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| **PRET USABILITY TESTING** |
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| **DATE** | March 2012 – June 2012 |
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| **PRET VERSION** | 2.0 |
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| [**FINAL REPORT**](file:///C%3A%5CPRET%20Open%20Gov%202017%5CPRET%20Versions%2C%20Data%2C%20Analysis%2C%20Reports%5CPRET%20version%202.0%5CReports) **DATE** | June 1, 2012 |
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| **ABSTRACT** | Performed usability testing on the Mars Rover simulation interface, |
| the immediate feedback module assessment, and the performance analysis module. Evaluated the usability of the PRET’s embedded NC tasks and tabulated a description of the problems associated with each task, recommended solutions, and whether or not fixing the problem was critical for validation testing. Proposed revisions to the task output file (data) structures and recommended changes to some measures of performance for each PRET task. |
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| **SOFTWARE CHANGES MADE PRIOR TO TESTING** |
| None |

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| **VALIDATION AGAINST NC TESTS (PART 1)** |
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| **DATE** | October 2012 – August 2013 |
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| **PRET VERSION** | 3.0 |
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| [**FINAL REPORT DATE**](file:///C%3A%5CPRET%20Open%20Gov%202017%5CPRET%20Versions%2C%20Data%2C%20Analysis%2C%20Reports%5CPRET%20version%203.0%5CReports) | August 30, 2013 |
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| **ABSTRACT** | Completed an initial validation of the PRET software (n=50) against |
| a battery of standardized NC tests consisting of the DKEFS, PASAT, PVT, TOVA, and selected subtests of the WAIS-IV and WMS-IV. Tabulated the performance metrics for each of the PRET’s embedded NC tasks, the PRET’s off-nominal tasks, and the standardized NC tests. Reported the results of a series of planned and exploratory correlational analyses between the PRET’s NC tasks and the standardized NC tests and summarized the results in a correlation summary table, and a task overlap matrix to indicate potential redundancies in the PRET’s embedded tasks. Recommended several changes to the PRET’s embedded NC tasks including increasing the number of mental calculations on the Perform Mission Relevant Calculations Task (PMRCT) and removing/replacing the Path Planning Task (PT).  |
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| [**ANALYSIS FILES**](file:///C%3A%5CPRET%20Open%20Gov%202017%5CPRET%20Versions%2C%20Data%2C%20Analysis%2C%20Reports%5CPRET%20version%203.0%5CAnalysis%20Files) |
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| **SOFTWARE CHANGES MADE PRIOR TO TESTING** |
| General Usability | * Prompts to begin next mission phase restricted from appearing when a NC test is active or when transferring data at the ISRU site.
* Driving routes no longer randomly generated. Instead, 30 routes were implemented with fixed start locations, extraction site locations, and ISRU site locations. Option was provided to select one of the 30 routes for training and/or mission scenarios.
* NC test messages and mission information text now appears in yellow on a black background.
* Instructions for rock extraction task changed to indicate that the Rover arm joint is to be activated by pressing the corresponding keyboard number, but that the key does not have to be held down.
* Inconsequential scenario messages (e.g., “Nav Cam Photo Mosaic”) removed.
* The “God Mode” camera toggle that was used in the original Race to Mars game was disabled.
* The camera view shortcut keys were disabled during the rock extraction task and the data transfer task.
* Code modified to allow the data transfer task to proceed whenever the angle error indicator at the ISRU site indicates “0” to account for rounding error.
* The user can now press the “M” key to toggle between the small real-time map and the large global map.
* An indication of the Rover’s lateral error alignment at the ISRU site now accompanies the longitudinal error indicator.
* The “Wheels Stuck” message was increased in size and flashes. An option to disable the wheels stuck feature was added to the configuration file.
* Power bonus message removed when user collects a power bonus.
* The size of the multiple camera view windows was decreased by 10%.
* The mouse cursor, which appeared as a large circle with semi-transparent red fill, was disabled.
