

Obsessive Compulsive Disorder: Infusing person-environment questions in studies of mental health

A collaboration between the University of Minnesota College of Design,
the Medical School, and the College of Science and Engineering

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Hand washing video





Obsessive Compulsive Disorder (OCD) is one of the world's top ten causes of disability based upon total lost pay and diminished quality of life.

World Health Organization, 2011



OCD Diagnosis

- **Obsessions:** recurrent, intrusive thoughts that cause marked distress or anxiety
- **Compulsions:** repetitive behaviors that the person feels driven to do in response to obsessions
- Spends at least 1 hr/day in obsessions/compulsions or shows functional impairment in daily life.

DSM-5, 2013



Dimensions of OCD

Contamination / Cleaning

Obsessions about germs and contamination, hand washing and cleaning compulsions

Ordering / Repeating

Checking, ordering, counting or repeating rituals

Hoarding

Need to retain objects and fear of throwing things away

Forbidden Thoughts

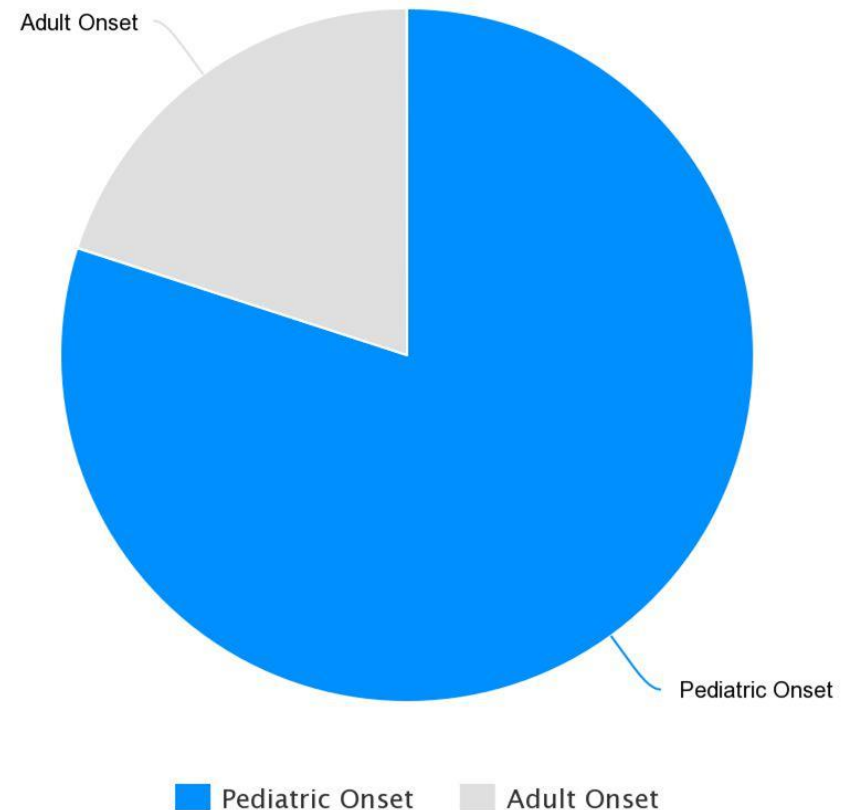
Intrusive taboo thoughts about aggression, sexuality and religion.

