2018

Mental workload assessment: knowledge-bases based upon the features of the original NASA Task Load Index

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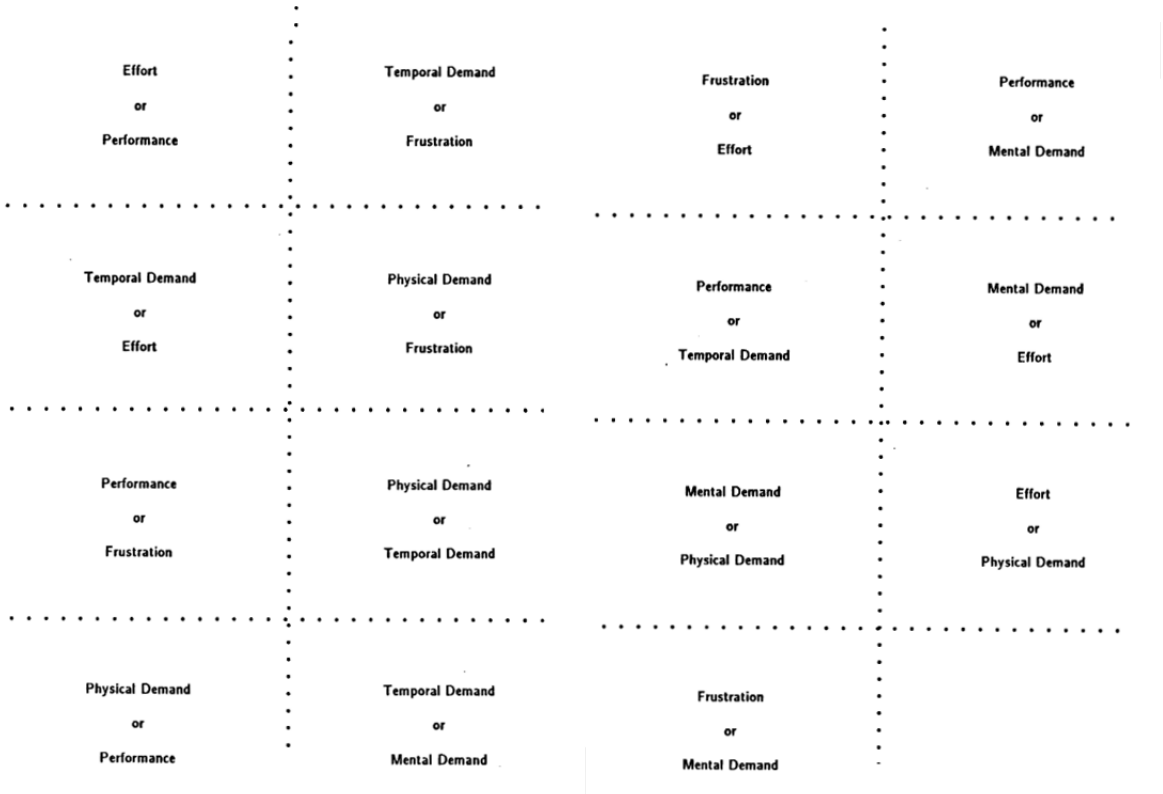
Contents

1 Dimensions descriptions and pair-wise comparison

. Hart, S.G., Staveland, L.E.: Development of nasa-tlx (task load index): Results of empirical and theoretical research. Advances in psychology 52, 139–183 (1988).

Dimension	Question
Mental demand	How much mental AND perceptual activity was required (e.g. thinking, deciding, calculating, remembering, looking, searching, etc.)? Was the task easy OR demanding, simple OR complex, exacting OR forgiving?
Physical demand	How much physical activity was required (e.g. pushing, pulling, turning, controlling, activating, etc.)? Was the task easy OR demanding, slow OR brisk, slack OR strenuous, restful OR laborious?
Temporal demand	How much time pressure did you feel due to the rate OR pace at which the tasks OR task elements occurred? Was the pace slow AND leisurely OR rapid AND frantic?
Effort	How hard did you have to work (mentally AND physically) to accomplish your level of performance?
Performance	How successful do you think you were in accomplishing the goals, of the task set by the experimenter (or yourself)? How satisfied were you with your performance in accomplishing these goals?
Frustration	How insecure, discouraged, irritated, stressed AND annoyed versus secure, gratified, content, relaxed AND complacent did you feel during the task?