* The Rover’s top drive velocity was reduced. A speed reduction factor (e.g., 0.5 = 50% reduction) was added to the configuration file.
* Mouse input disabled during training and mission scenarios.
* Sleep duration ranges were modified to reflect correct usage of “>” and “<” signs.
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| All Tasks | * The volume of the audio cue to alert the user to the beginning of all NC tasks was increased.
* The text message indicating the beginning of all NC tasks now appears in yellow ink on a black background.
* RT data now being logged at the highest level of precision that the system allows. Given that most responses are tied to keyboard inputs, this means that the measurement error on any RT response is approximately ± 30 ms.
* Unless specifically made active, all keyboard keys and mouse buttons are locked while an NC task is being executed.
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| CIT | * The to-be-classified messages now appear in yellow in a textbox with a black background instead of in white on the background scene.
* The only active keys during this task are “W”, “E”, and “T” for Weather, Ergonomic, and Technical, respectively, the “M” key to toggle between maps, and the arrow keys to control the Rover.
* Two existing messages were edited because their content was inaccurate.
* New messages were added to equate the number of messages within each of the three categories (i.e., 10 messages in each category), for a total of 30 messages.
* The to-be-classified messages are now pseudo-randomly selected without replacement so that no message appears more than once.
* Fifteen messages are presented in the two CIT phases with the constraint that five Weather, five Ergonomic, and five Technical messages are presented in each phase.
* Each of the 30 messages was assigned a unique identifier, which was logged in the data output file to indicate what message was displayed on each trial.
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| GDCCT | * The instructions changed from, “Click the left mouse button if the symbol matches. Click the right mouse button if it doesn’t.” to “Press the “Y” key if the symbol matches or press the “N” key if it does not.”
* The only active keys during this task are “Y” and “N” to indicate a match or a non-match, respectively.
* The message “Time elapsed: Please respond more quickly on the next trial” appears in yellow on a black background if the participant takes too long to respond.
* The number of trials in the *matching* phase of this task was increased from 70 to 80 to ensure that the ratio of match to non-match trials was 50:50. Each digit 0-9 was presented eight times (four matching and four non-matching).
* The ratio of match to non-match trials in the *memory* phase of this task was set at 50:50, with each digit 0-9 appearing once as a match and once as a non-match.
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| LNSAT | * A pop-up window now appears at the beginning of the LNSAT to indicate that the Rover driving task has been halted.
* The instructions now indicate that the participant should use the “Enter” key to submit a response instead of using the mouse to click the “OK” button.
* The “OK” button was removed from the response window.
* The only active keys during this task are all letter/number keys, the enter/return key, and the backspace key.
* The message, “The last trial was missed (timeout). The next one is coming up.” was replaced with, “Time elapsed: Please respond more quickly on the next trial.” This message appears in yellow on a black background if the participant takes too long to respond.
* Added ability to specify the beginning difficulty level (i.e., number of letter-digit pairs) to the configuration file.
* Added ability to specify how many attempts are allowed at a given level before proceeding to the next level to the configuration file.
* The RT clock now starts after the last item in the letter-digit sequence was presented instead of starting at the first item in the letter-digit sequence.
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| RCT | * The menu indicating the Rover’s arm positions on the right side of the screen only appears after the text message indicating the beginning of the task has been displayed.
* The only active keys during this task are the spacebar, the “M” key, the directional arrows, and number keys 1, 2, 3, and 4.
* The RCT messages now appear as yellow text on a black background.
* Participant inputs now remain active during rock extraction task animation.
* Rock extraction animation no longer occludes the RCT messages.
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| PMRCT | * The text message indicating the beginning of the acknowledgement sub-task (i.e., “Incoming Communication About To Begin”) now appears in yellow ink on a black background.
* An audio file now indicates that the participant is to, “Acknowledge the message by pressing the spacebar after the tone.”
* A tone is now presented immediately following the to-be-acknowledged message, with the RT clock starting at the same time as the tone.
