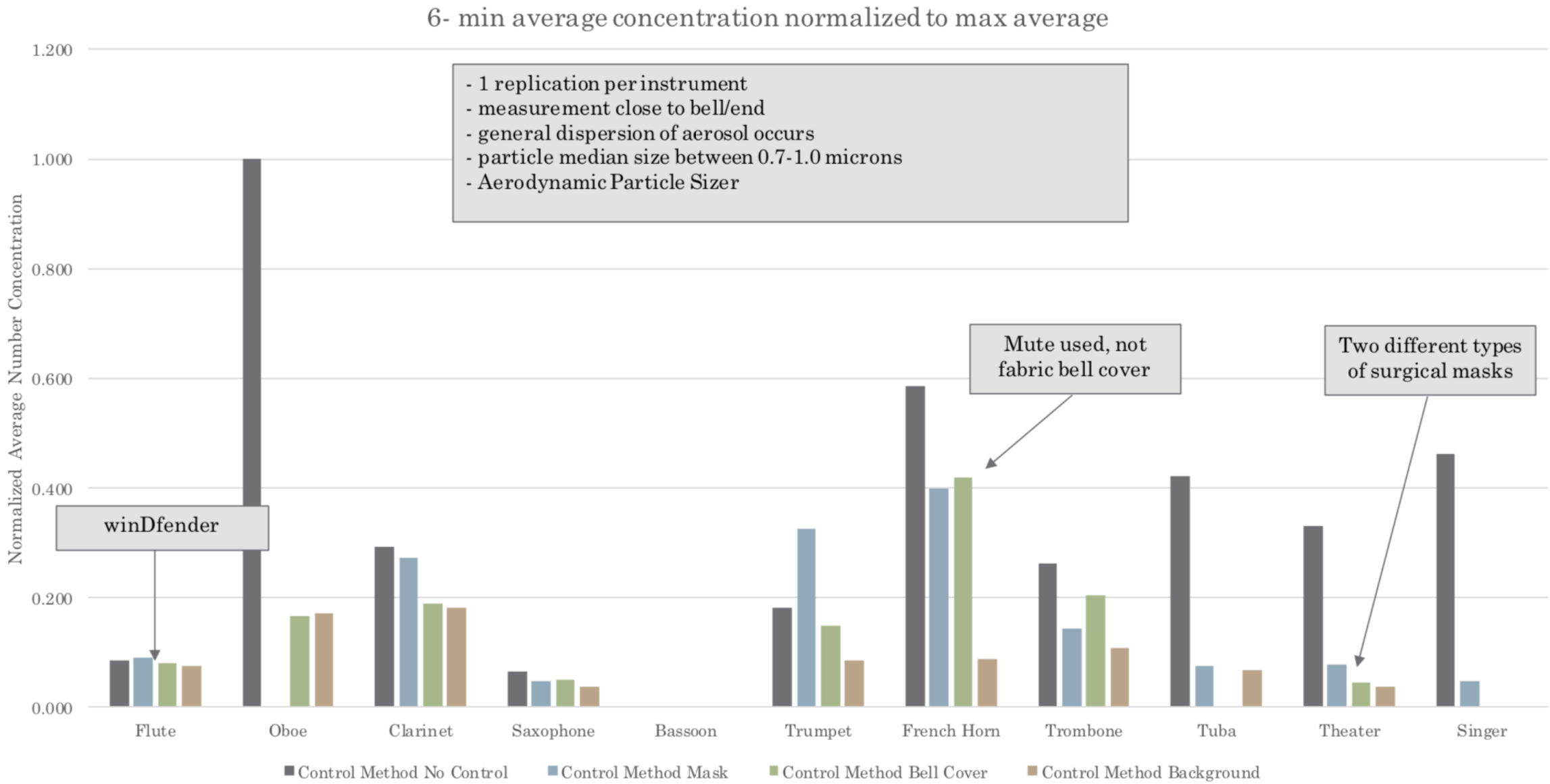
She is also President Elect of the Performing Arts Medicine Association (PAMA). She is the laryngologist for the Spoleto Festival where she regularly works with a variety of choral and solo singers.

