How Representative are our Quantitative Data on Performance Shaping Factors

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❑ **Introduction to Performance Shaping Factors**

❑ **Summarise a literature review of PSFs**

❑ **Discuss some ideas about how to deal with PSFs in the future**.

What are Performance Shaping Factors?

Also known as Error Producing Conditions or Performance Influencing Factors

Factors beyond the task itself that can influence performance

PSFs include adequacy of interfaces, work organisation, environmental factors, individual differences, stress etc

THERP: *Embedded PSFs* and *Undefined PSFs*

HEART: 38 PSFs from x17 to x1.02

SPAR-H: 7 PSFs which can be positive

Groth and Mosleh: Hierarchical list of > 60 PSFs.

Why consider Performance Shaping Factors?

Looking at those PSFs that may substantially influence performance enables HRA analysts to move from a limited number of Generic Task descriptions to develop a much more diverse range of more specific assessments

PSFs are also very useful in focusing analyst's attention on qualitative issues

BUT many experienced analysts have reservations at the quantitative level. Nevertheless, we tend to accept/ignore these limitations.

Approach Taken in a Review of PSFs

- Compared the PSF multipliers from different HRA methods (THERP, HEART, NARA, SPAR-H, ATHEANA, CREAM)

- Lack of consistency - e.g. *Poor feedback:*

    HEART = x4

    NARA = x30

- Search literature for two PSFs, find relevant studies, do some stats, revise or confirm PSF multipliers

- Williams and Bell: Revision of HEART PSFs (EPCs)

- Focus on the process rather than the actual PSF multipliers

- Aimed at understanding the PSF data and its limitations to enable assessors to use PSFs more intelligently.
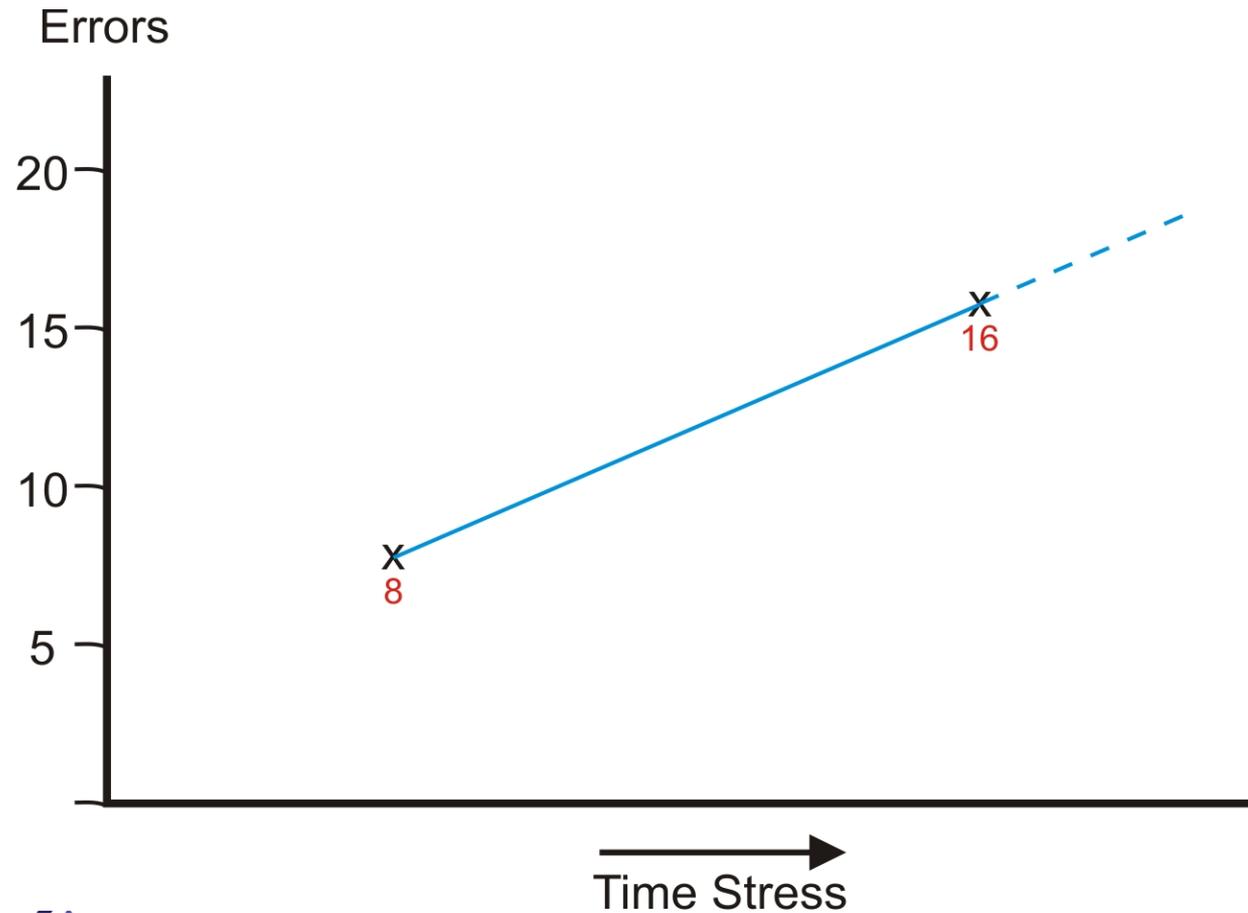
State of PSF Literature