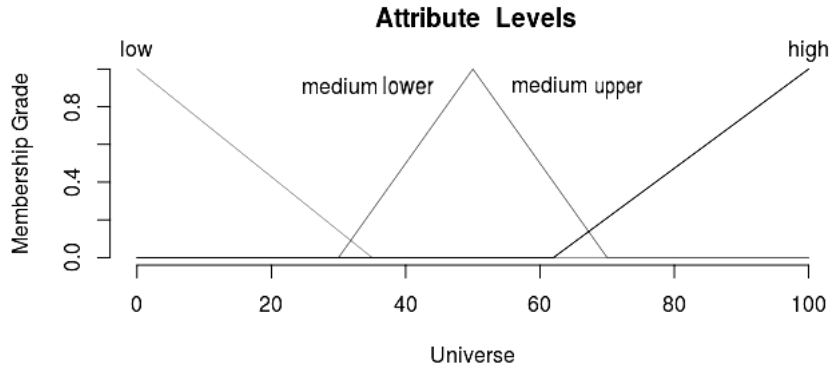


2 Knowledge-base 1

2.1 Dimensions crisp levels

- Low: [0, 32.999]
- Medium lower: [33, 49.999]
- Medium upper: [50, 66.999]
- High: [70, 100]

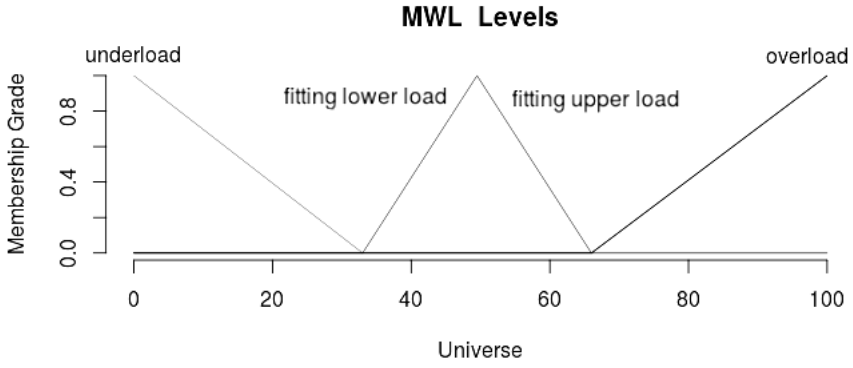
2.2 Dimensions fuzzy levels



2.3 MWL crisp levels

- Underload: [0, 32.999]
- Fitting lower load: [33, 49.999]
- Fitting upper load: [50, 66.999]
- Overload: [70, 100]

2.4 MWL fuzzy levels



2.5 Rules

- [MD1:] low mental demand *implies* underload mwl
- [MD2:] medium lower mental demand *implies* fitting lower load mwl
- [MD3:] medium upper mental demand *implies* fitting upper load mwl
- [MD4:] high mental demand *implies* overload mwl
- [TD1:] low temporal demand *implies* underload mwl
- [TD2:] medium lower temporal *implies* fitting lower load mwl
- [TD3:] medium upper temporal *implies* fitting upper load mwl
- [TD4:] high temporal *implies* overload mwl
- [EF1:] low effort *implies* underload mwl
- [EF2:] medium lower effort *implies* fitting lower load mwl
- [EF3:] medium upper effort *implies* fitting upper load mwl
- [EF4:] high effort *implies* overload mwl
- [PF1:] low performance *implies* overload mwl
- [PF2:] medium lower performance *implies* fitting upper load mwl
- [PF3:] medium upper performance *implies* fitting lower load mwl
- [PF4:] high performance *implies* underload mwl
- [FR1:] low frustration *implies* underload mwl
- [FR2:] high frustration *implies* overload mwl

