

**TNO** innovation  
for life

# Human-centered design

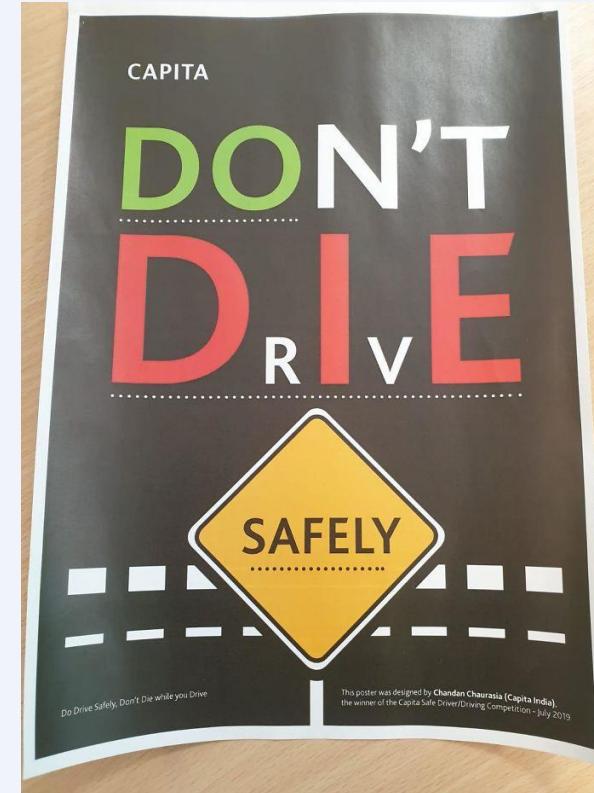
For trustworthy decision-support systems

Tjeerd Schoonderwoerd

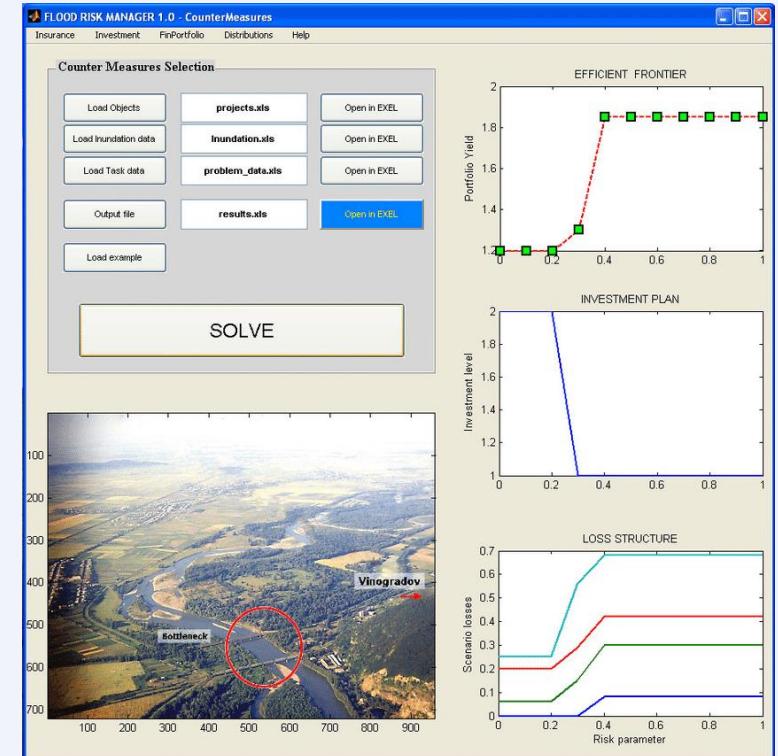
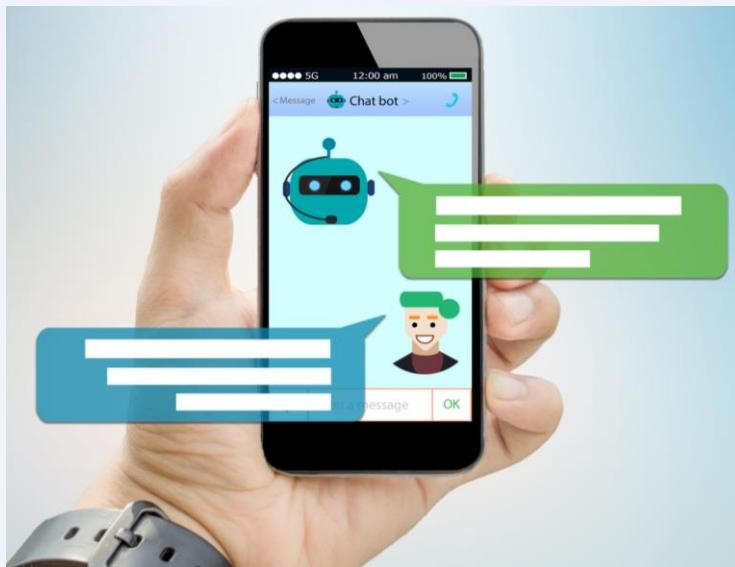
[tjeerd.schoonderwoerd@tno.nl](mailto:tjeerd.schoonderwoerd@tno.nl)



