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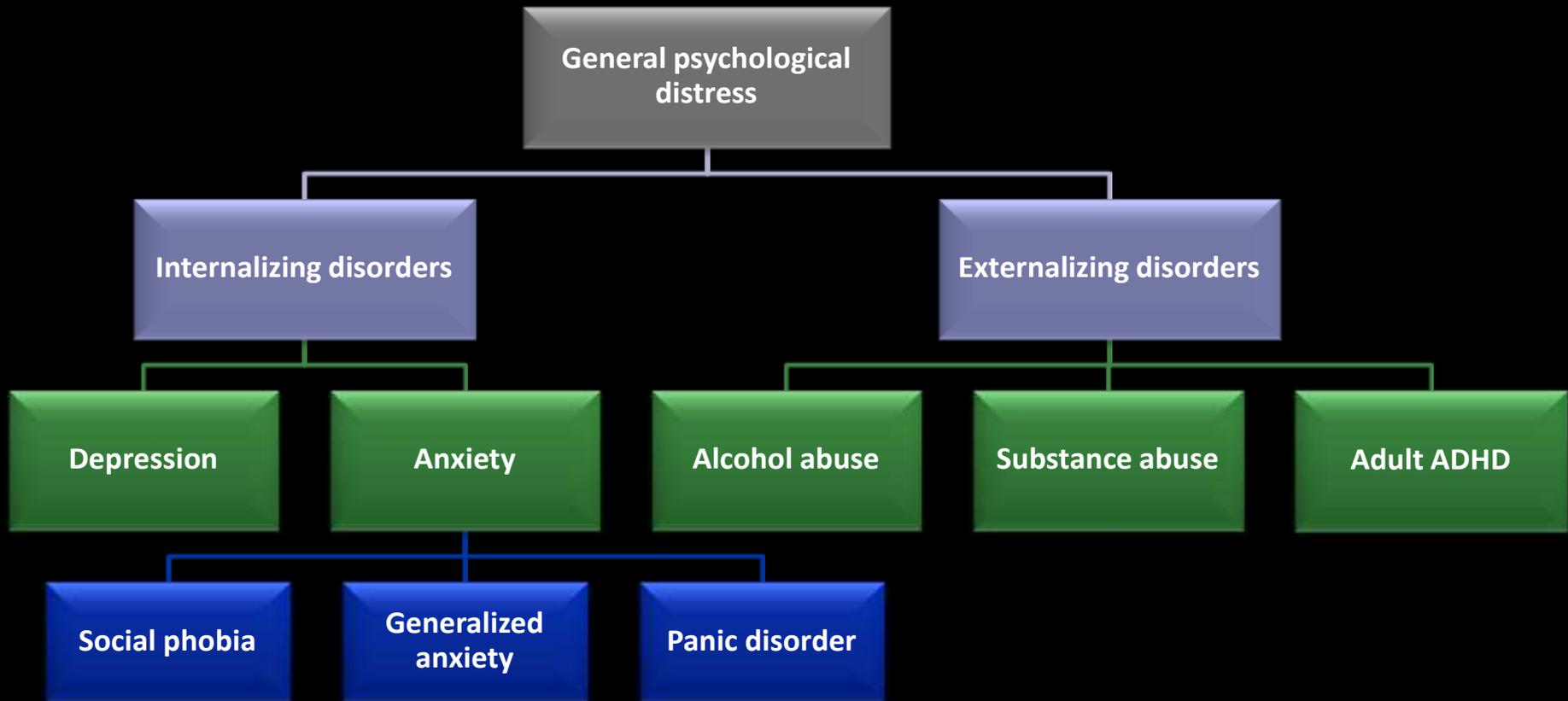
# Methods to improve the efficiency of screening for multiple mental disorders

**Phil Batterham**

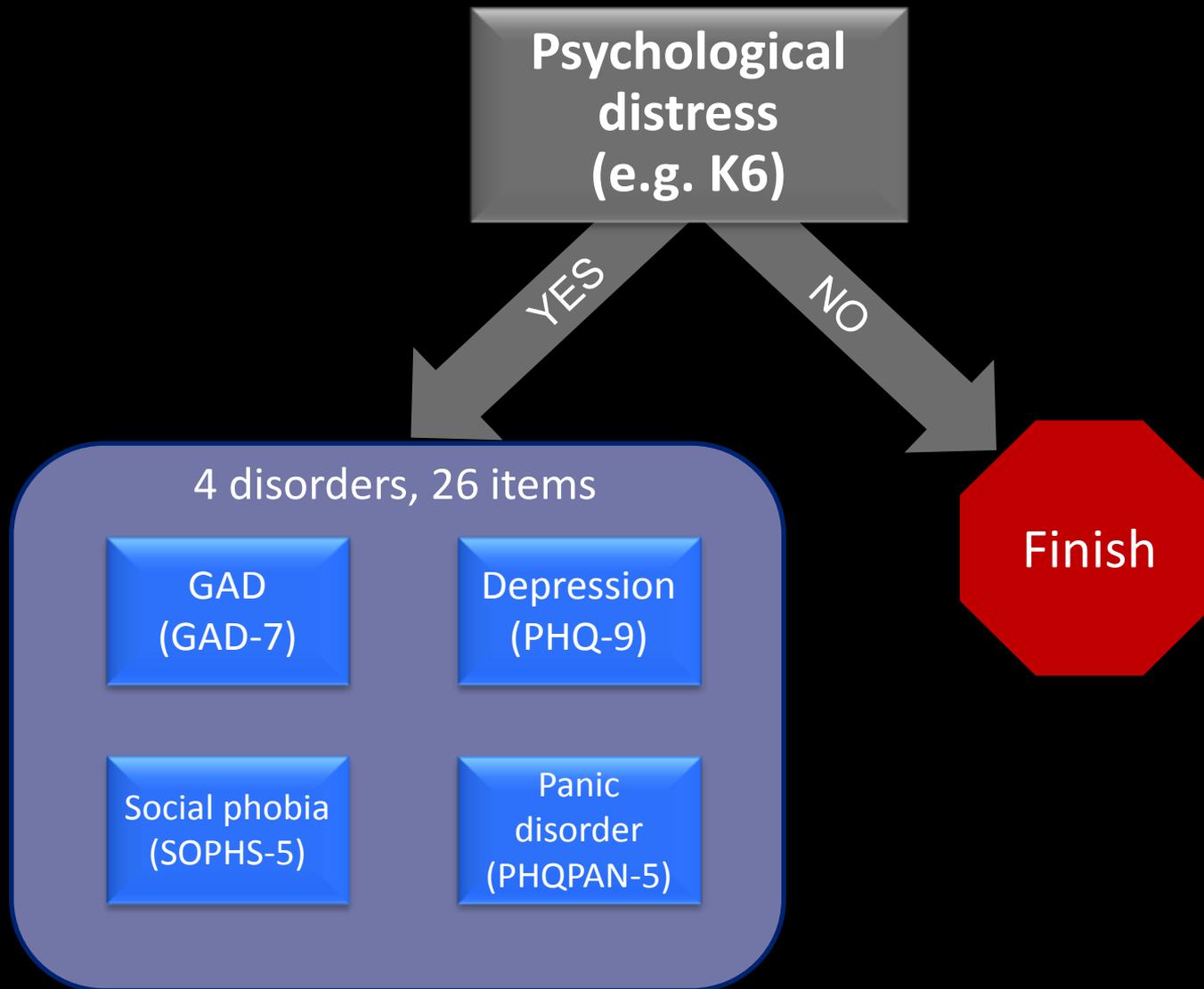
Centre for Mental Health Research

The Australian National University

# Hierarchical screening



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# Hierarchical screening

## First-phase screening approaches

1. No hierarchy (control)
2. K6 score
3. Psychological distress decision tree
4. Disorder-specific decision tree
5. Gating items

