Process and Medical Analysis of the 2008-09 European Space Agency Astronaut Selection Campaign (ASC)

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I have the following financial relationships to disclose:

- Employee of: Wyle Laboratories GmbH
- The 2008-2009 ESA Astronaut Selection Campaign was funded by the European Space Agency

I will not discuss off-label use and/or investigational use in my presentation.
Introduction

- Late 2000s, all 5 International Space Station agencies conducted their own Astronaut Selection Campaigns (ASC), specific for long-duration spaceflight.

- The ESA 2008-2009 ASC was the first end-to-end complete selection process conducted entirely by ESA.

- First addition to the astronaut corps since 1992, and aimed solely at selecting long-duration astronauts

- Large emphasis on RISK MITIGATION through identification of risk factors by implementing evidence-based medical knowledge and imaging technology

- This presentation focuses on the overall process and the primary reasons for medical disqualification.
Risk Mitigation Importance

• Probabilities of Evacuation – Results all causes
  – 6 person crew: 5.5 years per evacuation
  – Most likely causes:
    • Medical Emergency: 3 in 15 years or 1 evacuation/5 years
    • Radiation Event: 25% in 15 years or 1 evacuation/60 years
    • Micrometeorite or Debris: 7% in 15 years or 1 evacuation/214 years
    • Critical System Failure: 2% in 15 years or 1 evacuation/750 years

SOURCE: NASA Medical Risk Study 1996 and FUTRON Study 2001
Process

- Online Application (3 months – 1000)
- Psych I (2 months – 300)
- Psych II (2 months – 90)
- Medical Examination (MEX) (2 months – 36)
- ----------------------
- Interviews (4 months – 28)
- Appointment (1 month – 4)
Process Overview

JAR-FCL 3 → Online Applications & Questions

Online Applications & Questions

N = 8,413

Psych I: Cognitive Testing

N = 912

Psych II: Personality Testing

N = 224

2 x Personality Questionnaires

N = 192

Medical Examination

N = 45

Interview

N = 23

Appointment

N = 6

Medical questionnaire

Basic Questionnaire

PASS

In-depth questionnaire

PASS

GO
Online Application

- Top-level formal requirements
- Data-release and privacy statement
- Demographic data
- Class 2 JAR-FCL 3 (or equivalent)
- Education and professional expertise
- Background information
- Medical questionnaires
Psych I

- Engineering, Technology & Physics knowledge
- Mathematics
- Logic and reasoning
- Memory, concentration & attention
- Spatial orientation
- Psychomotor and multi-tasking
- Relevant basic personality skills
- English language (grammar and vocabulary)
Psych I facilities DLR Hamburg
Psych II

- Psychomotor tests
- Multi-tasking capabilities
- Problem-solving techniques (individual & groups)
- Behavior-oriented personality diagnostics
- Structured interviews
- Dyadic cooperation test
Psych II Dyadic Cooperation Test

• Traffic Management
  – Decision Making, Reliability, Cooperation, Working Style, Stress Resistance
Medical Examination

- Medical Standards from ISS Medical Volume A
- History and questionnaire review
- Clinical examinations & specialists examinations
- Anthropometry
- Imaging diagnostics
- Special tests if required or indicated
- Finished with review by ESA Medical Selection Board
Types of Medical Exams

- MRI Magnetic Resonance Imagery
- EBCT/MDCT Multi-Detector Computer Tomography (Coronary Calcium Scores)
- Carotid Doppler and ECHO
- CT Computerized Tomography / CAT Computerized Axial Tomography Scan
## Results of MEX

<table>
<thead>
<tr>
<th>Cause of Disqualification</th>
<th>Number of Applicants Disqualified</th>
<th>% of MEX Applicants (N=45)</th>
<th>% of Disqualified Applicants (N=23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular (CVD)</td>
<td>14</td>
<td>31%</td>
<td>61%</td>
</tr>
<tr>
<td>Vision</td>
<td>7</td>
<td>16%</td>
<td>30%</td>
</tr>
<tr>
<td>Thyroid</td>
<td>2</td>
<td>4%</td>
<td>9%</td>
</tr>
<tr>
<td>Ear-Nose-Throat (ENT)</td>
<td>1</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Respiratory</td>
<td>1</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Gastro-Intestinal (GI)</td>
<td>1</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>1</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Neurological</td>
<td>1</td>
<td>2%</td>
<td>4%</td>
</tr>
</tbody>
</table>
Appointments

Luca Parmitano (I)
Andreas Mogensen (DK)
Samantha Cristoferetti (I)
Alexander Gerst (G)
Timothy Peake (UK)
Thomas Pesquet (F)
Discussion for MEX

• 22 out of the 45 applicants passed the MEX

• Traditionally, in aviation and spaceflight, vision has been the highest cause of disqualification

• 31% of the 45 applicants were disqualified for CVD reasons compared to 16% for vision

• Focus on risk factors likely contributed to higher CVD disqualification rate

• JAR-FCL 3 pre-screening may have contributed to lower vision disqualification at the MEX stage

• Evolution of MED A vision requirements to be less stringent (e.g. accept corrective procedures)
Conclusion

• For the first time in an ESA astronaut selection campaign, the highest cause of disqualification at the medical examination stage was CVD and not vision

• Likely to be due to the evolution of the vision medical requirements and advances in evidence-based medicine and medical imaging technology that allowed for better estimation of potential disease (risk)

• Would be interesting to see if results were mirrored in other ISS Partner Agency Astronaut Selection Campaigns
Thank You!