Angles
The Angles test measures the participant's ability to recognize angles. This test contains 30 multiple-choice questions and allows participants up to 8 minutes to complete them. The score is based on the number of correct answers (with no penalty for wrong or unanswered questions). There are two types of questions on the test. The first presents a picture of an angle and the participant chooses the correct answer of the angle (in degrees) from among 4 response options. The second presents a measure in degrees and the participant chooses the angle (among 4 response options) that represents that measure.
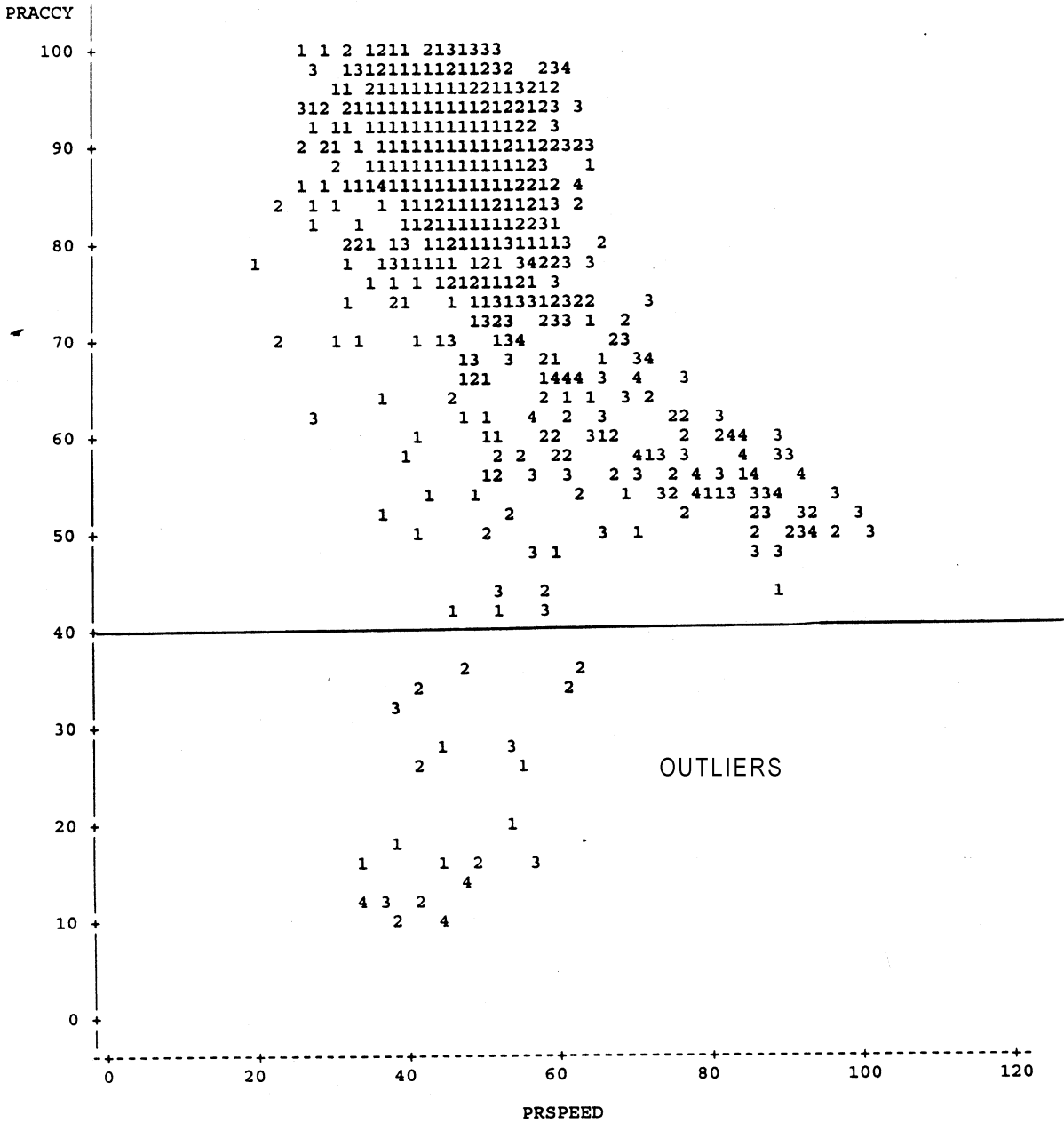
For each worker requirement listed below, enter the rating best describing the extent to which this test and/or its subtests measure that particular worker requirement.

      5=This test measures this worker requirement to a **very great extent**
      4=This test measures this worker requirement to a **considerable extent**
      3=This test measures this worker requirement to a **moderate extent**
      2=This test measures this worker requirement to a **limited extent**
      1=This test measures this worker requirement to a **slight extent**
      0=This test **does not measure** this worker requirement

Figure 2.1. Sample Description of an AT-SAT Measure.

Prioritization		Self-Awareness		Commitment to the Job	
Tolerance for High Intensity		Rule Application		Self-Esteem	
Composure		Perceptual Speed & Accuracy		Translation of Uncertainty	
Active Listening		Sustained Attention		Translating Information	
Oral Communication		Self-Monitoring/Evaluation		Behavioral Consistency	
Situational Awareness		Creativity		Encoding	
Planning		Working Cooperatively		Movement Detection	
Execution		Recall from Interruption		Interpersonal Tolerance	
Thinking Ahead		Self-Confidence		Motivation	
Taking Charge		Internal Locus of Control		Chunking	
Reasoning		Street Physics		Interpreting Information	
Time Sharing		Task Closure/Thoroughness		Mathematical Reasoning	
Decisiveness		Summarizing Information		Written Communication	
Short-Term Memory		Intermediate-Term Memory		Mechanical Reasoning	
Scanning		Visuospatial Reasoning		Angles	
Problem Solving		Flexibility (IP)		Rule Inference	
Flexibility (S/A)		Dynamic Visual-Spatial		Realistic Orientation	
Long-Term Memory		Professionalism		2-D Mental Rotation	
Projection		Attention to Detail		Numeric Ability (add/sub)	
Visualization		Verbal Reasoning		3-D Mental Rotation	
Concentration		Reading		Numeric Ability (mult/div)	
Confirmation		Learning			

Figure 2.2. Example of Linkage Rating Scale.

```
PRACCY  |
        |
   100  +                      1 1 2 1211 2131333
        |                        3  131211111211232  234
        |                         11 21111111122113212
        |                       312 21111111111112122123 3
        |                       1 11 111111111111122 3
    90  +                     2 21 1 1111111111121122323
        |                        2  1111111111111123    1
        |                   1 1 1114111111111112212 4
        |                 2  1 1   1 11121111211213 2
        |                 1   1    11211111112231
    80  +                    221 13 1121111311113   2
        |             1      1  1311111 121 34223 3
        |                    1 1 1 121211121 3
        |                  1   21   1 11313312322     3
        |                          1323  233 1  2
    70  +            2     1 1    1 13   134      23
        |                          13 3  21   1  34
        |                          121     1444 3   4    3
        |                  1     2     2 1 1  3 2
        |             3          1 1   4  2  3      22  3
    60  +                    1      11   22  312    2  244  3
        |                  1       2 2  22      413 3     4  33
        |                     12   3   3   2 3  2 4 3 14    4
        |                1   1        2    1 32 4113 334    3
        |              1      1      2      2      23  32   3
    50  +              1      2        3  1      2  234 2  3
        |                    3 1                  3 3
        |
        |                  3   2                1
        |                  1   1   3
    40  +─────────────────────────────────────────────────────────
        |
        |                     2       2
        |              2    2       2
        |            3
    30  +
        |             1   3
        |           2     1          OUTLIERS
        |
    20  +            1
        |          1
        |        1      1 2   3
        |               4
        |        4 3 2
    10  +        2   4
        |
        |
        |
     0  +
        |
      -+-------------+-------------+-------------+-------------+-------------+-------------+-
        0           20            40            60            80           100           120
                                          PRSPEED
```

Figure 3.3.1. Plot of PRACCY*PRSPEED. Symbol is value of TRIAL

Table 2.1. SACHA-Generated Worker Requirements

COGNITIVE ABILITIES

REASONING

1.	Deductive Reasoning
2.	Inductive Reasoning
3.	Chunking
4.	Mathematical Reasoning
5.	Visuospatial Reasoning
6.	Mechanical Reasoning
7.	Verbal Reasoning

COMPUTATIONAL ABILITY

8.	Number Facility
9.	Geometry

COMMUNICATION

10.	Oral Communication
11.	Listening
12.	Reading
13.	Writing

ATTENTION

14.	Selective Attention
15.	Time Sharing
16.	Vigilance

MEMORY

17.	Short-Term Memory
18.	Intermediate-Term Memory
19.	Long-Term Memory
20.	Associative Memory
21.	Visual Memory
22.	Auditory Memory
23.	Numerical Memory

METACOGNITIVE

Local

24.	Thinking Ahead
25.	Problem Recognition and Definition
26.	Deciding on the Steps to solve the Problem
27.	Ordering the Steps
28.	Creating a Mental Representation for Information
29.	Monitoring Performance
30.	Evaluating Performance

Global

31.	Prioritization
32.	Multitasking

Table 2.1. SACHA-Generated Worker Requirements (continued)

INFORMATION PROCESSING
33.	Encoding
34.	Rule Inference
35.	Rule Application
36.	Confirmation
37.	Sequential Distribution of Processing Steps
38.	Information Processing Strategies
39.	Learning
40.	Flexibility

PERCEPTUAL/SPATIAL ABILITIES

PERCEPTUAL ABILITIES

41. Dynamic Visual-Spatial Ability
42. Movement Detection
43. Verbal and Figural Closure
44. Perceptual Speed and Accuracy

SPATIAL ABILITIES

45. Projection
Flexibility of Closure
47. Scanning Efficiency
48. Two-Dimensional Mental Rotation
49. Three-Dimensional Mental Rotation
50. Spatial Scanning

TEMPERAMENT/INTERPERSONAL

INTERPERSONAL

51. Working Cooperatively
52. Establishing Rapport

WORK & EFFORT

53. Achievement/Self-Confidence
54. General Activity
55. Concentration
56. Taking Charge
57. Adherence to a Work Ethic
58. Thoroughness and Attentiveness to Details
59. Thinking Ahead
60. Decisiveness
61. Realistic Orientation

STABILITY/ADJUSTMENT

62. Stress Tolerance
63. Flexibility

SELF-EFFICACY

64. Internal Locus of Control
65. Self-Sufficiency

PSYCHOMOTOR ABILITIES

66. Multilimb Coordination
67. Control Precision
68. Reaction Time
69. Response Orientation
70. Finger Dexterity
71. Manual Dexterity
72. Eye-Hand Coordination
73. Response Integration

Table 2.2. Worker Requirements Generated by Subject Matter Experts

	COGNITIVE
1.	Oral Communication
2.	Written Communication
3.	Reading
4.	Active Listening
5.	Translating Information
6.	Interpreting Information
7.	Summarizing Information
8.	Numeric Ability (addition/subtraction)
9.	Numeric Ability (multiplication/division)
10.	"Street" Physics
11.	Short-Term Memory
12.	Intermediate-Term Memory
13.	Long-Term Memory
14.	Thinking Ahead
15.	Planning
16.	Prioritization
17.	Execution
18.	Problem Solving
19.	Reasoning (Thinking)
20.	Creativity
21.	Self-Monitoring/Evaluating
22.	Rule Application
23.	Sustained Attention
24.	Time Sharing
25.	Aviation Science Background
26.	Geography

	SPATIAL
27.	Situational Awareness
28.	Visualization
29.	Projection
30.	Scanning

	INTERPERSONAL
31.	Professionalism
32.	Working Cooperatively
33.	Personal Tolerance

	WORK/EFFORT
34.	Self-Esteem
35.	Self-Confidence
36.	Aggressiveness
37.	Self-Awareness
38.	Attention to Detail
39.	Task Closure/Thoroughness
40.	Decisiveness
41.	Consistency
42.	Flexibility
43.	Concentration
44.	Composure
45.	Tolerance for High-Intensity Work
46.	Motivation
47.	Commitment to Job