The next ten slides are excerpted from the preliminary results report of the 2nd Release of Preliminary Results of the Performing Arts Aerosol Study. The complete report and slide deck can be located at https://www.nfhs.org/articles/unprecedented-international-coalition-led-by-performing-arts-organizations-to-commission-covid-19-study/

Singing APS


Soprano Singing, APS: Total Concentration over Time
Concentration (#/cm^3)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Scales
Warm-up
Hymn with HEPA filters
Hymn
Pop song
Sing with mask
Sing with pantyhose screen
Sit and breath
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59
Time (minutes)

Playing wind instruments, singing, and theatrical voice releases airborne particles (aerosol).
These particles are of the size range that may transmit the COVID-19 virus.
Performing with mask and bell cover reduces emissions.



Initial CFD Results for Well-Fitted Mask Impacts on Aerosol Spread

Shengwei Zhu and Jelena Srebric

*C*enter for Sustainabil*ity* in the Built Environment (***City@UMD***)

University of Maryland

July 31, 2020

CFD (Computational Fluid Dynamics) Modeling

Using computational fluid dynamics and the Wells-Riley equation, the City@UMD team has analyzed the concentration of airborne COVID-19 particles in **outdoor and indoor case studies with a human body wearing a surgical mask with a 64% efficiency to capture aerosols of < 5 µm.**

The **outdoor study included a canopy tent of 3 m × 3 m (10 ft × 10 ft).** A person wearing the mask stands in a light wind field of 1m/s (2.2 mph) at 10 m (33ft) above ground, being roughly 0.2 m/s (0.5 mph) at a person's height. The person is at the center of the open space covered by the tent.

The **indoor case study** represent a typical small rehearsal hall with a human body wearing the mask and standing at the center of the well-ventilated room.

The simulated results are compared to those of cases with person not wearing the mask, which were reported on 07/11/2020.

Animations of difference cases are being posted at: **https://city.umd.edu/covid-19**

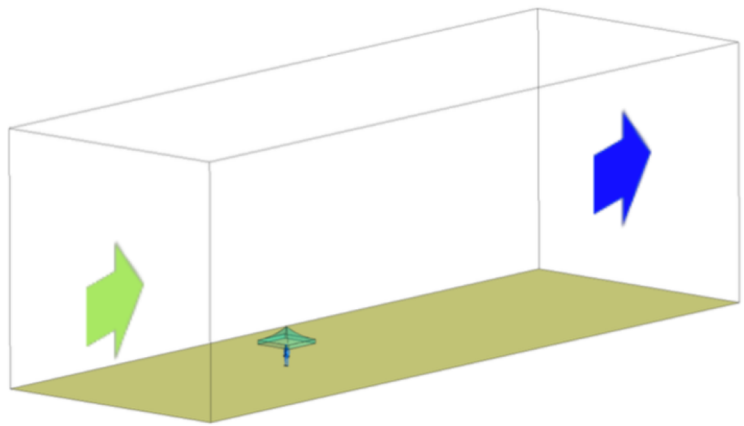
CFD Case Study Setups

Outdoor Case (20 m × 60 m × 20 m)

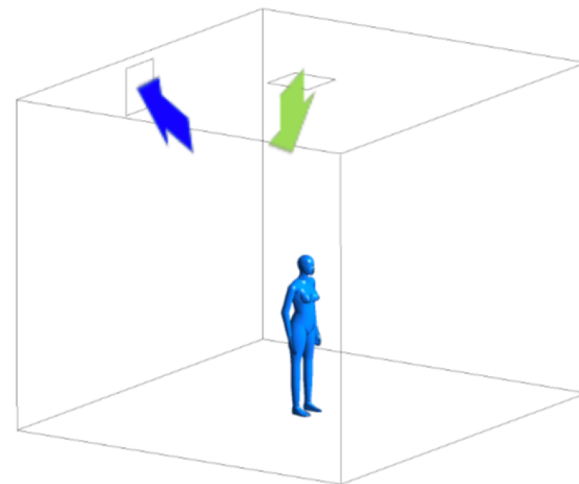
Inlet (green arrow):
Vel.: 2.2 mph at elevation of 10 m
Temp.: 22°C at elevation of 1.5 m

