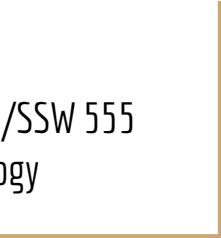




# Immersive Games to Improve Mental Health

Jie Zhao, PhD



Guest Lecture for Course Project CS/SSW 555  
Stevens Institute of Technology

# Jie Zhao, PhD



## Expertise: Human-building Interactions

- Delos
  - Head of Delos Labs
  - Executive Vice President
- University of Pennsylvania
  - Lecturer at School of Design
- Previous Experience
  - Lutron Electronics
  - PhD at Carnegie Mellon University
  - MS and BE at Tongji University



# delos™

elevating wellness

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We spend over 90%  
of our time indoors.

Delos is a global wellness leader with a mission to enhance health and well-being in the spaces where we live, work, learn, and play.

## DELOS IS ANCHORED BY A DIVERSE SET OF GLOBAL CLIENTS



Cleveland Clinic

Hines

Gensler

JLL



Deloitte.



Spotify

NYC  
Department of  
Education

MGM RESORTS  
INTERNATIONAL™

CUSHMAN &  
WAKEFIELD



DUBAI  
HOLDING

AECOM



Microsoft



BARCLAYS

Manulife

AdventistHealth



JPMorganChase

Prudential Center

Brookfield

SKANSKA

EMPIRE STATE  
REALTY TRUST

Morgan Stanley



Rudin

BURGERFI



STRUCTURETONE



Boston  
Properties®

Lenovo

Symantec

LOEWS  
HOTELS

Aimbridge  
Hospitality

BOSTON  
Public Schools

Marriott

WYNDHAM  
HOTELS AND RESORTS

MOHAWK

ARUP

WELLS  
FARGO

Vanke 万科

Unilever

OXFORD

FOUR SEASONS

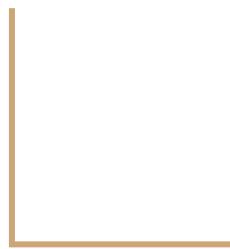
HSL GREEN  
REALTY CORP.

Tencent 腾讯

stryker®

Goldman Sachs

Verizon



# What is Mental Health? Why is It Important to Us?

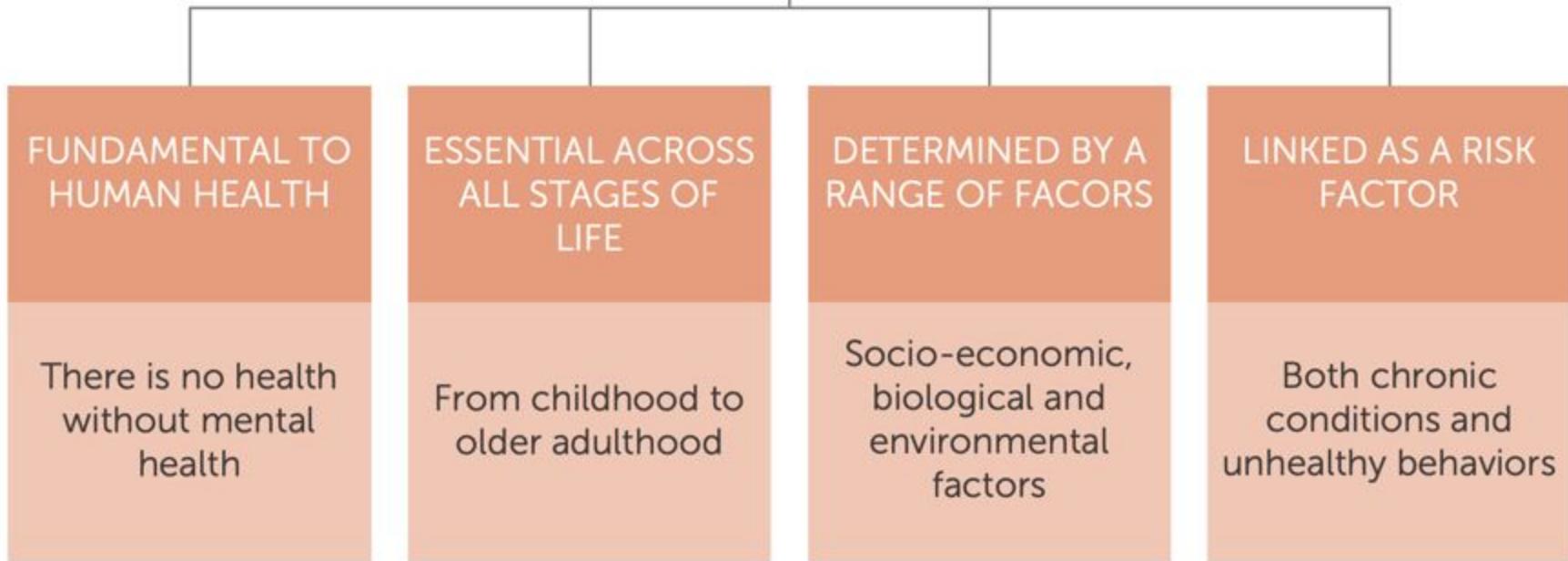


## WHAT IS MENTAL HEALTH?

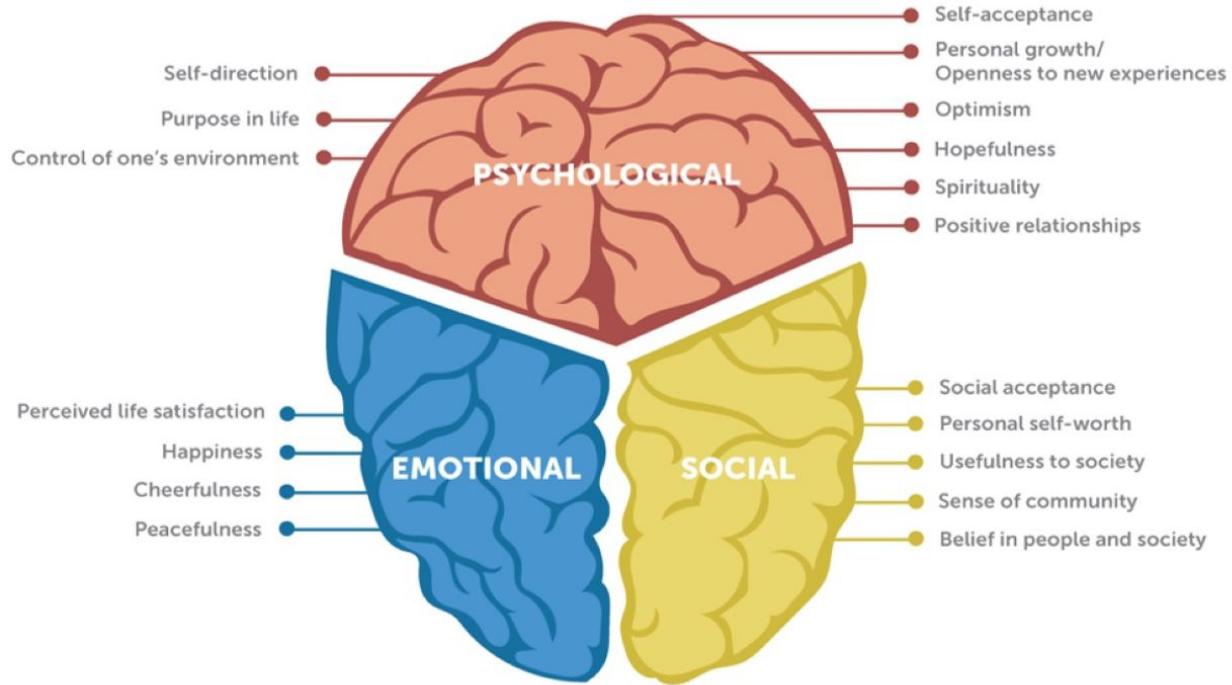
A state of well-being where an individual realizes their own potential, can effectively cope with normal stressors, can work productively, and can contribute to their community.<sup>1</sup>

