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Development of a brief MENTAL HEALTH SCREENING CHECK-LIST

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01. Introduction

- **Aviation personnel are responsible for the safe carriage of thousands of people each day** and need to be physically and mentally fit to perform the job.
- It is important to **regularly evaluate the mental health of aviation personnel** due to the stressors they face that can increase the risk of developing a mental health disorder.
- **Aeromedical Centers (AeMCs) and aeromedical examiners (AMEs) hold the responsibility** of identifying cognitive and emotional issues in these workers.

02. Introduction

- Performing **extensive psychiatric evaluations** as a regular part of aeromedical assessments is **neither productive nor cost-effective.**
- However, it is recommended that AMEs **pay more attention to common mental health disorders** (**CMDs**) as well as life stressors that can affect flight performance and flight safety.
- The use of **minimally intrusive, easy-to-use mental health check-lists** may **help AeMCs** and **AMEs** in the decision making process.

03. Objective of the present study

- Develop a **Mental Health Screening Checklist (MHSC)** to be used by AeMCs and AMEs as a screening tool.
- Devise an **automated strategy** that can **identify** individuals **with moderate-to-high risk profiles** who may require professional help from mental health experts.

04. MHSC › development principles

- Should be **short, yet exhaustive** in the coverage of CMDs and life stressors
  max 3 minutes to complete
- Should use a **simple and direct** language
  reduce misunderstandings, increase accountability of responses
- Should use a **limited number** of **response options**
  decrease the cognitive burden of respondents' decision making

05. MHSC › how we used the checklist

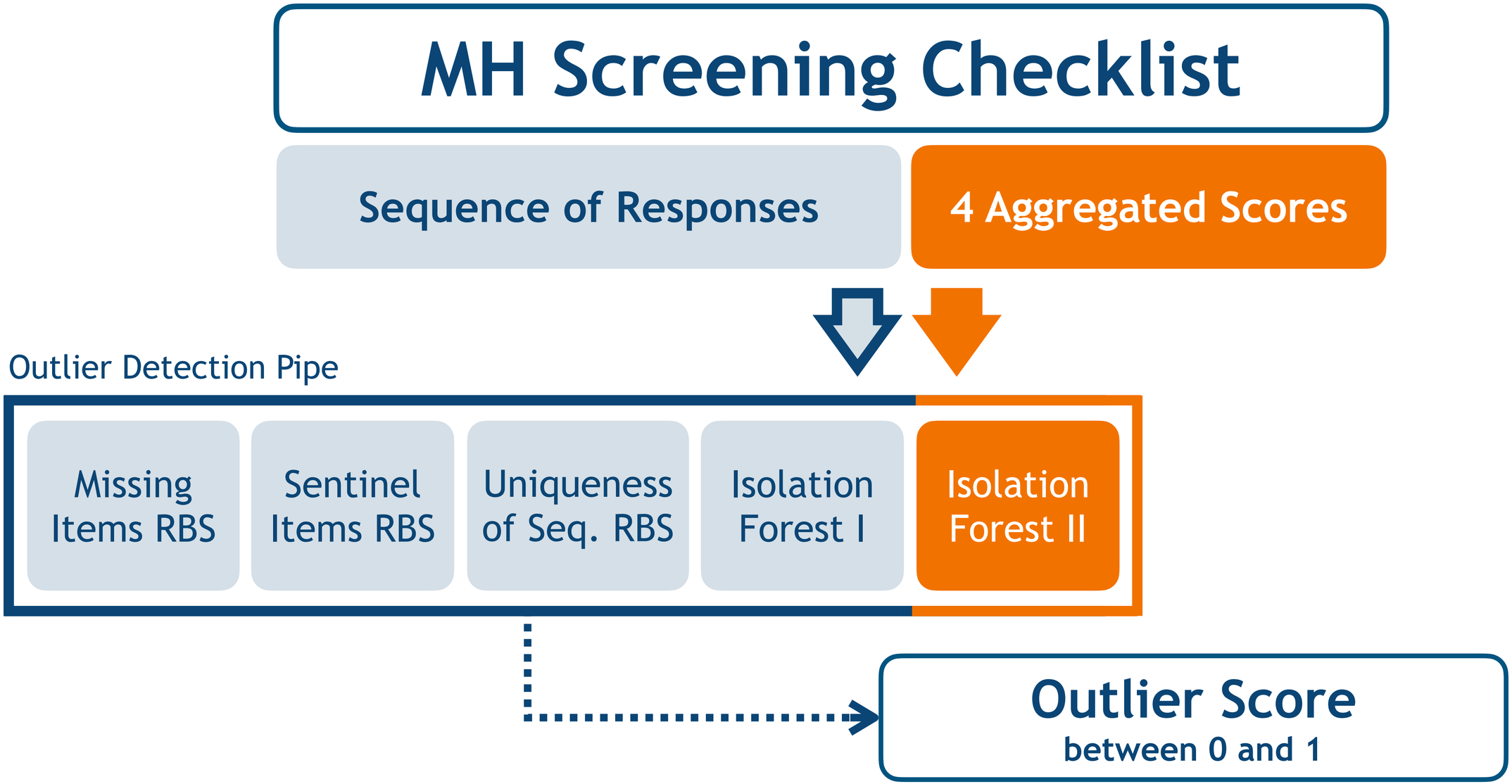
- We developed and **administered** our checklist **to the research sample.**
- We implemented an automated **“outlier detection pipe” in order to identify** those **profiles that** significantly **departed from** the majority of **the other ones.**
  - An **outlier profile** contains **responses** that fall **outside the typical range.**
  - Individuals with an **outlier profile** need to be referred to a mental health specialist.