Indoor Cases (4.5 m × 4.0 m × 3.5 m)

Inlet (green arrow):
Size: 0.5 m × 0.5 m
Vel: 0.21 m/s (3 ACH)
Temp.: 22°C



Outdoor Case



Indoor Case

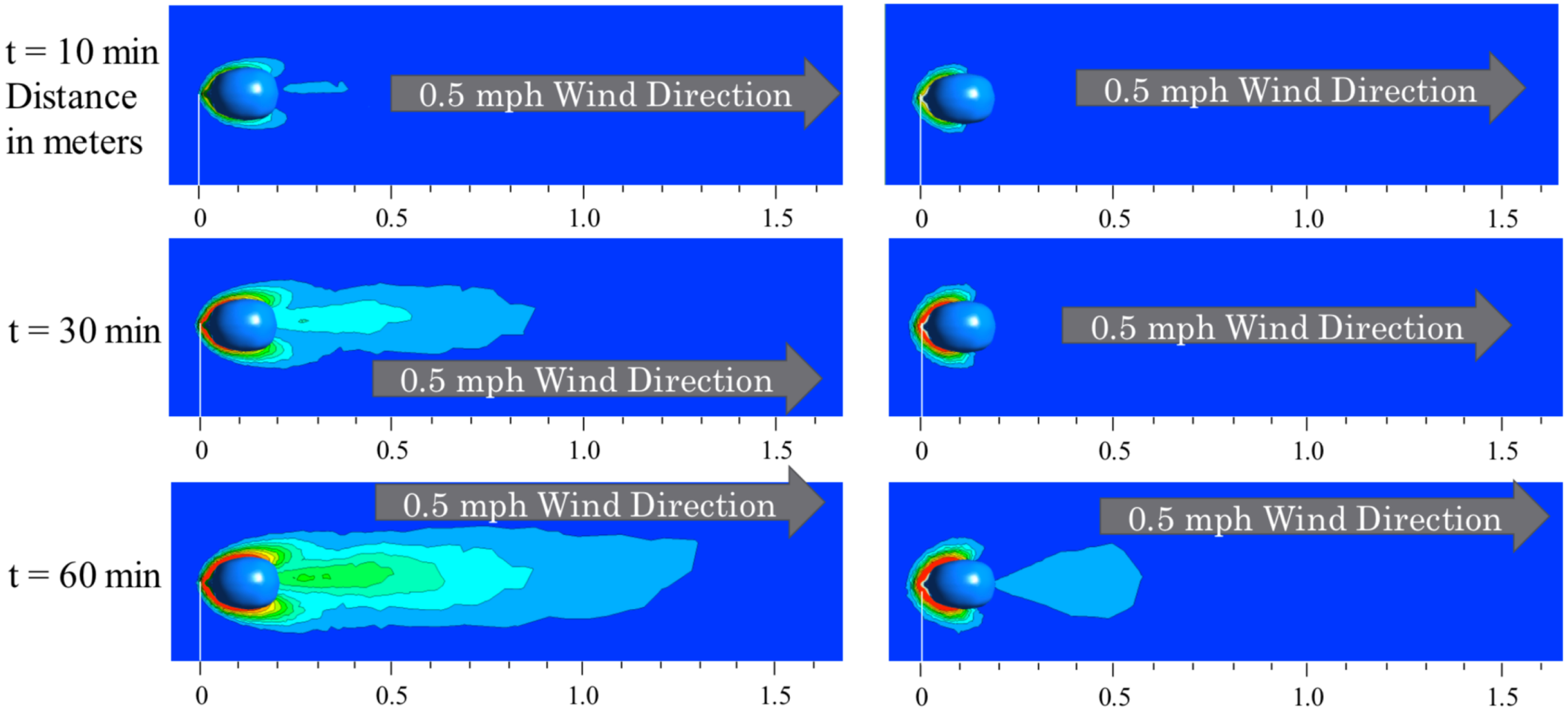
Human Body: Area of 1.47 m^2 and Heat flux of 23 W/m^2