# Method 1: No hierarchy (control)

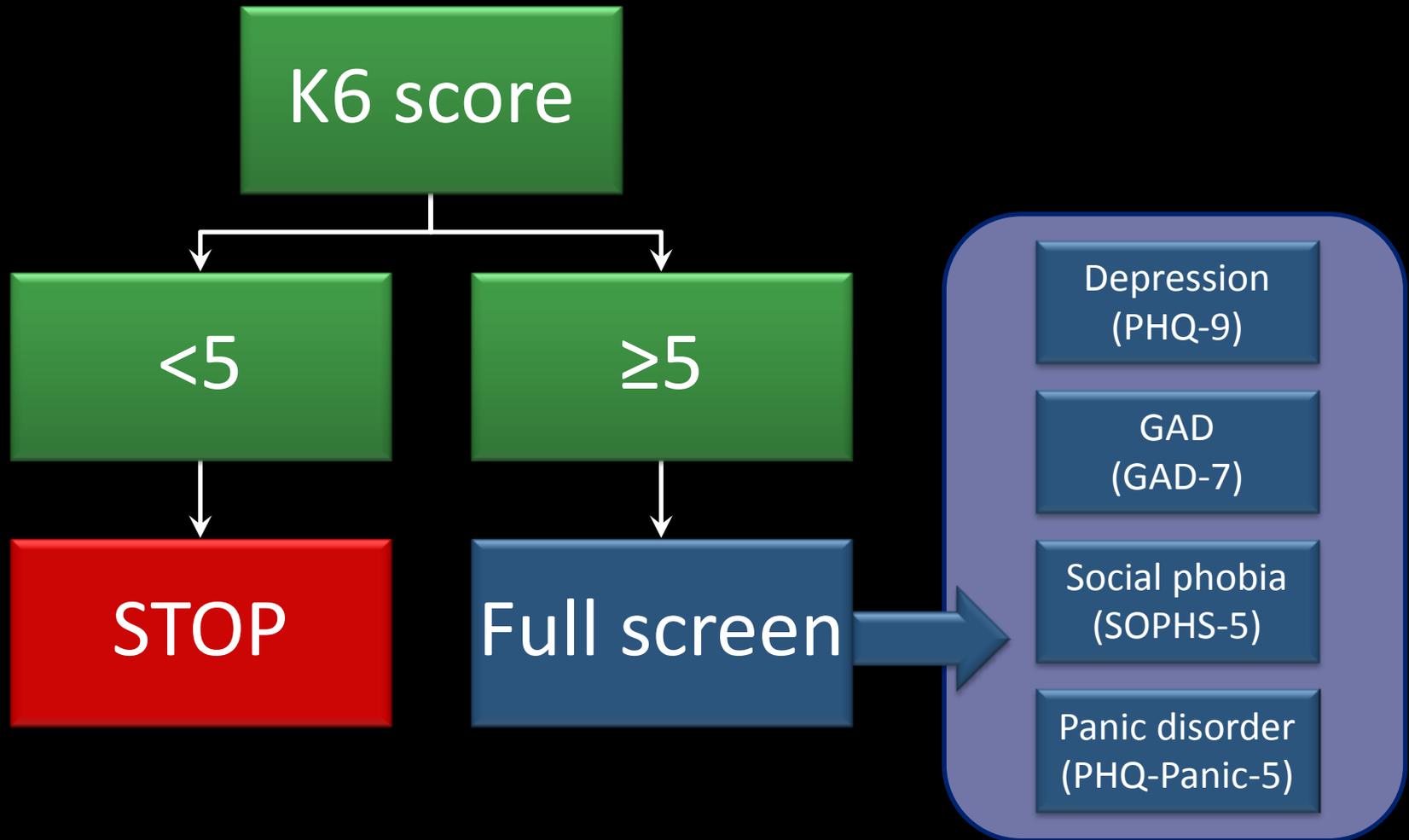
Depression  
(PHQ-9)

GAD  
(GAD-7)

Social phobia  
(SOPHS-5)

Panic disorder  
(PHQ-Panic-5)

# Method 2: K6 hierarchy



# Method 3: Distress decision tree

- Choose distress items that best discriminate absence of disorder
- Subgroups least likely to have disorder escape further screening
- Chi-Square Automatic Interaction Detection (*treedisc* macro in SAS)

# Method 3: Distress decision tree

## Chi-Square Automatic Interaction Detection (CHAID)

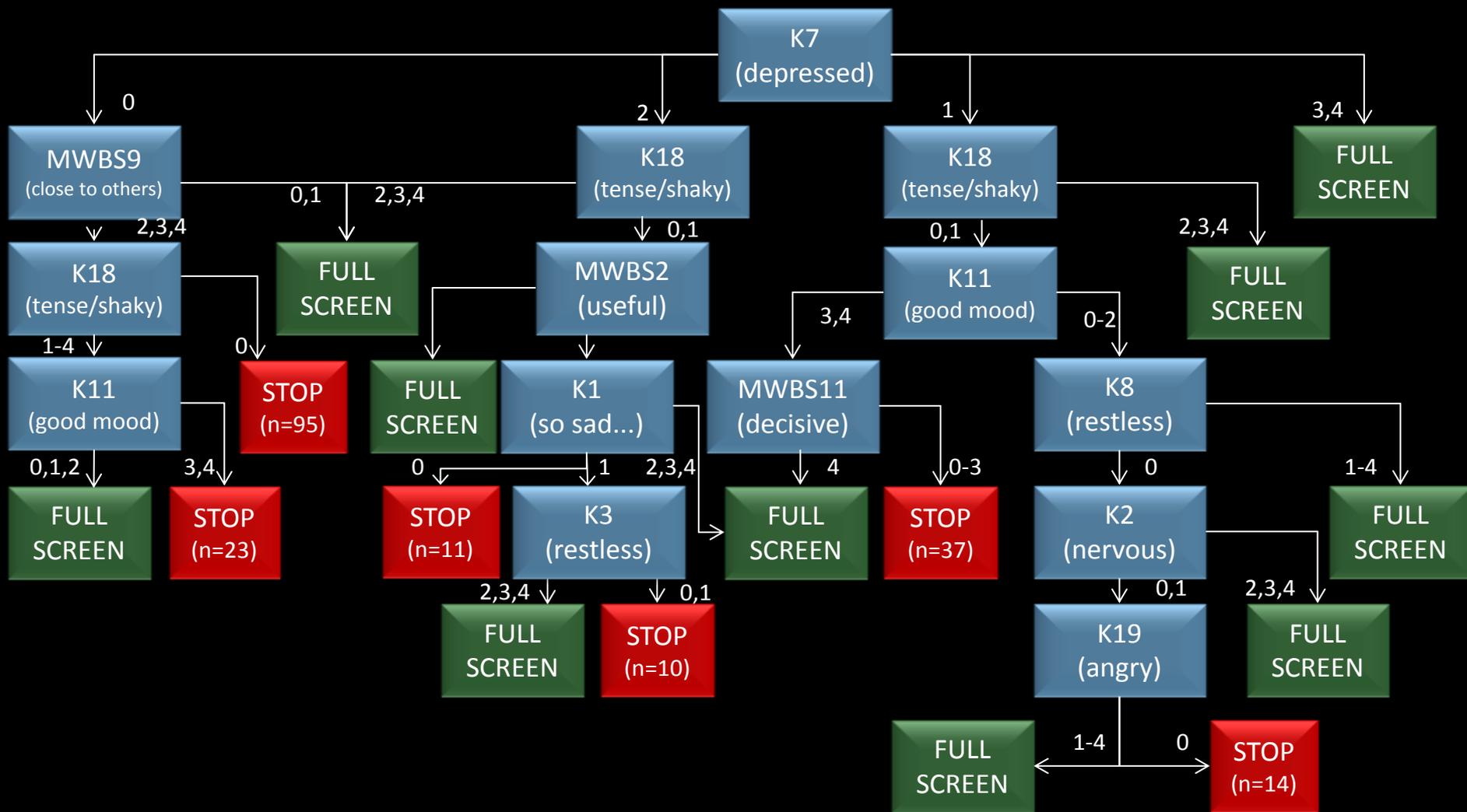
- Divides the sample into subsamples with different risks of outcome
- Diagram with leaves and branches
- Categorical items
- Branching based on item that best differentiates on the basis of the outcome
- Smallest p-value from a chi-square statistic

