Depression for Economists

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Depression

- Major depressive disorder (MDD) is the second leading cause of disease burden worldwide (GBD 2010)
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- Depression is also associated with many important economic behaviors and outcomes
  - Employment
  - Income/consumption
  - Specific consumption behaviors: food, sleep, temptation goods
Depression

From The Economist:

*Most common causes of disability*
2013*

- Lower back pain
- Major depression
- Iron deficiency
- HIV
- Diabetes
- War
- Other
- No data

Source: The Lancet

*Adjusted for severity*
This paper

- Claim: economic analysis is useful for understanding depression.

Caveat: the psychology of depression is rich and nuanced. Cannot and do not try to explain everything!
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- Goal: develop a language for economists to think about depression in a structured way.

- Facilitate economic analysis of effects of depression-targeting policies, and interactions between policy and depression.

**Caveat:** the psychology of depression is rich and nuanced. Cannot and do not try to explain everything!
Roadmap

Causes

Symptoms

Evidence

Model

Policy
Outline

Causes

Symptoms

Evidence

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Policy
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- Broad consensus that stress or stressful life events are a key trigger of depressive episodes (Hammen, 2005).

- Estimated 80% of depressive episodes preceded by "major life events" (Mazure, 1998).

- From economics:
  - Unemployment: Clark (2003), Marcus (2013), Farré et al. (2015)
  - Import competition: Colantone et al. (2015)
  - Wealth shocks: McInerney et al. (2013), Schwandt (2015), Haushofer & Shapiro (2016)
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Symptoms: Aaron T. Beck (1967)

Focus on “distorted thoughts” as central to depression.

Cognitive Triad: negative views about oneself, the world, the future.

▶ “World” & “future” particularly as they relate to self (Lewinsohn et al., 1982; Haaga et al., 1991)
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Four categories of symptoms

1. Cognitive
2. Motivational
3. Emotional
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Close parallels to diagnostic criteria in DSM-V
1. **Negative expectations about the future**: “a pattern of expecting the worst and rejecting the possibility of any improvement”

2. **Low self-evaluation and self-esteem**

3. **Self-blame and self-criticism**: “ascribe adverse occurrences to some deficiency in themselves” (“egocentric notions of causality”)

4. **Indecisiveness**: patients “anticipate making the wrong decision”

5. **Distortion of body image**: patients perceive themselves as unattractive
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5. *Distortion of body image*: patients perceive themselves as unattractive

**Crude summary**: pessimistic beliefs about self and ability.
“Motivational” Symptoms (Beck, 1967)

1. *Paralysis of the will*: “although they can define for themselves what they should do, they do not experience any internal stimulus to do it”
2. *Avoidance, escapist, withdrawal wishes*: shirk from their duties, withdraw into other activities
3. *Dependency on others*: want others to perform tasks for them
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**Crude summary:** withdrawal of effort, withdrawal from activities and decisions.
“Emotional” Symptoms (Beck, 1967)

1. *Dejected mood*: feel “sad”, “hopeless”, “miserable”
2. *Reduction in gratification*: (anhedonia) inability to derive pleasure from usually enjoyable activities (e.g. eating, sex)
3. *Loss of emotional attachment*: “decline in interest in particular activities or in ... concern for other persons”
4. *Negative feelings toward themselves*: blame themselves for mistakes, “can’t do anything right”
5. *Loss of mirth response*: don’t find jokes funny
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**Crude summary:** pessimism, preference change (?)
Delusions & Hallucinations (Beck, 1967)

1. *Delusions of worthlessness*: think they are a burden to others; “would be better if I had not been born”

2. *Delusions of crime and punishment*: think they have committed crimes, “deserve to be punished”. Extreme cases: believe they are the devil

3. *Nihilistic delusions*: world is empty, all others have died, or the person has died, has missing organs

4. *Somatic delusions*: body is decaying, fatal illness

5. *Delusions of poverty*: outgrowth of overconcern with finances; “All my money is gone. ... Who will buy food for my children?”

6. *Hallucinations*: Usually voices that condemn the patient
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**Crude summary**: (extreme) pessimism (?)
Somatic Symptoms (DSM-V)

1. Significant weight loss or weight gain
2. Insomnia or hypersomnia
3. Psychomotor agitation or retardation
Correlations

**Correlational** evidence on relationships between depression & behaviors or outcomes

- Employment/labor effort
- Income/consumption
- BMI
- Sleep
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Depression measure: Center for Epidemiologic Studies Depression Scale (CESD)

- Widely used survey measure, based on DSM-V
- Short form (10 questions, score 0–30); Long form (20 questions, score 0–60)
Correlations

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Samples:

- US-based Amazon MTurk sample (N=500) collected by us
- RAND Indonesia Family Life Survey (IFLS)
Correlations
Employment/labor effort

**US**

<table>
<thead>
<tr>
<th>Employment Status</th>
<th>Mean CESD Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>5.5</td>
</tr>
<tr>
<td>Unemployed</td>
<td>5.6</td>
</tr>
<tr>
<td>Part-time</td>
<td>5.7</td>
</tr>
<tr>
<td>Full-time</td>
<td>5.8</td>
</tr>
</tbody>
</table>