Bernstein et al., 2013

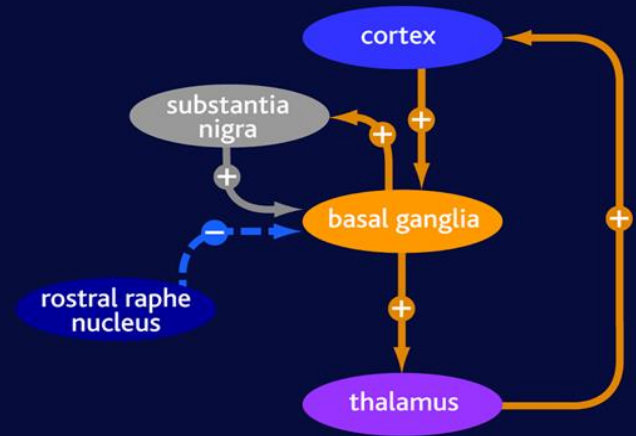
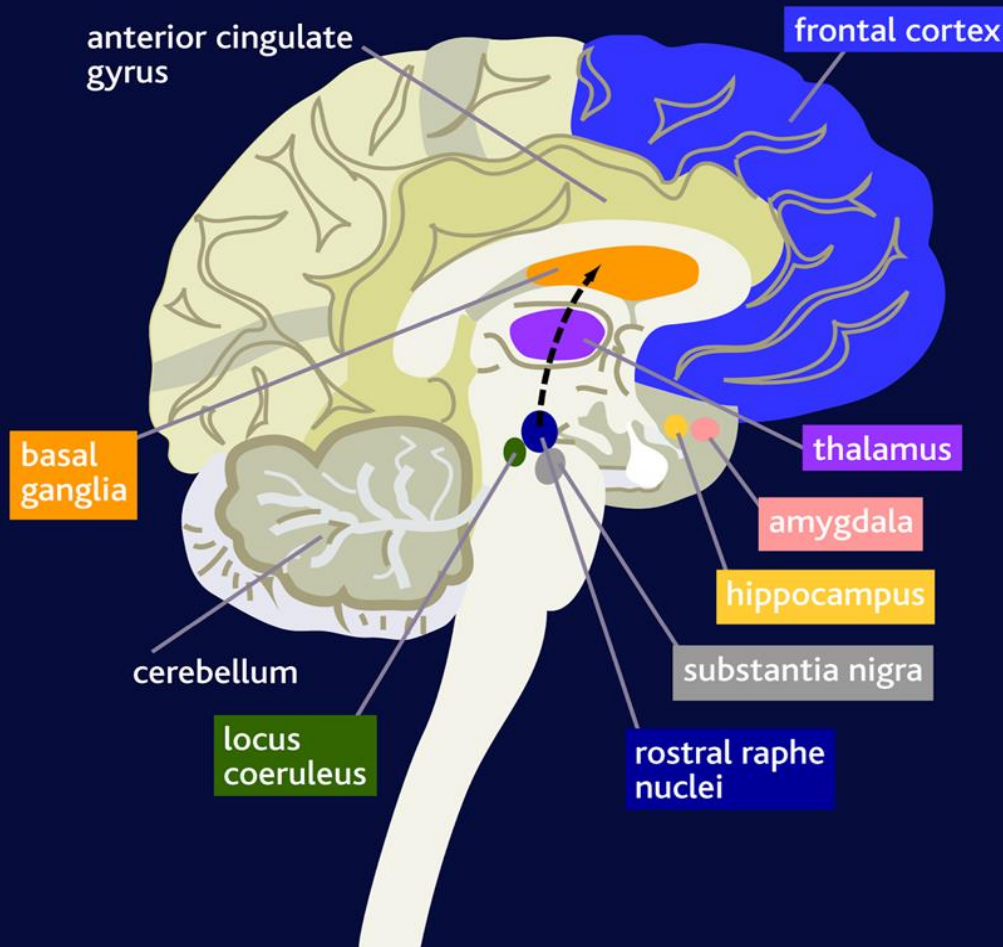


Prevalence of OCD

- About 2.3% of the U.S. population ages 18 to 54
- http://www.mhmrcv.org/poc/view_doc.php?type=doc&id=8877
- 1-3% of children have OCD
 - Up to 80% of all OCD cases may have a pediatric onset, although many children with OCD are unrecognized and undiagnosed.
 - Many aspects of this illness remain enigmatic and the paths to more effective diagnosis and treatments remain obscure.



Expanding Understandings - Brain Circuitry of OCD



https://www.cnsforum.com/upload/imagebank/download/Neuro_bioI_OCD_2.pr



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Research Purpose

Better understand the role of the environment in mental and behavioral conditions

Develop knowledge that contributes to diagnosis and treatment

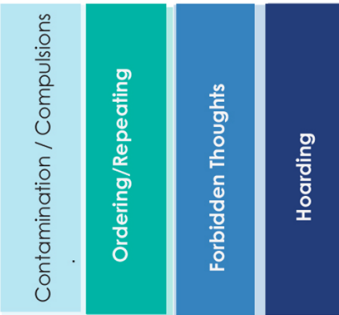


Matrix of Environmental Factors and Behaviors in the Home

Home

 = Missing Information

SUBCATEGORIES OF OCD



Environment

Behavior

MISC

| | | | | | |
|------------------------|---|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Flooring | Avoiding lines or cracks/particular patterns or colors when walking over flooring. ¹ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Entrances | Going back and forth over thresholds repeatedly. ¹ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Doors | Compulsively hecking locks to prevent break-in. ⁶ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Windows/Blinds | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Lighting | Switching on/off until feels "right". ² | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Switch | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Level of brightness | Closed space to protect from sunburn | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Natural | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Electrical | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Laundry | Personal space of hygenics. ³ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Office (Home/Work) | Clear of clutter, order (Symmetry, Ordering & Arrangement). ⁴ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Desk | Free of Scratches, Dings, Dents | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Personal Electronics | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Bedroom | (Symmetry, Ordering & Arrangement). ⁴ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Bed/Bed Sheets/Pillows | Made, organized | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Window/Blinds | Closed (locked) | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Door | Closed (locked) | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