# Method 3: Distress decision tree

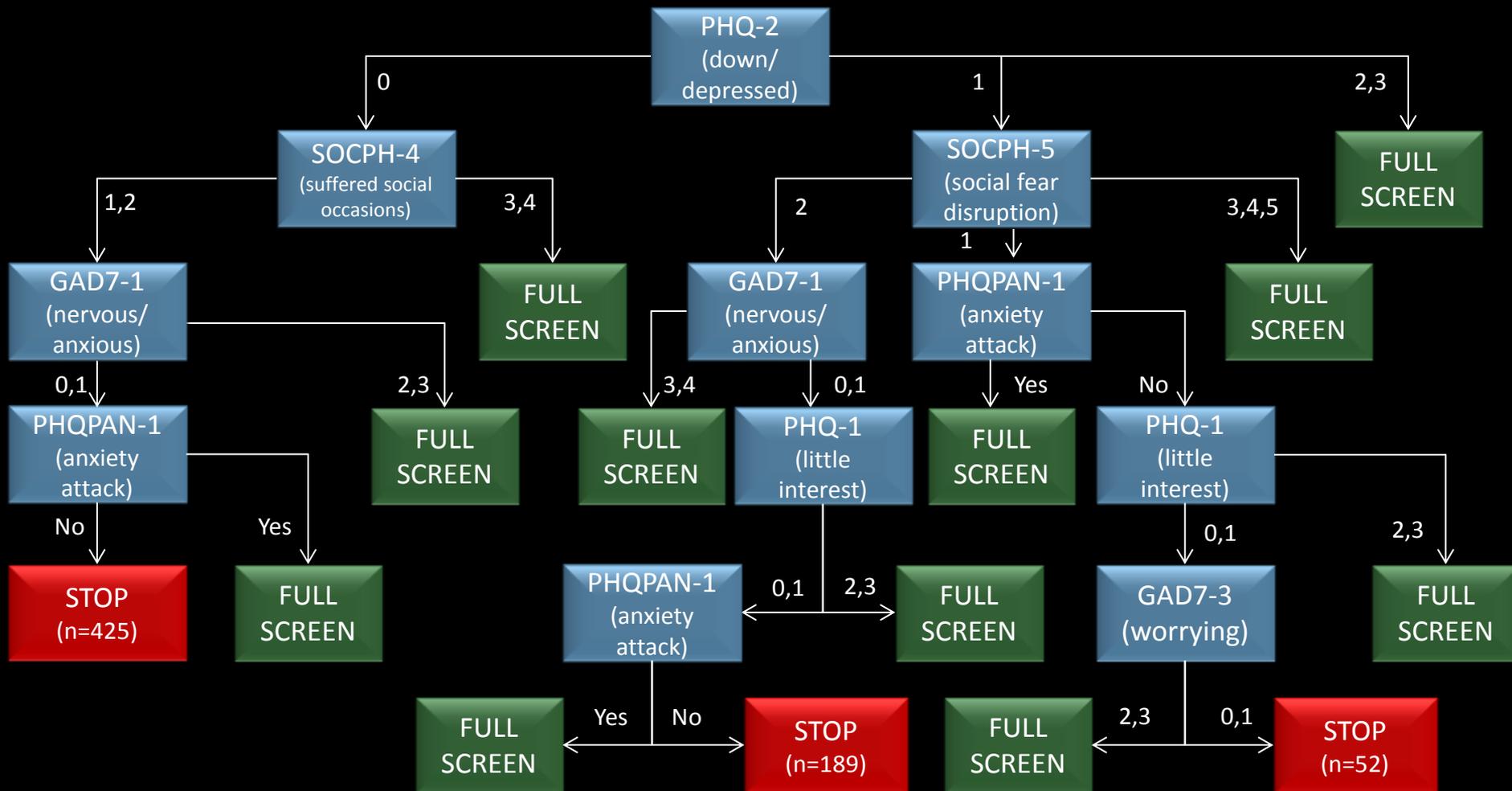
## Chi-Square Automatic Interaction Detection (CHAID)

- Splitting stops when:
  - There is a small number of observations in a leaf (20 observations)
  - No split would result in a significant  $\chi^2$  value ( $\alpha=.2$ )
  - A specified level of branching is reached (6 levels)