# Design examples



# More design examples

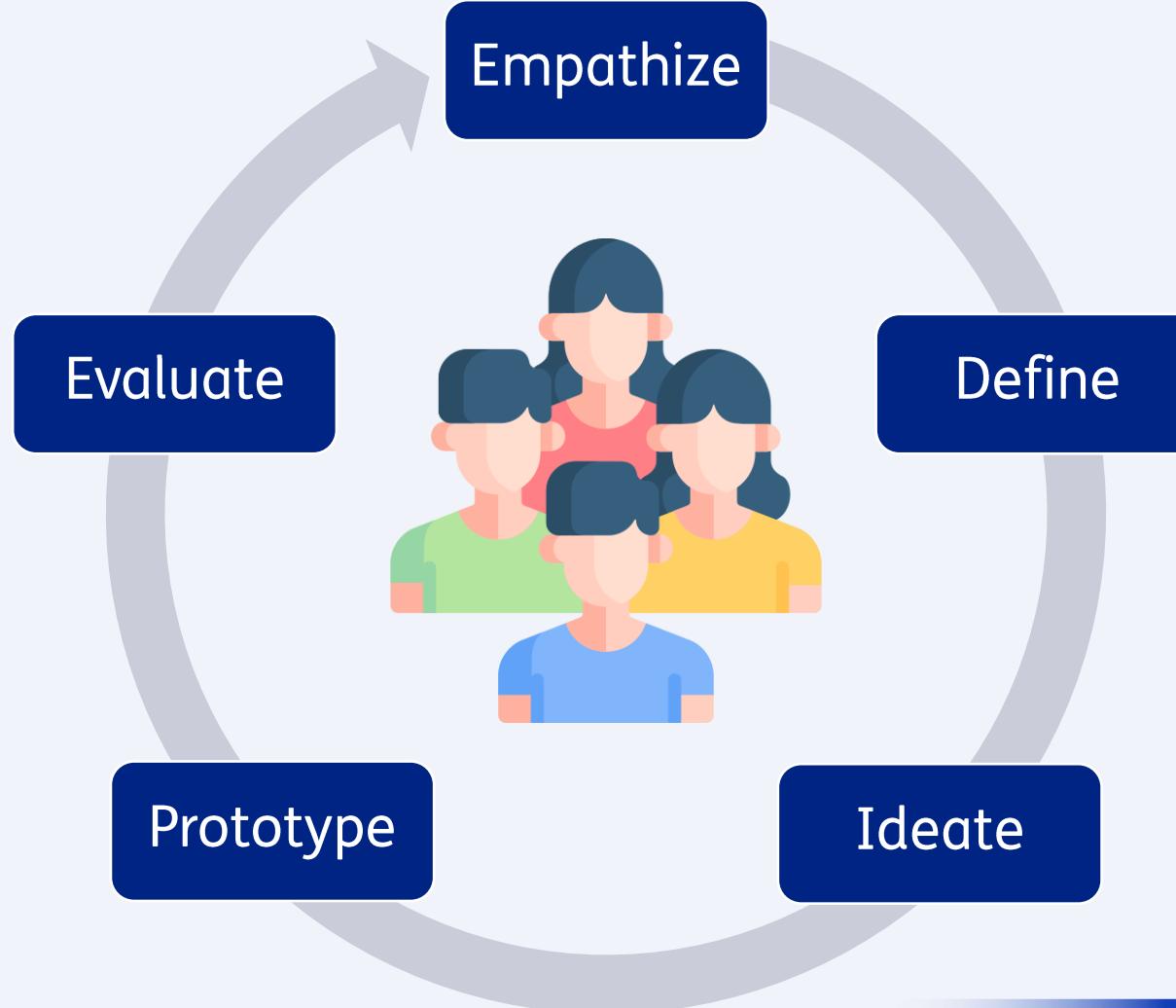


## Take-home message

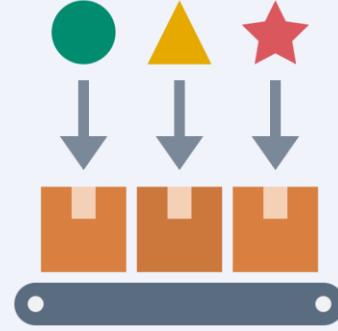
**“In the end, designing is all about people.  
Therefore, it should be about people  
from the very beginning.”**