Bathroom

| | | | | | |
|----------------|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Toilet | Clean (uncomfortable in dirty space). ⁵ turn handles off until it feels good. ⁵ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Sink | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Bathtub/Shower | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Mirror | Checking body to make sure appears healthy. ⁵ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Cabinetry | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

Living Area

| | | | | | |
|--|---|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Furniture (Couches/Chairs) | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Television | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Colors | Patterns that appear dirty or taboo due to superstition are avoided. ^{1,6} | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Patterns in walls | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Patterns in floors (these can be for each room even) | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Kitchen | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Countertop | Organization of food/utensils/cleanlines of "crumbs". ⁵ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Table | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Stove/Oven | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Sink | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Microwave | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Diswasher | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Small Appliances | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Other | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| High Spaces | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Other people | Irrational fear of harm: leads to avoidance | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Elevator (Small Spaces) | Personal Space/Territoriality Cleanliness/Germs | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |



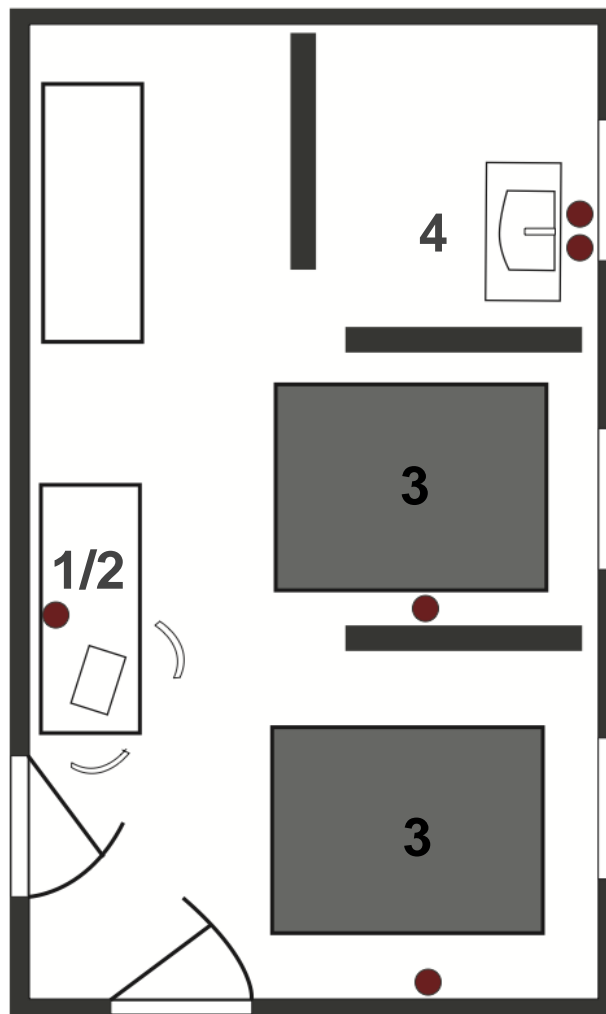
Traveler's Innovation Lab



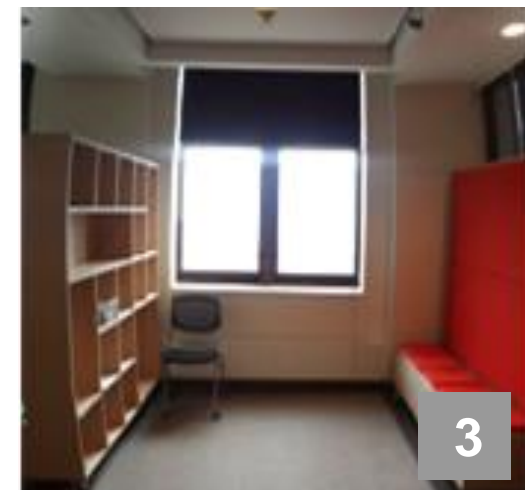
Northrop Memorial Auditorium



Pilot Study



 = GoPro Camera Locations



Cameras

Camera



Subject Recruitment: April 2014 - Dec 2014

Recruitment:

