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

- **Hoardiing**
  - Need to retain objects and fear of throwing things away

- **Forbidden Thoughts**
  - Intrusive taboo thoughts about aggression, sexuality and religion.

Bernstein et al., 2013
• 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_biol_OCD_2.png
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

## Environment

**MISC**
- Flooring
- Entrances
- Doors
- Windows/Blinds
- Lighting
- Switch
- Level of brightness
- Natural
- Electrical
- Laundry
- Office (Home/Work)
- Desk
- Personal Electronics

**Bedroom**
- Bed/Bed Sheets/Pillows
- Window/Blinds
- Door

## Behavior

- Avoiding lines or cracks/particular patterns or colors when walking over flooring.
- Going back and forth over thresholds repeatedly.
- Compulsively heciking locks to prevent break-in.
- Switching on/off until feels “right.”
- Closed space to protect from sunburn
- Personal space of hygenics.
- Clear of clutter, order (Symmetry, Ordering & Arrangement).
- Made, organized
- Closed/locked

## SUBCATEGORIES OF OCD

<table>
<thead>
<tr>
<th>Contamination / Compulsions</th>
<th>Ordering / Repeating</th>
<th>Forbidden Thoughts</th>
<th>Hoarding</th>
</tr>
</thead>
</table>

## Bathroom
- Toilet
- Sink
- Bathtub/Shower
- Mirror
- Cabinetry

## Living Area
- Furniture (Couches/Chairs)
- Television
- Colors
- Patterns in walls
- Patterns in floors (these can be for each room even)

## Kitchen
- Countertop
- Table
- Stove/Oven
- Sink
- Microwave
- Dishwasher
- Small Appliances

## Other
- High Spaces
- Other people
- Elevator (Small Spaces)

## Observations
- Clean (uncomfortable in dirty space).
- Turn handles off until it feels good.
- Checking body to make sure appears healthy.
- Patterns that appear dirty or taboo due to superstition are avoided.
- Organization of food/utensils/cleanliness of "crumbs".
- Irrational fear of harm; leads to avoidace
- Personal Space/Territoriality
- Cleanliness/Germs
Traveler’s Innovation Lab

Northrop Memorial Auditorium
Pilot Study

= GoPro Camera Locations
Cameras
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)
  o Severity of OCD and dimensions of OCD

Parent Scales

Obsessive Compulsive Impact Scale-Revised (COIS-R)
  o Impact of OCD on daily living skills, school, social, and family activities

Behavioral Assessment System for Children- 2 (BASC-2)
  o Multiple clinical scales

Child Scales

COIS-R
  o Impact of OCD on school, social life, activities

Multidimensional Anxiety Scale for Children-2 (MASC-2)
  o Anxiety subscales
### Demographics & Severity Scores

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

*4 controls with missing data
*COIS-R not required for controls
*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: $45 \pm 27$ seconds  
Range: 23 - 95 seconds

**Control (n=17)**

Mean: $50 \pm 32$ seconds  
Range: 12 - 76 seconds

No significant difference found between the two means
Greater OCD Severity Predicts Longer Time Hand Washing

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

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
- ¾ table
- ½ table
- ¼ table
Space Used During Free Arrangement

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

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean (± SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OCD (n=17)</strong></td>
<td>193 ± 208 seconds</td>
<td>25 - 690</td>
</tr>
<tr>
<td><strong>Control (n=20)</strong></td>
<td>121 ± 106 seconds</td>
<td>33 - 435</td>
</tr>
</tbody>
</table>

### Number of Moves

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<thead>
<tr>
<th>Group</th>
<th>Mean (± SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OCD (n=17)</strong></td>
<td>40.8 ± 29.4 moves</td>
<td>13.7 - 115</td>
</tr>
<tr>
<td><strong>Control (n=20)</strong></td>
<td>33.2 ± 12.4 moves</td>
<td>21.7 - 79.3</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Video measure</th>
<th>Clinical measure</th>
<th>R, p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrangement total time</td>
<td>MASC anxiety probability score</td>
<td>.565, .044</td>
</tr>
<tr>
<td>Arrangement number of movements</td>
<td>CY-BOCS ordering/repeating dimension</td>
<td>.592, .012</td>
</tr>
<tr>
<td></td>
<td>CY-BOCS ordering/repeating dimension</td>
<td>.564, .014</td>
</tr>
<tr>
<td></td>
<td>BASC hyperactivity</td>
<td>-.500, .046</td>
</tr>
<tr>
<td></td>
<td>BASC aggression</td>
<td>-.549, .023</td>
</tr>
<tr>
<td></td>
<td>BASC attention problems</td>
<td>-.539, .026</td>
</tr>
<tr>
<td></td>
<td>BASC social skills</td>
<td>.579, .015</td>
</tr>
</tbody>
</table>
Most & Least Liked Patterns – All Subjects

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

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

For more information please contact

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