* The participant is now given feedback if they respond prior to the end of the to-be-acknowledged message.
* The only active keys for the message acknowledgement sub-task are the spacebar (only active following the tone), the “M” key, and the directional arrows.
* The text message indicating the beginning of the calculation sub-task (i.e., “How many seconds will it take for the storm to reach the Rover?”) now appears in yellow ink on a black background.
* The information related to the mental calculation sub-task now appears as yellow text on a black background.
* The only active keys for the mental calculation sub-task are the enter/return key, all number keys, the “M” key, and the directional arrows.
* The instructions to, “Enter the response above and press OK (using the mouse)” were replaced with, “Enter the response above and press Return.”
* The text message indicating the beginning of the decision sub-task (i.e., “Do you wish to stop the Rover?”) now appears in yellow ink on a black background.
* The only active keys for the decision sub-task are the “Y” and “N” keys, the “M” key, and the directional arrows.
* The instructions to use the mouse to click on the “Yes” or “No” buttons were replaced with instructions indicating that the participant should press the “Y” or “N” key.
* Restricted the modality of the storm speed announcement to auditory and the storm distance announcement to visual.
* Removed the secondary goal of collecting a special power bonus while the dust storm approached (if the user decided not to power down the Rover).
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| SCT | * The only active key is the spacebar.
* The instructions now indicate that the participant is to “Press the spacebar as quickly as possible when the green indicator appears in the wheel status panel.”
* If a participant responds prior to a green indicator appearing, the instructions now read, “Press the spacebar AFTER a green indicator appears in the wheel status panel.”
* Response times are now displayed to the nearest 1/1000th of a second.
* The “Suspension Check in Progress” message that appeared before each trial was removed.
* The number of trials per session was fixed at 20.
* The inter-stimulus interval range was increased to between 500 and 2500 ms.
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| PT | * Only the letter keys, the enter/return key, and the backspace key are active.
* The instructions now read, “Enter your solution into the field above ensuring that it begins with the letter A and ends with the letter S. Press Return when done.”
* The font size of the point marker letters was increased.
* The distance bar was labeled.
* The “OK” button was removed from the response window.
* The first letter of the path (always “A”) is provided in the entry field.
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| **VALIDATION AGAINST NC TESTS (PART 2)** |
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| **DATE** | September 2013 – October 2014 |
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| **PRET VERSION** | 4.0 |
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| [**FINAL REPORT**](file:///C%3A%5CPRET%20Open%20Gov%202017%5CPRET%20Versions%2C%20Data%2C%20Analysis%2C%20Reports%5CPRET%20version%204.0%5CReports) **DATE** | October 31, 2014 |
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| **ABSTRACT** | Validated the PRET software (n=160) against a battery of  |
| standardized NC tests consisting of the DKEFS, PASAT, PVT, TOVA, and selected subtests of the WAIS-IV and WMS-IV. Provided a histogram and descriptive statistics, including measures of central tendency, variability, and skewness, for each measure of performance for each embedded PRET task and standardized NC test. Reported correlational analyses comparing performance within the PRET tasks, within the standardized NC tests, and between the PRET tasks and the standardized NC tests. Performed a confirmatory factor analysis (CFA) to verify whether or not the PRET’s embedded NC tests were reliably measuring key cognitive constructs (processing speed, memory, attention, and response control). Although the correlations between the PRET’s tasks and their parent NC tests were relatively weak, the PRET, as a whole, accounted for a significant amount of variance in the suite of standardized NC tests. Based on the results, it was concluded that the PRET is a reasonably good facsimile of the suite of standardized NC tests that it was derived from. It was recommended that the next steps towards validating the PRET would be to conduct an acquisition rate study to determine if and when performance on the PRET’s tasks stabilizes and to then conduct a test-retest reliability study on the PRET tasks. Following that, it was recommended that the PRET be tested for its sensitivity in detecting some forms of cognitive change (e.g., cognitive change due to fatigue).  |
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| **SOFTWARE CHANGES MADE PRIOR TO TESTING** |
| General Usability | * The Rover was automatically and optimally aligned for the rock extraction task when the Rover was within a set distance of the rock extraction location.