- Referrals from Psychiatrists
- Flyers in the Psychiatry Clinic and the community
- Craigslist

Incentives:

- Target gift card
- Parking pass



Protocol for Data Collection: April 2014 - Dec 2014

- Subjects arrive at the Traveler's Innovation Lab
- Informed parental consent and child assent obtained by Project Coordinator

- Project Coordinator administers CY-BOCS
- Parents & children complete self-report scales (COIS-R, MASC-II, BASC-2)

Subjects complete 4 tasks

- Task 1: Preferences of Pattern Images
- Task 2: Free Arrangement
- Task 3: Arrangement in Contrasting Environments
- Task 4: Hand Washing

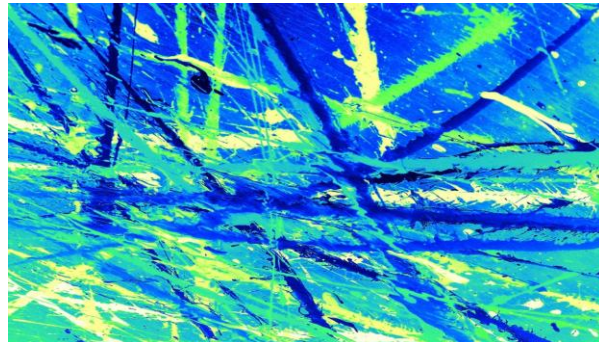
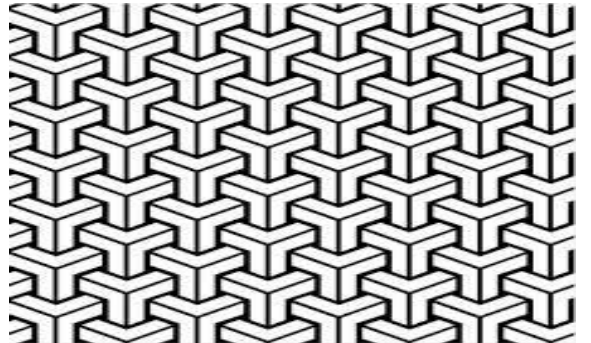
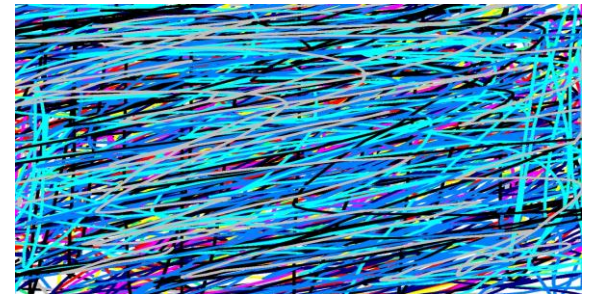
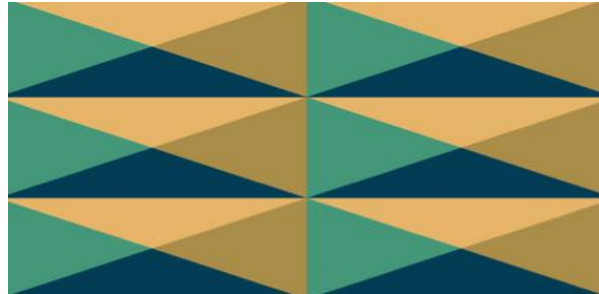
Subjects compensated with Target Gift Card



Task 1

Preferences of Patterned Images

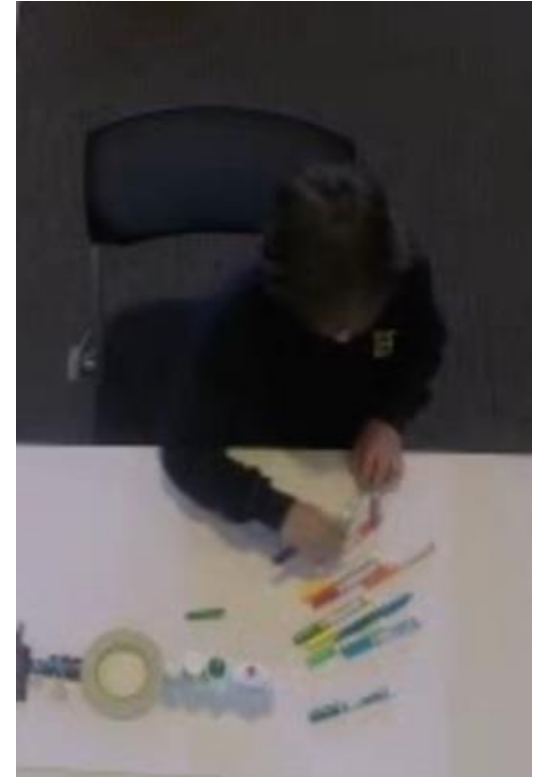
From a series of 20 patterns, subjects record their preferences