1. Promoting mental health : concepts, emerging evidence, practice : summary report / a report from the World Health Organization, Department of Mental Health and Substance Abuse in collaboration with the Victorian Health Promotion Foundation (ViHealth) and the University of Melbourne. Retrieved from [https://www.who.int/mental\\_health/evidence/en/promoting\\_mhh.pdf](https://www.who.int/mental_health/evidence/en/promoting_mhh.pdf)

## ACCORDING TO THE WORLD HEALTH ORGANIZATION, MENTAL HEALTH IS...



# Components of mental health



Centers for Disease Control and Prevention. Mental Health Basics. cdc.gov. [Online] October 4, 2013. [Cited: January 22, 2016.] <http://www.cdc.gov/mentalhealth/basics.htm>.



# MIND

## THE ISSUE

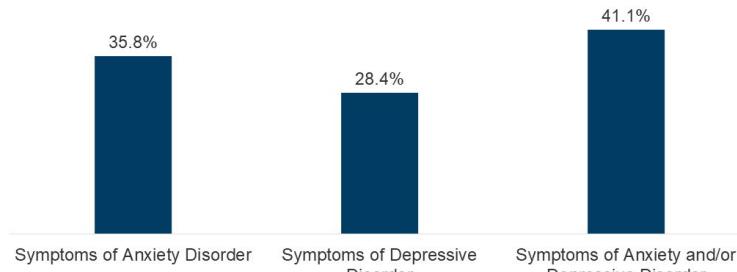
Over 30% of adults will experience a mental health condition during their lifetime.<sup>1</sup> Depression alone is considered to be among the largest causes of disability worldwide.<sup>2</sup>

1. Steel Z, Marnane C, Iranpour C, Chey T, Jackson JW, Patel V, et al. The global prevalence of common mental disorders: a systematic review and meta-analysis 1980–2013. International Journal of Epidemiology 2014; 43(2):476–93. doi: 10.1093/ije/dyu038 PMID: 24648481
2. World Health Organization. Mental Health Action Plan 2013–2020. Geneva, Switzerland; 2013. doi:ISBN 978 92 4 150602 1

# People Are More Aware of Mental Health Due To COVID-19

Figure 2

Share of Adults Reporting Symptoms of Anxiety or Depressive Disorder During the COVID-19 Pandemic



NOTES: These adults, ages 18+, have symptoms of anxiety or depressive disorder that generally occur more than half the days or nearly every day.  
Data shown is for January 6 – 18, 2021.

SOURCE: U.S. Census Bureau, Household Pulse Survey, 2020 - 2021.



## What We Can Learn From The Olympic Spotlight On Mental Health



**Sue Manber** Forbes Councils Member

**Forbes Agency Council COUNCIL POST** | Membership (Fee-Based)  
Leadership



BEIJING OLYMPICS

Mental health is a focus for Team USA at Beijing Olympics

SHARE THIS ...



Mental health is a focus for Team USA at Beijing Olympics

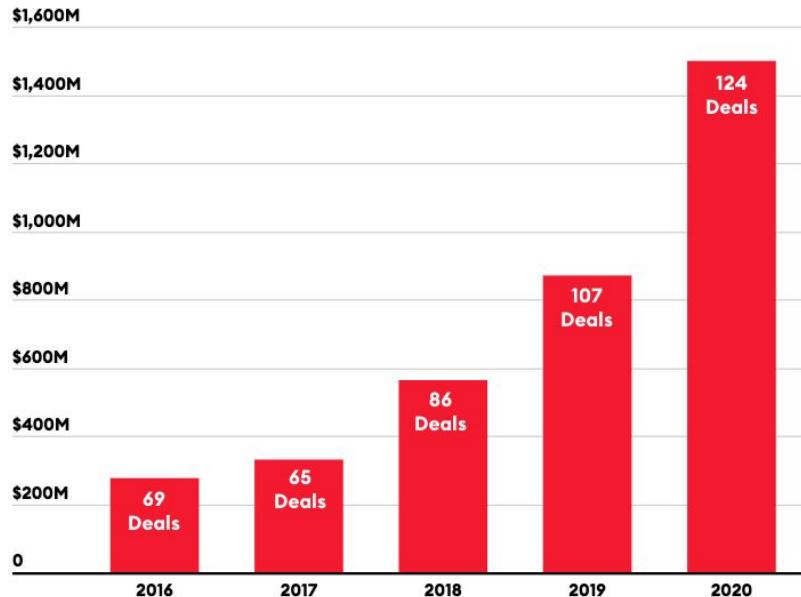
Tokyo highlighted the intense pressures felt by athletes at the Olympics.

### Image sources:

- <https://www.kff.org/coronavirus-covid-19/issue-brief/the-implications-of-covid-19-for-mental-health-and-substance-use/>
- <https://www.forbes.com/sites/forbesagencycouncil/2021/09/07/what-we-can-learn-from-the-olympic-spotlight-on-mental-health/?sh=1939207a2adc>
- <https://www.today.com/news/beijing-olympics/mental-health-olympics-rcna11792>

# Mental Health Startup Market is Booming

## VC FUNDING U.S.-BASED MENTAL HEALTH STARTUPS

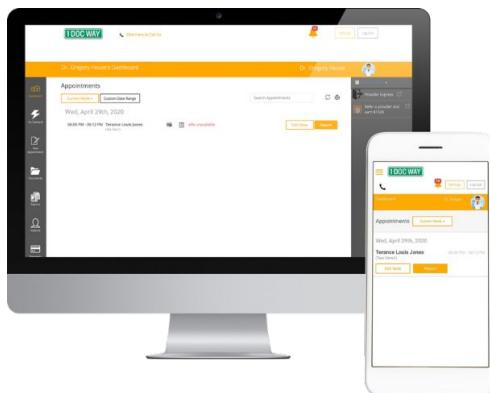


"Investors poured \$1.5 billion into the market in 2020, but technology alone won't solve long standing problems like low reimbursement rates and provider shortages."

