Relationship between Psychiatric Traits and Face Perception

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1. Introduction

- Humans perceive social & personality traits from face images
- We previously developed a model of human social perception of face images [1]
  - Social traits: trustworthiness, attractiveness, etc.
- Impact of psychiatric traits on face perception
  - Socially anxious participants judge ambiguously smiling faces as less trustworthy [2]
  - Participants with high trait anxiety tend to interpret ambiguous stimuli as threatening [3]
- **Question: How do anxiety and depression affect face perception?**

2. Experimental Design

2.1 Social decision making

- **Aim:** we study human social perception of faces: traits (trustworthy, attractive, etc.) and social decision making (prisoner's dilemma, etc.)
- **Subjects:** 613 UCSD undergraduate students participated, resulting in data from 480 subjects after removal of invalid responses
- **Stimuli:** 52 white female faces from 10K US Adult Dataset [4] (see example stimuli below)
- **2 Types of Tasks:** order counterbalanced across subjects

Traits	Economic Games
• Attractive	• Trust Game
• Dominant	• Ultimatum Game
• Emotional	• Prisoner's Dilemma
• Intelligent	
• Memorable	
• Trustworthy	

Trust Game: as the "investor", participants are asked to imagine being endowed with $10 and can decide how much (between $1 and $9) to "invest" by sending it to the "Trustee". The "invested" amount is tripled, and the Trustee decides how much from the tripled amount to return to the investor.

Ultimatum Game: as the "Proposer", participants are asked to imagine endowed with $10 and can decide how much to offer the "Responder" (and keep the rest). If the proposal is accepted, both players will earn the amount you proposed; if the proposal is rejected, both players end up with $0.

Prisoner's Dilemma: Participants are asked to imagine being a player. Both players are endowed with $3 each and simultaneously decide whether to cooperate (share) or defect (keep the money). If both cooperate, the total payoff between both players is the greatest and equally split.

In each of these three games, participants are asked to decide how much money they will give out.

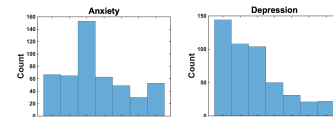## 2.2 Psychiatric questionnaire

- PHQ-4 Questionnaire (state depression and anxiety estimation)
  - [Anxiety] Feeling nervous, anxious or on edge
  - [Anxiety] Not being able to stop or control worrying
  - [Depression] Little interest or pleasure in doing things
  - [Depression] Feeling down, depressed or hopeless

For the above questions, subjects choose among the following four choices (over the past two weeks):
1: Not at all
2: Several days
3: More than half the days
4: Nearly every day

3. Results

### 3.1 Distribution of anxiety and depression

- Total 480 subjects
- Anxiety score is sum of the response to the two anxiety questions (possible score: 0-4)
- Depression score is sum of the response to the two depression questions (possible score: 0-4)
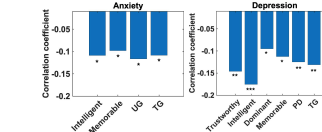
3.2 Psychiatric scores and ratings

3.2.1 Mean response vs. anxiety/depression score

Subjects grouped by anxiety score
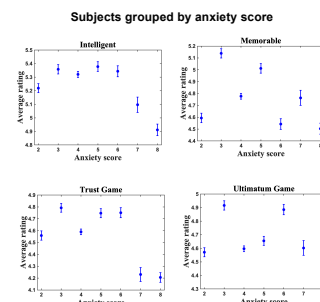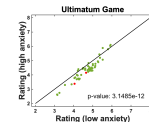

Subjects grouped by depression score
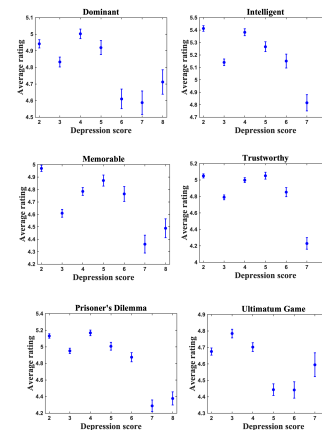
#### 3.2.1 Tasks sig. correlated with depression/anxiety