Table 2.3. Revised Consolidated Worker Requirements List, With Definitions

SME-Generated WORKER REQUIREMENTS	
Oral Communication	The ability to speak clearly and concisely to individuals so they understand what is being communicated. Projecting a confident tone of voice is an important component of this ability.
Written Communication	The ability to write legibly and accurately (e.g., strip markings).
Reading	The ability to read and understand written information (e.g., ATCS documents, manuals).
Active Listening	The ability to hear and comprehend spoken information. This ability requires an individual to recognize or pick out pertinent auditory information.
Translating Information	The ability to translate symbols or symbolic abbreviations into meaningful information.
Interpreting Information	The ability to put information into meaningful terms. It is the ability to recognize the implications for a statement or condition (e.g., cold front).
Summarizing Information	The ability to summarize and consolidate information most relevant to the situation.
Numeric Ability (add/sub)	The ability to quickly and accurately perform basic math operations (addition and subtraction).
Numeric Ability (mult/div)	The ability to quickly and accurately perform basic math operations (multiplication and division).
Street Physics	The ability to understand the general rules of science as practiced in the ATCS environment (e.g., aircraft size and turbulence effects, angles of intersect, overtake speed, headings).
Short-Term Memory	The ability to remember pertinent information within a brief period of time (less than 1 minute). Examples of information include call signs and keywords.
Intermediate-Term Memory	The ability to remember pertinent information over a 1-10 minute period.
Long-Term Memory	The ability to remember pertinent information over long periods of time. Examples of information include maps and separation procedures.
Thinking Ahead	The ability to anticipate or recognize problems before they occur and to develop plans to avoid problems. This includes thinking about what might happen.
Planning	The ability to determine the appropriate course(s) of action to take in any given situation.
Prioritization	The ability to identify activities that are most critical and require immediate attention. This involves a constant evaluation of new information followed by re-prioritization of job activities.
Execution	The ability to take timely action in order to avoid problems and to solve existing problems.
Problem Solving	The ability to identify a potential problem or existing problem and to identify the variables used in solving the problem.
Reasoning	The ability to apply available information to make decisions, draw conclusions, or identify alternative solutions.
Creativity	The ability to identify new or novel solutions to potential problems when existing or established solutions no longer applies.
Self-Monitoring/ Evaluation	The ability and willingness to check your own work performance, evaluate the effectiveness of your decisions, and alter your performance if necessary.
Rule Application	The ability to apply learned rules to the real work situation

(Continued)

Table 2.3. Revised Consolidated Worker Requirements List, With Definitions (Continued)

Sustained Attention	The ability to stay focused on a task(s) for long periods of time (over 60 minutes).
Time Sharing	The ability to perform two or more job activities at the same time.
Situational Awareness	Being cognizant of all information within a four-dimensional space (i.e., separation standards plus time). This involves the ability to "understand" the airspace as an integrated whole (e.g., getting the picture).
Visualization	The ability to translate material into a visual representation of what is currently occurring.
Projection	The ability to translate material into visual representation of what will occur in the future.
Scanning	The ability to quickly and accurately search for information on a computer screen, radar scope, or computer printout.
Professionalism	The ability to establish respect and confidence in your abilities among other controllers.
Working Cooperatively	The willingness to work with others to achieve a common goal. This includes a willingness to voluntarily assist another controller if the situation warrants.
Interpersonal Tolerance	The ability to accommodate or deal with differences in personalities, criticisms, and interpersonal conflicts in the work environment.
Self-Esteem	Having a positive opinion/image of oneself.
Self-Confidence	A belief that you are the person for the job and knowing that your processes and decisions are correct.
Taking Charge	The ability to take control of a situation and reach out and take correct action.
Self-Awareness	The ability to maintain an internal awareness of your actions and attitudes. This includes knowing your limitations.
Attention to Detail	The ability to recognize and attend to the details of the job that others might overlook.
Task Closure/ Thoroughness	The ability to continue an activity to completion through the coordination and inspection of work.
Decisiveness	The ability to make effective decisions in a timely manner.
Behavioral Consistency	The ability to behave consistently at work (e.g., dealing with coworkers in a consistent manner; consistently using the correct phraseology).
Flexibility (Stability/ Adjustment)	The ability to adapt to changing situations or conditions.
Concentration	The ability to focus on job activities amid distractions for short periods of time.
Composure	The ability to think clearly in stressful situations.
Tolerance for High Intensity	The ability to perform effectively and think clearly during heavy work flow.
Motivation	The desire to motivate oneself through challenges on the job and to progress to a higher level of skill.
Commitment to the Job	The desire to be an ATCS and work hard to be successful.

(Continued)

Table 2.3. Revised Consolidated Worker Requirements List, With Definitions (Continued)

SACHA-Generated WORKER REQUIREMENTS

Confirmation	The ability to efficiently select a response option consistent with the application of inferred rules.
Rule Application	The ability to efficiently apply transformational rules inferred from the complete portions of the stimulus array to the incomplete portion of the array.
Perceptual Speed and Accuracy	Ability to perceive visual information quickly and accurately and to perform simple processing tasks with (e.g., comparisons).
Internal Locus of Control	Believes that individuals have influence over the outcome of an event; takes responsibility for outcomes.
Visuospatial Reasoning	Ability to perceive and understand principles governing relationships among several figures.
Flexibility (Information Processing)	The ability to find new meanings for stimuli, to combine stimulus attributes to come up with new and different solution protocols, and to employ flexible ways of relating new information to stored knowledge.
Dynamic Visual-Spatial	Ability to deal with dynamic visual movement.
Verbal Reasoning	The ability to perceive and understand principles governing the use of verbal concepts and symbols.
Learning	Changes in information-processing strategies over time or trials not due to maturation or aging.
Encoding	Transformation or translation of information; coding; decoding.
Movement Detection	Ability to detect physical movement of objects and to judge their direction.
Chunking	The ability to organize stimuli into meaningful groups or units.
Mathematical Reasoning	Ability to perceive and understand principles governing the use of quantitative concepts and symbols.
Mechanical Reasoning	Ability to perceive and understand the relationship of physical forces and mechanical elements in a prescribed situation.
Angles	The ability to apply the principles of geometry to angles and computations involving angles. The ability involves both the speed and accuracy of computation.
Rule Inference	The ability to efficiently ascertain the rules governing relations between stimulus attributes.
Realistic Orientation	Prefers dealing with activities which have tangible and measurable consequences; enjoys activities which require skill, is reinforced by accomplishing realistic tasks.
2-D Mental Rotation	Ability to identify a two-dimensional figure when seen at different angular orientations.
3-D Mental Rotation	Ability to identify a three-dimensional object when seen at different angular orientations either within the picture plane or about the axis in depth.

OTHER WORKER REQUIREMENTS

Translation of Uncertainty	The ability to assign a subjective probability regarding the likelihood of an event occurring; the ability to use probabilities to identify optimal courses of action (CTA, 1988).
Recall from Interruption	The ability to recall a deferred or interrupted action when priorities permit, and to be able to resume the action appropriately (Ammerman et al., 1983)

Table 2.4. Mean Worker Requirement Ratings Rank Ordered for all ATCSs

Learning the Job			Doing the Job		
MEAN	SD	LABEL	MEAN	SD	LABEL
4.43	0.71	Active Listening	4.60	0.62	Tolerance for High Intensity
4.32	0.79	Tolerance for High Intensity	4.56	0.63	Oral Communication
4.30	0.83	Prioritization	4.53	0.66	Active Listening
4.27	0.80	Composure	4.53	0.70	Prioritization
4.25	0.87	Oral Communication	4.50	0.70	Composure
4.21	0.84	Planning	4.45	0.69	Planning
4.19	0.84	Rule Application	4.40	0.71	Decisiveness
4.18	0.85	Execution	4.37	0.80	Execution
4.16	0.85	Short-Term Memory	4.35	0.81	Thinking Ahead
4.15	0.86	Reading	4.33	0.86	Situational Awareness
4.15	0.82	Decisiveness	4.33	0.79	Scanning
4.13	0.82	Reasoning	4.31	0.74	Reasoning
4.12	0.92	Thinking Ahead	4.30	0.80	Short-Term Memory
4.12	0.90	Scanning	4.30	0.73	Taking Charge
4.11	0.88	Long-Term memory	4.26	0.78	Time Sharing
4.08	0.93	Situational Awareness	4.26	0.85	Visualization
4.06	0.91	Visualization	4.26	0.84	Projection
4.06	0.83	Concentration	4.25	0.79	Rule Application
4.05	0.85	Problem Identification	4.23	0.83	Problem Identification
4.05	0.91	Projection	4.23	0.80	Concentration
4.04	0.83	Flexibility (S/A)	4.22	0.77	Flexibility (S/A)
4.02	0.92	Taking Charge	4.13	0.83	Perceptual Speed and Accuracy
4.01	0.91	Time Sharing	4.11	0.92	Long-Term Memory
3.99	0.87	Perceptual Speed and Accuracy	4.11	0.78	Self-Awareness
3.98	0.92	Commitment to the Job	4.10	0.81	Working Cooperatively
3.91	0.86	Summarizing Information	4.07	0.94	Sustained Attention
3.90	0.90	Self-Awareness	4.06	0.83	Summarizing Information
3.89	0.93	Self-Monitoring/Evaluating	4.04	0.84	Self-Monitoring/Evaluating
3.87	0.92	Translating Information	4.02	0.78	Self-Confidence
3.87	0.87	Intermediate-Term Memory	3.96	0.88	Intermediate-Term Memory
3.87	0.96	Sustained Attention	3.96	0.85	Task Closure/Thoroughness
3.87	0.86	Self-Confidence	3.95	0.89	Reading
3.86	0.87	Task Closure/Thoroughness	3.92	0.90	Creativity
3.82	0.96	Working Cooperatively	3.92	0.90	Recall From Interruption

(Continued)

Table 2.4. Mean Worker Requirement Ratings Rank Ordered for all ATCSs (Continued)

	Learning the Job			Doing the Job	
MEAN	SD	LABEL	MEAN	SD	LABEL
3.82	0.87	Self-Esteem	3.89	0.86	Verbal Reasoning
3.81	0.86	Verbal Reasoning	3.88	0.98	Translating Information
3.78	0.81	Behavioral Consistency	3.88	0.92	Commitment to the Job
3.77	0.91	Recall From Interruption	3.83	0.92	Internal Locus of Control
3.74	0.95	Visuospatial Reasoning	3.80	0.85	Attention to Detail
3.72	0.98	Interpreting Information	3.80	1.02	Dynamic Visual-Spatial
3.71	0.95	Internal Locus of Control	3.80	1.03	Movement Detection
3.70	1.05	Movement Detection	3.79	0.87	Professionalism
3.69	0.95	Professionalism	3.78	1.00	Interpreting Information
3.69	0.99	Dynamic Visual-Spatial	3.78	0.97	Visuospatial Reasoning
3.68	0.99	Creativity	3.77	0.88	Self-Esteem
3.68	0.90	Interpersonal Tolerance	3.76	0.85	Behavioral Consistency
3.67	0.97	Street Physics	3.74	1.00	Street Physics
3.67	0.93	Motivation	3.72	0.85	Flexibility (IP)
3.59	0.90	Flexibility (IP)	3.68	0.86	Interpersonal Tolerance
3.58	0.92	Attention to Detail	3.67	1.01	Translation of Uncertainty
3.55	0.99	Translation of Uncertainty	3.67	0.91	Aviation Science Background
3.50	0.93	Chunking	3.53	0.92	Chunking
3.48	1.02	Aviation Science Background	3.47	0.93	Motivation
3.39	0.93	Written Communication	3.40	0.96	Written Communication
3.18	1.11	2-D Mental Rotation	3.32	1.13	Geography
3.18	1.17	3-D Mental Rotation	3.24	1.20	3-D Mental Rotation
3.16	1.03	Realistic Orientation	3.20	1.12	2-D Mental Rotation
3.14	1.12	Geography	3.19	1.02	Realistic Orientation
3.13	0.98	Mechanical Reasoning	3.15	1.00	Mechanical Reasoning
3.12	0.99	Mathematical Reasoning	3.08	1.01	Mathematical Reasoning
2.96	0.96	Numeric Ability (add/sub)	2.91	1.02	Numeric Ability (add/sub)
2.83	1.12	Angles	2.79	1.13	Angles
2.64	1.00	Numeric Ability (mult/div)	2.63	1.04	Numeric Ability (mult/div)

Table 2.5. Worker Requirement Ratings for Doing the Job for the Three Options and All ATCSs