06. MHSC › areas of inquiry

Area	Items	Response Options
Fatigue, Stress	2	No · Some · A lot of problems
Maladaptive Personality	4	No · Some · A lot of problems
Life Concerns	4	No · Some · A lot of problems
Relevant Events, Conditions	5	Yes · No
NRG Drinks, Alcohol, Tobacco, Drugs	5	Never · Occasionally · Weekly · Daily
Perceived Psychological Well-Being	1	10-points scale, from low to high

Note items are grouped in 4 parts (I, II, III and IV)

07. MHSC outlier detection pipe › visual representation



08. MHSC outlier detection pipe › description of pipe's steps

Step	Type	Description
Missing items	**RBS**	No missing items are admitted
Sentinel items	**RBS**	Aggressiveness towards others or self · Use of drugs · Psychiatric/Psychological Treatments · Legal issues
Uniqueness of sequence	**RBS**	Uniqueness of MHSC items sequence (part I & III)
Isolation forest I	**MLA**	Outlierness of MHSC items sequence (All parts)
Isolation forest II	**MLA**	Outlierness of MHSC aggregated scores

RBS = Rule-Based System · **MLA** = Machine Learning Algorithm

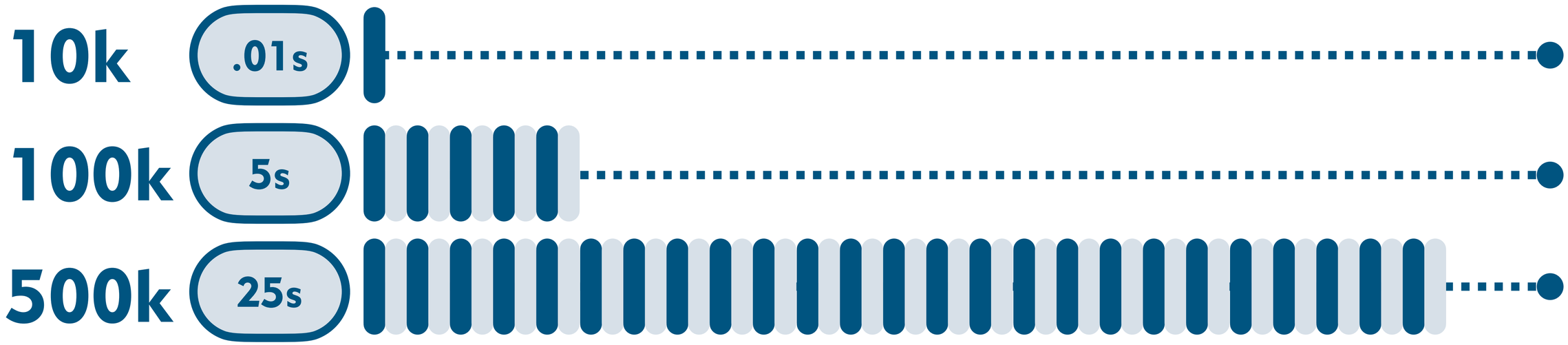
09. Rule-Based Systems and Isolation Forests › few explanatory words