Mask: Area of 107.7 cm^2, Velocity of 0.02 m/s (mass flow rate same as the exhaled air of the singer), ar
Temp. of 32°C

Covid-19 generation rate: 17.28 quant/hr with a 64% particle removal efficiency

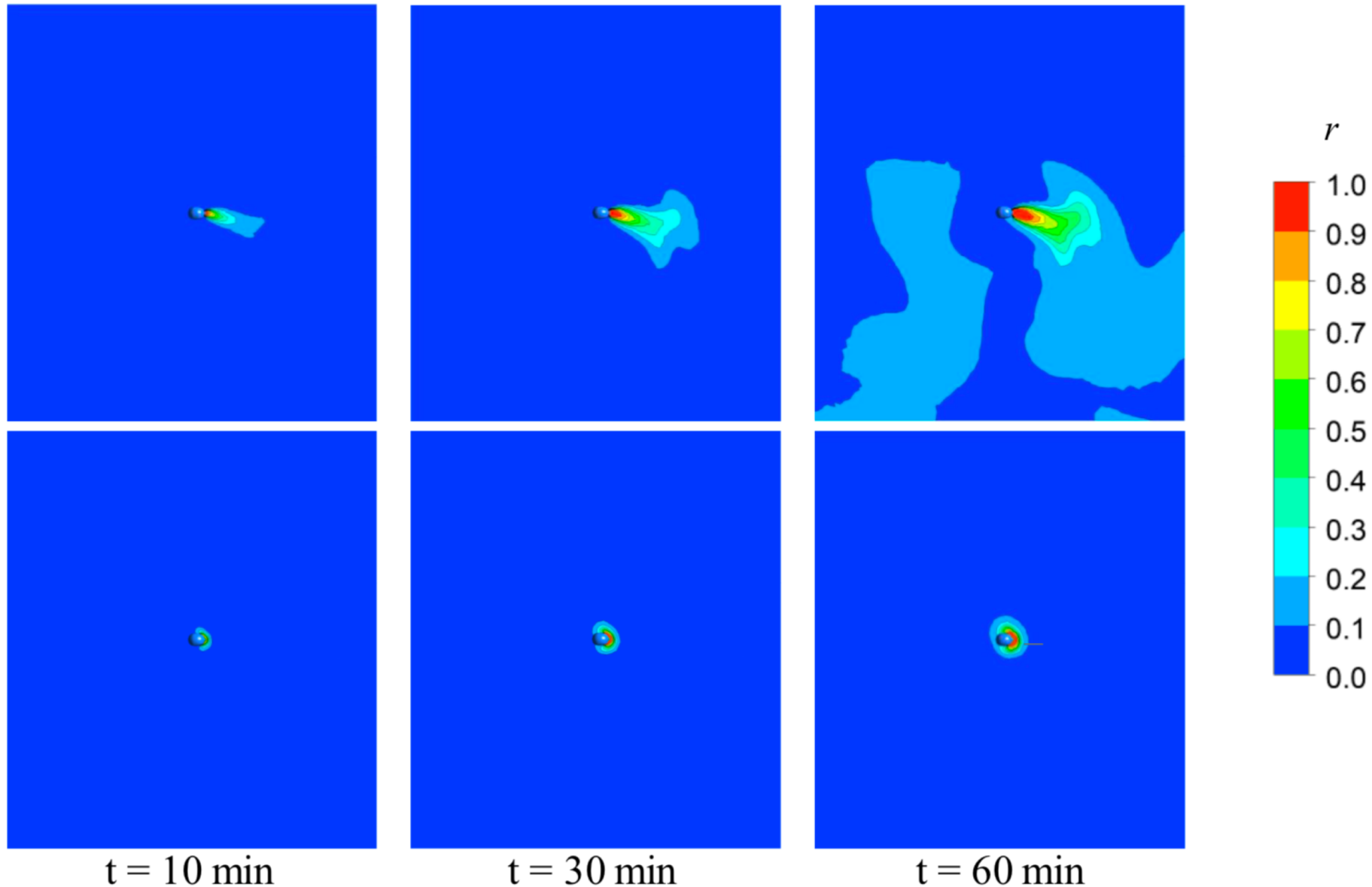
Outdoor Case: Impact of Tent/Masks on Infection Risk