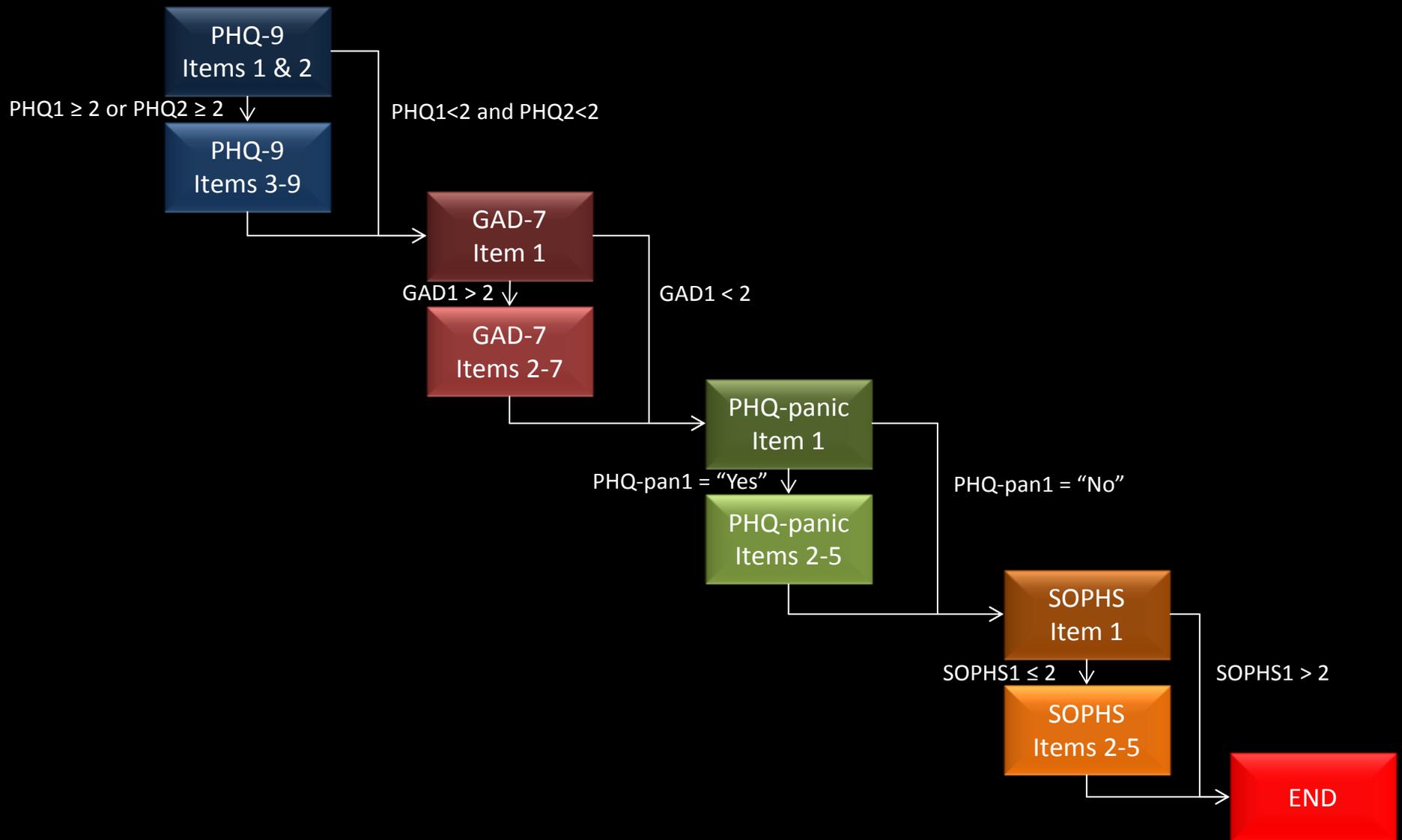
# Method 3: Distress decision tree



# Method 4: Disorder decision tree



# Method 5: Gating items



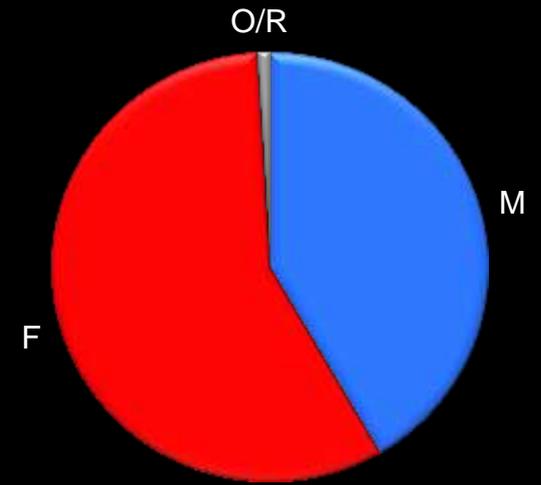
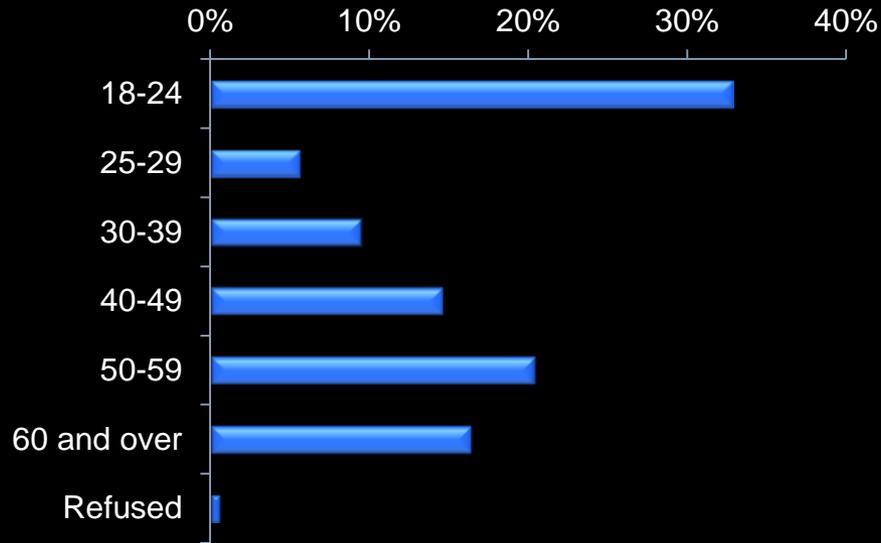
# Testing the hierarchies

- **Efficiency**
  - Mean number of items presented
- **Precision**
  - Sensitivity relative to control

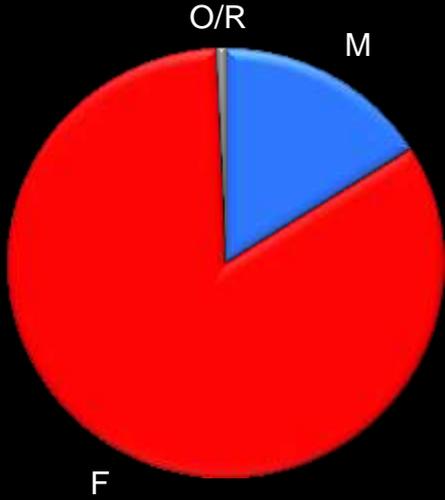
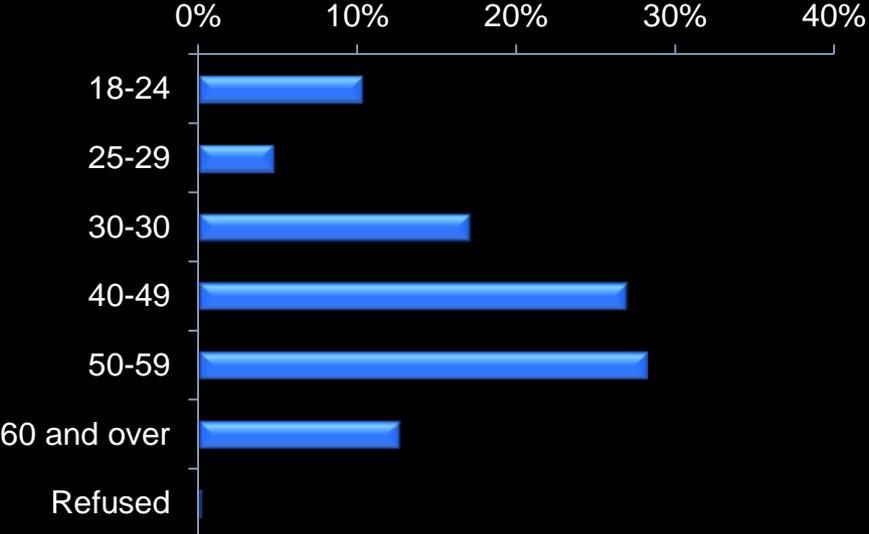
# Validation samples

- Two community-based samples
- $N_1 = 1360$ ;  $N_2 = 668$
- Recruited through Facebook ads
- Australia-wide, 18+

# Sample 1 (N=1360)



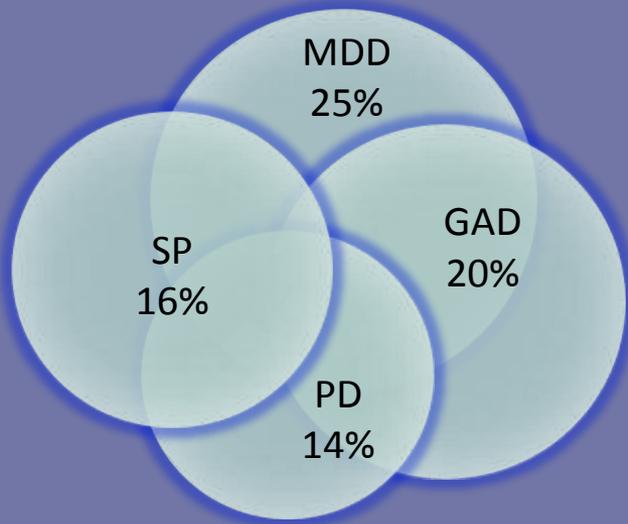
# Sample 2 (N=668)