Source:  
<https://www.forbes.com/sites/katiejennings/2021/06/07/venture-funding-for-mental-health-startups-hits-record-high-as-anxiety-depression-skyrocket/?sh=994855711165>

# Product Examples in the Market Today

# Telehealth Portal



**Patients get seen in days, not weeks**

By leveraging the power of telepsychiatry, providers can increase their caseload without the burden of traveling long distances



**Telepsychiatry is as effective as in-person care**

Robust evidence shows telepsychiatry leads to improved outcomes and higher patient satisfaction ratings



**Telepsychiatry has favorable reimbursement**

Telepsychiatry visits are reimbursable by Medicare, Medicaid, and private payers in most states

Source: <https://www.genatelepsychiatry.com/telepsychiatry-benefits/>

# Telehealth Portal



"On-demand and personalized experience for behavioral health coaching, therapy, and psychiatry"

Merged with  
The headspace logo consists of an orange circle followed by the word "headspace" in a lowercase, grey, sans-serif font.



"Access the best mental health providers and most effective treatments"



"Modern Health anticipates your mental health needs. We make value-based care easily accessible, personalized, culturally centered, and actionable for employers, all in one app."



"Feeling better starts with a single message"

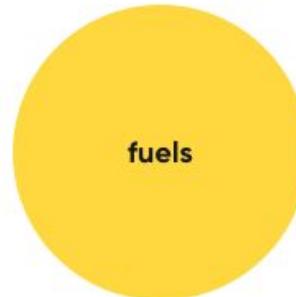
Source:  
<https://www.ginger.com/>  
<https://www.lyrahealth.com/>  
<https://www.modernhealth.com/>  
<https://www.talkspace.com/>  
<https://www.headspace.com/>

# Personal/Professional Coaching Platform



## INDIVIDUAL TRANSFORMATION

One-on-one, specialist, and on-demand coaching, group sessions, and an extensive library of resources – including leadership, nutrition, parenting, DEIB, and sleep – to propel individual performance and well-being.



## ORGANIZATIONAL GROWTH

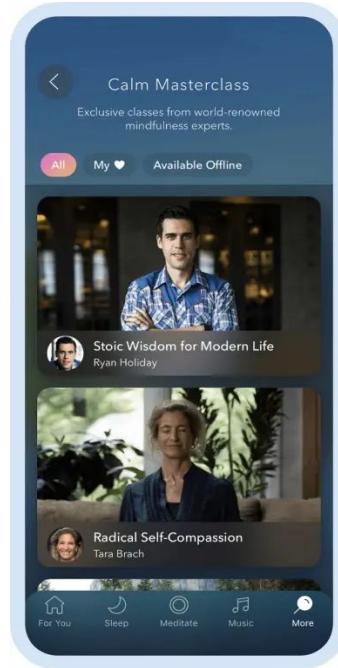
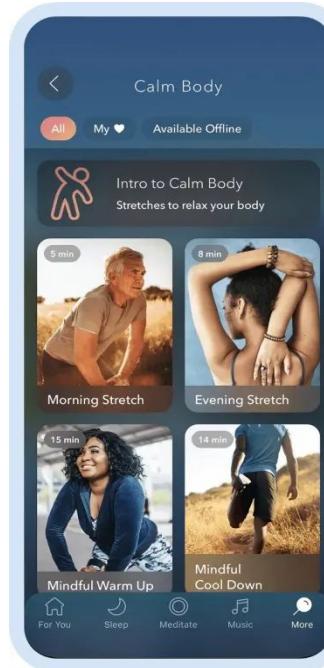
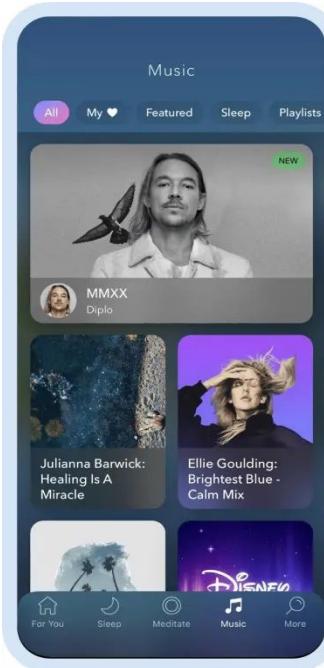
We weave coaching into the fabric of your enterprise – integrating with your critical systems and team tools, and providing actionable insights that connect individual growth to organizational outcomes – driving program effectiveness and ROI.

Source: <https://www.betterup.com/>

# Mental Wellness Content App



Business



# Summary of Existing Products

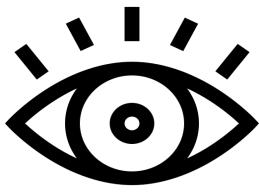
- Most of them are science-based and are helpful in theory
- All of them require regular engagements and habit forming

Change Behavior and Forming Habit is HARD!