WORKER REQUIREMENT LABEL	ARTCC		TERMINAL		FLIGHT SERVICE		ALL ATCSs	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
Oral Communication	4.56	0.56	4.57	0.66	4.63	0.53	4.56	0.63
Written Communication	3.18	0.94	3.43	0.88	3.49	1.11	3.40	0.96
Reading	3.79	0.98	3.87	0.89	4.26	0.78	3.95	0.89
Active Listening	4.59	0.60	4.55	0.65	4.52	0.65	4.53	0.66
Translating Information	3.68	1.08	3.73	0.98	4.32	0.74	3.88	0.98
Interpreting Information	3.30	1.02	3.59	0.97	4.51	0.64	3.78	1.00
Summarizing Information	3.94	0.87	3.92	0.86	4.46	0.62	4.06	0.83
Numeric Ability (add/sub)	3.00	1.23	2.88	1.01	3.02	0.86	2.91	1.02
Numeric Ability (mult/div)	2.75	1.28	2.58	1.01	2.66	0.95	2.63	1.04
Street Physics	3.97	0.98	3.82	3.38	1.00	1.00	3.74	1.00
Short-Term Memory	4.34	0.77	4.35	0.80	4.17	0.79	4.30	0.80
Intermediate-Term Memory	3.94	0.94	3.93	0.86	4.03	0.80	3.96	0.88
Long-Term Memory	4.29	0.80	4.11	0.80	4.01	0.91	4.11	0.92
Thinking Ahead	4.50	0.64	4.54	0.64	3.81	1.04	4.35	0.81
Planning	4.52	0.59	4.54	0.62	4.18	0.86	4.45	0.69
Prioritization	4.69	0.58	4.61	0.63	4.23	0.84	4.53	0.70
Execution	4.51	0.61	4.50	0.74	3.97	0.94	4.37	0.80
Problem Identification	4.31	0.76	4.33	0.75	3.96	0.97	4.23	0.83
Reasoning	4.42	0.70	4.33	0.69	4.16	0.86	4.31	0.74
Creativity	4.06	0.81	3.97	0.88	3.66	0.95	3.92	0.90
Self-Monitoring/Evaluating	4.09	0.93	4.03	0.83	3.96	0.77	4.04	0.84
Rule Application	4.18	0.87	4.29	0.75	4.20	0.83	4.25	0.79
Sustained Attention	4.13	0.86	4.14	0.92	3.87	1.01	4.07	0.94
Time Sharing	4.41	0.67	4.37	0.74	3.91	0.85	4.26	0.78
Situational Awareness	4.54	0.70	4.46	0.75	3.81	1.02	4.33	0.86
Visualization	4.21	0.90	4.33	0.79	4.12	0.96	4.26	0.85
Projection	4.24	0.90	4.36	0.78	4.04	0.91	4.26	0.84
Scanning	4.32	0.75	4.36	0.80	4.27	0.80	4.33	0.79
Professionalism	3.82	0.92	3.79	0.90	3.76	0.83	3.79	0.87
Working Cooperatively	4.06	0.86	4.12	0.78	4.13	0.85	4.10	0.81
Interpersonal Tolerance	3.51	0.97	3.71	0.85	3.76	0.79	3.68	0.86
Self-Esteem	3.78	0.98	3.75	0.87	3.82	0.85	3.77	0.88

(Continued)

Table 2.5 Worker Requirement Ratings for Doing the Job for the Three Options and All ATCSs (Continued)

WORKER REQUIREMENT LABEL	ARTCC		TERMINAL		FLIGHT SERVICE		ALL ATCSs	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
Self-Confidence	4.01	0.81	4.00	0.79	4.07	0.77	4.02	0.78
Taking Charge	4.43	0.68	4.38	0.68	4.03	0.81	4.30	0.73
Self-Awareness	4.17	0.82	4.15	0.79	3.94	0.73	4.11	0.78
Attention to Detail	3.82	0.86	3.76	0.86	3.84	0.81	3.80	0.85
Task Closure/Thoroughness	3.97	0.86	3.91	0.84	4.01	0.82	3.96	0.85
Decisiveness	4.40	0.76	4.45	0.69	4.26	0.75	4.40	0.71
Behavioral Consistency	3.65	0.94	3.73	0.85	3.96	0.72	3.76	0.85
Flexibility (S/A)	4.31	0.80	4.21	0.79	4.19	0.72	4.22	0.77
Concentration	4.21	0.80	4.28	0.78	4.11	0.83	4.23	0.80
Composure	4.60	0.65	4.53	0.69	4.38	0.73	4.50	0.70
Tolerance for High Intensity	4.68	0.58	4.66	0.56	4.46	0.68	4.60	0.62
Motivation	3.45	1.00	3.48	0.91	3.47	0.92	3.47	0.93
Commitment to the Job	3.79	0.96	3.90	0.92	3.98	0.88	3.88	0.92
Chunking	3.44	0.90	3.45	0.94	3.79	0.86	3.53	0.92
Mathematical Reasoning	3.27	0.95	2.99	1.01	3.13	1.01	3.08	1.01
Visuospatial Reasoning	3.94	0.87	3.90	0.97	3.39	0.93	3.78	0.97
Mechanical Reasoning	3.18	1.04	3.09	1.00	3.27	0.95	3.15	1.00
Verbal Reasoning	3.81	0.80	3.74	0.89	4.22	0.78	3.89	0.86
Angles	3.16	1.12	2.74	1.08	2.58	1.18	2.79	1.13
Flexibility (IP)	3.83	0.85	3.77	0.84	3.50	0.86	3.72	0.85
Dynamic Visual-Spatial	3.83	0.95	3.99	0.90	3.20	1.12	3.80	1.02
Movement Detection	3.54	1.08	4.03	0.89	3.31	1.10	3.80	1.03
Perceptual Speed & Accuracy	4.18	0.75	4.20	0.79	3.91	0.90	4.13	0.83
2-D Mental Rotation	3.05	1.20	3.35	1.04	2.97	1.11	3.20	1.12
3-D Mental Rotation	2.90	1.26	3.51	1.09	2.691	1.21	3.24	1.20
Realistic Orientation	3.07	1.16	3.24	0.97	3.19	1.03	3.19	1.02
Internal Locus of Control	4.00	0.82	3.81	1.10	3.74	0.84	3.83	0.92
Recall From Interruption	4.03	0.83	3.91	0.95	3.85	0.88	3.92	0.90
Translation of Uncertainty	3.74	0.96	3.79	1.00	3.37	1.00	3.67	1.01
Aviation Science Background	3.61	0.94	3.56	0.90	4.02	0.83	3.67	0.91
Geography	3.11	1.01	2.90	0.94	4.40	0.77	3.32	1.13

Table 2.6. Worker Requirement Ratings for Learning the Job for the Three Options and All ATCSs

WORKER REQUIREMENT LABEL	ARTCC		TERMINAL		FLIGHT SERVICE		ALL ATCSs	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
Oral Communication	4.26	0.81	4.30	0.87	4.20	0.91	4.25	0.87
Written Communication	3.29	0.98	3.41	0.85	3.44	1.04	3.39	0.93
Reading	4.03	0.97	4.09	0.85	4.34	0.81	4.15	0.86
Active Listening	4.45	0.68	4.51	0.66	4.31	0.74	4.43	0.71
Translating Information	3.82	0.91	3.76	0.91	4.15	0.86	3.87	0.92
Interpreting Information	3.23	1.08	3.59	0.90	4.33	0.81	3.72	0.98
Summarizing Information	3.77	0.87	3.81	0.86	4.24	0.79	3.91	0.86
Numeric Ability (add/sub)	3.14	1.07	2.91	0.96	3.00	0.90	2.96	0.96
Numeric Ability (mult/div)	2.79	1.21	2.62	0.94	2.61	0.97	2.64	1.00
Street Physics	3.79	1.01	3.77	0.90	3.38	0.99	3.67	0.97
Short-Term Memory	4.18	0.85	4.23	0.84	3.98	0.83	4.16	0.85
Intermediate-Term Memory	3.85	0.96	3.89	0.82	3.87	0.86	3.87	0.87
Long-Term Memory	4.37	0.76	4.14	0.86	3.89	0.91	4.11	0.88
Thinking Ahead	4.35	0.79	4.32	0.79	3.54	1.03	4.12	0.92
Planning	4.28	0.75	4.34	0.79	3.89	0.91	4.21	0.84
Prioritization	4.46	0.68	4.41	0.80	3.99	0.92	4.30	0.83
Execution	4.33	0.73	4.32	0.79	3.78	0.98	4.18	0.85
Problem Identification	4.22	0.76	4.16	0.80	3.71	0.94	4.05	0.85
Reasoning	4.21	0.88	4.22	0.76	3.92	0.85	4.13	0.82
Creativity	3.83	0.95	3.82	0.91	3.27	1.08	3.68	0.99
Self-Monitoring/Evaluating	3.91	1.04	3.97	0.90	3.68	0.85	3.89	0.93
Rule Application	4.27	0.75	4.22	0.86	4.03	0.84	4.19	0.84
Sustained Attention	3.95	0.98	3.95	0.92	3.66	0.99	3.87	0.96
Time Sharing	4.17	0.83	4.18	0.84	3.58	0.97	4.01	0.91
Situational Awareness	4.21	0.89	4.21	0.89	3.70	0.98	4.08	0.93
Visualization	4.09	0.85	4.15	0.91	3.86	0.96	4.06	0.91
Projection	4.13	0.84	4.17	0.87	3.76	0.99	4.05	0.91
Scanning	4.16	0.87	4.20	0.89	3.96	0.93	4.12	0.90
Professionalism	3.71	1.04	3.79	0.90	3.47	0.97	3.69	0.95
Working Cooperatively	3.83	1.02	3.94	0.86	3.63	1.10	3.82	0.96
Interpersonal Tolerance	3.71	0.89	3.78	0.90	3.50	0.88	3.68	0.90
Self-Esteem	3.88	0.95	3.88	0.83	3.73	0.88	3.82	0.87

(Continued)

Table 2.6. Worker Requirement Ratings for Learning the Job for the Three Options and All ATCSs (Cont.)

WORKER REQUIREMENT LABEL	ARTCC		TERMINAL		FLIGHT SERVICE		ALL ATCSs	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
Self-Confidence	3.91	0.92	3.93	0.84	3.74	0.87	3.87	0.86
Taking Charge	4.20	0.92	4.15	0.88	3.64	0.94	4.02	0.92
Self-Awareness	3.92	0.98	4.03	0.87	3.66	0.88	3.90	0.90
Attention to Detail	3.64	0.99	3.64	0.90	3.42	0.91	3.58	0.92
Task Closure/Thoroughness	3.85	0.92	3.88	0.85	3.80	0.86	3.86	0.87
Decisiveness	4.20	0.86	4.23	0.82	3.96	0.79	4.15	0.82
Behavioral Consistency	3.71	0.94	3.83	0.77	3.79	0.75	3.78	0.81
Flexibility (S/A)	4.08	0.81	4.10	0.83	3.86	0.82	4.04	0.83
Concentration	4.00	0.91	4.19	0.78	3.82	0.82	4.06	0.83
Composure	4.35	0.77	4.34	0.78	4.05	0.83	4.27	0.80
Tolerance for High Intensity	4.42	0.80	4.43	0.74	4.09	0.83	4.32	0.79
Motivation	3.69	0.99	3.74	0.89	3.49	1.00	3.67	0.93
Commitment to the Job	3.99	1.01	4.03	0.89	3.90	0.93	3.98	0.92
Chunking	3.43	0.92	3.52	0.93	3.53	0.94	3.50	0.93
Mathematical Reasoning	3.28	0.92	3.09	1.00	3.08	0.99	3.12	0.99
Visuospatial Reasoning	3.91	0.88	3.86	0.93	3.30	0.90	3.74	0.95
Mechanical Reasoning	3.13	1.04	3.10	0.97	3.18	0.93	3.13	0.98
Verbal Reasoning	3.75	0.90	3.73	0.90	3.99	0.74	3.81	0.86
Angles	3.16	1.06	2.82	1.10	2.54	1.13	2.83	1.12
Flexibility (IP)	3.71	0.90	3.70	0.85	3.25	0.92	3.59	0.90
Dynamic Visual-Spatial	3.74	0.97	3.85	0.91	3.17	1.04	3.69	0.99
Movement Detection	3.50	1.10	3.92	0.95	3.20	1.11	3.70	1.05
Perceptual Speed & Accuracy	4.03	0.82	4.09	0.84	3.74	0.93	3.99	0.87
2-D Mental Rotation	3.03	1.14	3.35	1.04	2.89	1.10	3.18	1.11
3-D Mental Rotation	2.89	1.20	3.43	1.06	2.59	1.21	3.18	1.17
Realistic Orientation	3.12	1.14	3.23	0.98	3.06	1.05	3.16	1.03
Internal Locus of Control	3.86	0.92	3.76	0.97	3.47	0.90	3.71	0.95
Recall From Interruption	3.93	0.86	3.81	0.93	3.56	0.93	3.77	0.91
Translation of Uncertainty	3.55	0.98	3.71	0.96	3.20	0.98	3.55	0.99
Aviation Science Background	3.33	1.09	3.45	0.98	3.71	1.00	3.48	1.02
Geography	2.88	1.05	2.85	0.95	4.01	1.00	3.14	1.12

