



NASA Task Load Index (TLX) for iOS

An Essential Workload Measure in the Human Performance Toolbox

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What is Workload?

- The effort to accomplish a set of tasks
- Has physical, temporal, and cognitive demands
- Suboptimal if too low or too high



<https://classteaching.wordpress.com/2017/02/27/workload-matters/>



<https://www.nts.gov/news/press-releases/Pages/PR20170619.aspx>



<https://www.istockphoto.com/photos/heavy-workload>

Safety Impacts of Excessive Workload

Aviation



Since 2009, workload has been identified as a contributing factor in **6,712 close-call and safety incident reports** by the Aviation Safety Reporting System (ASRS)

Medicine



Preventable errors from excessive workload has been cited for as many as **98,000 patient deaths in hospitals per year**

NASA TLX Measures Workload

- The most widely-used rating methodology to measure workload
- Multidimensionality captures the complexity of the various factors of workload
- Recognized as the *gold standard* (used in over 4,400 studies), diagnostic, subjective workload measurement approach





NASA TLX: Original Paper-and-Pencil Version



Appendix C
Subject ID: AX532 Task ID: TAXIWAY-A46

RATING SHEET

MENTAL DEMAND
Low X High

PHYSICAL DEMAND
Low X High

TEMPORAL DEMAND
Low X High

PERFORMANCE
Good X

EFFORT
Low X High

FRUSTRATION
Low X High

Appendix E
Subject ID: AX532 Task ID: TAXIWAY-A46

WEIGHTED RATING WORKSHEET

Scale Title	Weight	Raw Rating	Adjusted Rating (Weight X Raw)
MENTAL DEMAND	0.27	55	14.85
PHYSICAL DEMAND	0.20	20	4.00
TEMPORAL DEMAND	0.20	40	8.00
PERFORMANCE	0.20	70	14.00
EFFORT	0.13	70	9.10
FRUSTRATION	0.00	60	0.00

Sum of "Adjusted Rating" Column = 49.95

WEIGHTED RATING = [i.e., (Sum of Adjusted Ratings)/15] 3.33

Effort or Physical Demand

Performance or Temporal Demand

Performance or Frustration

Frustration or Effort



NASA TLX for iOS



Appendix C
Subject ID: 4X532 Task ID: TAXIWAR-A16

RATING SHEET

Appendix E
Subject ID: 4X532 Task ID: TAXIWAR-A16

WEIGHTED RATING WORKSHEET

Scale Title	Weight	Raw Rating	Adjusted Rating (Weight X Raw)
MENTAL DEMAND	0.27	55	14.85
PHYSICAL DEMAND	0.20	20	4.00
TEMPORAL DEMAND	0.20	40	8.00
PERFORMANCE	0.20	70	14.00
EFFORT	0.13	70	9.10
FRUSTRATION	0.00	60	0.00

Sum of "Adjusted Rating" Column = 49.95

WEIGHTED RATING =
[i.e., (Sum of Adjusted Ratings)/15] 3.33

16 of 21

Tap your response on the scale below.

Frustration
How insecure, discouraged, irritated, stressed, and annoyed were you during this task?

14 of 21

Tap the factor below that represents the more important contributor to workload for the specific task that you recently performed.

Effort

Physical Demand

9:41 AM

History

Subject : E-302
Condition : Cockpit Fatigue 2
Trial : 1
7/29/16 3:52 PM

	Rating	Tally	Weight
Mental Demand	95	2	0.13
Physical Demand	50	3	0.20
Temporal Demand	70	3	0.20
Performance	15	3	0.20
Effort	40	2	0.13
Frustration	65	2	0.13

Overall Score: 53.00



Summary of NASA TLX for iOS



Innovation and Creativity

- Accurately captures the original intent of the paper rating scale
- Provides a non-biased, consistent scoring mechanism from user input
- Delivers real-time, on-demand analysis output as research study unfolds
- Generates data visualizations to aid researchers or operational decision makers when viewing workload score trends over time
- Opens up powerful new opportunities to optimize human-system design through workload measurement

Usage

- Has been downloaded by over 11,300 users, is actively being used by over 3700 users across the USA, Canada, Asia Pacific, Europe, Latin America, The Caribbean, and Africa, with an average of 5.32 uses per month per device. In 2019, TLX for iOS was used 900 times per month.

