Mental Disorders
in the Light of Evolutionary Biology

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Spectacular Progress

- Psychiatry decided to be medical and biological in the 1970's — and succeeded
- We are now more evidence-based than most other areas of medicine
- We are vastly more effective
- Our diagnoses are reliable
- We understand neural mechanisms in remarkable detail

But Confusion Persists

- We are dissatisfied with the DSM
- We remain unsure of what mental disorders are
- Our relationship to medicine is awkward
- Causes and cures remain elusive
- Will more neuroscience get us there?
- Or is something missing?
Allen Frances

“We are at the epicycle stage of psychiatry where astronomy was before Copernicus and biology before Darwin. Our inelegant and complex current descriptive system will undoubtedly be replaced by... simpler more elegant models”

The Missing Question

Why isn’t the mind better designed?

This is an evolutionary question that requires an evolutionary answer

The Evolutionary Explanation for Brains

“We know what brains are for; From an evolutionary perspective our brains have evolved to make decisions that enhance reproductive success”;

Michael Gazzaniga, Cognitive Neuroscience
My Path

- Why are mental disorders so common?
- No real answers in psychiatry
- I turned to medicine and basic biology to ask.
- "Why do diseases exist at all?"
- Darwinian medicine is the result
- Ready for application to psychiatry

Mental Disorders Are Different from Most Other Medical Disorders

1. Vast prevalence
2. Huge comorbidity
3. Onset at age of peak health
4. Huge fitness costs
5. Waxing and waning courses
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Helping Individuals

1. 21 yo M single college student
2. 35 yo married mother of two
3. 59 yo divorced F janitor
4. 35 yo M star post doc

A Simple Thesis

Evolutionary biology is a missing basic science that can make psychiatry more coherent and clinicians more empathic

Two Kinds of Explanation Essential

Proximate

Evolutionary
Both Kinds of Explanation Needed

Social
Psycho
Bio

Social
Psycho
Bio

Bio-psycho-social
Evolutionary explanations

Would Every Detail Be Enough?
- Every gene, neurotransmitter and receptor
- Every neuron and every pathway
- Every mechanism that lead to disease
- Would we then understand mental disorders?
- No
- Neural mechanisms are only one level of one half of biology

Six Reasons Why Diseases Exist

Selection is slow
1. mismatch: body in a novel environment
2. competition with fast evolving organisms

Selection is constrained
3. constraints on natural selection
4. every trait is a trade-off

We misunderstand
5. organisms shaped for R/S, not health
6. defenses and suffering
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Evolution and Mental Disorders
- McGuire and Troisi
- Brant Wenegrat
- Melvin Konner
- Paul Gilbert
- Price, Gardner, Sloman, Stevens
- Baron-Cohen
- And many others...

Specific Topics (for Other Times)
- Why senescence exists?
- Why disease genes persist?
- Origins and functions of emotions
- Why mood exists?
- How relationships increase fitness?
- Origins of the moral passions
- Origins of psychodynamic defenses
- How to test an evolutionary hypothesis?

Trade-offs (Mental Disorders)
- Anxiety disorders
- Personality disorders
  - short term gain — sociopathy
  - long term gain — neurosis

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Focus: Defenses vs. Defects

<table>
<thead>
<tr>
<th>Defects</th>
<th>Defenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>seizures</td>
<td>fever</td>
</tr>
<tr>
<td>cancer</td>
<td>cough</td>
</tr>
<tr>
<td>paralysis</td>
<td>pain</td>
</tr>
<tr>
<td>jaundice</td>
<td>diarrhea</td>
</tr>
<tr>
<td>injury</td>
<td>fatigue</td>
</tr>
<tr>
<td></td>
<td>anxiety</td>
</tr>
</tbody>
</table>

Defense Regulation

- Pain, fever, cough, nausea, anxiety, etc. often seems excessive
- We can usually block them safely
- Did selection goof?