# Human-centered design



# Human-centered requirements analysis



Research

Collaboration

Cognitive

Behavioural

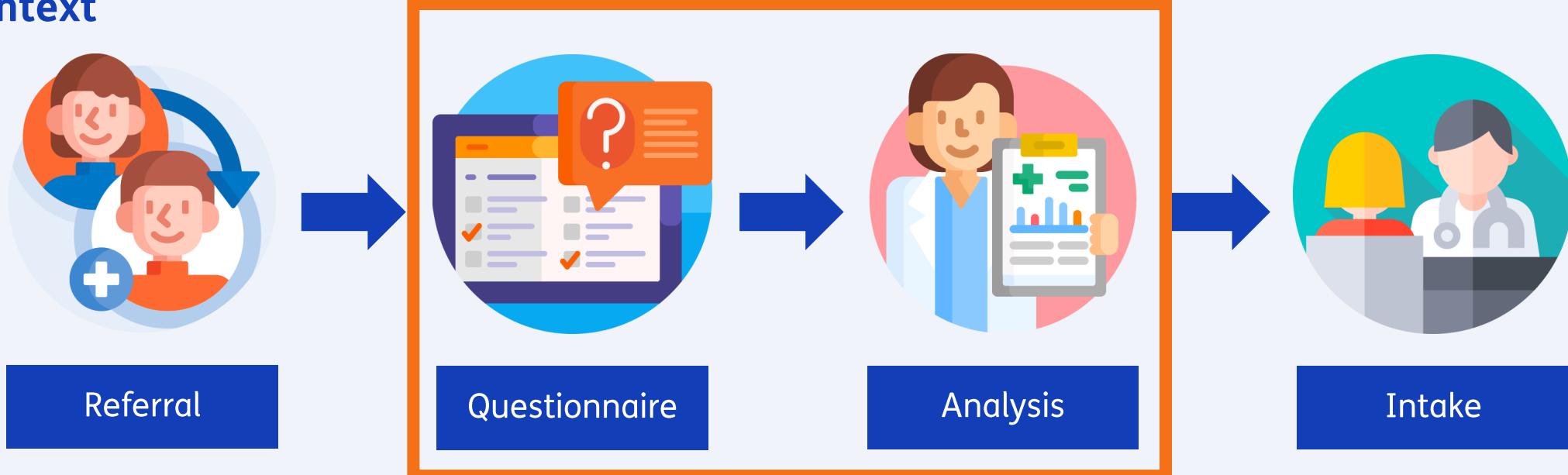
Creativity