Software Quality

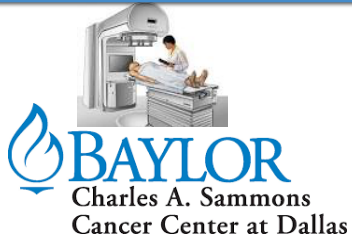
- Rigorous development and testing process, rapidly matured to TRL 9
- 9 iOS crashes in v1.0.2 (02/2017-06/2019), no crashes in current v1.0.3 (released 06/2019)

7

NASA TLX Uses



Extensive use of NASA TLX in medical and health care workload assessments



Radiation Therapy Supervisor

Uses the NASA TLX app for iOS in one of our studies for workload and radiotherapy tasks



Internal Medicine

Uses the NASA TLX app for a non-profit research task exploring information overload



Assistant Program Director, Internal Medicine Residency

Working with the American Medical Association on a project to establish standards between task load and burnout



Impact on NASA: Aviation Aviation Safety Program, Cockpit Operations

Operational testing to assess cockpit operations on the airport surface

"The iOS version ... allows for this important validated subjective workload tool to be available and used in many new user experience, research laboratory, and field studies."

— David C. Foyle, Ph.D.
Human Systems Integration Division

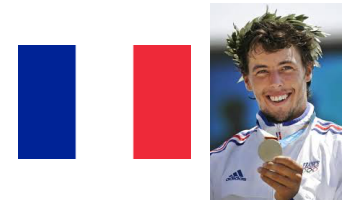
Impact on NASA Ames: Aerospace, Human Research Program, Intelligent Systems

Critical Design Inputs for Advanced Caution and Warning Systems – Paper to Digital Transition

"...The new TLX iOS [app] provides a major advance in the ability to collect workload data. Its ease of use and portability greatly enhances the collection of workload data..."

— Brent R. Beutter, Ph.D. Assistant Chief
Human-Systems Integration Division

- French national canoe team has been using TLX iOS app to follow up on athletes to prevent exhaustion and maximize team performance for national competitions



"We do use the NASA TLX [iOS app] to follow the impact of training with the athletes I work with...help[ing] them to achieve their goal at the Olympic Games! Every detail counts!"

— Benoît Peschier
Olympic Gold Medalist, Slalom Canoeing
French National Canoe Team





Summary of NASA TLX for iOS



Impact

TLX is being used to:

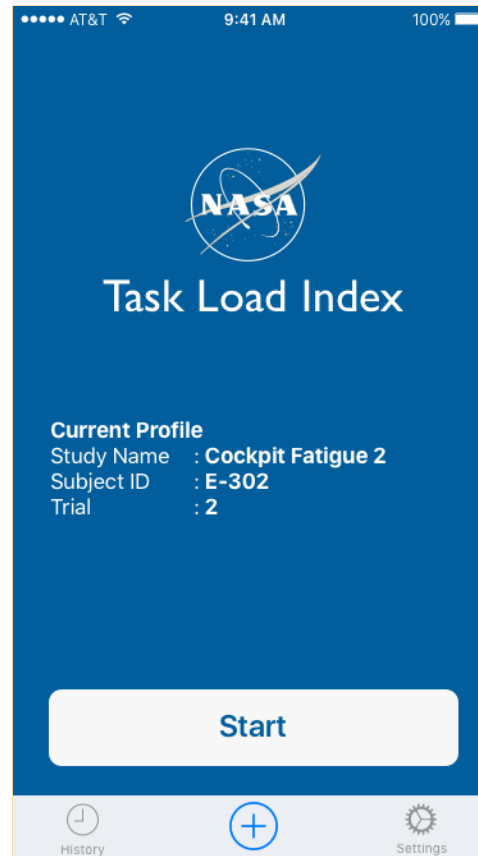
- Enhance cockpit designs and FAA air traffic control operations
- Improve safety at hospitals and nuclear power plants
- Enable comparisons across scientific studies

Significance

- Intuitive
- Ease of use in any environment
- Minimizes bias in data entry and quantization error in the scale
- Eliminates researcher subjectivity during workload scoring
- Brings a traditionally 'research-oriented' tool to the mainstream for operational decision-making



Walkthrough





Thank you!

NASA TLX for iOS – available at :

<https://itunes.apple.com/us/app/nasa-tlx/id1168110608>

<https://humansystems.arc.nasa.gov/groups/TLX/tlxapp.php>
<https://humansystems.arc.nasa.gov/groups/TLX/>

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