# Science of Sensory Interventions

# Sensory Stimuli

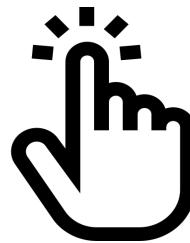
Visual



Auditory



Tactile



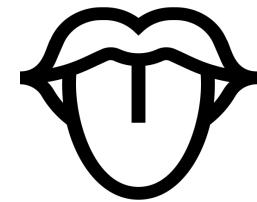
Olfactory

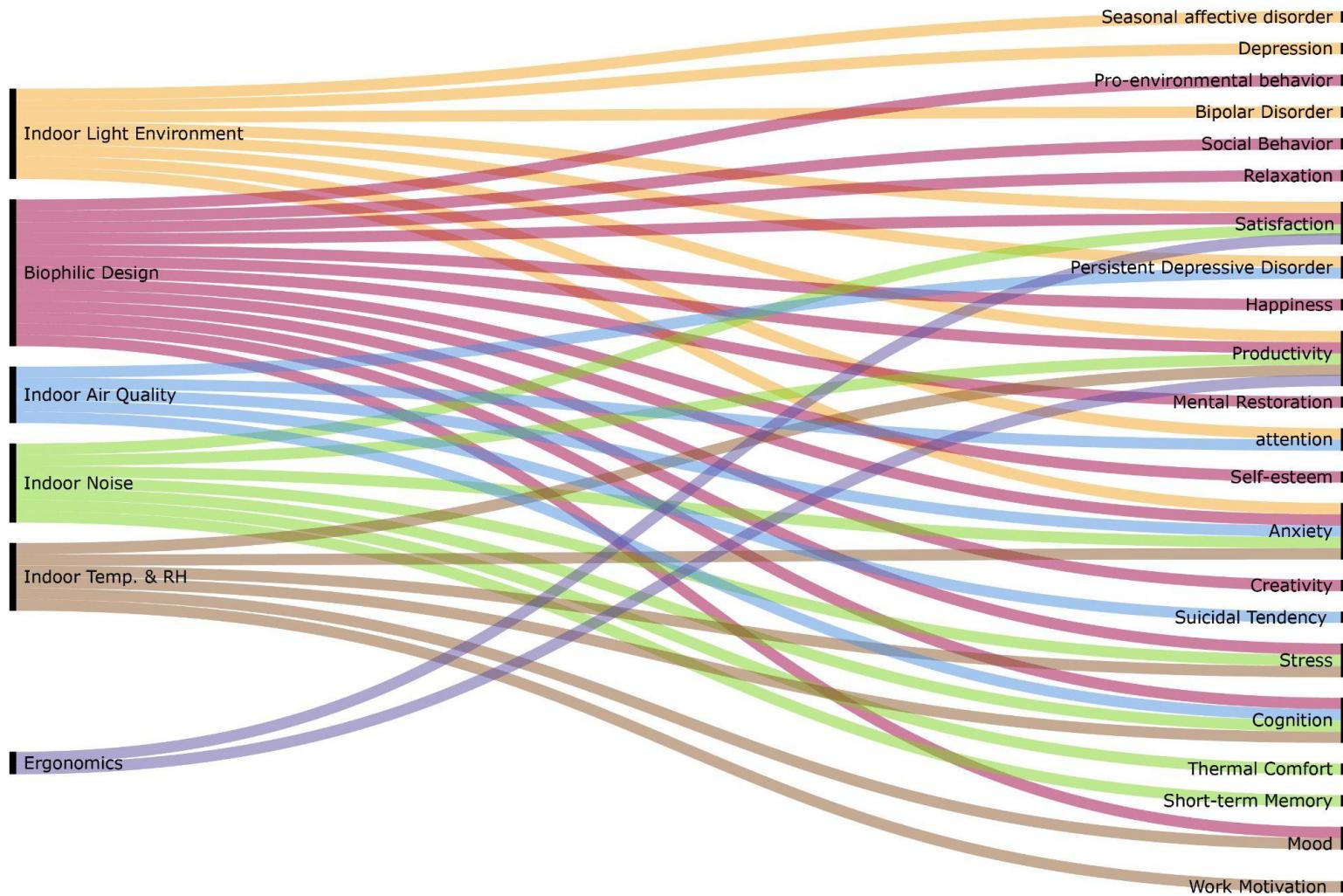


Proprioceptive



Gustatory





# Biophilic Design Elements



Biophilic Visual



Biophilic Sound



Biophilic Scent

## Biophilic Design Elements - Visual

### What are Biophilic Visual elements?

- Decorative indoor elements made with natural materials (wood wall/wooden floor)
- Indoor horticulture/ Plants (Living wall)
- Outdoor views to natural elements (Trees, park, water)
- Simulated natural sceneries (Photo, Slide show, Video, VR, AR)

### Mental Health Impacts of Visual Biophilic Design elements

- Improved attention [1]
- Reduced acute mental stress [2]
- Improved restoration of cognition and stress [3]–[7]
- Reduced mental anxiety and fatigue [8]–[12]
- Improved mood [13]–[16]



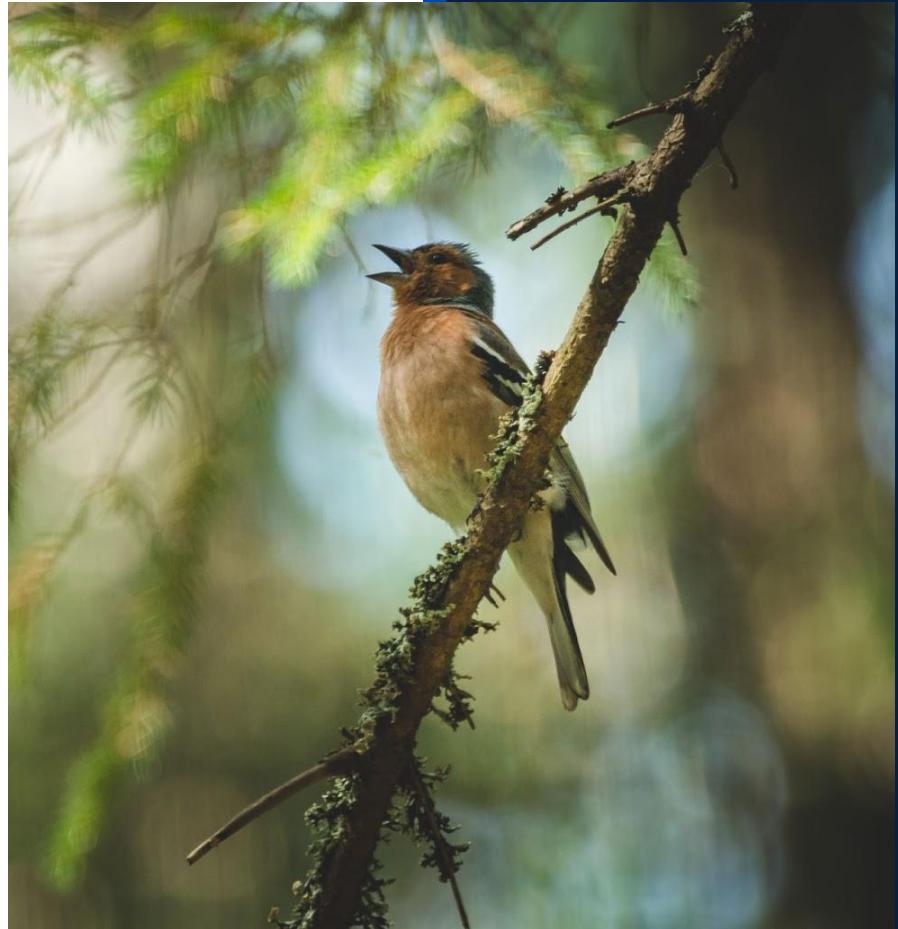
## Biophilic Design Elements - Sound

### What is Biophilic Sound?

- Real/Recorded natural sounds (i.e., birds chirping, water flowing, wind blowing, trees rustling, etc.)

### Mental Health Impacts of Biophilic Sound:

- Reduced depression and feelings of anger [17]
- Reduced stress [18]
- Improved restoration from social stress [19]
- Reduced mental anxiety and fatigue [20]
- Improved mood [21]-[31]



## Biophilic Design Elements - Scent

### What is Biophilic scent?

Scent that reminds people of nature. Can come either from natural plant extracts or artificial fragrances.

- Plant/animal scents (i.e., floral, fruity, citrus, fish scent, etc.)
- Natural environment scent (i.e., ocean, forest, rain, etc.)