Infection risk *r* by Wells-Riley equation at the height of mouth opening, with breathing rate of 8 L/min. Including 2.2 mph headwind at 10 meters, 0.5 mph at average head level.



Indoor Case Study: Mask Impact on Infection Risk

Infection risk r by Wells-Riley equation at the height of mouth opening, with breathing rate of 8 L/min.



Distance – It Matters

- CDC Guidance currently is 6-foot distancing
- Indoors
  - 6x6 area
  - 9x6 for trombone
- Outdoors
  - 6x6 area
  - Masks strongly recommended
  - Instrument bell covers should still be used

Time

- 30-minute rehearsal times
  - **Indoor**
    - Allow a minimum of 1 air change prior to next use of the room, 3 would be better.
  - **Outdoor**
    - Playing should cease for approximately five minutes to allow the aerosol to disperse.
- More study is needed prior to any recommendations of time changes

Air Flow

Outdoor is best

- Open air
- Tenting from elements

Indoor air filtration

- HEPA – Size of Room
- Filtration Certification
  - CADR - Clean Air Delivery Rate
  - AHAM Certification - Association of Home Appliance Manufacturers

Air Change Rate Per Hour (ACH)

- 3 ACH is the standard used for the modeling presented
- Increased ACH recommended if possible

ASHRAE Guidelines - American Society of Heating, Refrigerating and Air-Conditioning Engineers

Presenter Disclosure Information

LUCINDA HALSTEAD, MD

Financial Disclosure:
Nothing to Disclose

Keys To Reopening Safe Individual Lessons, Group Singing and Performances at PRE-COVID LEVELS

- Wide-spread Testing & Contact Screening
- **Vaccination Development - Operation Warp Speed**
- **Drug Treatments for infected individuals**
- **Mitigation Strategies**

Keys To Reopening Safe Individual Lessons, Group Singing and Performances

- **Vaccination - Operation Warp Speed**
  - 3 vaccines fast tracked & funding approved by US Government
    - Moderna's mRNA-1273 in July - Phase 3 trial
    - The University of Oxford and AstraZeneca's AZD1222 in August – Phase 2/3 trial
    - Pfizer and BioNTech's BNT162 in September– Phase 2/3 trial
  - Some of these vaccines in already in pre-production
- **Treatments for those infected**
  - Remdesivir
  - Dexamethasone
  - More needed

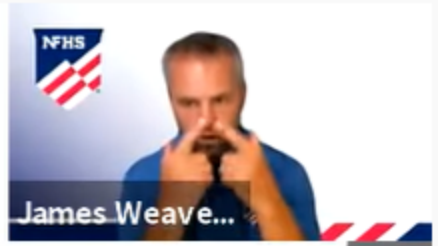
Return to Group Singing 2020: CURRENT RECOMMENDATIONS

- Acceptance of risk by group and sponsor
  - Risk assessment tool
- Mitigation Strategies
  - Social Distancing
  - Performance Space
  - Masks

Masking – Fit Matters

- Wash your hands before putting on your mask
- Place it over your nose and mouth and secure it under your chin
- Try to fit it snugly against the sides of your face
- Make sure you can breathe easily
- Wear a mask correctly for maximum protection
- **Woodwinds and Brass** should use a mask while playing which includes a small straight slit in a surgical style mask
- Do not use the woodwind/brass mask outside of rehearsal

zoom



Mask Fitting Importance

Poor fitting mask

- Gaps on the sides
- Nose not covered
- Loose around the edges
- All of the above are poor fitting in their own right