**Indonesia**

- CESD Total Raw Score
- Labor supply (hours/typical week)

Note: residuals from regression on gender, age, squares and X-products
Correlations
Income/consumption

Note: residuals from regression on gender, age, squares and X-products
Correlations
BMI

US

Indonesia

Note: residuals from regression on gender, age, squares and X-products
Correlations

Sleep

US

Indonesia

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Outline

Causes

Symptoms

Evidence

Model

Policy
Summary of motivating facts

1. Key role of shocks and stressors in precipitating depressive episodes.
3. Withdrawal from productive activities and decisions.
4. Non-monotone changes in weight and sleep.
5. Anhedonia.
Model

Decision-maker maximizes:

\[ U(c_t, e_t) = \alpha c_t - \gamma e_t + \nu_t \]

- \( c_t \): observable consumption index.
- \( \alpha \): (potentially unknown) “return to consumption”
- \( e_t \in \{0, 1\} \): observable effort choice.
- \( \gamma \): \textbf{known} cost of effort
- \( \nu_t \): unobserved i.i.d. shock
- \( U(.,.) \): “experienced utility”

DM knows what they did, what they consumed, and how they felt.
Budget constraint:

\[ c_t = [(1 - e_t)\bar{A} + e_t A]H_t + \varepsilon_t \]

- \( \bar{A} \): known return to low effort.
- \( A \): (potentially unknown) return to high effort.
- \( H_t \): “Human capital”
- \( \varepsilon_t \): unobserved i.i.d. shock

DM knows what they did, and what they consumed.
Plan of attack

1. Uncertain return to effort
2. Human capital
3. Food & Sleep
4. Uncertain return to consumption
5. Extensions
1. Uncertain return to effort

Assume $\alpha$ known, no utility shock:

$$U(c_t, e_t) = \alpha c_t - \gamma e_t$$

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- **Beliefs**

$$A \sim N(\mu_{A,t}, \sigma^{2}_{A,t})$$

$$\varepsilon \sim N(0, \sigma^{2}_{\varepsilon})$$
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- For simplicity, ignore information value of experimentation. Effort choice:

  $$e^*_t = 1 \iff \alpha(\mu_{A,t} - \bar{A}) H_t \geq \gamma$$
1. Uncertain return to effort

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▶ Beliefs

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Effort choice:

$$e_t^* = 1 \iff \alpha(\mu_{A,t} - \bar{A})H_t \geq \gamma$$

▶ Assume high effort is efficient: $A \geq \gamma/\alpha H_t + \bar{A}$
1. Uncertain return to effort

Consider a DM with correct prior ($\mu_{A,t} = A$). She exerts high effort in $t$. What happens after a negative $\varepsilon$ shock?
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Consider a DM with correct prior \((\mu_{A,t} = A)\). She exerts high effort in \(t\). What happens after a negative \(\varepsilon\) shock?

\[
\mu_{A,t+1} = \mu_{A,t} + \left(1 + \frac{\sigma^2_{\varepsilon}}{H_t^2 \sigma^2_{A,t}}\right)^{-1} \frac{\varepsilon_t}{H_t}
\]

2. Negative income shocks partially (mis)attributed to low \(A\).

3. DM becomes more pessimistic about returns to effort.

4. If \(\alpha(\mu_{A,t+1} - \bar{A})H_t + 1 < \gamma\), withdraw labor effort. \(\Rightarrow\) learning ceases. \(\Rightarrow\) persistence, “depression poverty trap”

5. Asymmetry: no trap after positive shocks.

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1. Negative income shocks partially (mis)attributed to low $A$. 

2. DM becomes more pessimistic about returns to effort.

3. $\Rightarrow$ more pessimistic forecasts of future consumption & utility.

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5. Persistence, “depression poverty trap”


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▷ Some evidence that depression increases temptation good consumption (e.g. smoking). Human capital disinvestment?
3. Food & Sleep

- Crude model of human physiology: body weight an increasing function of food consumption.

\[ \phi'(f_{C^*}) = \alpha, \quad \psi'(s_{C^*}) = 0 \]

- Production optima:
  \[ \Phi'(f_{P^*}) = 0, \quad \Psi'(s_{P^*}) = 0 \]

Intuition: sleeping too little or too much, under- or over-eating, are both unpleasant and bad for productivity.
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- Model: food and sleep have direct utility effects and affect production through $H$

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- Model: food and sleep have direct utility effects and affect production through $H$

\[
U(c_t, e_t) = \alpha c_t - \gamma e_t + \phi(f_t) + \psi(s_t)
\]

\[
c_t + f_t = [(1 - e_t)\bar{A} + e_tA](\Phi(f_t) + \Psi(s_t)) + \varepsilon_t
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where $\phi'', \psi'', \Phi'', \Psi'' < 0.$
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- Conjecture interior “production optima” and “consumption optima”
  - Consumption optima: $\phi'(f^{C*}) = \alpha$, $\psi'(s^{C*}) = 0$
  - Production optima: $\Phi'(f^{P*}) = 0$, $\Psi'(s^{P*}) = 0$
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- Intuition: sleeping too little or too much, under- or over-eating, are both unpleasant and bad for productivity
3. Food & Sleep