2.6 Contradictions

- **If** high performance **then not** FR2
- **If** low performance **then not** FR1
- MD1 AND FR2 *can not coexist*
- TD1 AND FR2 *can not coexist*
- FR1 AND MD4 *can not coexist*
- FR1 AND TD4 *can not coexist*
- FR1 AND EF4 *can not coexist*
- EF1 AND FR2 *can not coexist*
- EF1 AND MD4 *can not coexist*
- **If** EF4 **then not** MD1

3 Knowledge-base 2

3.1 Dimensions crisp levels

Same as section 2.1

3.2 Dimensions fuzzy levels

Same as section 2.2

3.3 MWL crisp levels

Same as section 2.3

3.4 MWL fuzzy levels

Same as section 2.4

3.5 Rules

Same as section 2.5

3.6 Contradictions

In case A > B it means dimension A was chosen over B on the pair-wise comparison.

- **If** high performance **then not** FR2
- **If** low performance **then not** FR1
- MD1 AND FR2 *can not coexist*
- TD1 AND FR2 *can not coexist*
- FR1 AND MD4 *can not coexist*
- FR1 AND TD4 *can not coexist*
- FR1 AND EF4 *can not coexist*
- EF1 AND FR2 *can not coexist*
- EF1 AND MD4 *can not coexist*
- **If** EF4 **then not** MD1
- **If** high effort AND low performance **then not** MD1
- **If** high effort AND low performance **then not** TD1
- **If** high performance AND low effort **then not** TD4
- **If** high performance AND low effort **then not** MD4
- **If** effort > frustration AND low effort **then not** FR2
- **If** frustration > effort AND high frustration **then not** EF1
- **If** effort > mental demand AND low effort **then not** MD4
- **If** mental demand > effort AND high mental demand **then not** EF1

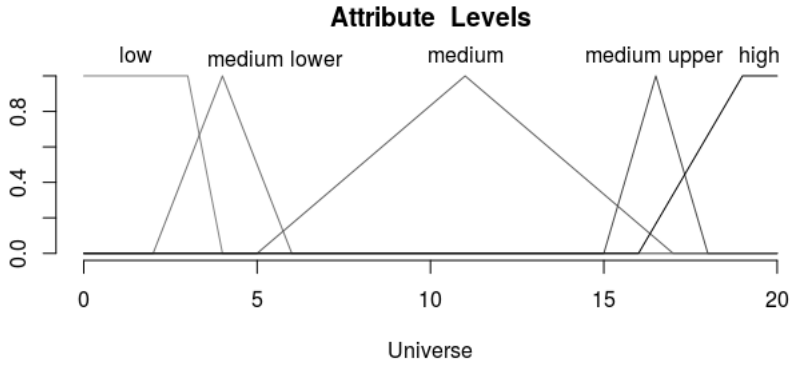
- **If** effort > frustration AND high effort **then not** FR1
- **If** frustration > effort AND low frustration **then not** EF4
- **If** frustration > temporal demand AND low frustration **then not** TD4
- **If** temporal demand > frustration AND high temporal demand **then not** FR1
- **If** frustration > mental demand AND low frustration **then not** MD4
- **If** mental demand > frustration AND high mental demand **then not** FR1
- **If** frustration > temporal demand AND high frustration **then not** TD1
- **If** temporal demand > frustration AND low temporal demand **then not** FR2
- **If** frustration > mental demand AND high frustration **then not** MD1
- **If** mental demand > frustration AND low mental demand **then not** FR2

4 Knowledge-base 3

4.1 Dimensions crisp levels

- Low: [0, 2.999]
- Medium lower: [3, 5.999]
- Medium: [6, 15.999]
- Medium upper: [16, 17.999]
- High: [18, 20]