Optimal Defense Regulation

Express defense whenever:

\[ C(D) < pH \times \left( (C(H_2O)) - C(H_2O) \right) \]
Signal Detection Theory

<table>
<thead>
<tr>
<th>Decision: respond</th>
<th>Signal: present</th>
<th>Signal: absent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hit (correct detection)</td>
<td>False alarm (false positive, type I error)</td>
</tr>
<tr>
<td>Decision: do not respond</td>
<td>Missed response (false negative, type II error)</td>
<td>Correct rejection</td>
</tr>
</tbody>
</table>

Should You Flee from a Noise?
- Is it a monkey... or a lion?!?
- Cost of fleeing = 200 calories
- Cost of not fleeing if a tiger = 200,000 calories
- Optimum: flee whenever p(tiger) > 1/1000

999/1000 panic attacks will be unnecessary, but perfectly normal
The Smoke Detector Principle

- Optimal regulation system expresses many normal false alarms
- This is why we can block defenses safely
  - (except for that one time out of a thousand)


Most Human Suffering Is Normal But Unnecessary

Except that one time in a thousand, when the defense is essential

Profound implications for psychopharmacology

Emotions

- Proximate explanations well developed
- Evolutionary explanations far behind
- Emotions are specialized states shaped to deal with fitness significant situations
  - Useful only in those situations
- Regulation is everything
Why Are Negative Emotions so Prevalent?

- They seem harmful because they are aversive and associated with harmful situations
- But negative emotions are useful
- People with no pain die young

If the immediate and direct purpose of our life is not suffering, then our existence is the most ill-adapted to its purpose in the world. Schopenhauer, 1851
Pain or suffering... is well adapted to make a creature guard itself against any great or sudden evil;  
Charles Darwin, 1887, pp. 51-52

Love joins hate; aggression, fear; expansiveness, withdrawal, and so on; in blends designed not to promote the happiness of the individual, but to favor the maximum transmission of the controlling genes; E. O. Wilson, 1975

When Are Negative Emotions Useful?  
- Anxiety — threat of loss  
- Sadness — after a loss occurs  
- Low mood — pursuing an unreachable goal  
- Depression???
Anxiety Disorders

- Normal responses but dysregulated
- Basic science foundations
  - what are the subtypes?
  - when is each useful?
  - how are they regulated?

Anxiety Subtypes Match Dangers

- Attack — panic and agoraphobia
- Dangerous animals — phobias
- Lost — separation fear
- Falling — height phobia
- Exclusion — social phobia
- Generic response partially differentiated to deal with specific kinds of situations
- Not separate diseases
- This explains comorbidity

Panic Disorder

- A fight-flight response false alarm
- The smoke detector principle in action

A dysregulated defense
Agoraphobia

- What should you do after an attack?
  - stay home if you can
  - go out only with others
  - be ready to flee

- Panic and agoraphobia are "comorbid" for excellent evolutionary reasons!!

Hypophobia: a Neglected Disorder

An unrecognized major mental disorder

Do Early Falls Create Later Fears?
(Poulon, et al., 1998)

<table>
<thead>
<tr>
<th></th>
<th>% Fear of heights at 18 yo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early fall with injury (n = 60)</td>
<td></td>
</tr>
<tr>
<td>No early fall (n = 789)</td>
<td></td>
</tr>
</tbody>
</table>

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Emotions for Goal Pursuit?

- Most human behavior is in pursuit of goals such as love, money, seeing children succeed
- Are there specific emotions for the situations that arise in goal pursuit?

Emotions for the Situations that Arise in Pursuing Goals

- Opportunity (promotion)
- Threat (prevention)

Before
- Hope (desire)
- Anxiety (fear)

After
- Happiness (pleasure)
- Sadness (pain)

Alt. outcome
- Disappointment
- Relief

Depression: Two Questions

1. Proximate: why are some people more vulnerable?
2. Evolutionary: why do we all have a capacity for low mood (and depression)?
Do Not Misunderstand

- Some depression is a disease that arises from brain abnormalities.
- We must still ask:
  - is low mood a defect or a defense shaped because it is useful?
  - how is low mood related to depression?
  - how can we separate depressions?
  - why is the mind poorly designed?

Why Vary Motivation?

- Increases when payoff is high.
- Decreases
  - from a specific activity when return rate < rate for another activity (optimal foraging).
  - from all activity when no activity offers a return rate > costs (staying home).