# Clinical decision-support

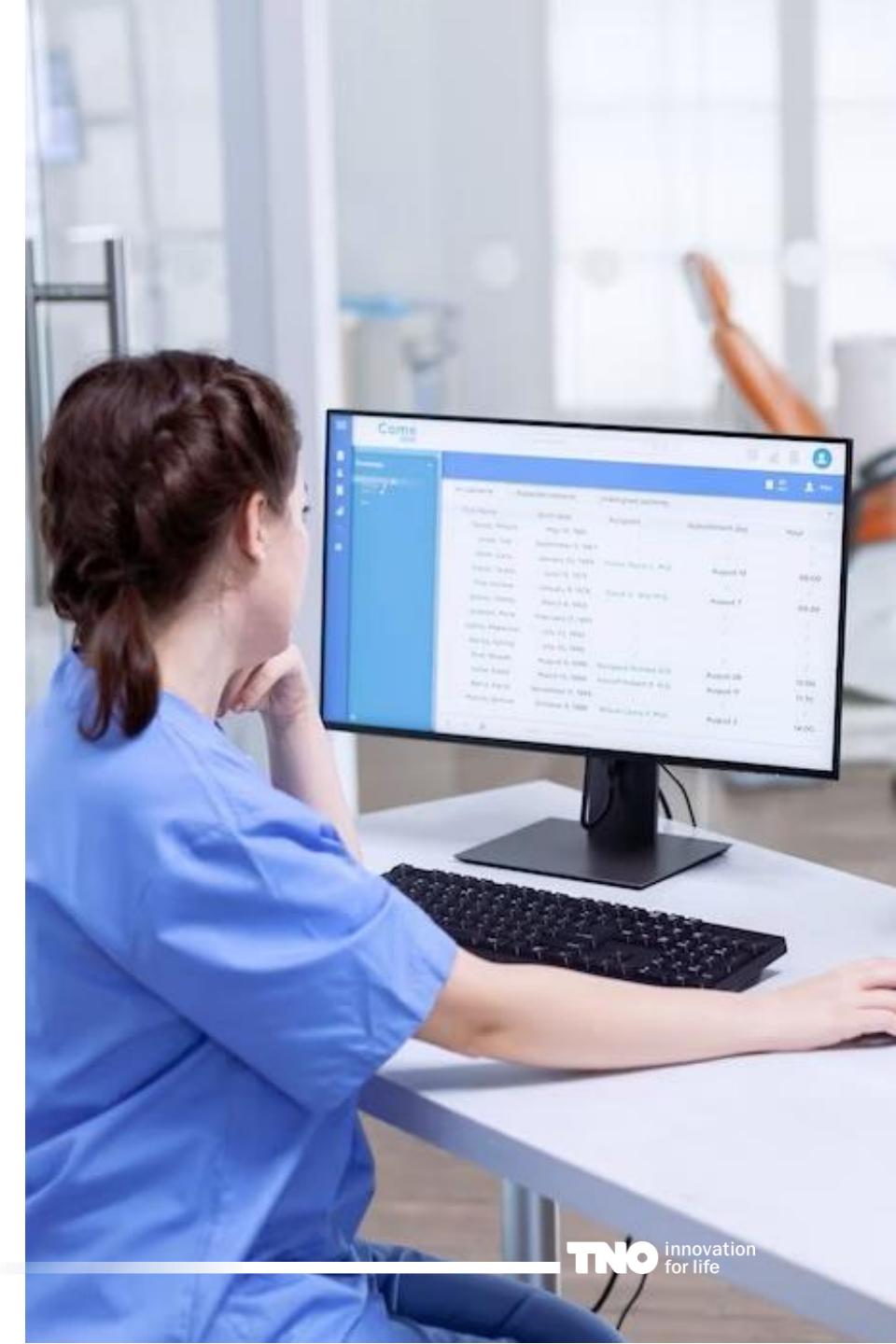
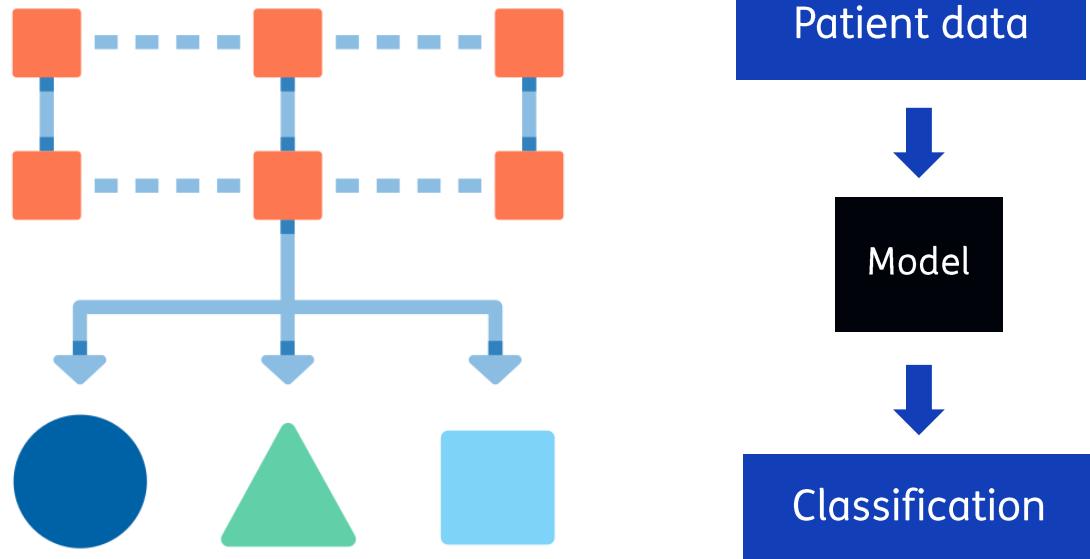
## Goal

- Explore the added value of a decision-support system for clinicians working in youth psychiatry.