### Mental Health Impacts of Biophilic scents:

- Mental relaxation or arousal [32]–[38]
- Increased alertness [39]–[43]
- Improved mood [34], [35], [44]–[55]



## Biophilic Design Elements - Virtual Reality

### What is Biophilic Virtual Reality (VR)?

- Simulated VR 3D natural environments that combine biophilic visual and acoustic elements

### Mental Health Impacts of Biophilic VR:

- Improved restoration of cognition and stress [5]–[7], [56]–[58]
- Improved mood [14]–[16]



# Light

## Mental Health Impacts of Light:

- Improved mental health conditions (i.e., bipolar disorder, seasonal affective disorder, persistent depressive disorder, etc.) [59]–[66]
- Reduced stress, anxiety [67], [68]
- Improved mood [67], [69]–[72]
- Improved productivity [73]
- Improved spatial satisfaction [74], [75]



# Noise

## What is Noise?

- Noise is unwanted and/or harmful sound (i.e., human noise, equipment/appliance noise, traffic noise). [76], [77]

## Mental Health Impacts of Noise:

- Stress and anxiety [78]–[81]
- Thermal comfort has confounding effect on noise [82]
- Reduced productivity and cognitive function [78], [80], [83]–[86]



# Thermal

## **Mental Health Impacts of Proper Thermal Environments:**

- Improved cognition, productivity and work motivation [87]–[94]
- Improved mood [95], [96]
- Reduced stress and anxiety [97]



# Air

## **Mental Health Impacts of poor IAQ:**

- Increased depression and suicidal tendency [98]–[102]
- Cognitive impairment and attention deficit [103]–[110]
- Stress [111]–[118]



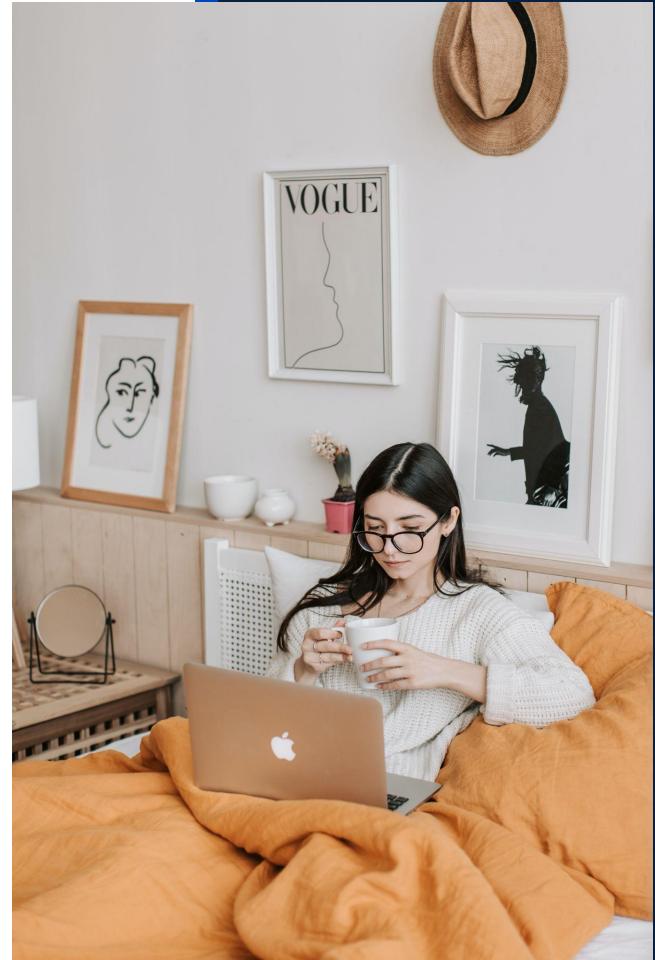
# Ergonomics

## What is Ergonomics?

- Ergonomics involves designing to fit the needs of the people rather than trying to make the people adjust to the design. This concept is being applied in different human-centric design domains from workspace, living space, to clothing, furnitures and even wearables.

## Mental Health Impacts of Ergonomic design:

- Boost productivity [126][127][130]
- Increase Job satisfaction [128]-[130]



# Emerging Science of Multisensory Environment

# What is A Multisensory Environment?

A Multisensory environments (MSEs) are defined as spaces that are equipped with sensory materials that provide users with visual, auditory, tactile, olfactory, proprioceptive and even gustatory stimulation.

Existing neuroscience and psychology studies have shown that MSEs improve mental health, intellectual and developmental disabilities, dementia, traumatic brain injuries, and maternity.

Source: Allison Cameron, Pippa Burns, Andrea Garner, Sim Lau, Roselyn Dixon, Carly Pascoe & Michael Szafraniec (2019): Making Sense of Multi-Sensory Environments: A Scoping Review, International Journal of Disability, Development and Education, DOI: 10.1080/1034912X.2019.1634247

# A Review Study of MSEs

Author, date	Country	Target User(s) and setting	Type of MSE
1. Knight et al. (2010)	USA	General psychiatry and geriatric neuropsychiatry patients experiencing distress Psychiatric settings	Calming
2. Sutton and Nicholson (2011)	New Zealand	Young persons' and adult mental health patients in acute mental health units	Calming
3. Chalmers et al. (2012)	Australia	People with acute psychiatric disturbances in an acute psychiatric hospital ward	Calming Comfort room
4. Novak et al. (2012)	Australia	People with psychiatric conditions in an acute inpatient psychiatric unit	Calming Comfort room
5. Smith and Jones (2014)	UK	Patients in acutely disturbed phase of serious mental disorder Specialist secure psychiatric unit	Calming Sensory room
6. Scanlan and Novak (2015)	Australia	People with mental health problems and psychiatric illnesses. Psychiatric wards in hospitals and mental health services.	Calming Comfort room
7. Kaplan et al. (2006)	USA	Adults with moderate to severe intellectual disability, autism and severe challenging behaviours attending a day program	Calming Snoezelen * room
8. Lotan (2006)	Israel	Adult females with Rett Syndrome living in a residential facility	Calming Snoezelen * room
9. McKee et al. (2007)	Canada	People with developmental delays, ASD and psychiatric disorders General psychiatry hospital	Calming Snoezelen * room
10. Botts et al. (2008)	USA	People with a range of developmental disabilities and cognitive impairments. Schools or day residential facilities	Calming Snoezelen * rooms
11. Lotan and Gold (2009)	Norway/ Israel	People with intellectual and developmental disabilities	Calming Snoezelen* room
12. Sachs and Nasser (2009)	Israel	Families of children with severe intellectual disability Long-term residential facility	Calming Snoezelen * room
13. Chan et al. (2010)	Hong Kong/UK	Adult clients with developmental disabilities Mental health facilities/facilities for people with developmental disabilities	Calming Snoezelen * room or other MSEs
14. Fava and Strauss (2010)	Italy/ Germany	Adults with profound intellectual disability or profound intellectual disability and ASD living in a residential facility for people with intellectual disability	1. Snoezelen * room 2. Stimulus Preference Environment
15. Stephenson and Carter (2011)	Australia	Students with moderate to severe intellectual disabilities. Schools with MSEs	Not specified MSE 1 White & dark
16. Thompson (2011)	USA	Students with severe physical and intellectual disabilities. Public pre-K-12 school	Not specified
17. Carter and Stephenson (2012)	Australia	Children with severe disabilities. MSEs in special schools	Calming
18. Hill et al. (2012)	UK	Teenagers and young adults with severe intellectual disability and ASD attending a residential school	Calming
19. Staal et al. (2007)	UK/USA	Geriatric patients with dementia and behavioural disturbances in an acute care geriatric psychiatry unit setting	Calming
20. Ward-Smith et al. (2009)	USA	People with dementia in a special care locked unit	Calming
21. Anderson et al. (2011)	Australia	People with severe dementia in a Residential Aged Care Facility	Calming Snoezelen * room
22. Klages, Secevic, Orange and Hobson (2011)	Canada	People diagnosed with dementia in a long-term care home	Snoezelen * room
23. Kim et al. (2012)	Korea	People with dementia	Calming
24. Bauer et al. (2012)	Australia	People with dementia living in Residential Aged Care Services	Calming, stimulating and recreation
25. Maseda, Sanchez, Pilar-Marante, Gonzales-Albraldes, Bujan et al. (2014)	Spain	People with dementia living in a residential centre for the elderly	Calming Snoezelen * room
26. Maseda et al. (2014)	Spain	People with dementia living in a residential centre for the elderly	Stimulating Snoezelen * room
27. Bauer et al. (2015)	Australia	People with dementia living in residential aged care facilities	Calming
28. Haigh and Mytton (2016)	UK	People with dementia	Calming
29. Hotz et al. (2006)	USA	Children recovering from severe traumatic brain injury. Hospital paediatric rehabilitation unit	Calming, White Snoezelen * room
30. Poza, Gómez, Gutiérrez, Mendoza and Hornero (2013)	Spain	Adults with mild to severe brain injuries. National Reference Centre for people with severe disabilities.	Calming, White Snoezelen * room