Task 2

Free Arrangement

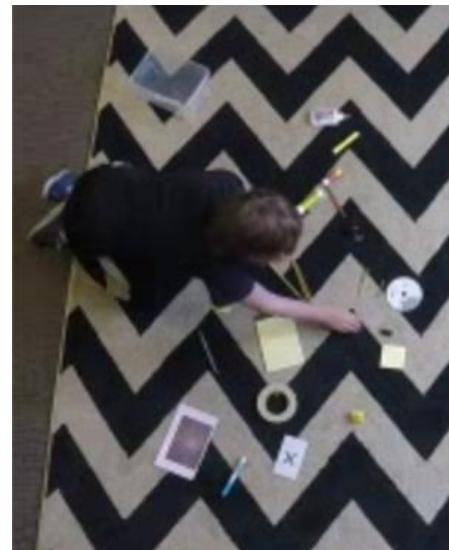
While seated on a desk, subjects are given materials that they are free to organize in any way they choose.



Task 3

Arranging Objects in Contrasting Environments

Subjects are asked to organize materials in two different environments – one with a plain rug and one with a bold and active pattern.



Task 4

Hand Washing

Subjects use a portable sink to wash and dry their hands.



Assessment Measures

Interview

Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS)

- Severity of OCD and dimensions of OCD

Parent Scales

Obsessive Compulsive Impact Scale-Revised (COIS-R)

- Impact of OCD on daily living skills, school, social, and family activities

Behavioral Assessment System for Children- 2 (BASC-2)

- Multiple clinical scales

Child Scales

COIS-R

- Impact of OCD on school, social life, activities

Multidimensional Anxiety Scale for Children-2 (MASC-2)

- Anxiety subscales



Demographics & Severity Scores

| | OCD (n=18) | Control (n=21) |
|--|------------------|-------------------|
| Age at assessment, mean (SD) | 11.5 (3.2) | 10.7 (3.3) |
| Gender, <i>n</i> (%) | | |
| Male | 12 (66.7%) | 12 (57.1%) |
| Female | 6 (33.3%) | 9 (42.9%) |
| Ethnicity, <i>n</i> (%) ^a | | |
| White | 14 (77.8%) | 15 (71.4%) |
| Hispanic | 2 (11.1%) | 1 (4.8%) |
| Asian | 2 (11.1%) | 0 (0.0%) |
| Black | 0 (0.0%) | 1 (4.8%) |
| CY-BOCS Total, mean (SD) | 21.8 (10.3) | 0 (0.0) |
| COIS-R Total, mean (SD) ^b | | |
| Parent Version | 29.9 (18.4) | --- |
| Child Version ^c | 27.2 (23.7) | --- |
| On psychotropic med, <i>n</i> (%) | 14 (77.8%) | 0 (0.0%) |
| Receiving therapy, <i>n</i> (%) | 11 (61.1%) | 0 (0.0%) |
| <u>Family history of OCD, <i>n</i> (%)</u> | <u>4 (22.2%)</u> | <u>1 (4.8%)</u> |

^a 4 controls with missing data

^b COIS-R not required for controls

^c 4 OCD with missing data



Process for Rating Videos

One independent evaluator from each of the three Colleges

- College of Design, Psychiatry, and Computer Science & Engineering

Independent evaluators were blind to OCD vs. Control status

Consensus meetings

- Review videotapes with lack of agreement among raters

Calculation of Mean scores



Data Analysis for Task 4 - Hand Washing



Ratings of Hand Washing Videos

Time

Total hand washing & drying process:

- Turn on water, turn off water, apply soap, rinse off soap, pick up towel, put down towel

Washes to: Wrist, elbow, beyond

Soap used: Built in, not built in

- Number of pumps of soap
- Washes individual fingers
- Washes under fingernails

Type of towel available

- Paper towels, hand towel

Repeating behaviors

- Repeated scrubbing/wiping
- Repeated towel-drying of hands
- Repeated stepping up and down onto stool
- Repeated turning the faucet on and off

Avoidant behaviors

- Avoids touching faucet handles after washing/drying.