## Context



# Clinical decision-support



# Clinical decision-support

The screenshot shows a web-based clinical decision-support application. At the top, there is a header bar with a 'Dash' button, a close ('x') button, and a '+' button. Below the header is a navigation bar with icons for back, forward, and home, followed by a URL field showing '127.0.0.1:8050/case\_cdss0'. The main content area displays patient information: 'Naar casussen' (To cases) next to a user icon, 'Naam: Hannah de Haas' (Name: Hannah de Haas), 'Geslacht: V' (Gender: V), and 'Geb. datum: 01-01-2011 (10 jaar)' (Birth date: 01-01-2011 (10 years)). Below this, there are two tabs: 'Rupe patiëntdata' (Raw patient data) and 'Voorspelling van het systeem' (Prediction of the system). The 'Voorspelling van het systeem' tab is active. In this section, the heading 'Waarschijnlijkheidsclassificatie' (Probability classification) is displayed above the classification 'Gegeneraliseerde angststoornis' (Generalized anxiety disorder).

\* Shown patient data (incl. names) are fictitious

# Empathize & Define

**It's not about classification**

- Identify potential problem areas
- Collect evidence
- Differential diagnoses
- Case-based comparison
- System-related: certainty, performance

How to support these tasks by  
**combining the strengths of AI and humans?**



# Ideation: From tasks to system functions

User task	System function
Identify potential problem areas	Classification algorithm
Collect and evaluate evidence	Feature importance (XAI)
Differential diagnoses	Classification hierarchy
Case-based comparison	Example-based explanations
Understand certainty of system outcome	Interpretable Confidence Measure (ICM)
Estimate trustworthiness of the outcome	Context-specific performance metrics

Schoonderwoerd, T. A., Jorritsma, W., Neerincx, M. A., & Van Den Bosch, K. (2021). Human-centered XAI: Developing design patterns for explanations of clinical decision support systems. *International Journal of Human-Computer Studies*, 154, 102684.

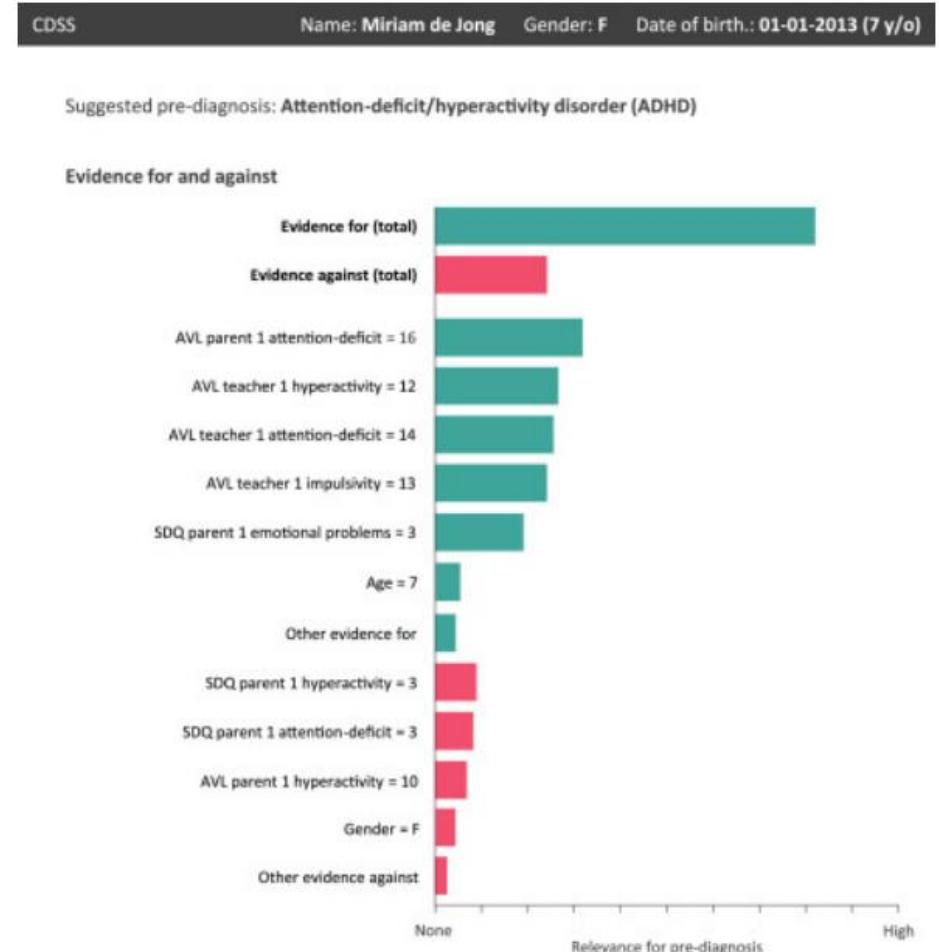
van der Waa, J., Schoonderwoerd, T., van Diggele, J., & Neerincx, M. (2020). Interpretable confidence measures for decision support systems. *International Journal of Human-Computer Studies*, 144, 102493.