❑ A lot of information available

BUT

❑ Much was subjective or discursive

❑ Even when human error was measured it was often not reported for the different states of a PSF

❑ Experimental conditions often poorly defined or confounded with other variables.

Determining PSF Multipliers

Quantitative Limitations

- ❑ **Elephant in the Room Syndrome**:
  - THERP data for missing a step in written procedures are based upon 1970s typewritten procedures
- ❑ **It's Alright to Extrapolate Syndrome**:
  - HRA methods do not provide data on reading computer-based displays, so use data from hard wired instruments as being analogous
  - Are they? Do navigation errors reduce reliability? Is it easier to find data on screen? Hickling and Bowie did not think so
- ❑ **Ignore the Underlying Psychology**:
  - The same PSF that degrades decision-making may have little impact upon a perceptual task
- ❑ **Poor Understanding of Data Sources**:
  - Underlying experimental criteria must be known to make meaningful comparisons.

Time Stress PSF

❑ Assessed 23 experimental conditions

❑ Control tasks or industrial inspection tasks negligible PSF multipliers

❑ Monitoring tasks the PSF multiplier was x5

❑ For tasks judged to be cognitively demanding and for tasks in highly realistic simulations the PSF multipliers were x8 and x9 respectively

❑ The original HEART value for this PSF was x11.

PSF Requirements: Consistency

❑ **Common Definitions for PSFs**
- Standard wording
- Avoid hierarchical inconsistency
- Define anchor points

❑ **Establish Single Source of PSF Quantifications**
- Use same data with different HRA methods
- Develop universal PSF multipliers from experimental data

❑ **Use Standard Approach to Derive Replacement Multipliers**
- Avoid collecting data for different PSFs from different types of source (simple experiments, simulators, actuarial data).

PSF Requirements: Base on Current Situations

❑ **Re-assess PSFs where Technology or Methods have Changed**
- THERP data for missing a step in written procedures are based upon 1970s typewritten procedures

❑ **Consider Adequacy of Underlying Data Sources**
- Avoid data where error criteria poorly defined or inappropriate.

PSF Requirements: Abandon Generic PSFs

❑ **Base PSFs on an Information Processing Model**
Separate PSFs for:
- Perceptual tasks
- Control tasks
- Cognitive tasks

❑ **Consider Applying Rasmussen's SRK Model**
No multiplier for Skill-based tasks, but amend multipliers for:
- Rule-based tasks
- Knowledge-based tasks

But is this dealt with by existing PSFs, such as *Unfamiliarity*.

Conclusions

❑ Interpretation of the impact of PSFs would be improved by establishing an agreed universal set of PSFs to be used with all HRA methods

❑ Such a set of PSFs should differentiate at least between perceptual, control and cognitive tasks

❑ A literature-based approach will be too influenced by the *literature review lottery*

❑ Ultimately the PSF multipliers should be derived from experimental investigations of the impact of different PSFs using a standard and repeatable approach. Such as the micro task method proposed by Hildebrandt

❑ Whilst this would be a tractable exercise, it would not be a trivial task and would require much effort and co-ordination between HRA professionals.

Thanks

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