Source: Allison Cameron, Pippa Burns, Andrea Garner, Sim Lau, Roselyn Dixon, Carly Pascoe & Michael Szafraniec (2019): Making Sense of Multi-Sensory Environments: A Scoping Review, International Journal of Disability, Development and Education, DOI: 10.1080/1034912X.2019.1634247

# Health Outcome of MSEs

Category	Outcome	Studies*
Autonomy	Provide user with choice or sense of control	2, 5, 8
Functional abilities	Improvement in activities of daily living and functional skills	7, 19, 25, 28
Social skills	Improve cognitive function Improve interpersonal relationships Improve pro-social behaviour, including communication skills Engagement	25 2, 5, 8, 12, 18, 21, 26, 9, 11, 13, 14, 15, 18, 21, 25, 26 7, 16, 18, 26
General well being	Improve well being Improve mood Relaxation and reductions in stress Recreation Sense of safety	23, 28 25, 28 5, 8, 10, 12, 15, 16, 17, 26, 29, 30 15, 17, 24 2
Learning	To teach specific skills Reduce distractions Increase focus	17 15 16
Generalisation	Carryover effects	7, 10, 11, 13, 14, 15
Distress, anxiety and agitation	Reduce distress, anxiety and/or agitation	1, 3, 4, 6, 8, 11, 13, 17, 19, 20, 24, 25, 28, 29
Distraction	Provide distraction	2, 5
Challenging behaviours	Reduce stereotypical and/or self-stimulating behaviours Reduce disturbed and disruptive behaviours Reduce wandering, pacing, restlessness Reduce aggressive behaviour	10, 11, 13, 18 4, 7, 8, 9, 11, 13, 14, 20, 21, 23, 24 3, 20, 24, 27 4, 7, 9, 10, 11, 13, 20, 24, 25
Aggression	Reduce rates of seclusion and restraint	1, 3, 4, 5, 6
Alternatives to seclusion and restraint	Improve balance and reduce falls	8, 22
Equilibrium and coordination	Heart rate Blood oxygen saturation EEG activity Muscle tone	26, 29 26 30 29
Biomedical and physiological changes	Music Weighted blanket Massage chair Items that could be squeezed or manipulated Fibre optics and adjustable lights or lamps Vibrating pillow	1, 3, 4, 5, 8, 20 4 3 1 3, 20 20
Frequently selected items of equipment by users		

Source: Allison Cameron, Pippa Burns, Andrea Garner, Sim Lau, Roselyn Dixon, Carly Pascoe & Michael Szafraniec (2019): Making Sense of Multi-Sensory Environments: A Scoping Review, International Journal of Disability, Development and Education, DOI: 10.1080/1034912X.2019.1634247

# Settings and Equipment in Mental Health Studies

MSE & Equipment	Knight et al. (2010)	Sutton and Nicholson (2011)	Chalmers et al. (2012)	Novak et al. (2012)	Smith and Jones (2014)
Hospital settings	General psychiatric and geriatric psychiatric units in Massachusetts, USA	4 mental health inpatient units (1 high needs unit, 1 general ward, 1 intensive care unit & 1 open ward) in New Zealand	Acute psychiatric inpatient unit in Victoria, Australia	Acute inpatient psychiatric unit in New South Wales, Australia	Psychiatric intensive care unit in the United Kingdom 5 x 2.5 m
Room dimensions					
Aromatherapy	✓		✓	✓	
Music	✓	✓	✓	✓	✓
Nature sounds			✓		
Adjustable lighting			✓		✓
Optic mat					✓
Projector					✓
Scenic pictures				✓	
Gustatory	✓				✓
Rocking chair	✓		✓	✓	
Fit ball			✓	✓	
Bean bags	✓		✓		✓
Tactile panels	✓				
Weighted blanket	✓		✓	✓	
Massage equipment		✓	✓		
Stress balls/stress items		✓			✓
Soft blankets		✓			
Comfortable seating				✓	
Bubble tube					✓

Source: Allison Cameron, Pippa Burns, Andrea Garner, Sim Lau, Roselyn Dixon, Carly Pascoe & Michael Szafraniec (2019): Making Sense of Multi-Sensory Environments: A Scoping Review, International Journal of Disability, Development and Education, DOI: 10.1080/1034912X.2019.1634247

# Snoezelen Room



[https://ww  
w.snoezele  
n.info/roo  
m-example  
s/](https://www.snoezelen.info/room-example-s/)

# Recharge Room



<https://www.youtube.com/watch?v=rhBl0yGqsbw>

<https://www.mountsinai.org/locations/abilities-research-center/programs-technologies/recharge-rooms>



# Course Project: Develop an interactive game in an MSE

# Value Propositions

An interactive game in an MSE for everyone to improve their mental health.