- A **rule-based system** is a type of expert system that uses a set of **predefined rules to interpret data and make decisions**. These rules are derived from the knowledge of human experts in a particular domain.

- An **isolation forest** is an **unsupervised machine learning algorithm that uses an ensemble of binary decision trees to identify outliers**. Simplifying a bit, we can say that an isolation forest:

  - grows each tree by selecting random features and splits that act as branching rules. By using such branching rules, the algorithm isolates points in the dataset (up until the maximum allowed tree growth);
  - outliers are rapidly isolated (i.e., they need fewer splits in order to be parted from the rest and thus are — on average — closer to the root of the trees);
  - the number of splits required to isolate each point is used as an outlier score.

10. MHSC outlier detection pipe › training time with different sized datasets



Macbook Pro M2, RAM 16Gb

Python 3.10.6 · **Numpy** 1.23.5 · **Pandas** 2.01 · **Scikit-Learn** 1.2.2 · **PyOD** 1.0.9

11. MHSC research › sample

79 PILOTS

26 CREW

56 APPL

141 males · **20** females

79 between 17-30 · **54** between 31-50 · **28** over 50

12. MHSC research › items endorsement rates › fatigue, stress

%	Rank P C A	Item
8		Fatigue, difficulties in recovering from fatigue
8		Stress, feeling of being overwhelmed

P = Pilots · **C** = Cabin Crew · **A** = Applicants

13. MHSC research › items endorsement rates › maladaptive personality

%	Rank P C A	Item
1		Difficulties in controlling impulses
6		Negative emotionality
1		Aggressiveness towards others or self
2		Difficulties in interpersonal relationships

P = Pilots · **C** = Cabin Crew · **A** = Applicants

14. MHSC research › items endorsement rates › life concerns

%	Rank P C A	Item
10		Concerns about private life
9		Concerns about job
4		Health concerns
5		Financial concerns

P = Pilots · **C** = Cabin Crew · **A** = Applicants

15. MHSC research › items endorsement rates › lifestyle

%	Rank P C A	Item
84		Energizing beverages (coffee, tea, energy drinks, etc.)
64		Alcoholic beverages
20		Tobacco or tobacco-related products
0		Light drugs (e.g., marijuana)
0		Other drugs