Table 2.7. Survey Subactivities for All ATCSs Ranked by the Mean Criticality Index

MEAN	SD	SUBACTIVITY LABEL
14.39	1.27	Checking and evaluating separation or traffic movement to ensure separation is maintained
12.96	2.25	Performing aircraft conflict resolution
12.70	2.37	Establishing and maintaining positive aircraft or vehicle identification
12.40	2.40	Establishing arrival sequences
12.34	2.61	Managing airborne departures (e.g., observe takeoff, issue go around)
11.89	2.66	Scanning to maintain awareness of surrounding airspace
11.61	2.61	Issuing arrival and landing information or instructions
11.51	2.59	Observing arrival aircraft
11.43	2.57	Establishing/maintaining/terminating radio communications
11.37	2.67	Managing departure flows
11.37	2.12	Responding to special conditions, contingencies, or emergencies
11.34	2.58	Managing departure traffic
11.32	2.46	Managing personal workload
11.31	2.58	Issuing departure information or instructions
11.26	2.14	Responding to contingencies/emergencies
11.22	2.29	Briefing relieving controllers
11.18	2.43	Assuming position responsibility
11.15	2.68	Recognizing and responding to deviations from ATCS instructions/clearances
10.94	2.79	Establishing/re-establishing/terminating radar identification
10.85	2.78	Disseminating weather information to pilots/other controllers
10.58	2.68	Conducting search and rescue procedures
10.56	2.37	Orienting lost aircraft
10.55	2.81	Prioritizing sector/position tasks
10.54	2.60	Issuing clearances
10.46	2.60	Responding to pointouts based on current or anticipated traffic situations
10.41	2.57	Responding to ground movement requests
10.35	2.62	Initiating pointouts
10.31	2.64	Responding to significant weather information
10.28	2.50	Initiating search and rescue procedures
10.04	2.67	Issuing unsafe condition advisories
10.02	3.05	Performing procedures for non-radar environment
9.92	2.88	Responding to changes in runway or taxiway usage
9.91	2.56	Receiving transfer of control or radar identification
9.90	3.08	Maintaining currency in weather data

Table 2.7 Survey Subactivities for All ATCSs Ranked by the Man Criticality Index (Continued)

MEAN	SD	SUBACTIVITY LABEL
9.89	2.38	Analyzing initial requests for clearances
9.83	3.03	Managing aborted takeoffs
9.82	2.55	Initiating transfer of control or radar identification
9.81	2.36	Responding to communications failures
9.63	2.46	Executing backup procedures for communications failures
9.61	2.64	Responding to computer failures
9.58	2.68	Processing flight plans or flight plan amendments
9.53	2.55	Executing backup procedures for radar display failures
9.50	2.63	Transferring control responsibilities for departure aircraft
9.49	2.46	Processing pilot requests for clearance
9.41	2.59	Reviewing route of flight
9.40	2.76	Processing weather reports
9.40	2.81	Conducting direct weather observations
9.37	2.74	Responding to traffic management constraints or flow control conflicts
9.32	2.75	Managing automated handoff features
9.30	2.43	Responding to ARTS/BRITE/FDIO failures
9.28	2.78	Performing minimum safe altitude processing
9.13	2.40	Forwarding flight data information
9.12	2.83	Managing staff workload (performing CIC duties)
9.11	2.37	Responding to flow constraints
9.08	2.54	Requesting, processing and entering PIREPS (pilot reports)
9.06	2.73	Broadcasting TIBS/TWEBS/PATWAS/HIWAS
9.00	2.69	Responding to position or sector reconfigurations
8.09	2.85	Providing hazardous area reporting services
8.96	2.52	Executing backup procedures for ARTS/BRITE/FDIO failures
8.86	2.53	Updating flight progress strips
8.85	2.50	Responding to movement area closures or reopenings
8.85	2.66	Responding to imposed airspace restrictions
8.82	3.04	Receiving system status information and automated weather information
8.82	3.04	Receiving system status information and automated weather information
8.81	2.53	Responding to imposed movement area restrictions
8.81	2.88	Planning clearances
8.78	2.42	Responding to requests for transfer of control
8.75	2.36	Operating airport or taxiway lighting systems

(Continued)

Table 2.7. Survey for All ATCSs Ranked by the Mean Criticality Index (Continued)

MEAN	SD	SUBACTIVITY LABEL
8.74	2.65	Processing emergency locator transmitter signals
8.74	2.61	Monitoring navigational equipment and communication equipment
8.73	2.66	Reporting significant aeronautical data
8.71	2.74	Processing pilot requests for airport information (airport advisories)
8.68	2.57	Performing movement area violation resolution
8.68	2.92	Processing aeronautical data (e.g., NOTAM's, MOA)
8.51	2.65	Executing backup procedures for loss of flight plan data base
8.50	3.08	Activating flight plans
8.49	2.50	Executing backup procedures for NAVAID failures
8.45	2.56	Responding to airport equipment failures
8.40	2.65	Responding to pilot requests for route planning
8.35	3.02	Maintaining inbound/proposed/suspense lists
8.34	2.63	Responding to special use airspace events
8.28	2.63	Housekeeping or sector/position management
8.24	2.33	Executing backup procedures for sensor or tracking failures
8.23	3.08	Processing flight plan closures
8.12	2.69	Processing departure or en route time information
8.02	2.40	Responding to requests for temporary release of airspace
8.02	2.35	Responding to sensor outages
7.98	3.10	Reviewing proposed/inbound/suspense lists
7.94	2.51	Responding to special operations (e.g., VIP movements, parachutes)
7.93	2.56	Requesting temporary release of airspace
7.92	2.64	Requesting temporary release of movement areas
7.88	2.71	Responding to requests for temporary release of movement areas
7.65	2.76	Handling other facilities starting/closing operations
7.58	2.29	Processing requests for flight following
7.49	2.39	Suppressing or restoring alerts
7.45	2.29	Editing data base messages
7.40	2.70	Monitoring non-controlled objects (e.g., parachutes, balloons, animals)
7.24	2.65	Coordinating with US Customs

Table 2.8. Worker Requirement Definitions Used in the Predictor-WR Linkage Survey

Worker Requirement	Definitions
Prioritization	The ability to identify activities that are most critical and require immediate attention. This involves a constant evaluation of new information followed by re-prioritization of job activities.
Tolerance for High Intensity	The ability to perform effectively and think clearly during heavy work flow.
Composure	The ability to think clearly in stressful situations.
Active Listening	The ability to hear and comprehend spoken information. This ability requires an individual to recognize or pick out pertinent auditory information.
Oral Communication	The ability to speak clearly and concisely to individuals so they understand what is being communicated. Projecting a confident tone of voice is an important component of this ability.
Situational Awareness	Being cognizant of all information within a four dimensional space (i.e., separation standards plus time). This involves the ability to "understand" the airspace as an integrated whole (e.g., getting the picture).
Planning	The ability to determine the appropriate course(s) of action to take in any given situation.
Execution	The ability to take timely action to avoid problems and to solve existing problems.
Thinking Ahead	The ability to anticipate or recognize problems before they occur and to develop plans to avoid problems. This includes thinking about what might happen.
Taking Charge	The ability to take control of a situation and reach out and take correct action.
Reasoning	The ability to apply available information in order to make decisions, draw conclusions, or identify alternative solutions.
Time Sharing	The ability to perform two or more job activities at the same time.
Decisiveness	The ability to make effective decisions in a timely manner.
Short-Term Memory	The ability to remember pertinent information within a brief period of time (less than 1 minute). Examples of information include call signs and keywords.
Scanning	The ability to quickly and accurately search for information on a computer screen, radar scope, or computer print-out.
Problem Solving	The ability to identify a potential problem or existing problem and to identify the variables used in solving the problem.
Flexibility (Stability/ Adjustment)	The ability to adapt to changing situations or conditions.
Long-Term Memory	The ability to remember pertinent information over long periods of time. Examples of information include maps and separation procedures.
Projection	The ability to translate material into visual representation of what will occur in the future.
Visualization	The ability to translate material into a visual representation of what is currently occurring.
Concentration	The ability to focus on job activities amid distractions for short periods of time.
Confirmation	The ability to efficiently select a response option consistent with the application of inferred rules.

(Continued)

Worker Requirement	Definitions
Self-Awareness	The ability to maintain an internal awareness of your actions and attitudes. This includes knowing your limitations.
Rule Application	The ability to efficiently apply transformational rules inferred from the complete portions of the stimulus array to the incomplete portion of the array.
Perceptual Speed & Accuracy	Ability to perceive visual information quickly and accurately and to perform simple processing tasks with (e.g., comparisons).
Sustained Attention	The ability to stay focused on a task(s) for long periods of time (over 60 minutes).
Self-Monitoring/ Evaluation	The ability and willingness to check your own work performance, evaluate the effectiveness of your decisions, and alter your performance if necessary.
Creativity	The ability to identify new or novel solutions to potential problems when existing or established solutions no longer apply.
Working Cooperatively	The willingness to work with others to achieve a common goal. This includes a willingness to voluntarily assist another controller if the situation warrants.
Recall from Interruption	The ability to recall a deferred or interrupted action when priorities permit, and to be able to resume the action appropriately.
Self-Confidence	A belief that you are the person for the job and knowing that your processes and decisions are correct.
Internal Locus of Control	Believes that individuals have influence over the outcome of an event; takes responsibility for outcomes.
Street Physics	The ability to understand the general rules of science as practiced in the ATCS environment (e.g., aircraft size and turbulence effects, angles of intersect, overtake speed, headings).
Task Closure/ Thoroughness	The ability to continue an activity to completion through the coordination and inspection of work.
Summarizing Information	The ability to summarize and consolidate information most relevant to the situation.
Intermediate-Term Memory	The ability to remember pertinent information over a 1-10 minute period.
Visuospatial Reasoning	Ability to perceive and understand principles governing relationships among several figures.
Flexibility (Information Processing)	The ability to find new meanings for stimuli, to combine stimulus attributes to come up with new and different solution protocols, and to employ flexible ways of relating new information to stored knowledge.
Dynamic Visual-Spatial	Ability to deal with dynamic visual movement.
Professionalism	The ability to establish respect and confidence in your abilities among other controllers.
Attention to Detail	The ability to recognize and attend to the details of the job that others might overlook.
Verbal Reasoning	The ability to perceive and understand principles governing the use of verbal concepts and symbols.
Reading	The ability to read and understand written information (e.g., ATCS documents, manuals).
Learning	Changes in information-processing strategies over time or trials not due to maturation or aging.

(Continued)

Table 2.8. Worker Requirement Definitions Used in the Predictor-WR Linkage Survey (Continued)

Worker Requirement	Definitions
Commitment to the Job	The desire to be an ATCS and work hard to be successful.
Self-Esteem	Having a positive opinion/image of oneself.
Translation of Uncertainty	The ability to assign a subjective probability regarding the likelihood of an event occurring; the ability to use probabilities to identify optimal courses of action.
Translating Information	The ability to translate symbols or symbolic abbreviations into meaningful information.
Behavioral Consistency	The ability to behave consistently at work (e.g., dealing with coworkers in a consistent manner; consistently using the correct phraseology).
Encoding	Transformation or translation of information; coding; decoding.
Movement Detection	Ability to detect physical movement of objects and to judge their direction.
Interpersonal Tolerance	The ability to accommodate or deal with differences in personalities, criticisms, and interpersonal conflicts in the work environment.
Motivation	The desire to motivate oneself through challenges on the job and to progress to a higher level of skill.
Chunking	The ability to organize stimuli into meaningful groups or units.
Interpreting Information	The ability to put information into meaningful terms. It is the ability to recognize the implications for a statement or condition (e.g., cold front).
Mathematical Reasoning	Ability to perceive and understand principles governing the use of quantitative concepts and symbols.
Written Communication	The ability to write legibly and accurately (e.g., strip markings).
Mechanical Reasoning	Ability to perceive and understand the relationship of physical forces and mechanical elements in a prescribed situation.
Angles	The ability to apply the principles of geometry to angles and computations involving angles. The ability involves both the speed and accuracy of computation.
Rule Inference	The ability to efficiently ascertain the rules governing relations between stimulus attributes.
Realistic Orientation	Prefers dealing with activities that have tangible and measurable consequences; enjoys activities which require skill, is reinforced by accomplishing realistic tasks.
2-D Mental Rotation	Ability to identify a two-dimensional figure when seen at different angular orientations.
Numeric Ability (add/sub)	The ability to quickly and accurately perform basic math operations (addition and subtraction).
3-D Mental Rotation	Ability to identify a three-dimensional object when seen at different angular orientations either within the picture plane or about the axis in depth.
Numeric Ability (mult/div)	The ability to quickly and accurately perform basic math operations (multiplication and division).