Better fitting mask

- No gaps on the sides
- Nose covered
- A fairly good fit around the edges

Well fitting mask

- No gaps
- Nose covered
- Tight around the edges
- Should leave a mask outline once removed

zoom

Return to Group Singing 2020:
CURRENTLY RECOMMENDED MITIGATIONS

- Masks
  - Purpose: ***Limit*** droplet and aerosol spread
  - COALITION RECOMMENDS LIMITING INDOOR SINGING TO 30 MINUTES REGRADLESS OF MASK TYPE
    - Based on current heterogeneity of mask types and fit
  - Mask types
    - N95
    - Surgical masks
    - Cotton masks

Return to Group Singing 2020:
CURRENTLY RECOMMENDED MITIGATIONS

- Masks Types
  - N95 –reserve for medical personnel
    - Fit testing to assure tight fit
      - Leaves imprint on face when removed
    - Cannot sing in this mask
      - No air flow into mask
      - Decreased oxygen & increased carbon dioxide saturations documented with 1 hour of mask wear

Return to Group Singing 2020:
CURRENTLY RECOMMENDED MITIGATIONS

- Masks Types
  - **Surgical masks –**
    - RECOMMENDED by the Coalition
    - INDOOR PRACTICE LIMITED TO 30 MIN
    - 64% efficiency to capture aerosols < 5 microns
    - Multilayer
    - Fits snugly to face with ties
    - Washable or Disposable

Return to Group Singing 2020:
CURRENTLY RECOMMENDED MITIGATIONS

- Masks Types
  - **Cotton masks**
    - 2-3 layers of cotton recommended
    - Fit usually poor to better based on mask style
    - Tight weave can filter very small particles
      - Aerosol Filtration Efficiency of Common Fabrics Used in Respiratory Cloth Masks PMID32329337
    - N95 with breathing filter -**NO**
      - Releases your breath into the room with exhale