# Samples: Psychopathology

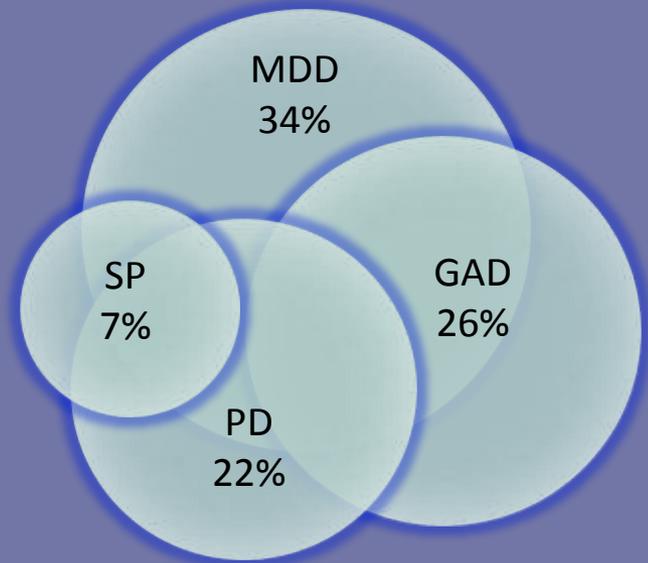
N = 1360

None: 63%



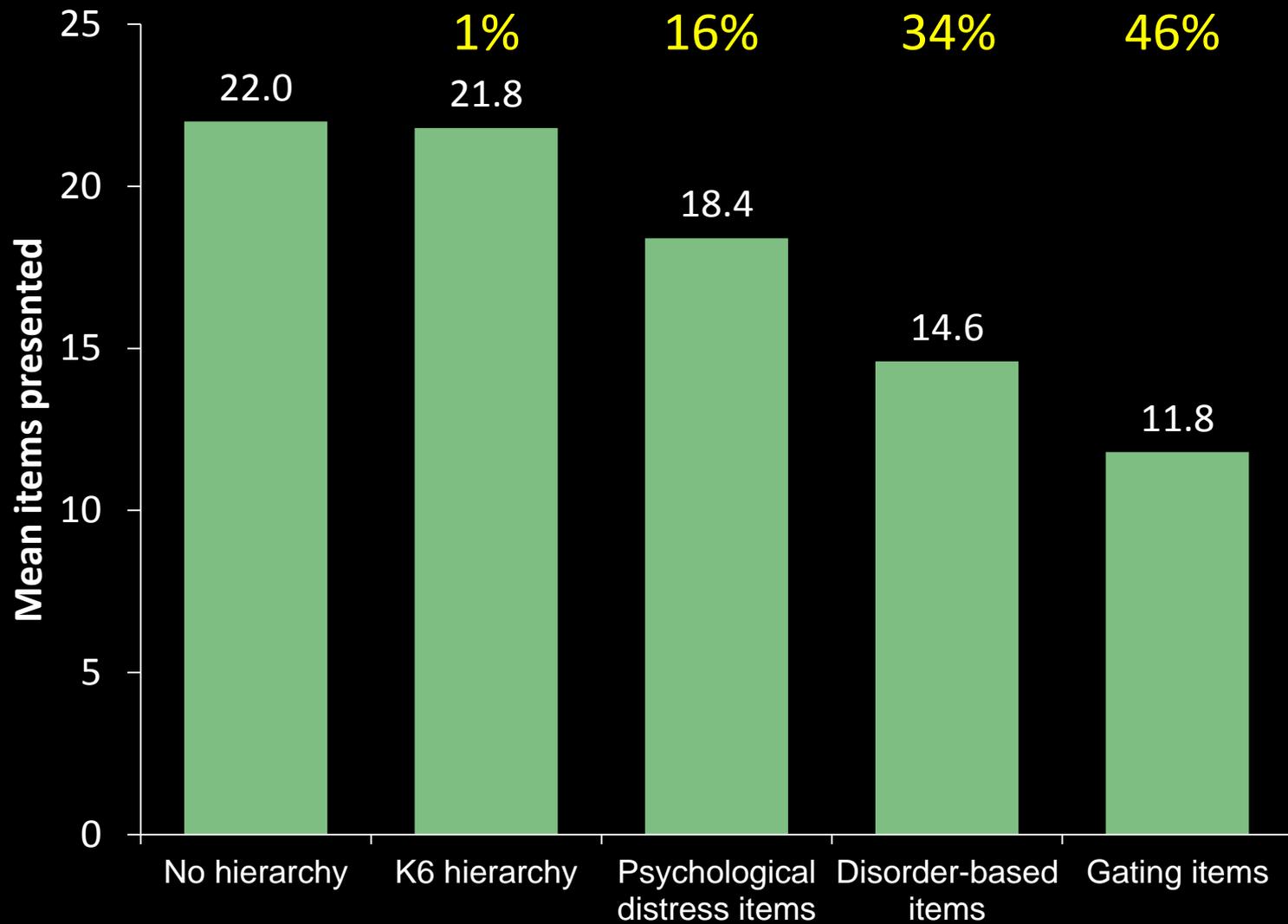
N = 668

None: 53%

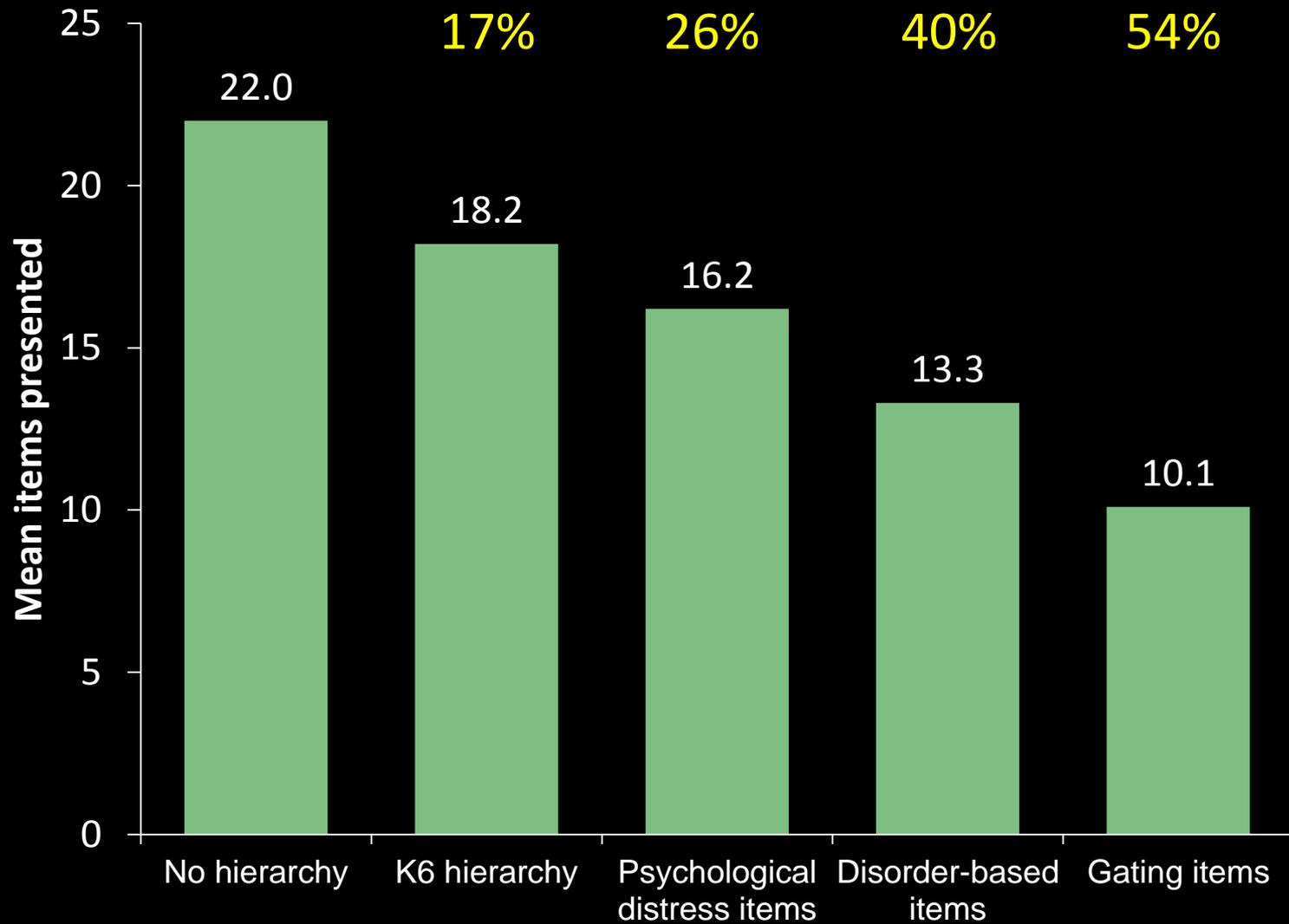


*(Not to scale)*

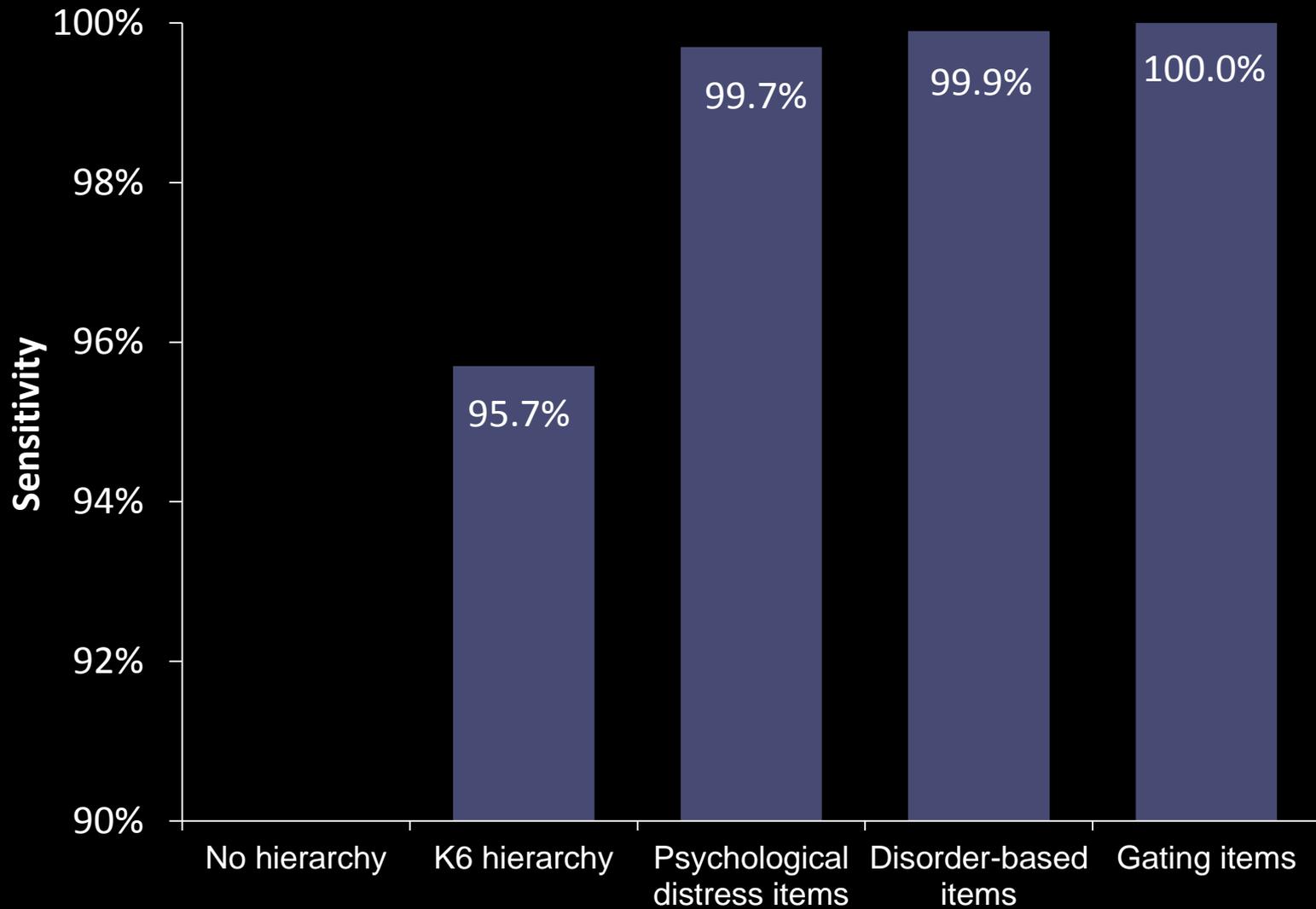
# Results: Efficiency gains



# Results: Projected efficiency gains



# Results: Summary



# Results: Summary

- Two-phase hierarchical screening was efficient and precise
- Using gating items had most efficiency gain (up to 54%)
- Using decision trees also had large efficiency gains (up to 40%)
- K6 did not improve screening efficiency

# Considerations

- The K6/K10 were designed to “rule in” not “rule out”
- Hierarchical screening works better for:
  - Low rates of psychopathology
  - Longer screening scales (60% fewer items)
- Tested with other disorders/outcomes
  - PTSD, adult ADHD, alcohol abuse, suicidality

# Considerations

- Purpose of screening
- Brevity vs. need for data
- Ease of implementation vs. efficiency
  - Gating only works for scales with gated scoring criteria
  - Pencil and paper vs. computer-based

# Future research: Adaptive screening

- Fully adaptive measures
  - Each response determines next item presented
- PROMIS measures
  - IRT-calibrated item banks
  - PROMIS-depression 5-item adaptive screener more precise than 20-item CES-D

# Future research: Adaptive screening

**Table 2.** Calibrated Depression Items

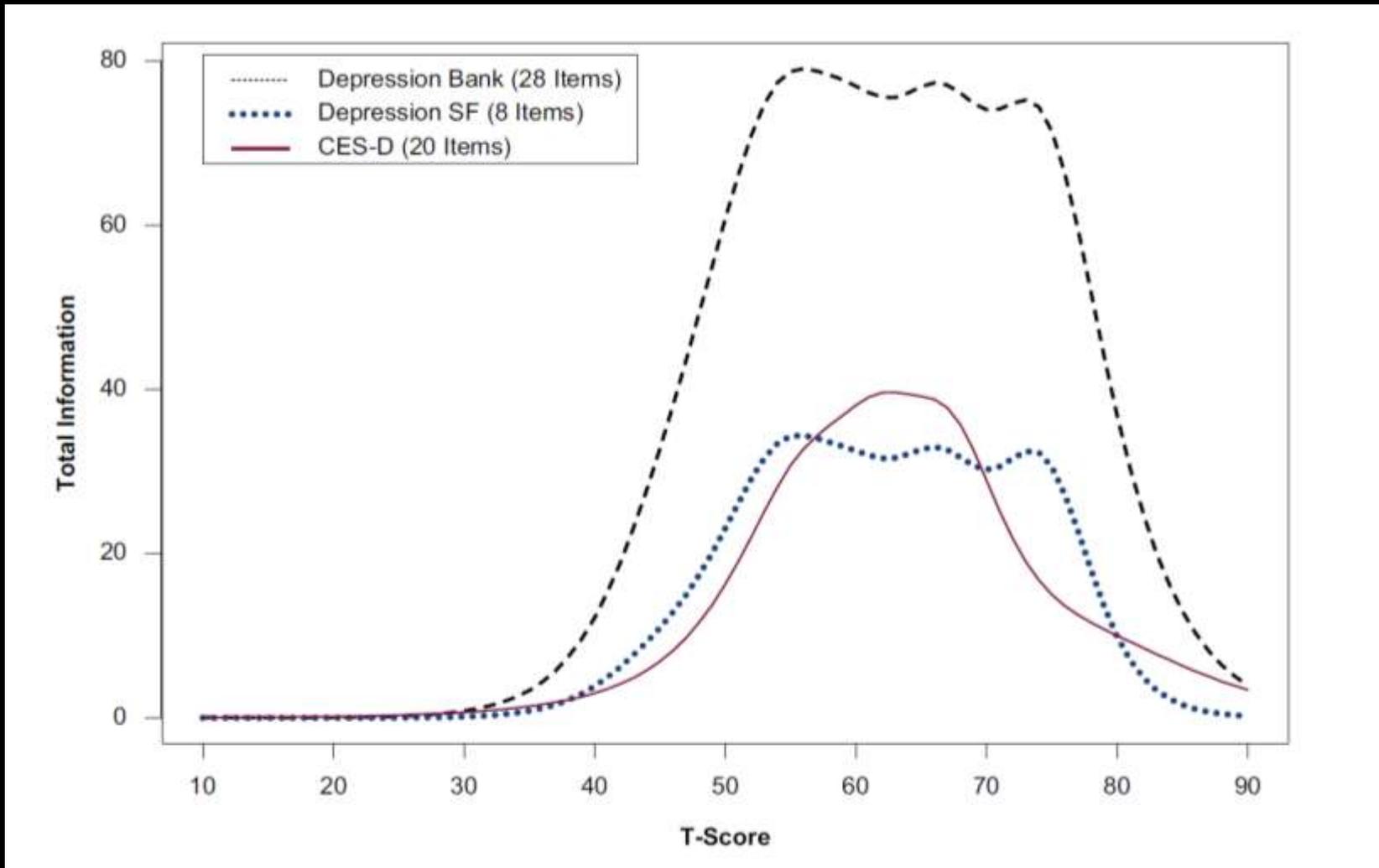
| Item stem   | Slope<br>(discrimination) | Location<br>threshold 1 | Location<br>threshold 2 | Location<br>threshold 3 | Location<br>threshold 4 |
|---|---------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| I felt hopeless <sup>a</sup>                              | 4.46                      | 0.49                    | 1.00                    | 1.71                    | 2.46                    |
| I felt depressed <sup>a</sup>                             | 4.35                      | -0.19                   | 0.53                    | 1.36                    | 2.20                    |
| I felt worthless <sup>a</sup>                             | 4.27                      | 0.33                    | 0.90                    | 1.62                    | 2.37                    |
| I felt helpless <sup>a</sup>                              | 4.15                      | 0.29                    | 0.84                    | 1.61                    | 2.40                    |
| I felt like a failure <sup>a</sup>                        | 3.97                      | 0.13                    | 0.72                    | 1.58                    | 2.22                    |
| I felt that I had nothing to look forward to <sup>a</sup> | 3.94                      | 0.23                    | 0.84                    | 1.52                    | 2.34                    |
| I felt that nothing could cheer me up                     | 3.66                      | 0.24                    | 0.91                    | 1.71                    | 2.50                    |
| I felt unhappy <sup>a</sup>                               | 3.49                      | -0.61                   | 0.28                    | 1.27                    | 2.28                    |
| I felt sad <sup>a</sup>                                   | 3.28                      | -0.57                   | 0.33                    | 1.34                    | 2.30                    |