Assuming an MSE game console has been invented:

- Visual
- Auditory
- Tactile
- Olfactory
- Proprioceptive



Source:

<https://www.nbcnews.com/select/shopping/best-game-consoles-nintendo-switch-sony-playstation-xbox-ncna1179446>

<https://segd.org/12-influential-immersive-environments-implemented-last-12-months>

# Xbox Kinect Interactive Experience



Photo source:

<https://www.gamerevolution.com/news/630-microsofts-e3-conference-shows-way-too-much-kinect-so-long-controller>

<https://www.theverge.com/2013/5/21/4353232/kinect-xbox-one-hands-on>

# VR + Theme Park Immersive Experience



Photo source:

<https://www.space.com/oculus-quest-2-review>

<https://www.latimes.com/business/la-fi-harry-potter-4k-20170323-story.html>

# The Most Popular Mental Wellness Game on VR



<https://www.tripp.com/>

# Put Interactive and Immersive Experience Inside a Box

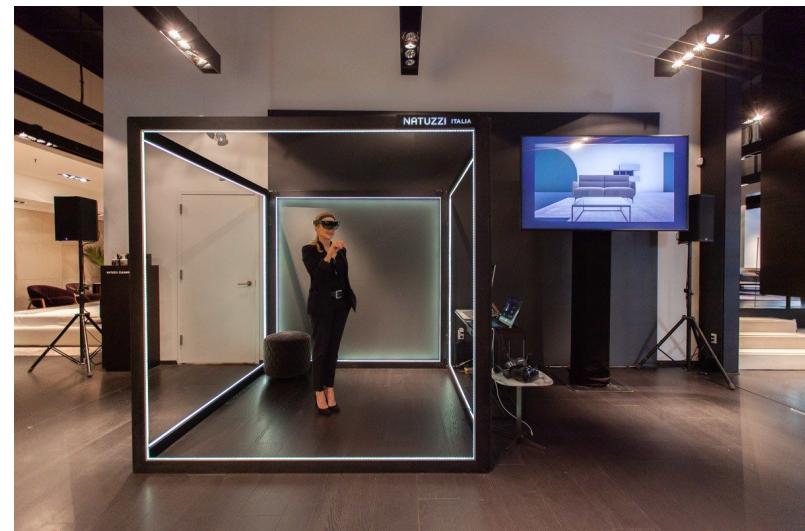
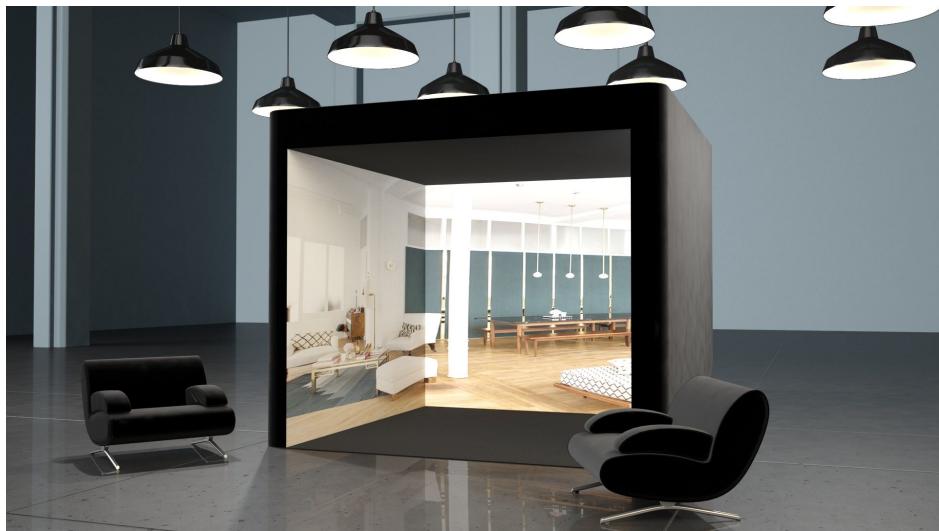


Photo source:  
<http://lena-immersive.com/en/1273-2/>  
<https://www.twogoats.us/immersiveaugust12/>

# Target Users

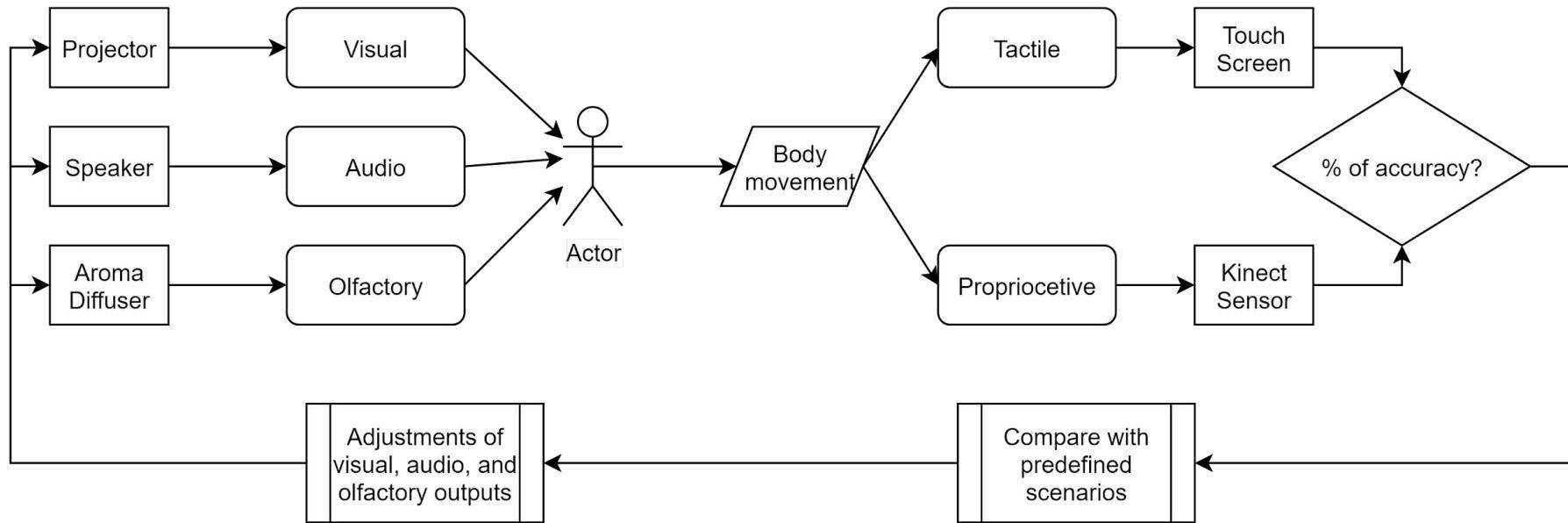
Employees in high stress work environment:

- Suffers acute stress and anxiety
- Limited time to relax
- Want to improve cognitive performance
- Want to be happier
- Want to socialize

Seniors in senior housing communities:

