

ISSMP	PSYCHOMOTOR VIGILANCE SELF TEST ON ISS (PVT)	Reaction Self Test
<b>Principal Investigator</b>		
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<b>Description</b>		
<p>The Psychomotor Vigilance Test (PVT) Self Test was developed to provide astronauts with objective feedback on neurobehavioral changes in vigilant attention, psychomotor speed, state stability, and impulsivity while on ISS missions. The PVT Self Test is ideal for repeated use in spaceflight because unlike other cognitive tests, it is very brief while being free of learning effects and aptitude differences that make interpretation of other cognitive measures difficult. The test was successfully deployed in three NASA Extreme Environment Mission Operation (NEEMO) missions (9, 12 and 13) and found to be acceptable by the 12 astronauts, whose data provided a normative database for development of a feedback interface for the PVT Self Test to alert astronauts to their performance level. These data support the readiness of the PVT Self Test for deployment and study on the International Space Station (ISS).</p> <p>This project has five specific aims as listed below.</p> <ol style="list-style-type: none"> <li>1) To evaluate the extent to which PVT Self Test performance of astronauts is sensitive to fatigue from sleep loss and circadian disruption during ISS missions. This will include the following conditions evaluated individually and in aggregate: <ol style="list-style-type: none"> <li>i) extended wake duration between 16 hours;</li> <li>ii) sleep restriction defined as total sleep time &gt;0 and &lt;6 hours per 24-hour period;</li> <li>iii) and circadian perturbation associated with night work and sleep shifting.</li> </ol> </li> <li>2) To evaluate the extent to which PVT Self Test performance of astronauts is sensitive to fatigue from work intensity during ISS missions. This will include the following conditions evaluated individually and in aggregate: <ol style="list-style-type: none"> <li>i) extend work durations up to 16 hours per day;</li> <li>ii) more than 6 consecutive work days without a day off for rest; and</li> <li>iii) work requiring extravehicular activity (EVA).</li> </ol> </li> <li>3) To evaluate the extent to which PVT Self Test performance of astronauts declines with time in mission.</li> <li>4) To evaluate the extent to which PVT Self Test performance of astronauts will be sensitive to the carry-over effects of medications for sleep (e.g., zolpidem, ramelteon, etc.) on ISS.</li> <li>5) To evaluate the extent to which PVT Self Test performance feedback (via a graphical interface) is perceived by ISS astronauts as a useful tool for assessing performance capability. This will be addressed after the mission by astronaut ratings.</li> </ol>		
<b>Objectives</b>		
<p>The project will deploy the PVT Self Test on ISS to provide astronauts with objective feedback on neurobehavioral changes in vigilant attention, psychomotor speed, state stability, and impulsivity. It will evaluate the extent to which PVT Self Test performance of astronauts is sensitive to fatigue from sleep loss and circadian disruption during the mission, fatigue from work intensity during the mission, decline of performance with time during the mission, and carry-over effects of medications for sleep on ISS. It will also evaluate the extent to which PVT Self Test performance feedback (via a graphical interface) is perceived by ISS astronauts as a useful tool for assessing performance capability.</p>		
<b>Relevance</b>		
<p>The PVT Self Test, which will be deployed on the International Space Station, includes pre-test questions, the PVT reaction time test, and feedback displays, is estimated to take 5 minutes to complete. This 5-minute PVT Self Test is derived from the original standard 10-minute Psychomotor Vigilance Test. The test measures changes in psychomotor speed, lapses of attention, wake state instability, and impulsivity induced by fatigue and other performance-degrading factors commonly found in operational environments.</p> <p>The overarching goal of the project is to establish the extent to which the PVT Self Test can aid astronauts to objectively identify when their performance capability is degraded by various fatigue-related conditions that can occur as a result of ISS operations and time in space (e.g., acute and chronic sleep restriction, sleep shifts, EVA, and residual sedation from sleep medications). Thus, the project addresses a number of high-priority NASA Behavioral Health and Performance (BHP) research gaps including (1) identification of the best measure for assessing decrements in cognitive function due to fatigue and other aspects of spaceflight; (2) determination of an individual astronaut's vulnerability to sleep loss; (3) establishment of cognition decline or change during long-duration missions (LDM); and (4) facilitation of ways for crewmembers and ground support to detect and compensate for decreased cognitive readiness to perform in space. The project, which will bring the PVT Self Test to Countermeasure Readiness Level (CRL) 7 and Technology Readiness Level (TRL) 7 (i.e., system prototype demonstration in space environment), builds on our previous NASA-funded work. Preliminary validation studies of the PVT Self Test in astronauts engaged in NEEMO missions 9, 12, and 13 indicated that the 3-minute test was acceptable to astronauts, and provided unique astronaut norms on the test. We have</p>		

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<p>used the data from astronauts engaged in NEEMO missions, and related data on the PVT Self Test from extensive laboratory validation studies, to optimize the algorithm for astronaut PVT Self Test performance, and to complete a feedback interface that displays their performance relative to astronaut norms.</p>		
<p><b><i>BDC Summary</i></b></p>		
<p>Pre-flight baseline data collection (BDC) requires 26 sessions, where each session is 5 minutes long. The sessions are scheduled to occur twice a day on L-180, L-150, L-120, L-90, L-60, L-30, and L-7 through L-1. There is a 45 minute overview session before the L-180 BDC. The total crew time for pre-flight BDC for one subject is 175 minutes. Post-flight baseline data collection requires 22 sessions, where each session is 5 minutes long. The sessions are scheduled to occur twice a day on R+0 through R+7, R+30, R+60, and R+90. The total crew time for post-flight BDC for one subject is 110 minutes.</p>		
<p><b><i>In-flight Operations Summary</i></b></p>		
<p>During flight, it is imperative that the PVT Self Test be completed regularly through the entire mission. The PVT Self Test will use the Human Research Facility (HRF) laptop or Station Support Computer (SSC) and will take about 5 minutes to complete. It includes pre-test questions, the PVT reaction time test and feedback displays on the computer. The crewmember will be requested to complete the PVT Self Test twice a day every 4th day of the mission. In addition to that, the crewmembers will be asked to complete the PVT Self Test twice a day for 3 days preceding the sleep shift and another PVT Self Test twice a day for 5 days after the sleep shift. Similarly, the crewmembers will be asked to complete the PVT Self Test twice on the day prior to an EVA and once at the end of each EVA.</p>		