| I felt that I wanted to give up on everything             | 3.24                      | 0.39                    | 0.96                    | 1.76                    | 2.44                    |
| I felt that my life was empty                             | 3.19                      | 0.13                    | 0.71                    | 1.45                    | 2.25                    |
| I felt discouraged about the future                       | 3.19                      | -0.33                   | 0.33                    | 1.23                    | 2.06                    |
| I felt I had no reason for living                         | 3.13                      | 0.85                    | 1.41                    | 2.09                    | 2.78                    |
| I found that things in my life were overwhelming          | 3.11                      | -0.03                   | 0.65                    | 1.57                    | 2.40                    |
| I felt disappointed in myself                             | 3.10                      | -0.43                   | 0.34                    | 1.33                    | 2.15                    |
| I felt that I was not needed                              | 2.92                      | 0.13                    | 0.82                    | 1.58                    | 2.46                    |
| I felt that nothing was interesting                       | 2.84                      | 0.07                    | 0.83                    | 1.77                    | 2.80                    |
| I withdrew from other people                              | 2.80                      | 0.08                    | 0.70                    | 1.53                    | 2.46                    |
| I felt that I was to blame for things                     | 2.74                      | 0.00                    | 0.74                    | 1.73                    | 2.60                    |
| I felt emotionally exhausted                              | 2.69                      | -0.37                   | 0.35                    | 1.29                    | 2.23                    |
| I had trouble making decisions                            | 2.62                      | -0.09                   | 0.80                    | 1.79                    | 2.75                    |
| I felt lonely   | 2.59                      | -0.15                   | 0.56                    | 1.41                    | 2.25                    |
| I had trouble feeling close to people                     | 2.57                      | -0.11                   | 0.62                    | 1.58                    | 2.51                    |
| I felt upset for no reason                                | 2.55                      | 0.12                    | 0.94                    | 1.94                    | 3.05                    |
| I felt pessimistic  | 2.38                      | -0.53                   | 0.41                    | 1.47                    | 2.56                    |
| I felt ignored by people                                  | 2.37                      | 0.14                    | 0.92                    | 1.83                    | 2.86                    |
| I felt that I was not as good as other people             | 2.34                      | 0.12                    | 0.88                    | 1.66                    | 2.56                    |
| I felt guilty   | 2.02                      | -0.12                   | 0.85                    | 1.93                    | 2.89                    |

