Driver Distraction: Confusing “Cause” with “Effect”

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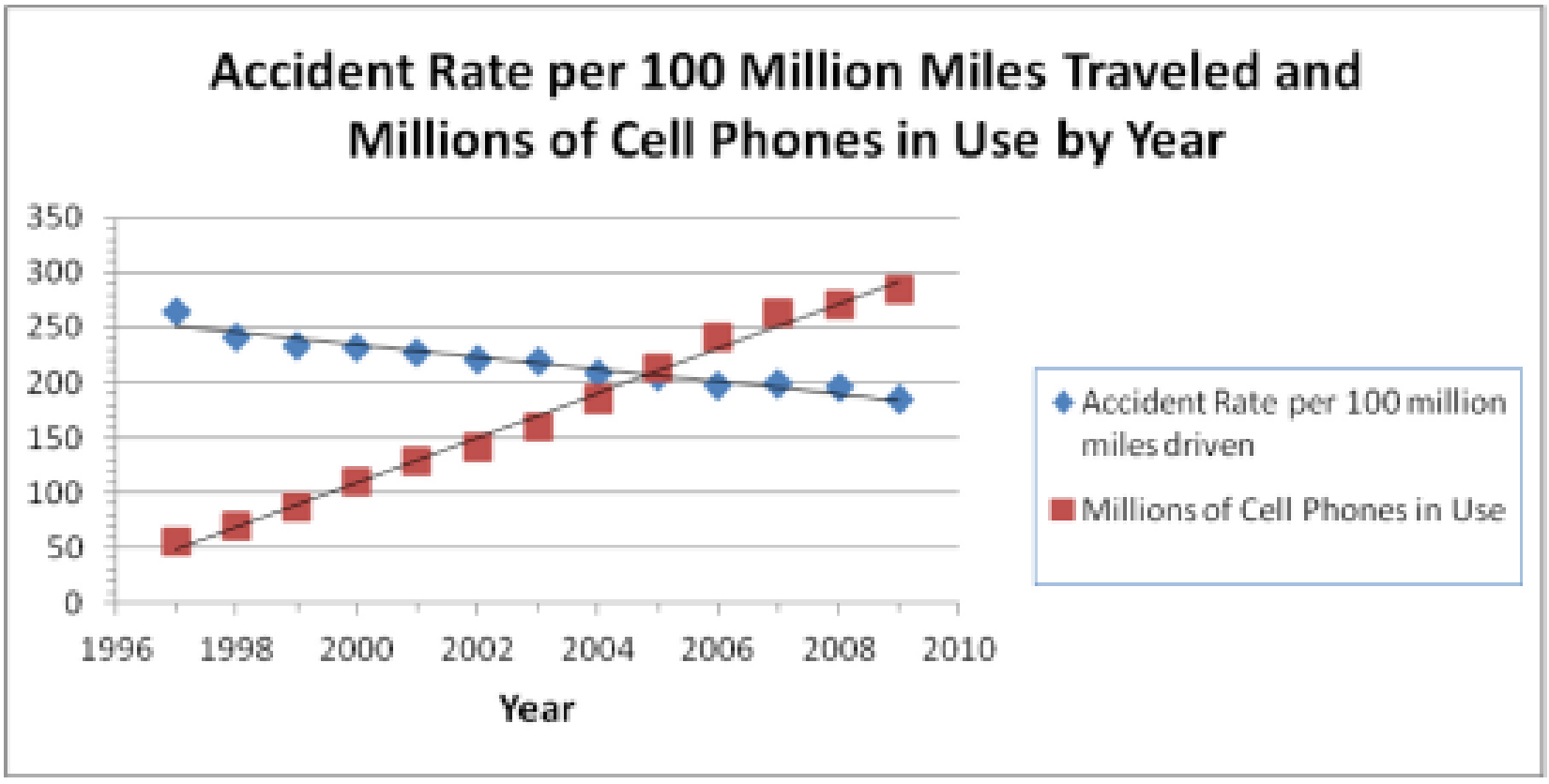
The "Problem"

- Concern with "Driver distraction" first became noted as an issue with the advent of windshield wipers in 1903
  - Concern was elevated in the 1930's with the incorporation of radios in automobiles
- For much of the past 15+ years, the phrase "driver distraction" has been almost synonymous with the use of electronic devices within the vehicle
  - Multitudes of laboratory/simulator studies have been presented demonstrating detrimental effects of using such devices while behind the wheel
  - Naturalistic/on-road studies have largely either failed to replicate these results, or found a negative effect only during specific, visually-intensive tasks such as texting, dialing, searching for the phone, etc)

Accident Rate vs Cellular Phone Prevalence



Definitions of “Driver Distraction”

- *“Attention given to a non-driving-related activity, typically to the detriment of driving performance”*
- *“A diversion of attention from driving, because the driver is temporarily focusing on an object, person, task or event not related to driving, which reduces the driver's awareness, decision making ability and/or performance, leading to an increased risk of corrective actions, near-crashes, or crashes.”*
- *“The diversion of attention away from activities critical for safe driving toward a competing activity”*
- *“Delay by the driver in the recognition of information necessary to safely maintain the lateral and longitudinal control of the vehicle (the driving task) due to some event, activity, object or person, within or outside the vehicle that compels or tends to induce the driver's shifting attention away from fundamental driving tasks by compromising the driver's auditory, biomechanical, cognitive or visual faculties, or combinations thereof.”*