Table 2.9. Number of Raters and Intra-Class Correlations for Each Scale

AT-AT-SAT Predictor	Number of Raters	Intra-Class Correlation
Version 1		
Applied Math	12	.95
Dials	12	.91
Letter Factory	12	.94
Scanning	12	.92
Sound Memory	12	.94
Time Wall	12	.92
Version 2		
Angles	14	.89
Air Traffic Scenarios	14	.92
Analogies	14	.93
Memory	13	.88
Planes	13	.86
EQ-Tolerance for High Intensity	14	.93
EQ-Composure	14	.95
EQ-Decisiveness	14	.90
EQ-Execution	14	.94
EQ-Taking Charge	14	.89
EQ-Concentration	14	.93
EQ-Flexibility	14	.89
EQ-Self-Awareness	14	.95
EQ-Working Cooperatively	14	.96
EQ-Sustained Attention	12	.94
EQ-Self-Confidence	12	.96
EQ-Task Closure/Thoroughness	12	.92
EQ-Interpersonal Tolerance	12	.94
EQ-Consistency of Work Behavior	12	.87

Table 2.10. AT-SAT Tests Rated as Measuring Each SACHA-Generated Worker Requirement

Worker Requirement [a]	Test	Mean [b]	SD
Prioritization	Air Traffic Scenarios	4.64	.50
	Letter Factory	4.25	.97
Tolerance for High Intensity	EQ-Tol. for High Intensity	4.71	.47
	Air Traffic Scenarios	4.14	.86
	Letter Factory	3.92	1.00
	EQ-Composure	3.79	.89
Composure	EQ-Composure	4.57	.85
	EQ-Tol. for High Intensity	3.43	1.09
	Air Traffic Scenarios	3.36	1.01
Active Listening	Sound Memory	4.33	.89
Oral Communication			
Situational Awareness	Air Traffic Scenarios	4.50	1.34
	Letter Factory	3.33	1.83
Planning	Air Traffic Scenarios	4.14	.77
	Letter Factory	4.00	.85
Execution	Letter Factory	4.42	.67
	Air Traffic Scenarios	4.07	.73
	EQ-Execution	3.86	1.79
Thinking Ahead	Air Traffic Scenarios	4.14	.66
	Letter Factory	3.92	1.08
Taking Charge	EQ-Taking Charge	4.43	.94
Reasoning	Analogies	3.36	1.65
	Air Traffic Scenarios	3.09	1.58
Time Sharing	Time Wall/Pattern Recog.	4.08	1.56
	Letter Factory	3.50	1.51
Decisiveness	EQ-Decisiveness	4.07	1.44
	Air Traffic Scenarios	3.57	1.09
	Letter Factory	3.50	1.09
	EQ-Execution	3.14	1.17
Short-Term Memory	Sound Memory	4.92	.29
	Letter Factory	3.33	1.23
	Memory Test	3.23	2.01
Scanning	Scanning	5.00	0
	Letter Factory	4.17	.72
	Air Traffic Scenarios	3.86	1.23
	Time Wall/Pattern Recog.	3.83	1.47
	Dials	3.42	1.44
Problem Solving			
Flexibility (Stabil./Adjustment)	EQ-Flexibility	4.29	1.44
Long-Term Memory			

(Continued)

Table 2.10. AT-SAT Tests Rated as Measuring Each SACHA-Generated Worker Requirement (Cont.)

Worker Requirement [a]	Test	Mean [b]	SD
Projection	Planes	3.77	1.79
Visualization			
Concentration	EQ-Concentration	4.29	1.44
	Letter Factory	3.17	1.70
Self-Awareness	EQ-Self Awareness	4.50	.94
Rule Application (SME-generated)			
Perceptual Speed & Accuracy	Time Wall/Pattern Recog.	4.58	.67
	Scanning	4.58	.67
	Dials	4.33	.89
	Planes	3.92	1.61
	Letter Factory	3.75	.97
	Air Traffic Scenarios	3.21	1.63
Sustained Attention	EQ-Sustained Attention	4.07	.92
Self-Monitoring/Evaluation	EQ-Self Awareness	2.92	2.02
Creativity			
Working Cooperatively	EQ-Working Cooperatively	4.64	.74
Recall from Interruption			
Self Confidence	EQ-Self Confidence	4.64	.74
Internal Locus of Control			
Street Physics			
Task Closure/Thoroughness	EQ-Task Closure	4.43	.94
Summarizing Information			
Intermediate-Term Memory	Memory Test	3.77	1.92
Visual-Spatial Reasoning	Analogies	3.57	1.74
Flexibility (Inform. Processing)			

(Continued)

Table 2.10. AT-SAT Tests Rated as Measuring Each SACHA-Generated Worker Requirement (Cont.)

Worker Requirement [a]	Test	Mean [b]	SD
Dynamic Visual-Spatial	Air Traffic Scenarios	4.07	1.44
	Planes	3.54	1.66
	Time Wall/Pattern Recog.	3.50	1.45
	Letter Factory	3.50	1.51
	Scanning	3.08	1.73
Professionalism			
Attention to Detail	Letter Factory	2.50	1.57
Verbal Reasoning			
Reading			
Commitment to the Job			
Self-Esteem	EQ-Self Confidence	3.21	1.63
Translation of Uncertainty			
Translating Information			
Behavioral Consistency	EQ-Consist. Of Work Behavior	3.43	1.87
Movement Detection	Air Traffic Scenarios	4.29	.91
	Time Wall/Pattern Recog.	3.08	1.78
Interpersonal Tolerance	EQ-Interpersonal Tolerance	4.29	1.44
	EQ-Working Cooperatively	3.00	1.76
Motivation			
Chunking			
Interpreting Information			
Mathematical Reasoning	Applied Math	4.83	.39
Written Communication			
Mechanical Reasoning			
Angles	Angles	4.64	.84
Realistic Orientation			

(Continued)

Table 2.10. AT-SAT Tests Rated as Measuring Each SACHA-Generated Worker Requirement (Cont.)

Worker Requirement [a]	Test	Mean [b]	SD
2-D Mental Rotation			
Numeric Ability (add/sub)	Applied Math	4.58	.90
3-D Mental Rotation			
Numeric Ability (mult./div.)	Applied Math	4.25	1.48
Confirmation [a]	Analogies	3.64	1.69
	Letter Factory	3.17	1.53
Encoding [a]	Memory Test	3.00	1.47
Rule Inference [a]	Analogies	4.79	.43
Rule Application [a]	Analogies	4.29	1.38
Learning [a]			

[a] All but five of the Worker Requirements are rank ordered by mean ratings (of ARTCC controllers from SACHA job analysis) regarding importance for *doing the job*. SACHA did not collect data on the last five worker requirements (Confirmation, Encoding, Rule Inference, Rule Application (SACHA-generated), and Learning) because it was felt that the complex cognitive nature of these WR definitions would not be fully graspable by controllers completing the SACHA job analysis surveys.

[b] A criterion cutoff mean ≥ 3 was established to indicate whether a test was able to measure a particular WR.

Table 2.11. Indicators of the Success of AT-SAT Measures in Measuring Multiple Worker Requirements

AT-SAT Predictor	Number of WRs With Ratings ≥ 3	Number of WRs With Ratings ≥ 3 Measured by 1 or Fewer Tests	Number of WRs With Ratings ≥ 3 Not Measured by Other Tests	Mean of Linkage Rating x SACHA Rating	Sum of Linkage Rating x SACHA Rating
Applied Math	3	3	3	13.7	41.2
Dials	2	0	0	16.5	32.9
Letter Factory	14	7	0	16.2	226.4
Scanning	3	0	0	17.5	52.5
Sound	2	1	1	20.7	41.3
Time Wall	5	2	0	15.6	77.9
Angles	1	1	1	14.7	14.7
AT Scenarios	12	5	0	17.5	209.4
Analogies	5	5	4	15.6	78.2
Memory	3	2	2	13.4	40.1
Planes	3	1	1	15.3	46.0
EQ-Tol. for High Int.	2	0	0	18.4	36.8
EQ-Composure	2	0	0	19.4	38.8
EQ-Decisiveness	1	0	0	17.9	17.9
EQ-Execution	2	0	0	15.6	31.2
EQ-Taking Charge	1	1	1	19.6	19.6
EQ-Concentration	1	1	0	18.1	18.1
EQ-Flexibility	1	1	1	18.5	18.5
EQ-Self-Awareness	1	1	1	18.9	18.9
EQ-Working Coop.	1	1	1	18.8	18.8
EQ-Sustained Attent.	1	1	1	16.8	16.8
EQ-Self-Confidence	2	2	2	15.4	30.7
EQ-Task Closure	1	1	1	17.6	17.6
EQ-Interperson. Tol.	1	1	1	15.1	15.1
EQ-Consis. Of Work Behavior	1	1	1	12.5	12.5

Table 3.1.1. Regression Coefficients for PTS Pre-Training Screen

Variable	Beta	St. Err. of Beta	B	St. Err. of B	T(351)	p-Level
Static Vector % Correct	.1337	.0507	.2481	.0341	2.636	.0088
Static Vector Correct Reaction Time	-.1494	.0601	-.0054	.0022	-2.485	.0134
Continuous Memory Correct Reaction Time	-.0501	.0551	-.0014	.0015	-.909	.3639
Time Wall Absolute Time Error	-.0546	.0527	-.0014	.0016	-1.035	.3012
Pattern Recognition Correct Reaction Time	-.0166	.0506	-.0025	.0075	-.239	.7427
ATST Safety	-.3068	.0536	-.6992	.1221	-5.725	.0000

Table 3.1.2 Regression Table for Pre-Training Screen

Dependent Variable	Academy Screen Comprehensive Test Score
Multiple R	.4906
Multiple R-Square	.2404
Adjusted R-Square	.2277
Minimum Pairwise N	358
F (6,351) = 18.54	p < .0000
Standard Error of Estimate	10.59
Intercept	72.07
Standard Error	10.50 t(351) = 6.860 p<.0000

Table 3.1.3 Meta-Analysis of Prior ATCS Validation Studies

Criterion Measure Group	Predictor Measure Grouping									
	Basic Cognitive Ability Measures	Experience Measures	Personality and Interest Inventory Measures	Simulation Type Measures	Multi-Tasking Measures	Visual and Spatial Measures	Bio-Measures (e.g., Age, Education)	Keyboard & Visual RT Measures	Psycho-motor Measures	Across All Predictor Measures
Screen Performance										
Number of studies	189	165	99	80	51	64	38	25	4	715
Total Sample Size	54,211	91,543	23,949	32,606	5,746	30,829	39,040	5,499	1,112	284,535
Mean sample r	0.22	0.17	0.12	0.25	0.08	0.24	0.11	0.32	0.32	0.18
Variance of sample r	0.0174	0.0084	0.0055	0.0191	0.0053	0.0154	0.0042	0.0617	0.0033	0.0149
Est Sampling Var(r)	0.0032	0.0017	0.0040	0.0021	0.0087	0.0019	0.0009	0.0042	0.0027	0.0023
Instructor Ratings										
Number of studies	84	21	101	10	57	11	6	2	5	297
Total Sample Size	12,045	25,398	16,802	5,973	3,417	3,680	780	260	650	69,005
Mean sample r	0.13	0.13	0.07	0.11	0.20	0.19	0.13	0.20	0.05	0.12
Variance of sample r	0.0080	0.0030	0.0042	0.0044	0.0158	0.0053	0.0074	0.0685	0.0007	0.0064
Est Sampling Var(r)	0.0067	0.0008	0.0059	0.0016	0.0152	0.0028	0.0074	0.0067	0.0077	0.0041
Supervisor or Self Appraisal										
Number of studies	23	35	7	12		5	14	2		98
Total Sample Size	7,205	9,302	1,616	3,677		2,244	6,472	486		31,002
Mean sample r	0.17	0.08	0.04	0.16		0.08	0.11	012		0.11
Variance of sample r	0.0175	0.0039	0.0033	0.0034		0.0046	0.0072	0.0144		0.0090
Est Sampling Var(r)	0.0028	0.0037	0.0043	0.0031		0.0022	0.0021	0.0040		0.0030
Field Training Duration										
Number of studies		21		21						42
Total Sample Size		32,667		18,070						50,737
Mean sample r		0.05		0.05						0.05
Variance of sample r		0.0045		0.0010						0.0032
Est Sampling Var(r)		0.0006		0.0012						0.0008
Field Training Process										
Number of studies	4	9	4	12		2	8	3		42
Total Sample Size	1,506	7,062	1,001	8,161		379	4,179	1,124		23,412
Mean sample r	0.07	0.04	0.18	0.11		0.15	0.04	0.11		0.08
Variance of sample r	0.0019	0.0025	0.0058	0.0035		0.0012	0.0021	0.0095		0.0043
Est Sampling Var(r)	0.0026	0.0013	0.0038	0.0014		0.0051	0.0019	0.0025		0.0017
Attrition										
Number of studies		1	5	1			10			17
Total Sample Size		2,992	1,912	2,992			6,252			14,148
Mean sample r		0.00	0.06	0.00			0.10			0.08
Variance of sample r		0.0000	0.0013	0.0000			0.0077			0.0055
Est Sampling Var(r)		0.0000	0.0026	0.0000			0.0015			0.0012