# Design patterns

- General and reusable solutions to commonly occurring problems within a given context.
- Patterns for conveying and interacting with information that supports a decision-making process.

## Example problem

- A decision maker wants to understand the reasoning of the AI system to arrive at a particular outcome.



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# Design pattern prototype

## Feature importance

Waarschijnlijkheidsclassificatie

Gegeneraliseerde angststoornis

Zekerheid ▼

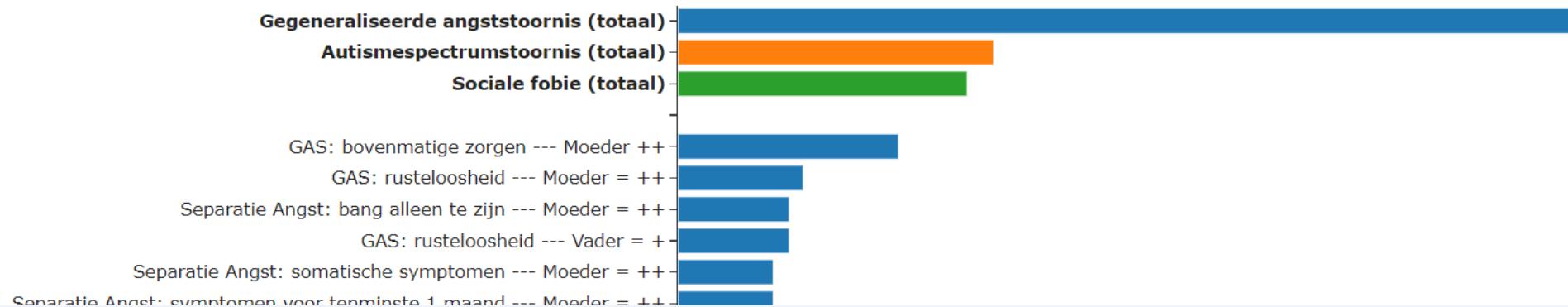
Bewijs voor en tegen ▲



# Design pattern prototype

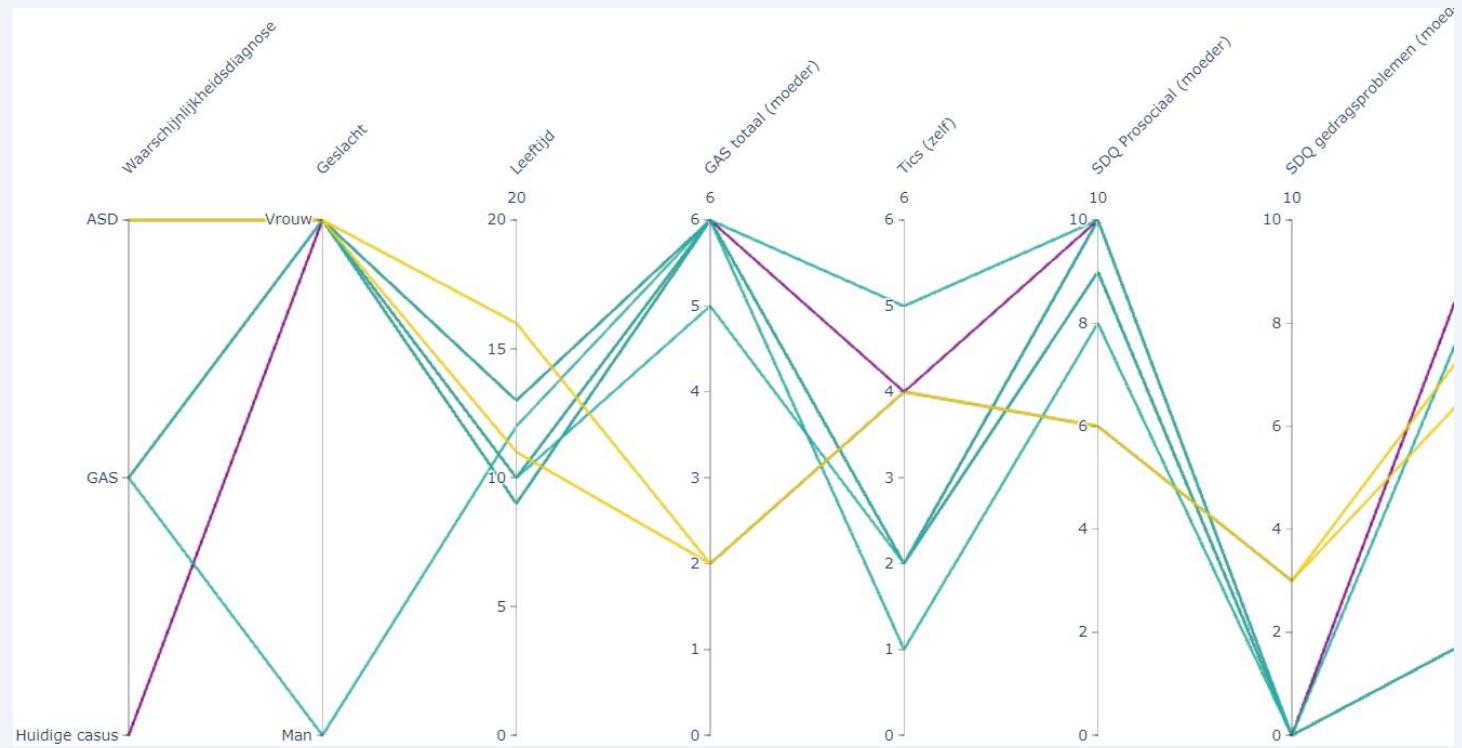
## Classification hierarchy

Bewijs voor deze en andere mogelijke classificaties 



# Design pattern prototype

## Example-based explanations



Schoonderwoerd, T. A., Jorritsma, W., Neerincx, M. A., & Van Den Bosch, K. (2021). Human-centered XAI: Developing design patterns for explanations of clinical decision support systems. *International Journal of Human-Computer Studies*, 154, 102684.

# Design pattern prototype

## Interpretable Confidence Measure

Waarschijnlijkheidsclassificatie

Gegeneraliseerde angststoornis

Zekerheid 

Zekerheid:

Zeer laag

Laag

Gemiddeld

Hoog

Zeer hoog

[Waarom deze zekerheid?](#)

Schoonderwoerd, T. A., Jorritsma, W., Neerincx, M. A., & Van Den Bosch, K. (2021). Human-centered XAI: Developing design patterns for explanations of clinical decision support systems. *International Journal of Human-Computer Studies*, 154, 102684.

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# Design pattern prototype

## Context-specific performance metrics

### CDSS prestatie ^

De prestatie van het systeem voor deze waarschijnlijkheidsclassificatie op de validatie dataset (10.000 casussen)

Sensitiviteit: **94%**      Specificiteit: **86%**

		Gouden standaard	
		Gegeneraliseerde angststoornis	Anders
CDSS suggestie	Gegeneraliseerde angststoornis	True positive: 900 (9%)	False positive: 1310 (13%)
	Anders	False negative: 55 (1%)	True negative: 7735 (77%)