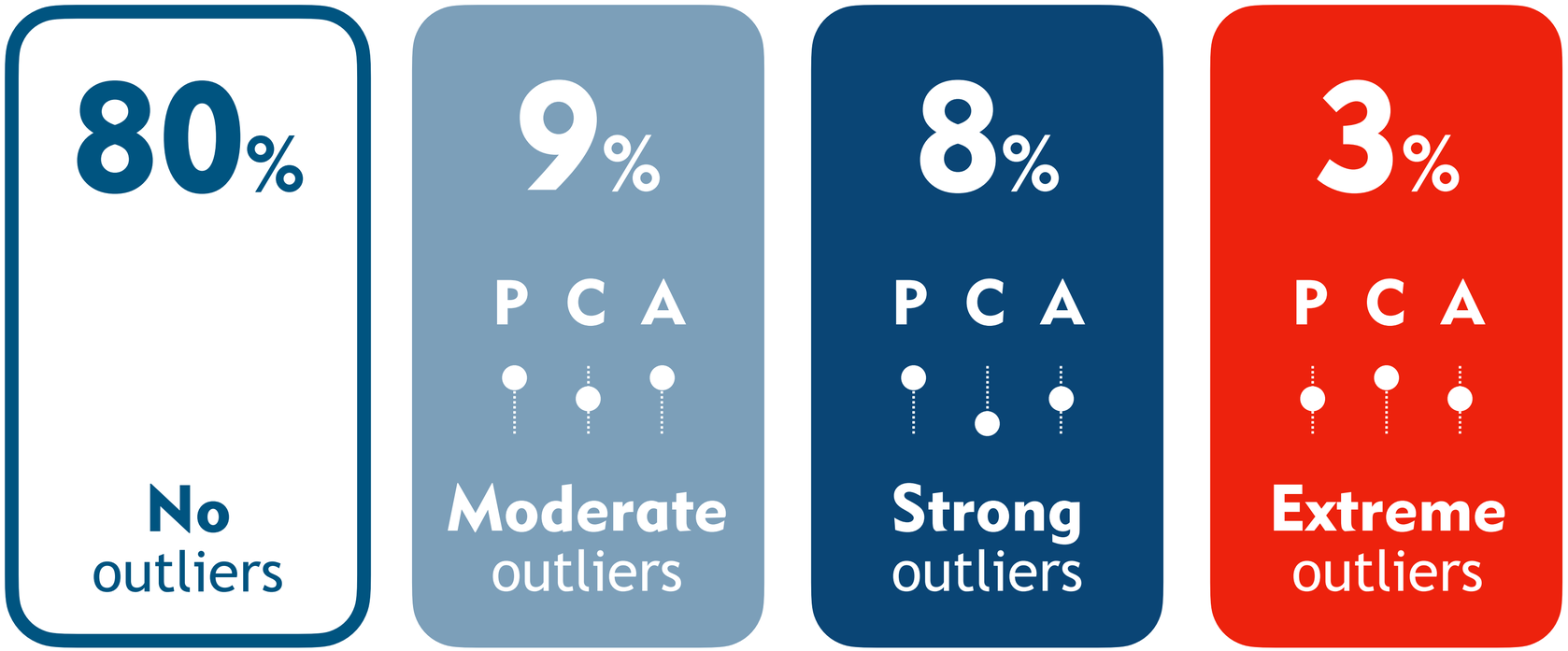
P = Pilots · **C** = Cabin Crew · **A** = Applicants

16. MHSC research › items endorsement rates › significant events and conditions

%	Rank P C A	Item
3		Psychiatric or psychological treatments
1		Access to corporate services dedicated to worker support
3		Inconveniences, dangerous events, accidents in the workplace
4		Other significant/relevant events
2		Judicial/quasi-judicial/disciplinary proceedings