Note. Items are rank ordered on the basis of their slope (discrimination) parameters. All items are reprinted with the permission of the Patient-Reported Outcomes Measurement Information System (PROMIS) Health Organization and the PROMIS Cooperative Group.

a. Items included in the short form.

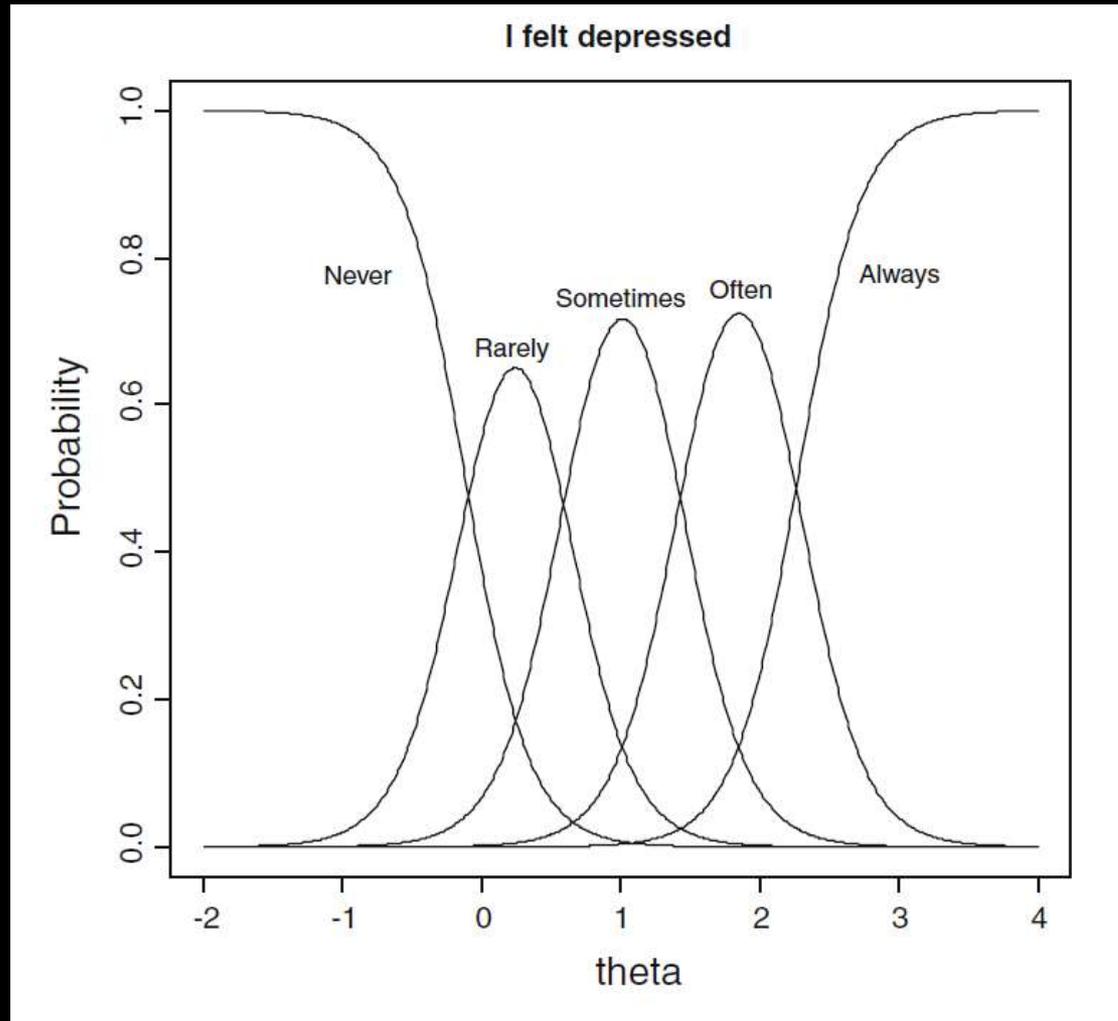
From: Pilkonis PA, et al. Item Banks for Measuring Emotional Distress From the Patient-Reported Outcomes Measurement Information System (PROMIS®): Depression, Anxiety, and Anger. *Assessment* 2011 18: 263-283

# Future research: Adaptive screening



From: Pilkonis PA, et al. Item Banks for Measuring Emotional Distress From the Patient-Reported Outcomes Measurement Information System (PROMIS®): Depression, Anxiety, and Anger. *Assessment* 2011 18: 263-283