Return to Group Singing 2020: CURRENTLY RECOMMENDED MITIGATIONS

- Masks Extenders
  - Can improve fit and comfort
    - Countless designs

Masks for Singers – Testing Forthcoming

Singer's Mask

D I Y Mask for Singers, Version 2

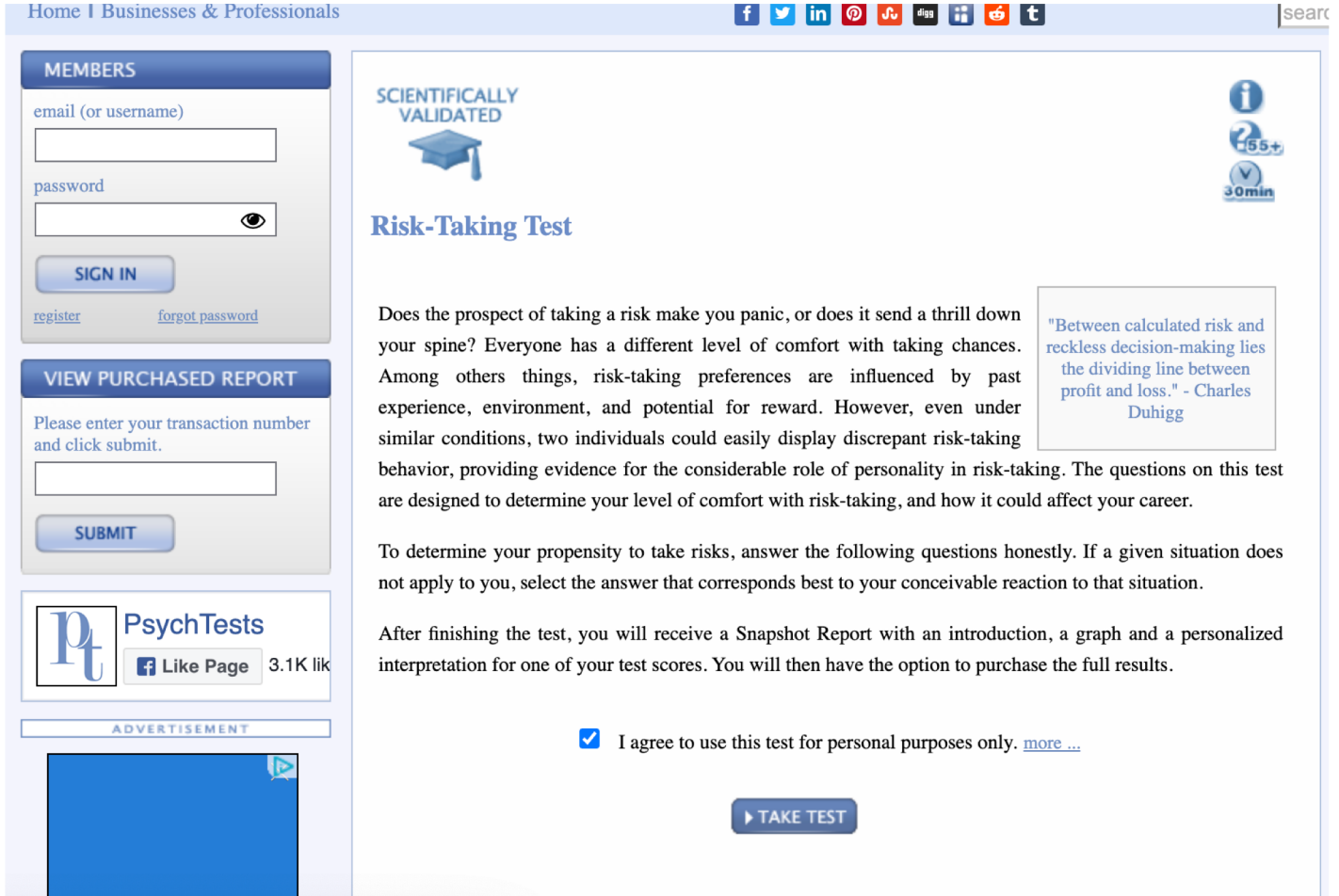
#FaceMask #diymask #วิธีทำหน้ากากผ้าอนามัย

Diy Face Mask Breathable Sewing Tutorial New Design |

Risk Assessment

- Personal Risk Tolerance – understand your personal risk tolerance

https://testyourself.psychtests.com/testid/2122



Risk-Taking Test

SUMMARY | INTRO | GRAPHS | DETAILED RESULTS | AREAS OF CONCERN | ADVICE

Snapshot Report

Sensation-seeking

Sensation-seekers thrive on new, intense, and varied situations. Their personalities are associated with risk-taking because sensation-seeking drives individuals to seek out highly stimulating experiences, which often include risk. Sensation-seekers have strong positive reactions to intense stimuli. While there are many constructive aspects of this personality type, those with this trait often take more risks, are more impulsive, and become bored more easily. In certain ways, a sensation-seeking personality is an asset - such individuals thrive on stress, action, uncertainty, and challenge. In other ways, it is a liability - they may take outlandish risks. Low sensation-seekers, on the other hand, are reliable, can handle monotony, and prefer to sleep on their decisions. They avoid novel and stimulating experiences.

According to your results, you are a sensation seeker. Sensation-seeking can take the form of searching out harmless yet invigorating stimuli such as art or music, or traveling to an exotic locale. It can also refer to more dangerous risks, intended to achieve an adrenaline rush. You seek out new experiences, and may become bored by repetitive, routine tasks. While you enjoy the thrill of risk-taking, your behavior is rarely extreme or reckless.

Environmental Risk Assessment

- **What does the data say in my locale?**
- GA Tech Event Risk Assessment Tool https://covid19risk.biosci.gatech.edu/
- **What about my studio/building?**
- The University of Colorado Boulder has developed a risk assessment tool: https://tinyurl.com/covid-estimator
- Harvard-UC Boulder Portable Air Cleaner Calculator for Schools.v1.1

https://docs.google.com/spreadsheets/d/1NEhk1IEdbEi_b3wa6gI_zNs8uBJjlSS-86d4b7bW098/edit#gid=1882881703

- ASHRAE https://www.ashrae.org/technical-resources/resources

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