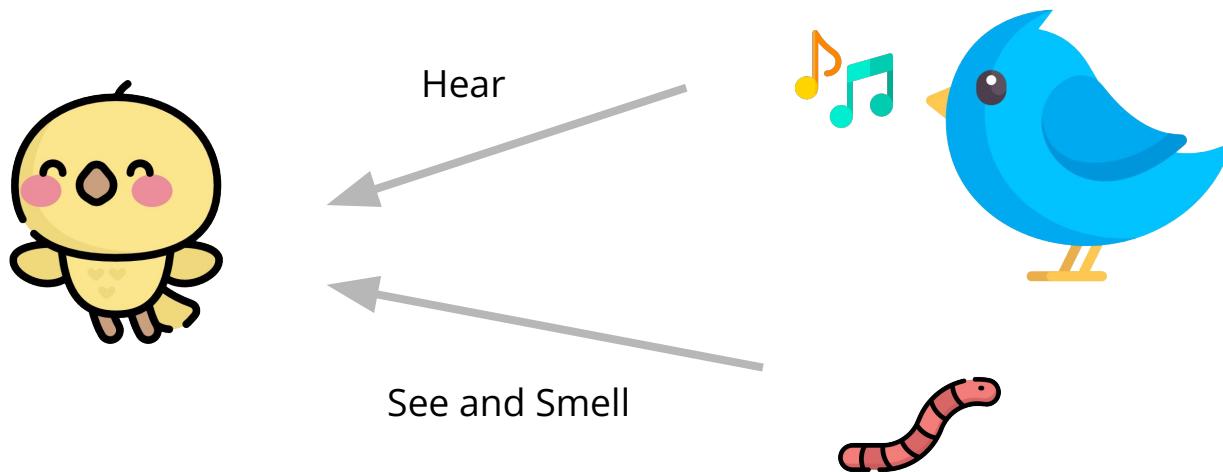
- Suffers social isolation and loneliness
- A lot of time to kill
- Want to improve cognitive performance
- Want to be happier
- Want to socialize

# Complete Game Concept



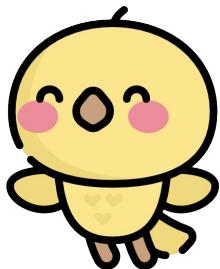
# Example game - Catch a Worm!

How many worms can I eat in 1 minutes?



# Example game - Catch a Worm!

How many worms can I eat in 1 minutes?



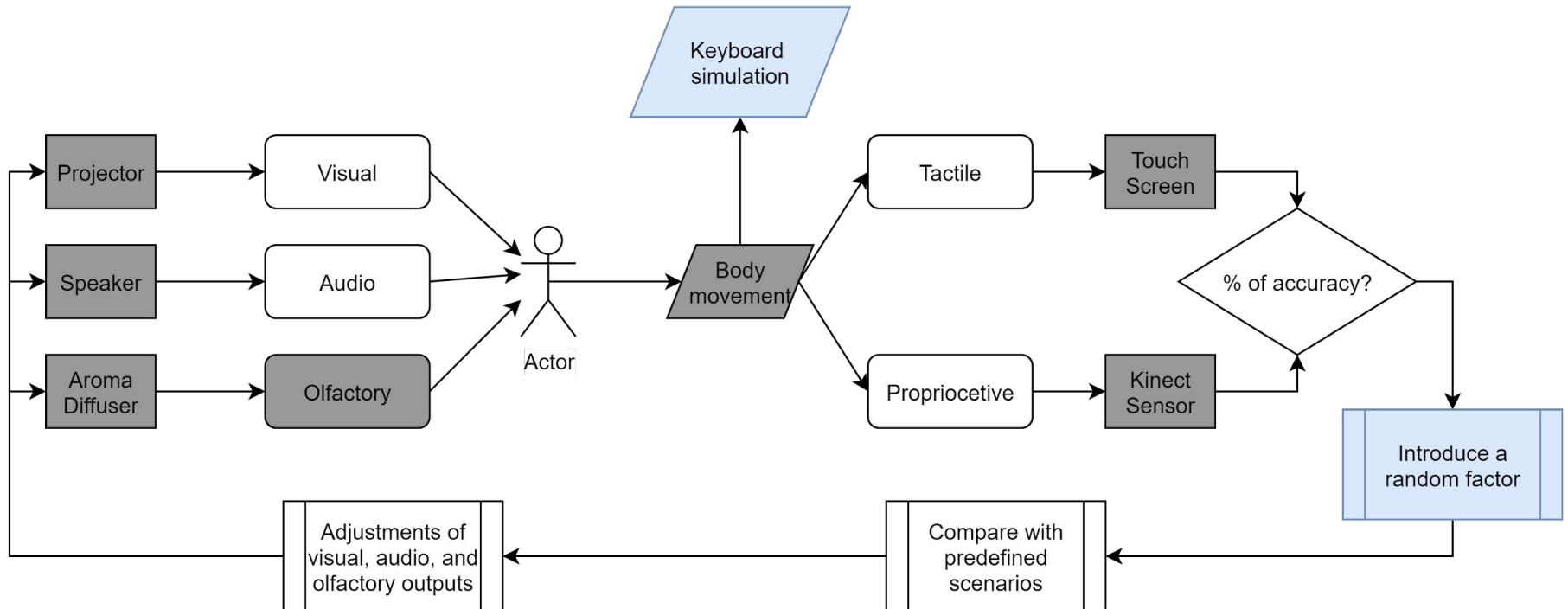
Move your body to control the speed and direction of the bird, just like what you would play Just Dance or other Xbox Kinect games!

When you are in the right position to catch a worm, use your hand touch the screen in front of you to catch it!



<https://www.amazon.com/Just-Dance-Nintendo-Wii/dp/B002MWSY3O>

# The scope of this project is the software algorithm!



# Use Google Doodle Games as Inspirations!

- <https://www.google.com/logos/doodles/2017/fischinger/fischinger17.9.html?hl=en>
- [https://www.google.com/search?gs\\_ssp=elzj4tVP1zc0LLQoT6-sLDcyYPQSTS\\_PT89|VUj|z08BUumJuanFANYqDDA&q=google+doodle+games&rlz=1C5CHFA\\_enUS788US788&oq=google+doodle+&aqs=chrome.1.69i57j46i20i263i433i512j0i433i512l3j69i60l3.3901j0j4&sourceid=chrome&ie=UTF-8](https://www.google.com/search?gs_ssp=elzj4tVP1zc0LLQoT6-sLDcyYPQSTS_PT89|VUj|z08BUumJuanFANYqDDA&q=google+doodle+games&rlz=1C5CHFA_enUS788US788&oq=google+doodle+&aqs=chrome.1.69i57j46i20i263i433i512j0i433i512l3j69i60l3.3901j0j4&sourceid=chrome&ie=UTF-8)

# Additional Content Requirements

- The goal is to improve mental health!
- You need a storyboard
- Nature-inspired themes
- High color contrast and saturation
- More than 50% success rate for beginners
- Pace is slower than typical video games



Group Discussion - 20 minutes

Will talk about how to get an A for this project after!

# Evaluation Criteria

Application of the science	25
Balance between difficulty and excitement	25
Completion of the game algorithm	25
Completion of the game story and design	25
Have 3+ modes of sensory inputs and outputs	10
<b>Total</b>	<b>110</b>

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