# Future research: Adaptive screening

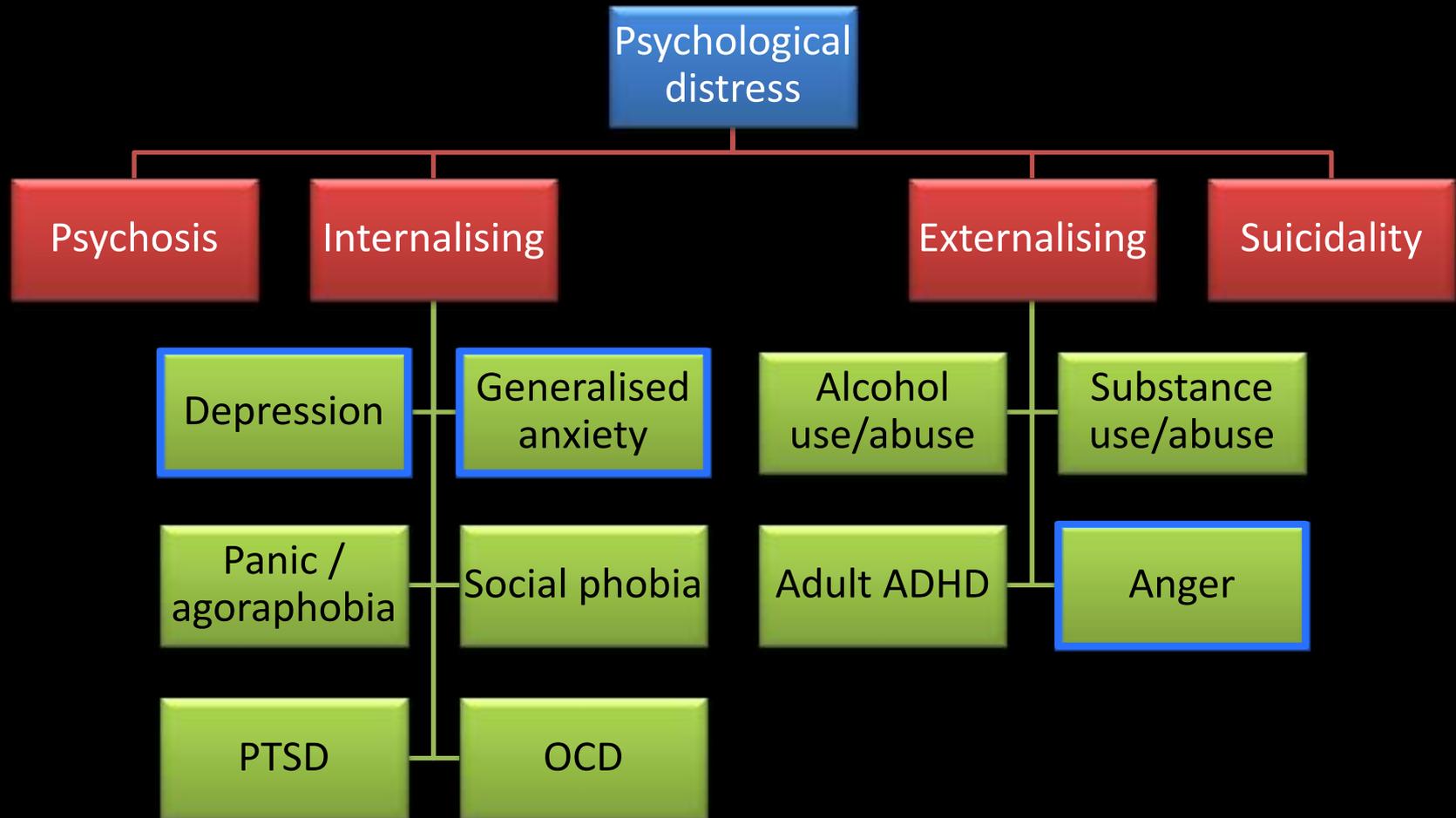


From: Choi SW et al. Efficiency of static and computer adaptive short forms compared to full-length measures of depressive symptoms. *Qual Life Res*, 2010, 19: 125-136.

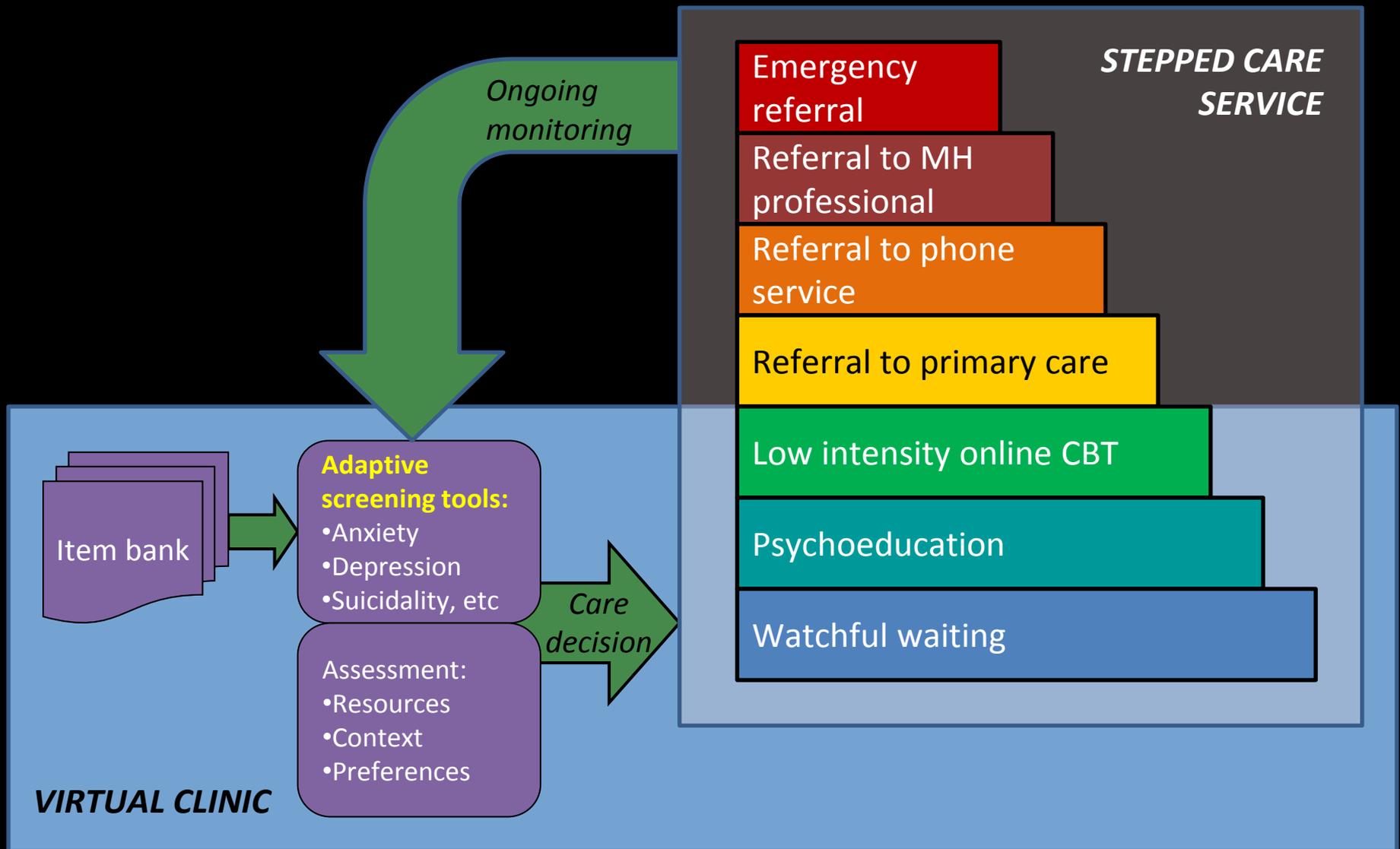
# Future research: Adaptive screening

- **Assess severity level, not clinical criteria**
  - Test against DSM criteria using decision tree approach
- **Validated in US**
  - Validate internationally
- **Limited array of mental health problems**
  - Develop item banks for other disorders

# Future research: Adaptive screening



# Future research: Adaptive screening



# Conclusions

- Hierarchical screening for multiple disorders can result in large efficiency gains without sacrificing accuracy
- Disorder-specific items more useful than general distress items
- Much promise in adaptive screening

# Conclusions

- **May be applied to**
  - Virtual clinics
  - Primary care screening
  - Research
  - School-based screening
  - Other service contexts

# Collaborators

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