Motivation for Specific Goals

Utility

--- Search time --- 

--- Feeding time ---

Marginal value theorem - Charnov
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When Payoff Is Positive
High Motivation

In propitious times, efforts and persistence pay off

Utility

Big payoff

Small search costs

When Payoff Is Negative
Global Motivation Disengages

In unpropitious situations, all initiative is maladaptive

Utility

0.0

Big search costs

Small rare payoff

When costs > benefits for all possible actions, what is the best thing to do?

Nothing

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A Motto for Unpropitious Times

Don't just do something stand there!

Depressogenic Situation

- Committed to an unreachable goal
- Motivation disengages
  - to protect against harm
  - to save wasted effort
  - to shift effort to something productive

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Why Don’t People Give Up on Hopeless Goals?
- Ambition
- No alternative strategy
- Too anxious to change
- The goal is central to life’s purpose

Life Events vs. Life Situations
- Depressogenic life events block progress towards important life goals
- Emotions are useful only by changing future behavior
Deeper Understanding of Individual’s Motivational Structures

1. 21 yo M single healthy college student
2. 35 yo married mother of two
3. 59 yo divorced janitor and mother of one
4. 35 yo M single star post doc

Research on Goals and Affect

- Klinger (1975) current concerns
- Brickman (1978) adaptation theory and persistence
- Oatley — emotions to manage goals
- Emmons (1989) personal strivings
- Carver and Scheier — cybernetics, rate of progress
- Ellsworth — appraisals of rate of goal attainment
- Cantor (1987) life tasks
- Markus (1990) possible selves
- Little (1983) personal projects
- Hamburg and Barchus (1975)

Low Mood Subtypes?

- Demonstrating subtypes matched to the needs of different domains would be strong evidence for the utility of low mood
- Q: do depression symptoms differ depending on the precipitant?
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Epidemiological Study

- Community sample
  - 100 subjects, 6 hours of interviews, behavioral measures, physiological measures, salivary samples
- Question: is depression more common in people who are pursuing unreachable goals they can’t give up?

Keller and Nesse, 2005

Nesse, Williams, Oyserman, et al.,
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Kind of Problem vs. Depression

![Graph showing the comparison between Kind of Problem vs. Depression with statistical significance level indicated at p<0.001.]

Behavioral Biology Is Useful
How Can We Begin to Use It?

- Diagnosis
- Research
- Education
- Clinical

Pathological Optimism: a Neglected Disorder

- Absence of low mood is dangerous

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What Will It Take to Bring Evolution to Psychiatry?

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Base DSM on an Evolutionary Understanding of Emotions

- DSM needs to follow a genuine medical model that distinguishes symptoms from diseases
- To determine when a negative emotion is abnormal you have to know what it is for
- This requires evolutionary understanding

Action: create a DSM subcommittee to bring in behavioral ecology and emotions expertise

A Medical Model for Diagnosis

1. Defects (OCD, schizophrenia)
2. Dysregulated emotions (panic, bipolar)
3. Normal regulation but useless emotions
4. Useful emotions (anxiety, low mood)
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Research Opportunities
Action: NIMH and other research founders establish a behavioral biology section
- No capacity to even review proposals now
- A whole basic science of behavior is missing from the war against mental illness
- An essential scientific foundation for using genomic information

Opportunities for Industry
- Companies with evolutionary expertise will have the advantage in drug discovery
- Most drugs block normal defenses just like in the rest of medicine!
- An evolutionary approach explains why medications are safe and effective even when there is no brain disease

Education: Actions
- Psychiatry training: a task force could ask: should residents know the basic science of behavior and emotions?
- Board examinations: a task force could ask: what knowledge about basic behavioral science is essential for psychiatrists?
Psychiatric Associations: Actions

- Appoint a task force to advise on how to bring the other half of biology to psychiatry
- Invite scientists from the Animal Behavior Society and the Society for Behavioral Ecology to join us for next year’s meeting
- Ensure that courses are available

Clinical Advances

- Idiographic understanding is essential
- There is no substitute for a gifted clinician
- People have good reasons for not changing
- Seek cause before prescribing
- See if the cause can be removed
- Then, relieve suffering by whatever means
- We must understand each person with all available knowledge and empathy

Conclusion

Psychiatry has been missing a crucial basic science: As we ask and answer new questions about why the mind isn’t better designed, we will find new answers

www.EvolutionAndPsychiatry.org