P = Pilots · **C** = Cabin Crew · **A** = Applicants

17. MHSC research › outlier detection pipe › results › by level of outlierness



P = Pilots · **C** = Cabin Crew · **A** = Applicants

32 outliers out of **161** profiles

18. MHSC research › outlier detection pipe › results › by pipeline step

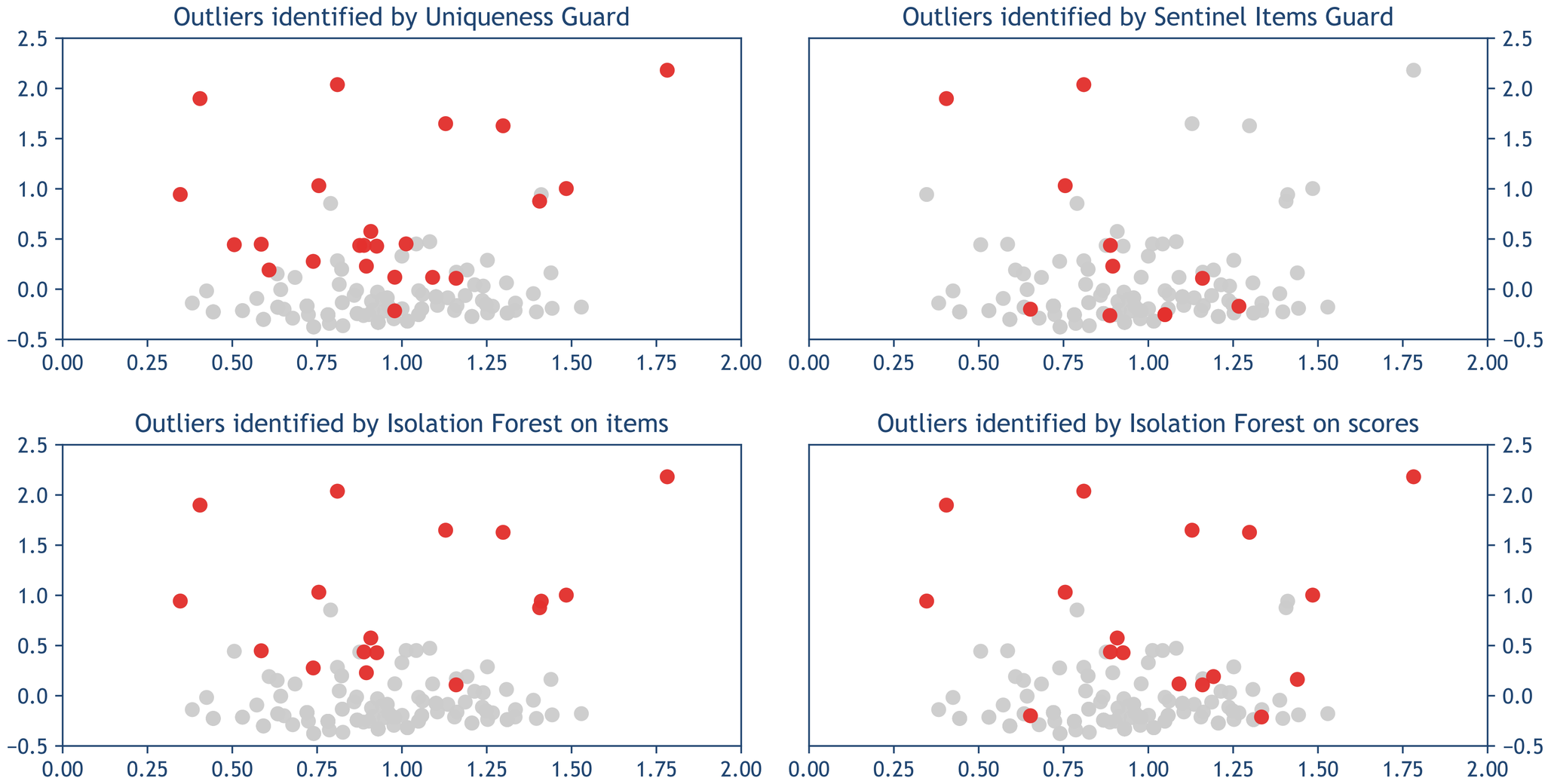
Outliers captured by pipeline step	%
Missing items step *only*	**0**
Sentinel items step *only*	**9**
ISOFs on responses and scores steps *only*	**6**
Uniqueness of sequence step *only*	**19**
Any combination of steps	**66**