Choices

\[ 0 = \alpha (1 - e_t) \bar{A} + e_t \mu_t \phi'(f^*_t) + \phi'(f^*_t) - \alpha \]
\[ 0 = \alpha (1 - e_t) \bar{A} + e_t \mu_t \psi'(s^*_t) + \psi'(s^*_t) \]
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- “Drift toward natural tendencies.”
- **Falsifiable predictions:**
  - Weight loss, sleep loss concentrated among those already under production optimum
  - (Measurable?)
Recap

Model so far:

- Negative income shock $\rightarrow$ pessimistic beliefs about returns to effort. “Self-blame”
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Missing:
- Anhedonia. Loss of pleasure in normally pleasurable activities.
- Income shocks not the only precipitates of depression.
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4. Uncertainty about return to consumption

Back to the basic model, but now assume uncertain $\alpha$:

$$U(c_t, e_t) = \alpha c_t - \gamma e_t + \nu_t$$

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- Beliefs:

$$\alpha \sim N(\mu_{\alpha,t}, \sigma_{\alpha,t}^2)$$

$$\nu \sim N(0, \sigma_{\nu}^2)$$
4. Uncertainty about return to consumption

- Observe $c_t, e_t, U(c_t, e_t)$, update belief about $\alpha$. With correct prior:

$$\mu_{\alpha,t+1} = \mu_{\alpha,t} + \left(1 + \frac{\sigma^2_v}{c_t^2 \sigma^2_{\alpha,t}}\right)^{-1} \frac{\nu_t}{c_t}$$

- Negative utility shock $\Rightarrow$ more pessimistic beliefs about $\alpha$.
- $\Rightarrow$ "Consumption doesn't satisfy me" or "I make bad choices"
  $\Rightarrow$ more pessimistic predictions about future utility, and the benefits of future consumption. DM anticipates anhedonia.
- $\Rightarrow$ diminished incentive to exert effort. Low effort if: $\mu_{\alpha,t+1} < \gamma (A - \bar{A})$

No poverty trap in this formulation. But diminished slows learning.
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- No poverty trap in this formulation. But diminished $c$ slows learning.
What kinds of shocks make people depressed?

- Both formulations: sensitivity of beliefs to shocks decreasing in noise-to-signal ratio:

\[
\frac{\sigma^2_\varepsilon}{H_t^2 \sigma^2_{A,t}} \quad \text{or} \quad \frac{\sigma^2_v}{c_t^2 \sigma^2_{\alpha,t}}
\]

- Shocks particularly harmful when DM believes \( \sigma^2_\varepsilon \) (\( \sigma^2_v \)) is small.
- I.e. events “within her control” (sometimes “dependent” events)
  - Relationship breakdown, financial problems, job loss.
  - cf. bereavement, crime.
- Some evidence for this proposition (Kendler et al., 1999)
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- "Depressive realism" vs "cognitive distortions"
  - Low self-esteem (belief-based utility? Benabou & Tirole)
  - Predisposition (hard to separate from exposure: Hammen, 2005)
  - Psychomotor agitation, extreme delusions, hallucinations.

How to test the model? Some falsifiable behavioral predictions. Measure beliefs directly?
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Cognitive Behavioral Therapy

- Developed in 1980s and 1990s
- Answer to the “behaviorist” approach (Skinner); focus on cognition
- Most commonly studied therapy for depression (111/189 RCTs)

Crude summary:
- Correct distorted thoughts ($\mu$)
- Change distorted behaviors ($e$)

Meta-analysis: effectiveness relative to control (mostly short-run). Though individual studies have small samples and publication bias (Haushofer, 2016)
Model predicts behavior will respond to prices.

In particular, increasing the returns to effort (e.g. through wage subsidy) increases effort provision and learning.

In the utility-shock formulation, consumption subsidies also increase learning.
Conclusion

- Very simple model fits several key facts about depression.
- Central complementarity between beliefs about returns, behaviors, and subsequent learning.
- Close alignment with structure of Cognitive Behavioral Therapy
- New theoretical and empirical avenues to explore.
The DSM-V suggests a diagnosis of MDD if 5 or more of the following are present in a 2-week period (must include at least (1) or (2)):

1. Depressed mood most of the day, nearly every day.
2. Markedly diminished interest or pleasure in all, or almost all, activities.
3. Significant weight loss when not dieting or weight gain.
4. Insomnia or hypersomnia nearly every day.
5. Psychomotor agitation or retardation nearly every day.
6. Fatigue or loss of energy nearly every day.
7. Feelings of worthlessness or excessive or inappropriate guilt.
8. Diminished ability to think or concentrate, or indecisiveness.
9. Recurrent thoughts of death (not just fear of dying), recurrent suicidal ideation.

and

The symptoms cause clinically significant distress or impairment.