Criterion Measure Group	Predictor Measure Grouping									
	Basic Cognitive Ability Measures	Experience Measures	Personality and Interest Inventory Measures	Simulation Type Measures	Multi-Tasking Measures	Visual and Spatial Measures	Bio-Measures (e.g., Age, Education)	Keyboard & Visual RT Measures	Psycho-motor Measures	Across All Predictor Measures
Simulation Scores										
Number of studies	9		1	1		3		3		17
Total Sample Size	1,008		112	112		336		336		1,904
Mean sample r	0.39		0.42	0.51		0.39		0.32		0.39
Variance of sample r	0.0038		0.0000	0.0000		0.0000		0.0536		0.0104
Est Sampling Var(r)	0.00064		0.0000	0.0000		0.0065		0.0068		0.0064
Archival Perf Records										
Number of studies	15					1				16
Total Sample Size	3,165					211				3,376
Mean sample r	0.24					0.22				0.24
Variance of sample r	0.0252					0.0000				0.0235
Est Sampling Var(r)	0.0040					0.0000				0.0041
Controller Skills Test										
Number of studies	1	2		1		2				6
Total Sample Size	1,225	8,228		1,255		2,510				13,248
Mean sample r	0.20	0.19		0.16		0.30				0.21
Variance of sample r	0.0000	0.0029		0.0000		0.0008				0.0037
Est Sampling Var(r)	0.0000	0.0002		0.0000		0.0007				0.0004
Composite Criteria										
Number of studies		5	5	10		4	10	5		
Total Sample Size		2,688	2,398	5,856		2,945	8,725	3,507		
Mean sample r		0.26	0.16	0.23		0.17	0.09	0.15		
Variance of sample r		0.0029	0.0011	0.0006		0.0001	0.0132	0.0004		
Est Sampling Var(r)		0.0016	0.0020	0.0015		0.0013	0.0011	0.0014		
Across Criterion Measure Types										
Number of studies	325	259	222	148	108	92	86	40	9	1,289
Total Sample Size	80,395	179,880	47,790	78,702	9,163	43,134	65,448	11,212	1,762	515,883
Mean sample r	0.20	0.13	0.10	0.17	0.12	0.23	0.10	0.24	0.22	0.15
Variance of sample r	0.0174	0.0087	0.0058	0.0157	0.0128	0.0138	0.0059	0.0411	0.0211	0.0134
Est Sampling Var(r)	0.0037	0.0014	0.0045	0.0017	0.0111	0.0019	0.0013	0.0033	0.0046	0.0023

Table 3.1.4 Proposed New Measures for the g WR Constructs

CONSTRUCT CATEGORIES	WORKER REQUIREMENT CONSTRUCTS	PRELIMINARY TESTS	PROPOSED MEASURES
Applied Reasoning	Chunking		Grouping Info. Test
	Translating Information		
	Interpreting Information		
	Summarizing Information		
	Reasoning (Thinking)	Reasoning Battery	
	Visuospatial Reasoning	Syllogisms	
	Verbal Reasoning	Analogies	
	Mechanical Reasoning	Classifications	
	Mathematical Reasoning		
	Creativity		
	Rule Application		Rule Application Test
	Translation of Uncertainty into Probability		
	Street Physics		Revise Available Street Physics Test
Computational	Numeric Ability (Addit./Sub.)	Headings Test	
		Time Test	
	Numeric Ability (Mult./Div.)		
	Angles	Angles	
Spatial	Visualization	Projection Test	Revise Paper Fold. Test
	Projection	Ships/Planes Test [a]	
		Direct. & Distance	
	Dynamic Visual-Spatial	Ships/Planes Test	
Perceptual	Scanning		
	Movement Detection		
	Perceptual Speed & Accuracy	Dial Reading Test	
Memory	Short-Term (working memory)	2 Short-Term Tests	
		Direct. & Distance	
	Intermediate-Term Memory	Short-Term Test (Repeated)	
	Long-Term Memory	Map Memory	
Communication	Oral Communication		Consider Revision of Ship Test
	Active Listening		
	Written Communication		
	Reading		Reading Test

[a] We renamed the Ships test to Planes for face validity purposes.

Table 3.1.5. Proposed New Measures for the Processing Operations WR Constructs

CONSTRUCT CATEGORIES	WORKER REQUIREMENT CONSTRUCTS	PRELIMINARY TESTS	PROPOSED MEASURES
Perceptual	Scanning Movement Detention Perceptual Speed and Accuracy	Dial Reading Test	A Complex Stimuli Test [a]
Information Processing	Encoding Rule Inference Rule Application Confirmation Learning Flexibility	Reasoning Battery Info. Process Measures STIX Test	
Metacognitive	Thinking Ahead Problem Identification Planning Prioritization Self-Monitoring Situational Awareness	NONE	Analyze ATST for Measurement Possibilities [b]
Attention	Sustained Attention Recall From Interruption Timesharing	Ships/Planes Test [c]	Add scale to PEAQ [a] Develop Test Parallel Ships Test for Multitasking aspect of Timesharing

[a] Proposed new measure completed.
[b] The SACHA team completed an investigation of the ATST for measurement possibilities. We are currently designing a metacognitive test based on this analysis.
[c] We renamed the Ships test to Planes for face validity purposes.

Table 3.1.6. Temperament/Interpersonal Model

Big Five	Temperament/Interpersonal Construct Categories (Hough's Taxonomy)		Temperament/Interpersonal Constructs
	Affiliation	→	[none]
Extraversion →	Potency	→	Professionalism [a] (I) Taking Charge [b] (W) Self-Esteem [b] (S)
Conscientiousness →	Achievement [b]	→	Self-Esteem [b] (S) Self-Confidence [b] (S) Execution [b] (W) Task Closure/Thoroughness [b] (W) Motivation (W) Commitment to the Job (W)
	Dependability	→	Task Closure/Thoroughness [b] (W) Behavioral Consistency (W) Working Cooperatively [b] (I)
Neuroticism →	Adjustment	→	Self-Esteem [b] (S) Flexibility (A) Composure (A) Tolerance for High Intensity Work Situations (A)
Agreeableness →	Agreeableness	→	Working Cooperatively [b] (I) Interpersonal Tolerance (I)
Openness →	Intellectance	→	[none]
	Rugged Individualism	→	Decisiveness (W) Realistic Orientation (W)
	Locus of Control	→	Taking Charge [b] (W) Execution (W) Internal Locus of Control (S)
	Focus [c]	→	Self Awareness (S) Concentration (W) Attention to Detail (W)

[a] The letters included in the parentheses indicate SACHA's initial worker requirement categorization (W = Work and Effort, I = Interpersonal, S = Self-Efficacy, A = Stability/Adjustment).
[b] Included in more than one higher-order construct.
[c] Not part of Hough's taxonomy.

EXHIBIT 3.2.1 PILOT TEST ADMINISTRATION TEST BLOCK SEQUENCING					
GROUPS	**SESSION 1**	**SESSION 2**	**SESSION 3**	**SESSION 4**	**SESSION 5**
Group 1 Computers 1 - 10	Block A	Block B	Block C	Block D	Ending Block 1 LFT
Group 2 Computers 11 - 20	Block B	Block E	Block A	Block C	Ending Block 2 ATS
Group 3 Computers 21 - 30	Block C	Block A	Block D	Block E	Ending Block 3 SVCM, Word Memory
Group 4 Computers 31 - 40	Block D	Block C	Block E	Block B	Ending Block 4 Word Memory, TWPR
Group 5 Computers 41 - 50	Block E	Block D	Block B	Block A	Ending Block 1 LFT

EXHIBIT 3.2.2 AIR TRAFFIC SCENARIOS TEST EXAMPLE OF THE PLANE DESCRIPTORS

F   3   B

☐   ☐   ☐

The first letter
indicates the speed.
F = Fast
M = Medium
S = Slow

The number indicates
The level. There are
four levels. "1" is
the lowest (closest to the
ground) while "4" is the
Highest (furthest from
The ground).

The second letter
indicates the
destination. "A",
"B", "C", and "D"
are exits out of
your airspace. "E"
and "F" are airports.

	EXHIBIT 3.2.3	
	SUMMARY OF THE PROPOSED REVISIONS	
	TO THE AT-SAT PILOT TEST	
TEST BLOCK	TESTS	SUGGESTED REVISIONS
BLOCK A	**Air Traffic Scenarios**	◻ Clarify general test instructions ◻ Clarify the meaning of and action to take on the new planes ◻ Modify the countdown ◻ Further clarify the purpose and position of the landing heading indicator
BLOCK B	**Sound Test**	◻ Clarify test instructions ◻ Clarify the keys to use for the sound level adjustment ◻ Instruct participants to remove the headphones after the test
	Letter Factory Test	◻ Clarify test instructions ◻ Clarify the demonstration ◻ Clarify the instructions for the mouse exercise ◻ Put a time limit on the mouse exercise
BLOCK C	**Dials Test**	◻ No changes needed
	Static Vector/ Continuous Memory Test	◻ Clarify test instructions ◻ Explain and familiarize the participants with the keys needed to answer the scenarios
	Experiences Questionnaire	◻ No changes needed
BLOCK D	**Time Wall/ Pattern Recognition Test**	◻ Relocate the broken wall ◻ Explain and familiarize the participants with the keys needed to answer the scenarios
	Analogy Test	◻ Reduce the required level of vocabulary and reasoning skills
	Classification Test	◻ Reduce the required level of vocabulary and reasoning skills
BLOCK E	**Word Memory Test**	◻ Remove the scoring for the test items ◻ Remove the extraneous window prompts
	Scan Test	◻ Clarify the test instructions
	Planes Test	◻ Reduce the length of the practice session ◻ Modify the keystrokes for "True" and "False" ◻ Remove the scoring for each test item

EXHIBIT 3.2.3 CONTINUED SUMMARY OF THE PROPOSED REVISIONS TO THE AT-SAT PILOT TEST		
BLOCK E	**Angles Test**	☐ None
	Applied Mathematics Test	☐ Clarify the test instructions ☐ Reduce the level of required mathematics skills
ENDING BLOCK (**Groups 1, 5**)	**Letter Factory Test**	☐ Clarify test instructions ☐ Clarify the demonstration ☐ Clarify the instructions for the mouse exercise ☐ Put a time limit on the mouse exercise
ENDING BLOCK (**Group 2**)	**Air Traffic Scenarios Test**	☐ Clarify general test instructions ☐ Clarify the meaning of and action to take on the new planes ☐ Modify the countdown ☐ Further clarify the purpose and position of the landing heading indicator
ENDING BLOCK (**Group 3**)	**Static Vector/ Continuous Memory Test & Word Memory**	☐ Clarify test instructions (SV) ☐ Explain and familiarize the participants with the keys needed to answer the scenarios (SV) ☐ Remove the scoring for the test items (WM) ☐ Remove the extraneous window prompts (WM)
ENDING BLOCK (**Group 4**)	**Word Memory & Time Wall/ Pattern Recognition Test**	☐ Remove the scoring for the test items (WM) ☐ Remove the extraneous window prompts (WM) ☐ Relocate the broken wall (TW) ☐ Explain and familiarize the participants with the keys needed to answer the scenarios (TW)