32 outliers out of **161** profiles

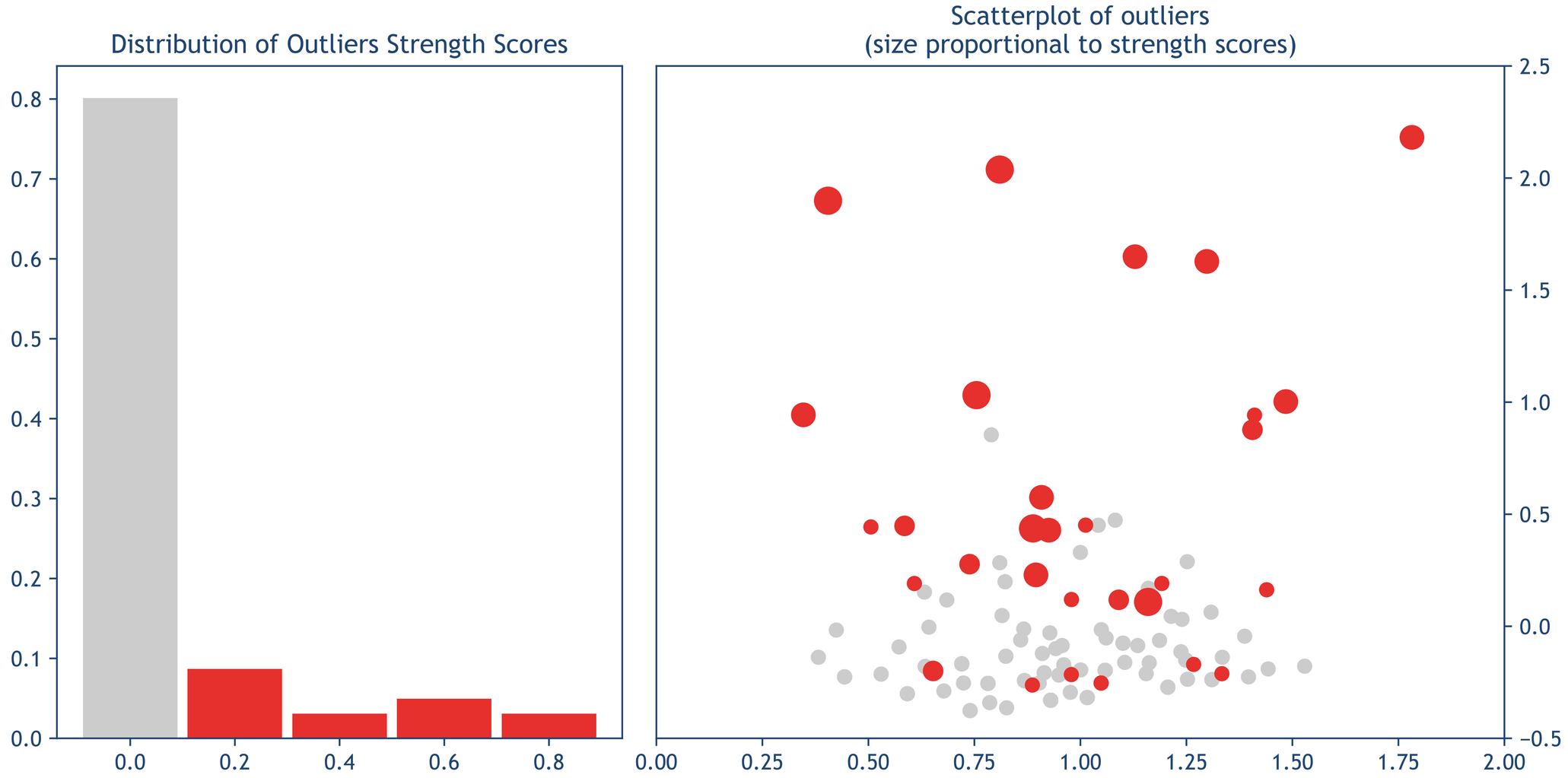
19. MHSC research › outlier detection pipe › visualizing outliers › part I

- In order to visualize the outliers identified by the pipe, **we reduced the original features space to a bi-dimensional surface**, while preserving most of the information available.
- We employed a factorization technique called **Truncated Single Value Decomposition**, which works very well with sparse matrices like our dataset (i.e., profiles contains many zeroes).

20. MHSC research › outlier detection pipe › visualizing outliers › part II



21. MHSC research › outlier detection pipe › visualizing outliers › part III



22. MHSC › conclusions

- The MHSC proved to be a **fast, easy, unobtrusive way to screen** aviation workers for **mental health** issues.
- The users perceived **MHSC** quite well, the reason being that it is a **“cultural device” proximal to the aviation industry** mental toolset.
- The machine learning **pipeline** was a valuable tool for **automatically flagging** individuals who should be considered candidates for an in-depth clinical interview.

23. MHSC › limitations, future directions

- Some steps of the **MHSC outlier detection pipe** need be trained on a **sample representative of the assessed population** before being able to make predictions.
- In those working cultures where mental health issues are considered a social stigma, **phenomena of under-reporting** may be an issue as the MHSC is easily fakeable.
- An **MSHC profile not** flagged as **outlier doesn’t rule out** the presence of a **mental health condition**.
- In future versions of the MHSC outlier detection pipe, **more sophisticated ML** algorithms (e.g., semantic reasoner models) **will be implemented**.

24. MHSC › additional resources

MSHC (ita-eng) + analysis

bit.ly/3MYTLes