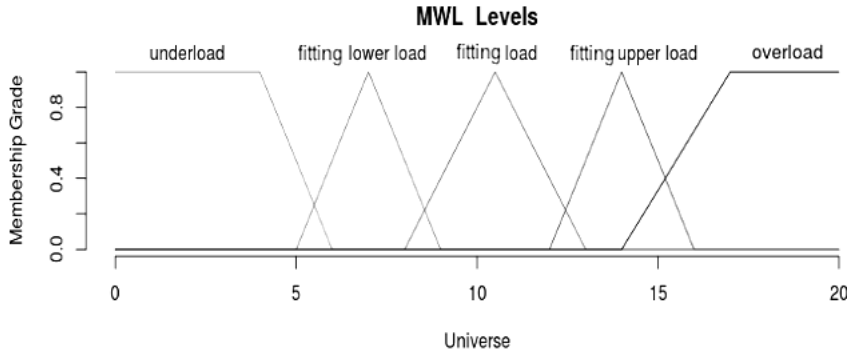
4.2 Dimensions fuzzy levels



4.3 MWL crisp levels

- Underload: [0, 5.999]
- Fitting lower load: [6, 8.999]
- Fitting load: [9, 12.999]
- Fitting upper load: [13, 15.999]
- Overload: [16, 20]

4.4 MWL fuzzy levels



4.5 Rules

- [HPF1:] (high OR medium upper) effort AND (medium lower OR medium OR low) performance AND (low OR medium lower) frustration AND (low OR medium lower) mental demand *implies* underload mwl
- [HPF2:] (high OR medium upper) performance AND (medium OR medium lower) effort AND medium mental demand AND medium lower frustration *implies* fitting lower load mwl
- [HPF3:] high performance AND (medium OR medium upper) mental demand AND medium frustration AND low effort *implies* fitting load mwl
- [HPF4:] (high OR medium upper) performance AND medium upper frustration AND medium upper mental demand AND (medium lower OR medium OR medium upper) effort *implies* fitting upper load mwl
- [HPF5:] high effort AND high frustration AND (medium lower OR medium) performance AND high mental demand *implies* overload mwl
- [HPF6:] high effort AND high frustration AND high mental demand AND low performance *implies* overload mwl
- [fMD1:] low mental demand *implies* underload mwl
- [fMD2:] medium lower mental demand *implies* fitting lower load mwl
- [fMD3:] medium mental demand *implies* fitting load mwl
- [fMD4:] medium upper mental demand *implies* fitting upper load mwl
- [fMD5:] high mental demand *implies* overload mwl
- [fTD1:] low temporal demand *implies* underload mwl
- [fTD2:] medium lower temporal demand *implies* fitting lower load mwl
- [fTD3:] medium temporal demand *implies* fitting load mwl
- [fTD4:] medium upper temporal demand *implies* fitting upper load mwl
- [fTD5:] high temporal demand *implies* overload mwl
- [fEF1:] low effort *implies* fitting load mwl
- [fP1:] high effort AND high mental demand *implies* overload mwl
- [fEF2:] (medium upper OR medium OR medium lower) effort *implies* fitting lower load mwl
- [fP2:] high effort low mental demand *implies* underload mwl
- [fF1:] high frustration *implies* underload mwl
- [fF2:] low frustration *implies* underload mwl
- [fME1:] high mental demand AND high effort *implies* overload mwl
- [fPF1:] medium lower performance AND medium lower frustration *implies* fitting lower load mwl
- [fPF2:] medium performance AND medium frustration *implies* fitting load mwl