Table 3.3.1. Item Analyses and Scale Reliabilities: Non-Semantic Word Scale on the Analogy Test (N=439)

Item Number	Corrected Item-Total Correlation	Rerun of Corrected Item-Total Correlation	Information-Processing Corrected Item-Total Correlation[a]	
			Total Screen Views	Total Item Response Time
1	.08	---	---	---
2	.16	.17	.36	.46
4	-.01	---	---	---
6	.19	.18	.45	.49
8	.19	.21	.36	.44
11	.17	.18	.44	.56
12	.14	.15	.43	.53
14	.00	---	---	---
16	.09	.16	.30	.45
18	.03	---	---	---
20	.22	.23	.37	.42
22	.09	---	---	---
24	.27	.26	.34	.46
28	-.01	---	---	---
30	.15	.12	.38	.49
	Alpha = .39	Alpha = .44	Alpha = .84	
	15 Items	9 Items	9 Items	

[a]Standardized score

Table 3.3.2. Item Analyses and Scale Reliabilities: Semantic Word Scale on the Analogy Test (N=439)

Item Number	Corrected Item-Total Correlation	Rerun of Corrected Item-Total Correlation	Information-Processing Corrected Item Total Correlation[a]	
			Total Screen Views	Total Item Response Time
3	.03	---	---	---
5	.24	.24	.31	.38
7	.09	---	---	---
9	.15	.17	.32	.41
10	.13	.13	.30	.39
13	.20	.19	.29	.40
15	.14	.14	.40	.54
17	.33	.34	.30	.42
19	.12	.11	.33	.45
21	.13	.13	.42	.52
23	.20	.20	.35	.40
25	.23	.23	.38	.49
26	.28	.31	.34	.45
27	.02	---	---	---
29	.33	.33	.39	.42
	Alpha = .50	Alpha = .52	Alpha = .84	
	15 Items	12 Items	24 Items	

[a]Standardized score

Table 3.3.3. Item Analyses and Scale Reliabilities: Semantic Visual Scale on the Analogy Test (N=439)

Item Number	Corrected Item-Total Correlation	Rerun of Corrected Item-Total Correlation	Information-Processing Corrected Item-Total Correlation[a]	
			Total Screen Views	**Total Item Response Time**
31	.20	.22	.33	.40
34	.19	.23	.41	.43
35	.16	.13	.40	.42
37	.14	.17	.40	.28
39	.24	.26	.39	.30
41	.16	.15	.47	.42
44	.04	---	---	---
47	.06	---	---	---
50	.26	.28	.35	.36
51	.09	---	---	---
	Alpha = .40	Alpha = .44	Alpha = .77	
	10 Items	7 Items	14 Items	

[a]Standardized score

Table 3.3.4. Item Analyses and Scale Reliabilities: Non-Semantic Visual Scale on the Analogy Test (N=439)

Item Number	Corrected Item-Total Correlation	Rerun of Corrected Item-Total Correlation	Information-Processing Corrected Item-Total Correlation[a]	
			Total Screen Views	Total Item Response Time
32	.25	.25	.56	.56
33	.26	.26	.61	.57
36	.26	.26	.66	.51
38	.26	.26	.52	.48
40	.40	.40	.43	.49
42	.41	.41	.57	.52
43	.37	.37	.49	.54
45	.22	.22	.69	.69
46	.35	.35	.56	.60
48	.30	.30	.62	.61
49	.18	.18	.62	.66
52	.37	.37	.52	.52
53	.18	.18	.52	.57
	Alpha = .67	Alpha = .67	Alpha = .93	
	13 Items	13 Items	26 Items	

[a]Standardized score

Table 3.3.5. Distribution of Test Completion Times for the Analogy Test

Percentile	Test Completion Time (Minutes)
Minimum	6.1
5th	10.1
25th	14.9
50th	18.8
75th	24.3
95th	32.1
Maximum	35.6
Mean	19.8
SD	6.59

Table 3.3.6. Estimates of Test Length to Increase Reliability of the Analogy Test

Test Part	Current Test		No. Items Needed for Alpha =	
	No. Items	**Alpha**	**.90**	**.80**
Non-Semantic Visual	13	.67	59	26
Non-Semantic Words	9	.44	102	46
Semantic Visual	6	.42	76	34
Semantic Words	12	.52	98	44
Total No. Items	40		335	150
Estimated Test Time			190 minutes	85 minutes

Table 3.3.7. Item Analyses and Scale Reliabilities: Non-Semantic Word Scale on the Classification Test (N=427)

Item Number	Corrected Item-Total Correlation[a]
1	.03
4	.06
5	.12
6	.07
8	.03
9	.03
13	.06
14	.07
16	.05
18	.00
21	.08
22	.05

Alpha = .10

12 Items

[a]Standardized score

Table 3.3.8. Item Analyses and Scale Reliabilities: Semantic Word Scale on the Classification Test (N=427)

Item Number	Corrected Item-Total Correlation	Rerun of Corrected Item-Total Correlation	Information-Processing Corrected Item-Total Correlation[a]	
			Total Screen Views	Total Item Response Time
2	.04	---	---	---
3	.21	.23	.48	.36
7	.20	.21	.40	.45
10	.22	.19	.42	.40
11	.10	.13	.32	.51
12	.16	.16	.41	.45
15	.01	---	---	---
17	.22	.21	.41	.48
19	.26	.28	.30	.51
20	.28	.28	.20	.32
23	.22	.23	.44	.43
	Alpha = .46	Alpha = .49	Alpha = .82	
	11 Items	9 Items	18 Items	

[a]Standardized score

Table 3.3.9. Item Analyses and Scale Reliabilities: Non-Semantic Visual Scale on the Classification Test (N=427)

Item Number	Corrected Item-Total Correlation	Rerun of Corrected Item-Total Correlation	Information-Processing Corrected Item-Total Correlation[a]	
			Total Screen Views	Total Item Response Time
24	.10	.10	.34	.40
27	.09	.10	.48	.60
28	.04	---	---	---
31	.23	.24	.48	.51
33	.03	---	---	---
36	.02	---	---	---
37	.10	.13	.68	.60
38	.17	.18	.46	.52
39	.15	.14	.29	.24
42	.10	.07	.49	.51
43	.15	.14	.51	.53
45	.15	.17	.41	.46
46	.25	.25	.52	.41
	Alpha = .36	Alpha = .40	Alpha = .87	
	13 Items	10 Items	20 Items	

[a]Standardized score

Table 3.3.10. Item Analyses and Scale Reliabilities: Semantic Visual Scale on the Classification Test (N=427)

Item Number	Corrected Item-Total Correlation	Rerun of Corrected Item-Total Correlation	Information-Processing Corrected Item-Total Correlation[a]	
			Total Screen Views	Total Item Response Time
25	.14	.15	.46	.35
26	.06	---	---	---
29	.10[b]	---	---	---
30	.05	---	---	---
32	.06	---	---	---
34	-.01	---	---	---
35	-.08	---	---	---
40	.05	---	---	---
41	.11	.09	.51	.44
44	.13	.12	.37	.41
	Alpha = .18	Alpha = .23	Alpha = .69	
	10 Items	3 Items	6 Items	

[a]Standardized score
[b]The alpha was higher excluding this item.

Table 3.3.11. Distribution of Test Completion Times for the Classification Test (N=427)

Percentile	Test Completion Time (Minutes)
Minimum	2.9
5th	6.3
25th	9.6
50th	12.0
75th	15.8
95th	21.7
Maximum	25.4
Mean	12.86
SD	4.69

Table 3.3.12. Estimates of Test Length to Increase Reliability of the Classification Test

Test Part	Current Test		No. Items Needed for Alpha =	
	No. Items	**Alpha**	**.90**	**.80**
Non-Semantic Visual	10	.40	138	61
Semantic Visual	3	.23	92	41
Semantic Words	9	.50	83	37
Total No. Items	22		313	139
Estimated Test Time			138 minutes	63 minutes

Table 3.3.13. Planning/Thinking Ahead: Distribution of Total Number Correct on the Letter Factory Test (Form A) (N = 441)

Percentile	Number of Attempts
Minimum	0
5th	35
25th	56
50th	67
75th	74
95th	80
Maximum	85
Mean	63.39
SD	14.64

Table 3.3.14. Distribution of Number of Inappropriate Attempts to Place a Box in the Loading Area on the Letter Factory Test (Form A) (N = 441)

Percentile	Number of Attempts
Minimum	0
5th	2
25th	7
50th	13
75th	25
95th	99
Maximum	448
Mean	26.78
SD	46.27

Table 3.3.15. Recall from Interruption (RI) Score Analyses on the Letter Factory Test (Form A) (N = 405)

Sequence No.	Pre-Interruption Sequence Scores			Post-Interruption Sequence Scores			Difference Score (Post-Pre)	
	No. of Items Within Sequence	Mean	SD	No. of Items Within Composite	Mean	SD	Mean	SD
4	16	14.5	1.49	16	13.7	2.08	-0.81	1.68
6	16	15.2	1.08	16	14.08	1.63	-1.12	1.57
8	20	19.15	1.65	20	17.69	2.49	-1.46	1.98
11	11	10.04	1.54	11	8.15	1.54	-1.89	1.76
Scale Statistics	63	58.89	4.57	63	53.62	5.87	-5.27	3.64
	Alpha = .79 4 items (sequence scores)			Alpha = .73 4 items (sequence scores)			Alpha = .10 4 items (difference scores)	

Table 3.3.16. Planning/Thinking Ahead: Reliability Analysis on the Letter Factory Test (Form A) (N = 405)

Sequence No.	No. of Items Within Sequence	Mean For Each Sequence	Corrected Sequence-Total Correlation	Alpha if Sequence Deleted
2	9	2.81	.60	.85
3	7	3.60	.63	.85
4	13	7.20	.66	.84
6	13	7.80	.66	.84
7	8	4.89	.62	.85
8	12	6.39	.69	.84
11	9	3.37	.61	.85

Alpha = .86   7 items (composite scores)

Table 3.3.17. Situational Awareness (SA) - Reliability Analysis: Three Scales on the Letter Factory Test (Form A) (N = 405)

	Sequence No. (Item No.)	Before Item Deletion Corrected Item-Total Correlation	After Item Deletion Corrected Item-Total Correlation	Alpha if Item Deleted
SA Level 1	2(1)	.14	.14	.41
	2(2)	.25	.24	.36
	4(1)	-.09	---	---
	4(2)	.17	.21	.37
	6(1)	.15	.18	.38
	6(2)	.07	---	---
	6(3)	.18	.20	.38
	6(4)	.13	.19	.38
	8(1)	.02	---	---
	8(2)	-.12	---	---
	8(3)	.06	---	---
	8(4)	.10	.11	.42
	11(1)	.17	.17	.39
	11(2)	.09	---	---
	Alpha = .31 14 items		Alpha = .42 8 items	
SA Level 2	1(1)	.32	.33	.58
	1(2)	.30	.30	.58
	1(3)	.38	.41	.55
	1(4)	.20	.23	.60
	5(1)	.31	.35	.57
	5(2)	.26	.26	.59
	5(3)	.01	---	---
	5(4)	-.03	---	---
	9(1)	.27	.28	.59
	9(2)	.31	.34	.57
	9(3)	.15	.15	.61
	9(4)	.04	---	---
	10(1)	-.01	---	---
	10(2)	.20	.18	.61
	10(3)	.11	.12	.62
	10(4)	.09	---	---
	Alpha = .53 16 items		Alpha = .61 11 items	

Table 3.3.17. Situational Awareness (SA) - Reliability Analysis: Three Scales on the Letter Factory Test (Form A) (N = 405) (Continued)

	Sequence No. (Item No.)	Before Item Deletion Corrected Item-Total Correlation	After Item Deletion Corrected Item-Total Correlation	Alpha if Item Deleted
SA Level 3	2(3)	.21	.11	.49
	2(4)	.05	---	---
	3(1)	.20	.24	.42
	3(2)	.21	.30	.42
	3(3)	.24	.33	.38
	3(4)	.18	.24	.42
	4(3)	.04	---	---
	4(4)	.01	---	---
	7(1)	.07	---	---
	7(2)	.00	---	---
	7(3)	.07	---	---
	7(4)	.04	---	---
	11(3)	.11	.13	.47
	11(4)	.17	.26	.42
	Alpha = .32 14 items		Alpha = .47 7 items	

Table 3.3.18. Situational Awareness (SA) - Reliability Analysis: One Scale on the Letter Factory Test (Form A) (N = 405)