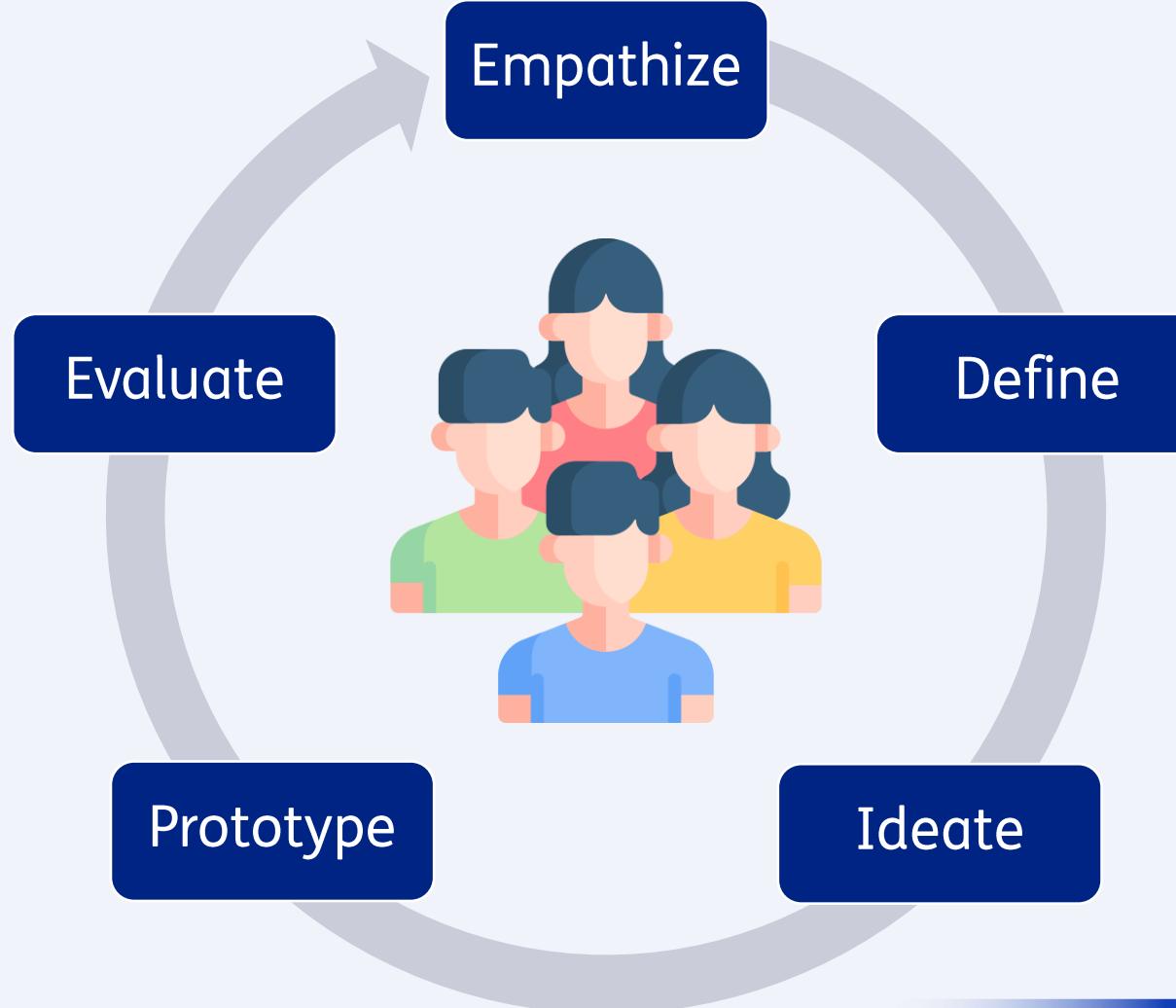
# Prototype evaluation

- Most information was highly valued
- Better informed decision-making
- Broadened perspective on case
- Understandable system outcomes
- Helps to align trust in the system
- Increased congruency between clinicians

The screenshot shows a user interface for a medical decision support system. At the top, there's a header bar with the text "Naar casussen" and "Naam: Hannah de Haas, Geslacht: V, Geb. datum: 01-01-2011 (10 jaar)". Below this is a navigation bar with "Ruwe patiëntdata" and "Voorspelling van het systeem". The main content area starts with "Waarschijnlijkheidsclassificatie" and "Gegeneraliseerde angststoornis". A section titled "Zekerheid" has an upward arrow icon and a button labeled "Hoog" which is highlighted in green. Below this are sections for "Bewijs voor en tegen", "Bewijs voor deze en andere mogelijke classificaties", "Waarom deze en niet een andere classificaties?", "Vergelijking met andere casussen", and "CDSS prestatie". Each of these sections has a downward arrow icon.

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# Human-centered design



# Take-home message

**“In the end, designing is all about people.  
Therefore, it should be about people  
from the very beginning.”**





# Thank you for your attention!

Tjeerd Schoonderwoerd | TNO