4.6 Contradictions

- **If** high performance **then not** fMD5
- **If** high performance **then not** fTD5
- **If** high performance **then not** fMD1
- **If** high performance **then not** fTD1
- **If** high performance **then not** fP1
- **If** low performance **then not** fP1
- **If** low performance **then not** fEF1
- **If** low performance **then not** fEF2
- **If** low performance **then not** fTD1
- **If** low performance **then not** fMD1
- **If** high effort **then not** fF2
- **If** high physical demand the not fMD1
- **If** high physical demand the not fTD1
- fTD5 AND fMD1 *can not coexist*
- fTD1 AND fMD5 *can not coexist*
- fP1 AND fF2 *can not coexist*
- fP2 AND fF1 *can not coexist*
- fEF1 AND fF1 *can not coexist*
- fF1 AND fTD1 *can not coexist*
- fPF2 AND fME1 *can not coexist*
- fPF1 AND fME1 *can not coexist*
- **If** HPF5 **then not** fMD3
- **If** HPF5 **then not** fTD4
- **If** HPF5 **then not** fTD2
- **If** HPF5 **then not** fTD3
- **If** HPF5 **then not** fEF1
- **If** HPF5 **then not** fEF2
- **If** HPF5 **then not** fF1
- **If** HPF5 **then not** fP2
- **If** HPF5 **then not** fTD1
- **If** HPF5 **then not** fMD1
- **If** HPF5 **then not** fF2
- **If** HPF3 **then not** fMD4
- **If** HPF3 **then not** fMD2
- **If** HPF3 **then not** fTD4
- **If** HPF3 **then not** fTD2
- **If** HPF3 **then not** fEF2
- **If** HPF3 **then not** fF1
- **If** HPF3 **then not** fP2
- **If** HPF3 **then not** fTD1
- **If** HPF3 **then not** fMD5
- **If** HPF3 **then not** fMD1
- **If** HPF3 **then not** fTD5
- **If** HPF3 **then not** fP1
- **If** HPF3 **then not** fF2
- **If** HPF2 **then not** fMD4
- **If** HPF2 **then not** fMD3
- **If** HPF2 **then not** fTD4
- **If** HPF2 **then not** fTD3
- **If** HPF2 **then not** fEF1
- **If** HPF2 **then not** fF1
- **If** HPF2 **then not** fP2
- **If** HPF2 **then not** fTD1
- **If** HPF2 **then not** fMD5
- **If** HPF2 **then not** fMD1
- **If** HPF2 **then not** fTD5
- **If** HPF2 **then not** fP1
- **If** HPF2 **then not** fF2
- **If** HPF6 **then not** fMD4
- **If** HPF6 **then not** fMD2
- **If** HPF6 **then not** fMD3
- **If** HPF6 **then not** fTD4
- **If** HPF6 **then not** fTD2
- **If** HPF6 **then not** fTD3
- **If** HPF6 **then not** fEF1

- **If** HPF6 **then not** fEF2
- **If** HPF6 **then not** fF1
- **If** HPF6 **then not** fP2
- **If** HPF6 **then not** fTD1
- **If** HPF6 **then not** fMD1
- **If** HPF6 **then not** fF2
- **If** HPF1 **then not** fMD4
- **If** HPF1 **then not** fMD2
- **If** HPF1 **then not** fMD3
- **If** HPF1 **then not** fTD4
- **If** HPF1 **then not** fTD2
- **If** HPF1 **then not** fTD3
- **If** HPF1 **then not** fEF1
- **If** HPF1 **then not** fEF2
- **If** HPF1 **then not** fMD5
- **If** HPF1 **then not** fTD5
- **If** HPF1 **then not** fP1
- **If** HPF4 **then not** fMD2
- **If** HPF4 **then not** fMD3
- **If** HPF4 **then not** fTD2
- **If** HPF4 **then not** fTD3
- **If** HPF4 **then not** fEF1
- **If** HPF4 **then not** fEF2
- **If** HPF4 **then not** fF1
- **If** HPF4 **then not** fP2
- **If** HPF4 **then not** fMD5
- **If** HPF4 **then not** fTD1
- **If** HPF4 **then not** fMD1
- **If** HPF4 **then not** fP1
- **If** HPF4 **then not** fF2