* An on/off toggle for the automatic rock extraction alignment feature was created.
* A training sub-menu was developed that allows a user to select/repeat any training module without having to exit the program following completion of a previous module.
* Changed wording in training session to indicate that the program would exit after each training task.
* Reduced time between the onset of the embedded NC tasks to ensure that all tasks would be administered prior to the user completing the session.
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| CIT | * Messages from Ergonomic and Technical categories were combined into one category (Technical), thus changing this task from a 3-Alternative-Forced-Choice to a 2-Alternative-Forced-Choice.
* Messages that did not relate to the mission scenario were removed.
* Additional Technical and Weather messages were created, resulting in 16 Technical messages and 16 Weather messages (32 messages total).
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| LNSAT | * Visual feedback provided on the training portion of this task when the participant entered an incorrect response. The incorrect response was shown in red with the correct responses shown in green below.
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| RCT | * This task no longer occurred during rock extraction. Instead, the RCT occurred throughout the mission scenario (i.e., while the participant was driving the Rover from one goal location to the next) so long a no other NC test was active.
* An auditory cue was presented immediately prior to an RCT message being displayed.
* Removed distinction between “Global” and “Mission” messages. All messages now prefixed with “Global:”
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| PMRCT | * The acknowledgement portion of this task was removed.
* The number of mental calculations was increased from one to five.
* Participants now required to multiply the storm speed by the storm arrival time to determine the storm distance. The storm distance systematically increased/decreased across the five calculations.
* The question on the decision portion of this task was re-phrased as follows: “It is recommended that you power down the Rover if the storm is approaching. Do you want to power down the Rover?”
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| SCT | * The wheel status indicator display was centred on the screen and magnified when the SCT task was active.
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| PT | * This task was removed.
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| **TEST-RETEST RELIABILITY AND STABILIZATION** |
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| **DATE** | November 2014 – February 2016 |
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| **PRET VERSION** | 5.0 |
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| [**FINAL REPORT**](file:///C%3A%5CPRET%20Open%20Gov%202017%5CPRET%20Versions%2C%20Data%2C%20Analysis%2C%20Reports%5CPRET%20version%205.0%5CReports) **DATE** | February 29, 2016 |
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| **ABSTRACT** | Examined the test-retest reliability of the PRET’s embedded NC tests  |
| at 1-week and 4-week intervals and compared this reliability to that of two established NC assessment tools (DANA and WinSCAT). Further, this validation work attempted to establish how many administrations of the PRET is required before a stable baseline is achieved and compared this acquisition rate to that of the DANA and WinSCAT. To that end, tested 40 participants over 10 testing sessions that spanned a 6-week period. The results indicated that the PRET was comparable to the DANA and the WinSCAT in terms of its 1-week reliability with the condition that three PRET tasks be removed. Further, the PRET was comparable to the DANA in terms of its 4-week test-retest reliability, with the condition that one of the PRET subtasks be removed. The WinSCAT had better 4-week test-retest reliability scores than the PRET and the DANA. The acquisition rates of the PRET’s subtasks were similar to those of the DANA and the WinSCAT, with stability being attained within six testing sessions for all but one of the PRET’s subtasks. It was concluded that these validation results provided further support for the PRET being a proof-of-concept for the feasibility of embedding NC tests in the context of a simulation-based exercise. It was further noted that more validation work is required (e.g., examining the PRET’s sensitivity to cognitive change) before the PRET can be adopted as an alternative to established clinical tools for monitoring the status of astronauts.  |
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| **SOFTWARE CHANGES MADE PRIOR TO TESTING** |
| LNSAT | * Increase letter/digit presentation rate from 1 letter/digit per every 3 seconds to 1 letter/digit per second.
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| SCT | * Increase length of SCT to 3 minutes.
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