- **Anxiety** score significantly negatively correlated with intelligence, dominance, and (hypothetical) offers in Ultimatum game and Trust Game; insignificant traits/tasks excluded
- **Depression** score significantly negatively correlated with trustworthiness, intelligence, dominance, memorability, as well as (hypothetical) offers in Prisoner's Dilemma and Trust Game; insignificant traits/tasks excluded

3.2.2 Compare responses from subjects within the low/high anxiety/depression group

- **Low/high anxiety:** we denote subjects with anxiety score <= 6 as low anxiety, otherwise as high anxiety

Ultimatum Game

- **Low/high depression:** we denote subjects with depression score <= 6 as low depression, otherwise as high depression
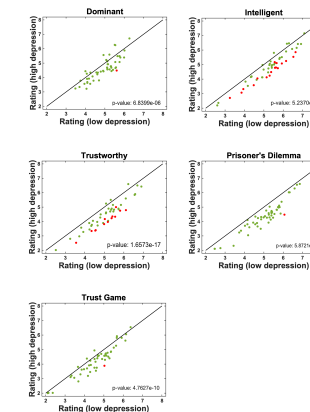

- Each point: mean rating (across subjects) for one face
- Traits/tasks shown: low-depression and high-depression groups differ significantly in ratings (p<0.05, paired t-test)
- Red: individual faces individually differ b/t the two groups for each trait/task (p<0.05, FDR correction for multiple comparisons)
- Green: faces not individually elicit significantly different ratings from the two groups
- Overall, more depressed (and anxious) subjects give lower social trait ratings and show less cooperation in economic games, across the great majority of faces

3.2.3 Individual faces rated differently by the low vs. high depression (anxiety) subjects

- Each point: ratings of one face along different axes
- Faces eliciting greatest differences according to depression/anxiety lie fairly evenly across face distribution (no obvious clustering, or other pattern)
- Faces most often perceived by high-depression group as less socially positive (red) lie in the center of the distribution
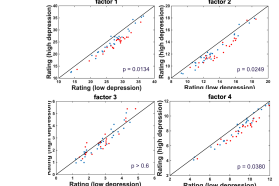
- Sim 1, Sim 2: the two (orthogonal) axes most important for psychological face space as informed by similarity judgments [5]
- t-SNE [6]: non-linear dimensionality reduction, based on similarity-informed basis vectors

3.3 Correlation Structure Across Tasks

3.3.1 Correlation Matrix & Factor Analysis
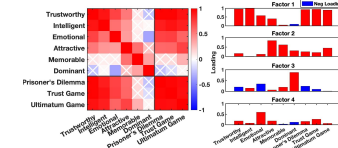
3.3.2 Factors corr. with anxiety/depression

- Factor 1 (trustworthy/intelligent/economic games), 2 (attractive/memorable), and 4 (emotional) ratings significantly different b/t high & low depression (2-sample t-test), red: individual faces significantly differ b/t the two groups for at least one task

4. Discussion

- Higher depression & anxiety correlate with lower face-based social ratings/cooperativeness
  - **Depression:** dominant, trustworthy, intelligent, memorable, Prisoner's Dilemma, Trust Game
  - **Anxiety:** intelligent, memorable, Ultimatum Game, Trust Game
- Social traits/tasks cluster into four factors: depression (and, to a lesser extent, anxiety) particularly affect three of the factors (trustworthy/intelligent, attractive, emotional) but not a fourth (dominant)
- Faces most often perceived by high-depression group as less socially positive are near average faces

5. References

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[3] Willis, ML., Dodd, HF., & Palermo, R. (2013). The Relationship between Anxiety and the Social Judgements of Approachability and Trustworthiness. PLoS ONE 8(10): e78825. https://doi.org/10.1371/journal.pone.0076825.

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