Symmetrical behaviors

- Symmetrical approach to washing
- Symmetrical approach to drying

Hoarding/saving behaviors

- Subject shows or expresses difficulty throwing towels away

Ritualistic behaviors

- Ritualistic washing (noticeable particularity in way subject washes)
- Ritualistic drying (noticeable particularity or ritualized way subject dries)

SIGNIFICANT FINDING

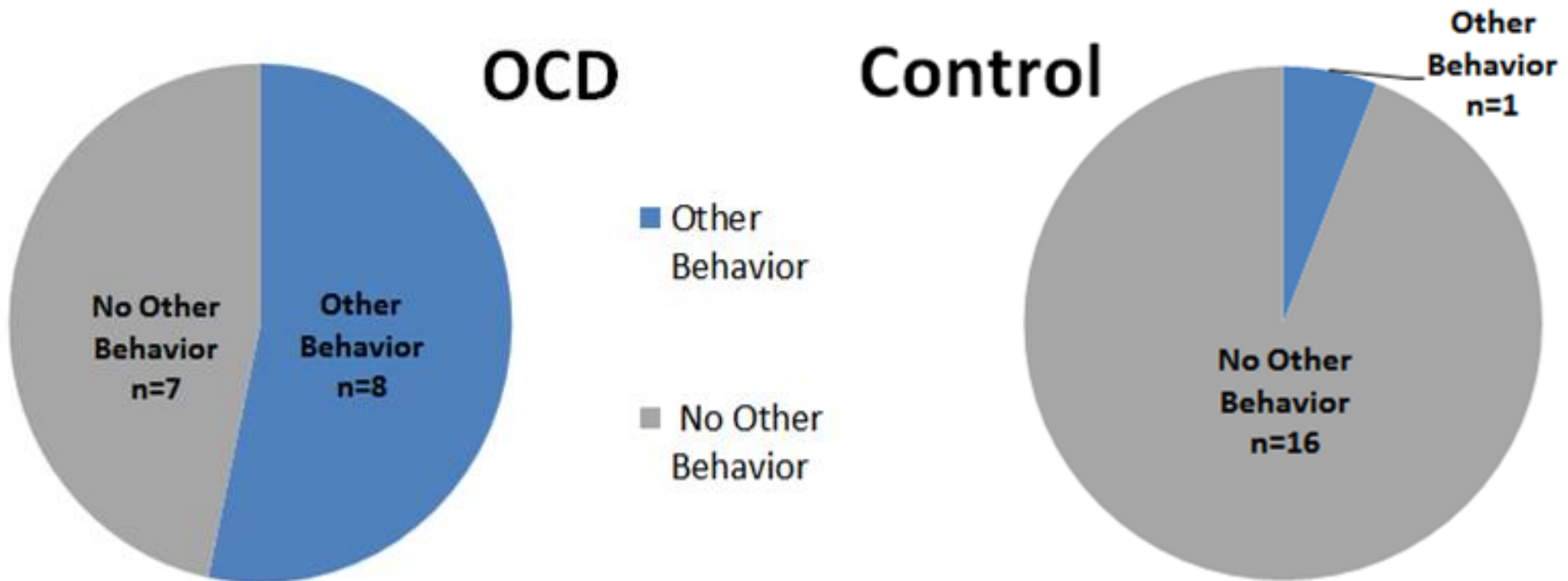
Other behaviors

- Subject exhibits other behaviors simultaneously with washing or drying
 - Touches, taps, or rubs objects and/or self while washing or drying
 - Shows excessive attention to the sink (cleans sink, plays with sink, etc.)



Behaviors Associated with Hand Washing

Children with OCD are more likely to exhibit other behaviors during hand washing
 $p = .005$



Other Behaviors

**Touching/tapping
the sink**

**Washing/drying
the sink**

**Drinking the
water**

**Investigating the
setup**



Duration of Hand Washing

OCD (n=15)

Mean: 45 ± 27 seconds
Range: 23 - 95 seconds

Control (n=17)

Mean: 50 ± 32 seconds
Range: 12 - 76 seconds

No significant difference found between the two means



Greater OCD Severity Predicts Longer Time Hand Washing

| Video Measure | OCD Measure | R, p |
|-------------------------|---------------------------------|------------|
| Hand Washing Total Time | CY-BOCS total | .539, .038 |
| | Ordering/repeating dimension | .565, .028 |
| | Forbidden thoughts dimension | .569, .027 |
| | Child COIS-R total | .581, .047 |
| | MASC obsessions and compulsions | .668, .017 |

