A Systematic Yet Flexible Systems Analysis Framework

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Background & Problem

- Efforts to improve health care quality have led to an increased push to develop and adopt systems that enforce or encourage consistent procedures based on best practices and evidence-based medicine.
  - Standard Operating Procedures
  - Clinical Guidelines
  - Decision Support Systems
  - Hard Stops in EHRs
- Such systems can lead to more efficient and safer care, but health care is filled with complexity and variation, which are not easily captured by idealized processes.

Systematicity & Flexibility

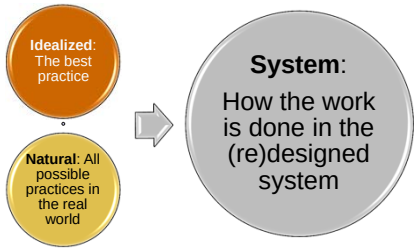
- Systematicity
  - Provides structure to ensure consistency, efficiency, and safety by imposing necessary structure
- Flexibility
  - The ability to constantly adapt to circumstances and still reach the goal state
- Systematicity & Flexibility are at odds with one another.

Goals of a Systematic Yet Flexible (SYF) Framework

- Guide the design of systems that support graceful degradation from idealized practices to those that are more suitable for a given situation
- Allow exploration of trade-offs among designs
- Provide objective measures of flexibility for comparing designs

SYF Systems Analysis (SYFSA)

- Identify a task (a problem to be solved)
- Analyze three problem spaces
  - Idealized space: The best or idealized practice
  - Natural space: Natural constraints on task performance
  - System space: The new or redesigned system
- Quantitatively compare flexibility measures for each space.

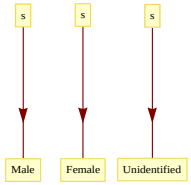


The Task of Gender Selection

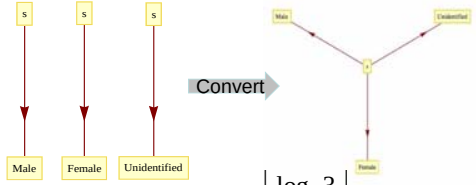
List the tasks the interface must support

- s → Male
- s → Female
- s → Unidentified

Each task requires 0 bits; i.e. 0% flexibility

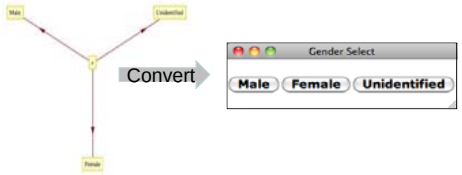


Combine Individual Task Spaces to Create Idealized Space



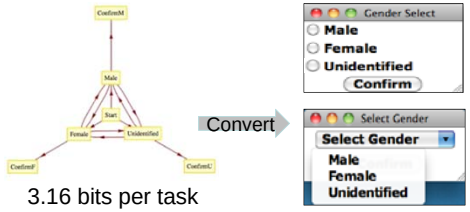
Average bits per task is $3\left\lfloor \frac{\log_2 3}{3} \right\rfloor = 1.58$

No Flexibility Implmentation



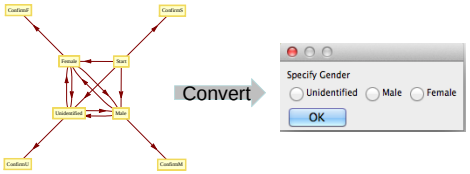
Upon selection, dialog closes and selection is recorded— regardless of whether or not the selection is correct.

Corrective Flexibility Implementation - Allows for Error Correction



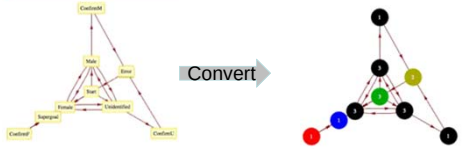
3.16 bits per task

Overly Flexible Implementation



3.58 bits per task

Convert System Space to Markov Model to Analyze Tasks



Stationary Distribution Shows 1 Success for every 2 Errors, so the Task Completion Rate is 1/3

Analysis of Simulated User Knowledge

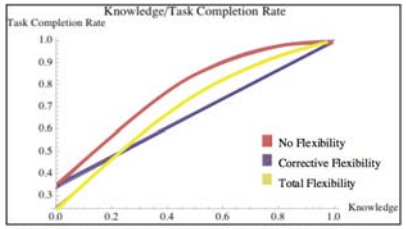


Figure 1. Task completion rate across all knowledge levels

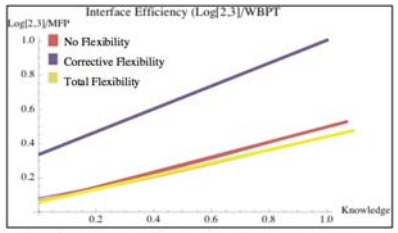


Figure 2. Interface efficiency across all knowledge levels

Both graphs show a trade-off: the interface that offers no flexibility (red) has a higher task completion rate at all levels of user knowledge (Figure 2), but is less efficient than the interface that allows for error correction (purple).

Summary of Conclusions

Both graphs show a trade-off: the interface that offers no flexibility (red) has a higher task completion rate at all levels of user knowledge (Figure 2), but is less efficient than the interface that allows for error correction (purple). Thus, SYFSA can reveal trade-offs between systematicity and flexibility.

Acknowledgements

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