	Sequence No. (Item No.)	Item Difficulty	Corrected Item-Total Correlation	Alpha if Item Deleted
SA Level 1	2(1)	.47	.08	.69
	2(2)	.33	.29	.67
	4(2)	.45	.23	.67
	6(1)	.40	.17	.68
	6(3)	.47	.27	.67
	6(4)	.49	.15	.68
	8(4)	.38	.13	.68
	11(1)	.76	.20	.68
SA Level 2				
	1(1)	.67	.27	.67
	1(2)	.62	.28	.67
	1(3)	.45	.38	.66
	1(4)	.46	.17	.68
	5(1)	.48	.34	.66
	5(2)	.45	.28	.67
	9(1)	.45	.29	.67
	9(2)	.35	.39	.66
	9(3)	.17	.16	.68
	10(2)	.61	.24	.67
	10(3)	.18	.11	.68
SA Level 3				
	2(3)	.45	.23	.67
	3(1)	.36	.22	.67
	3(2)	.09	.25	.67
	3(3)	.62	.34	.66
	3(4)	.37	.18	.68
	11(3)	.14	.11	.68
	11(4)	.21	.10	.68

Note. Scale Statistics: Mean = 10.87 ; SD = 4.05; Alpha = .68 (26 items)

Table 3.3.19. Planning/Thinking Ahead: Distribution of Total Number Correct on the Letter Factory Test (Form B) (N = 217)

Percentile	Number of Attempts
Minimum	0
5th	16
25th	28
50th	33
75th	36
95th	38
Maximum	40
Mean	30.77
SD	7.29

Table 3.3.20. Distribution of Number of Inappropriate Attempts to Place a Box in the Loading Area on the Letter Factory Test (Form B) (N = 217)

Percentile	Number of Attempts
Minimum	0
5th	0
25th	2
50th	5
75th	13
95th	54
Maximum	135
Mean	13.09
SD	20.73

Table 3.3.21. Tests of Performance Differences Between LFT and Retest LFT (N = 184)

| Variable | LFT Mean Score | | R | t-value |
	Test	Retest		
Planning & Thinking Ahead	20.72	22.42	.763	3.25***
Situational Awareness	4.70	4.75	.508	0.30

*** $p < .001$

Table 3.3.22. Distribution of Test Completion Times for the Letter Factory Test (N = 405)

Percentile	Test Completion Time (Minutes)
Minimum	31.0
5th	41.0
25th	46.4
50th	50.9
75th	55.8
95th	64.9
Maximum	107.3
Mean	51.77
SD	7.63

Table 3.3.23. Proposed Sequence Length and Number of Situational Awareness Items for the Letter Factory Test

Sequence Length (Minutes)	Number	Number SA Items		
		Level 1	Level 2	Level 3
0.5	6		24	
2.5	12	24		2

Note. These recommended sequences would provide a test time of 45 minutes (not including instructions) based on our experience on the current LFT.

Table 3.3.24. Distribution of Number Correct Scores on the Scan Test (N = 429)

Percentile	Number Correct Scores
Minimum	22
5th	77
25th	120
50th	128
75th	136
95th	146
Maximum	158
Mean	123.73
SD	21.78

Table 3.3.25. Scanning: Reliability Analyses on the Scan Test

| Sequence | With Change Items[a] | | Without Change Items[a] | | | Without Any Part of Change Items[b] | | |
| | | | | Alpha | | | Alpha | |
	No. Items	Alpha	No. Items	Actual	Expected[c]	No. Items	Actual	Expected[c]
T1	61	.88	51	.88	.86	41	.89	.83
T2	63	.84	54	.87	.87	45	.85	.79
T3	61	.84	53	.84	.82	45	.83	.79
T4	54	.88	45	.87	.85	35	.86	.80

[a]N = 151

[b]N = 429

[c]"Expected" alphas were calculated using the Spearman-Brown Formula to step down reliabilities based on a reduced number of "like" items.

Table 3.3.26. Distribution of Test Completion Times for the Scan Test (N = 429)

Percentile	Test Completion Time (Minutes)
Minimum	13.57
5th	14.45
25th	15.58
50th	16.85
75th	17.93
95th	19.87
Maximum	25.50
Mean	16.92
SD	1.75

Table 3.3.27. Reliability Analyses on the Three Parts of the Planes Test

Test Section	No. Items	No. Examinees[a]	No. Items With Item-Total Correlations < .100	Alpha
Part 1	48	297	8	.76
Part 2	48	314	0	.84
Part 3	96	103	24	.80

[a]This is the number meeting all inclusion criteria <u>and</u> having data for all items.

Table 3.3.28. Distribution of Test Completion Times for the Planes Test

Percentile	Test Completion Time (Minutes)
Minimum	14.1
5th	20.0
25th	25.0
50th	28.3
75th	30.6
95th	34.6
Maximum	39.5
Mean	27.73
SD	4.42

Table 3.3.29. Generalizabilty Analyses and Reliability Estimates

Variable	Trials	Variance Components:				error	Reliabilities with number of trials =							
		T(rial)	G(roup)	T*G	SSN(G)	SSN*T	1	2	3	4	5	6	7	8
Air Traffic Scenarios Test														
SEPSKILL	P1-2,T1-4	132.43	5.00	2.35	124.66	632.21	0.16	0.28	0.37	0.44	0.50	0.54	0.58	0.61
	P2, T1-4	118.18	3.44	2.86	118.65	612.46	0.16	0.28	0.37	0.44	0.49	0.54	0.58	0.61
	T1-T4	115.88	5.74	4.40	97.60	546.17	0.15	0.26	0.35	0.42	0.47	0.52	0.56	0.59
	T2-T4	136.43	4.10	8.80	106.67	425.51	0.20	0.33	0.43	0.50	0.56	0.60	0.64	0.67
	T3-T4	0.00	10.57	5.85	222.97	207.59	0.52	0.68	0.76	0.81	0.84	0.87	0.88	0.90
PRCSKILL	P1-2,T1-4	12.84	3.93	0.00	267.24	343.24	0.44	0.61	0.70	0.76	0.80	0.82	0.84	0.86
	P2, T1-4	9.45	1.82	0.00	292.95	257.54	0.53	0.69	0.77	0.82	0.85	0.87	0.89	0.90
	T1-T4	8.94	1.61	0.02	312.14	194.76	0.62	0.76	0.83	0.87	0.89	0.91	0.92	0.93
	T2-T4	9.16	0.53	0.00	270.96	171.84	0.61	0.76	0.83	0.86	0.89	0.90	0.92	0.93
	T3-T4	5.69	0.15	0.00	242.15	119.67	0.67	0.80	0.86	0.89	0.91	0.92	0.93	0.94
EFFNCYA	P1-2,T1-4	190.92	0.00	0.58	200.71	264.65	0.43	0.60	0.69	0.75	0.79	0.82	0.84	0.86
	P2, T1-4	93.30	0.00	0.84	215.22	239.49	0.47	0.64	0.73	0.78	0.82	0.84	0.86	0.88
	T1-T4	95.33	0.00	2.20	189.42	156.17	0.55	0.71	0.78	0.83	0.86	0.88	0.89	0.91
	T2-T4	134.88	0.00	3.28	210.56	158.53	0.57	0.73	0.80	0.84	0.87	0.89	0.90	0.91
	T3-T4	50.55	0.00	4.85	261.42	163.73	0.61	0.76	0.83	0.86	0.89	0.91	0.92	0.93
EFFNCYB	P1-2,T1-4	3.96	0.10	0.19	53.49	104.38	0.34	0.51	0.61	0.67	0.72	0.75	0.78	0.80
	P2, T1-4	3.77	0.00	0.25	63.64	87.20	0.42	0.59	0.69	0.74	0.78	0.81	0.84	0.85
	T1-T4	5.13	0.00	0.02	84.13	73.87	0.53	0.69	0.77	0.82	0.85	0.87	0.89	0.90
	T2-T4	6.79	0.00	0.22	100.32	69.45	0.59	0.74	0.81	0.85	0.88	0.90	0.91	0.92
	T3-T4	12.13	0.00	0.00	142.24	57.40	0.71	0.83	0.88	0.91	0.93	0.94	0.95	0.95
Time Wall/Pattern Recognition Test														
PRACCY	T1-T3	0.36	2.51	0.51	84.27	39.85	0.68	0.81	0.86	0.89	0.91	0.93	0.94	0.94
	T2-T3	0.19	4.04	0.17	92.34	35.03	0.72	0.84	0.89	0.91	0.93	0.94	0.95	0.95
PRSPEED	T1-T3	10.77	1.76	0.32	65.59	27.05	0.71	0.83	0.88	0.91	0.92	0.94	0.94	0.95
	T2-T3	3.59	2.21	0.46	80.35	22.40	0.78	0.88	0.91	0.93	0.95	0.96	0.96	0.97
TWACCY	T1-T3	2.86	0.33	1.77	52.78	48.20	0.52	0.69	0.77	0.81	0.85	0.87	0.88	0.90
	T2-T3	0.87	1.11	0.00	59.61	41.34	0.59	0.74	0.81	0.85	0.88	0.90	0.91	0.92

Table 3.3.30. Correlation of Alternative ATST Composites with End-of-Day Retest Measure

Composite	Correlation with Retest Measure:				Composite	Correlation with Retest Measure:		
	SEPSKLL	PRCSKLL	EFFNCYA	EFFNCYB		PRACC4	PRSPD4	TWACC4
SEPSK1-6	0.08	0.45	0.16	-0.10	PRACC1-3	0.37	-0.03	0.09
SEPSK2-6	0.14	0.40	0.16	-0.16	PRACC2-3	0.41	-0.08	0.12
SEPSK3-6	0.23	0.37	0.19	-0.09	PRACC3	0.47	-0.13	0.12
SEPSK4-6	0.21	0.33	0.14	-0.01	PRACCWT	0.28	-0.12	0.13
SEPSK5-6	0.37	0.19	0.25	0.10				
SEPSK6	0.38	0.15	0.21	0.08	PRSPD1-3	-0.12	0.58	0.08
SEPSKWT	0.26	0.31	0.21	0.02	PRSPD2-3	-0.19	0.55	0.06
					PRSPD3	-0.15	0.51	0.06
PRCSK1-6	0.17	0.64	0.20	-0.03	PRSPDWT	-0.16	0.67	0.11
PRCSK2-6	0.18	0.71	0.18	-0.11				
PRCSK3-6	0.18	0.75	0.21	-0.14	TWACC1-3	0.21	-0.01	0.50
PRCSK4-6	0.16	0.76	0.18	-0.16	TWACC2-3	0.22	-0.04	0.49
PRCSK5-6	0.14	0.77	0.10	-0.20	TWACC3	0.08	-0.02	0.43
PRCSK6	0.17	0.76	0.11	-0.23	TWACCWT	0.18	-0.07	0.52
PRCSKWT	0.18	0.77	0.20	-0.18				
EFFNA1-6	0.09	0.40	0.59	0.21	Note:			
EFFNA2-6	0.08	0.34	0.64	0.22	SETSKILL - Avoiding separation errors/crashes			
EFFNA3-6	0.10	0.27	0.67	0.22	PRCSKILL - Avoiding procedural errors			
EFFNA4-6	0.09	0.24	0.69	0.22	EFFNCA - % reaching destination			
EFFNA5-6	0.13	0.19	0.73	0.27	EFFNCB - Speed in reaching destination			
EFFNCA6	0.17	0.16	0.71	0.18	PRACCY - % correct pattern classificaitons			
EFFNAWT	0.10	0.24	0.73	0.24	PRSPD - Speed in making correct pattern judgments			
					TWACCY - Nearness to the Time Wall			
EFFNB1-6	-0.07	-0.14	0.31	0.46	xxxxxxm-n - Mean over trials m through n for xxxxxx			
EFFNB2-6	-0.07	-0.22	0.35	0.54	xxxxxxWT - Weighted mean over trials for xxxxxx			
EFFNB3-6	-0.09	-0.23	0.38	0.60				
EFFNB4-6	-0.11	-0.18	0.37	0.61				
EFFNB5-6	-0.16	-0.23	0.26	0.63				
EFFNCB6	-0.18	-0.21	0.24	0.61				
EFFNBWT	-0.14	-0.21	0.33	0.64				

Table 3.3.31. Time Distributions for Current Tests
(Based on Cases Completing All Trials)

Test	Instruction Time			Total Time		
	5th	Median	95th	5th	Median	95th
AT	2.5	5.5	9.5	88.6	91.7	97.0
TW	1.1	2.8	4.8	20.8	24.8	29.9