Higher total score on CY-BOCS is associated with longer duration of hand washing

Higher scores on ordering/repeating and forbidden thoughts dimensions of CY-BOCS are associated with longer duration of hand washing

Higher total score on Child COIS-R is associated with longer duration of hand washing

Higher score on obsessions and compulsions scale of MASC is associated with longer duration of hand washing



Data Analysis for Task 3 - Free Arranging



Rating of Free Arrangement Videos

Ordering/arrangement behaviors

- Duration of arrangement from start to finish
- Category/pattern of arrangement
- Symmetrical arrangement
- Subject straightens object/s
- Other ordering/arrangement behaviors

Repetitive behaviors

- Label the 5 objects moved the most, from most moved, to least moved and record the most moved materials

Total number of moves

- Total Movement (Rater 1)
- Total Movement (Rater 2)
- Total Movement (Rater 3)
- Average of Raters 1-3
- Standard Deviation of Raters 1-3
- Total number of moves on videos scored together
- FINAL number of moves (score from average ratings or those calculated together)

Behaviors involving others

- Subject seeks reassurance from someone in room (parent, researcher)
- Other behaviors involving others

Artistry

- Subject creates an artistic pattern

Other repetitive behaviors

- Subject starts over in arrangement
- Number of times subject appears to start task over

Other behaviors

- Subject touches, taps, and/or rubs object(s) or self while arranging

SIGNIFICANT FINDING

Space used for arrangement

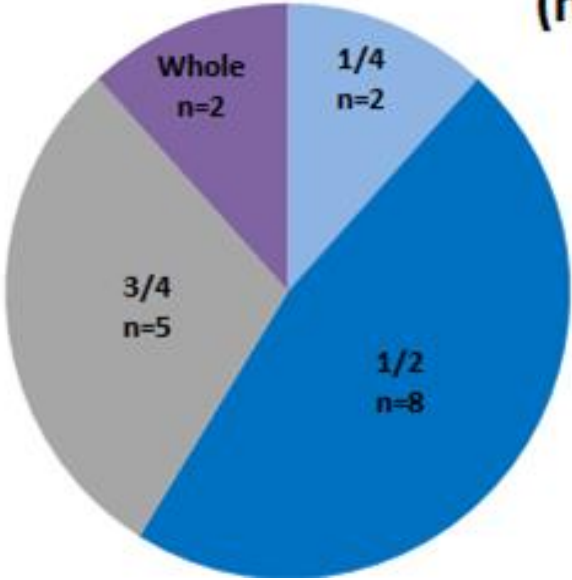
- Whole table
- $\frac{3}{4}$ table
- $\frac{1}{2}$ table
- $\frac{1}{4}$ table



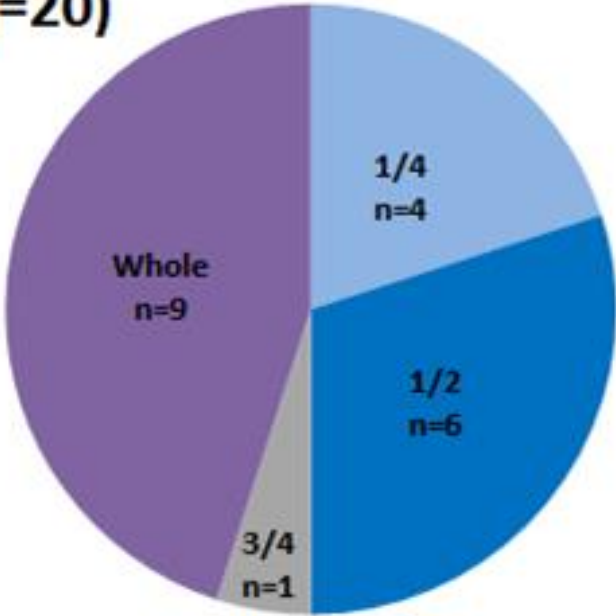
Space Used During Free Arrangement

OCD group used less space for arrangement than the control group
 $p = .049$

**OCD
(n=17)**



**Control
(n=20)**



- .25 table
- .5 table
- .75 table
- Whole table



Free Arrangement — No significant difference found between means

Duration

OCD (n=17)

Mean: 193 ± 208 seconds
Range: 25 - 690 seconds

Control (n=20)

Mean: 121 ± 106 seconds
Range: 33 - 435 seconds

Number of Moves

OCD (n=17)

Mean: 40.8 ± 29.4 moves
Range: 13.7 - 115 moves

Control (n=20)

Mean: 33.2 ± 12.4 moves
Range: 21.7 - 79.3 moves



Findings – OCD group

| Video measure | Clinical measure | R, p |
|---------------------------------|--------------------------------------|-------------|
| Arrangement total time | MASC anxiety probability score | .565, .044 |
| | CY-BOCS ordering/repeating dimension | .592, .012 |
| Arrangement number of movements | CY-BOCS ordering/repeating dimension | .564, .014 |
| | BASC hyperactivity | -.500, .046 |
| | BASC aggression | -.549, .023 |
| | BASC attention problems | -.539, .026 |
| | BASC social skills | .579, .015 |
| | | |

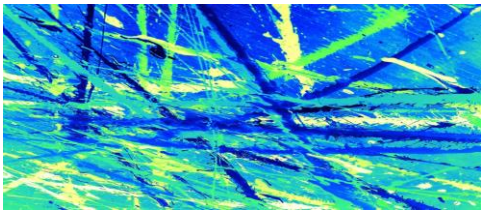
Higher anxiety is associated with longer time to arrange the objects.

Higher scores on ordering/repeating dimension are associated with longer time to arrange the objects and more moves.

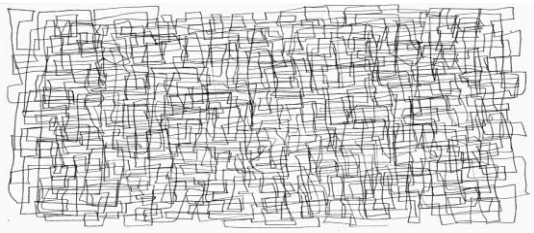
Increased hyperactivity, attention problems, and aggression are associated with fewer moves.

Better social skills are associated with fewer moves.

Most & Least Liked Patterns – All Subjects



Most Liked – dynamic, energetic, moving, colorful, and complex patterns



Least Liked – static, monotonous, monochromatic, and simplistic patterns



Research Purpose and Findings

Better understand the role of the environment in mental and behavioral conditions

- Certain environmental factors are found to be associated with OCD
 - Bathroom fixtures
 - Amount of space used
- Color and pattern appear to have similar effects across groups

Develop knowledge that contributes to diagnosis and treatment

- Treatment may incorporate body/space relationships
- Challenge approaches and assumptions about ability/disability and mental illness
- Focus should include both similarity and difference



Next Steps for Our Team

Analyzing data from Task 3

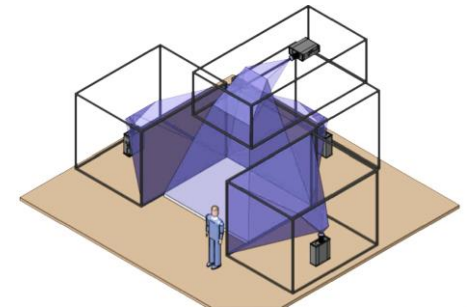
- Arranging task on two rugs

Examining findings for behavioral markers of OCD and development of **Computer Assisted Virtual Environment (CAVE)**

- Study of videos

Completing comparative study of OCD & Autism

- Identifying overlaps & gaps
- Identifying common environmental variables



Challenges

Finding a Space

- Space available for several months
- No interruption
- Space that could be modified
- Space acceptable for children

Controlling the Space - Traveler's Innovation Lab

- Problem of sharing the space
 - Equipment
 - Setup
- Subject protection

Subject Recruitment

- Time to identify subjects
- Need for controls
- Need to match subjects & controls on age/gender



Implications for Future Studies & E-B Research

Future Studies

- Lighting, acoustics
- Spatial layout
- Settings - parks, civic buildings, commercial settings
- Other psychiatric conditions

Value of interdisciplinary team

- Importance of videos
- Deep understanding of user group
- Role of environment to minimize disabilities

E-B Research on Behavioral Conditions

- Methodologies - POE versus Experimental
- Subjects - different disabilities
- Implications for research - home vs school
- Assumptions of mental illness or disability

Forming a Network

- Sharing knowledge, experiences, case studies, POEs
- Interdisciplinary group / website



TRAVELERS
INNOVATION LAB

THANK YOU

For more information please contact

thadjiya@umn.edu