Shortcoming of Laboratory Studies

- When a driver elects to divert attention to a competing activity they (in most cases) have some latitude to self-regulate their driving behavior to either compensate for the anticipated impact of this diversion on their driving performance or to choose when to undertake such an activity.
  - Either course allows them to maintain their situation awareness.
  - The operator generally chooses when and if to divert attention to a secondary task based on the driving conditions prevalent at the time.
- Task unrelated thoughts (e.g., performance of non-driving related activities) may interfere with performance of task-related activities
  - The number of task-unrelated thoughts are related to task complexity and demands and stimulus rates.
  - Essentially “the easier the task, the more the mind wanders.”

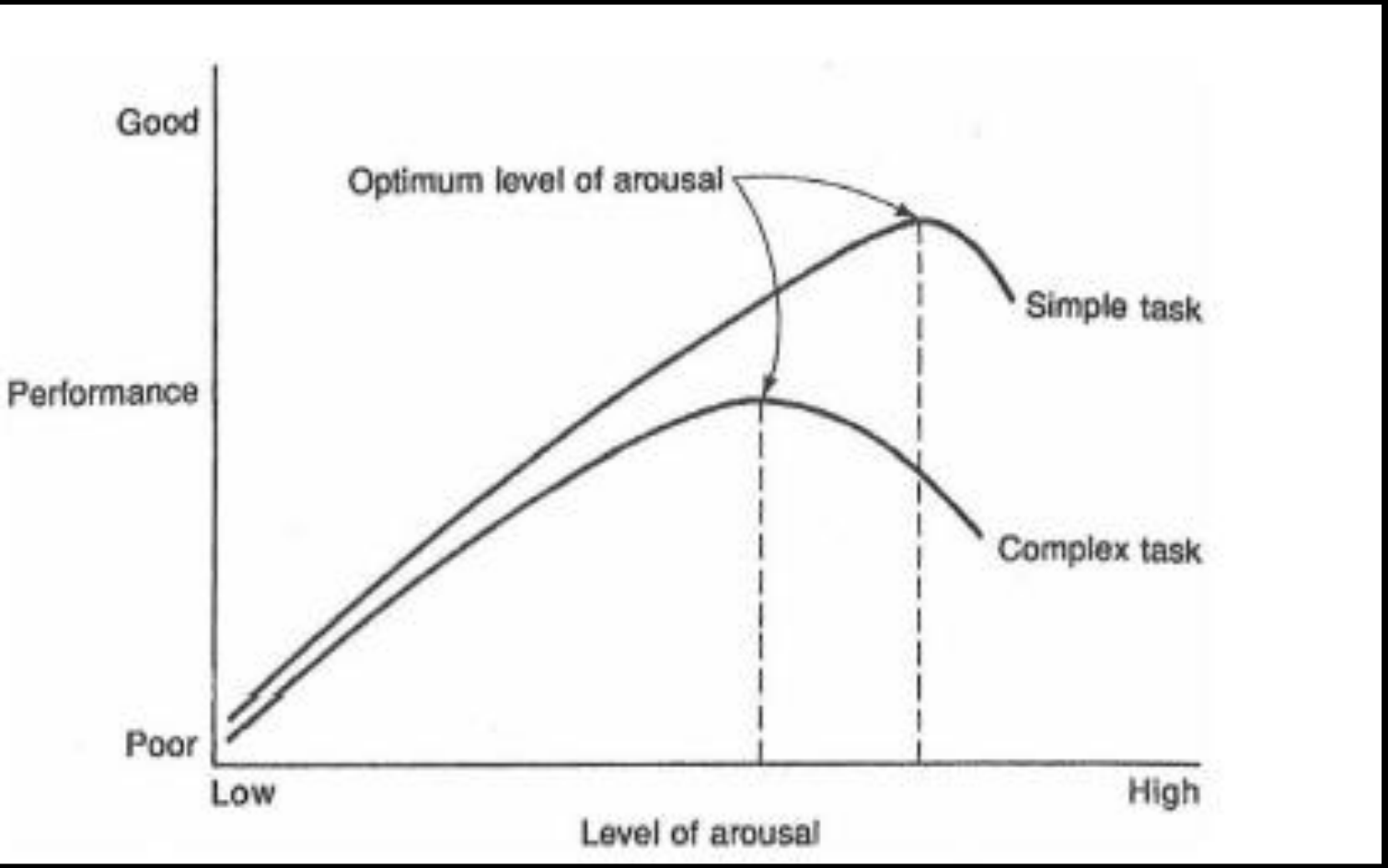
Engineering Development

- Central focus of most engineering refinements/ improvements of any products are generally centered around either reduction of workload or reduction of potential for human error
- Error reduction generally focused on removing the decision making from the human, rather than aiding the human in making better decisions
  - Fewer decisions generally results in lower workload as well

Sources of Technological/Environmental Workload Reduction in Automobiles

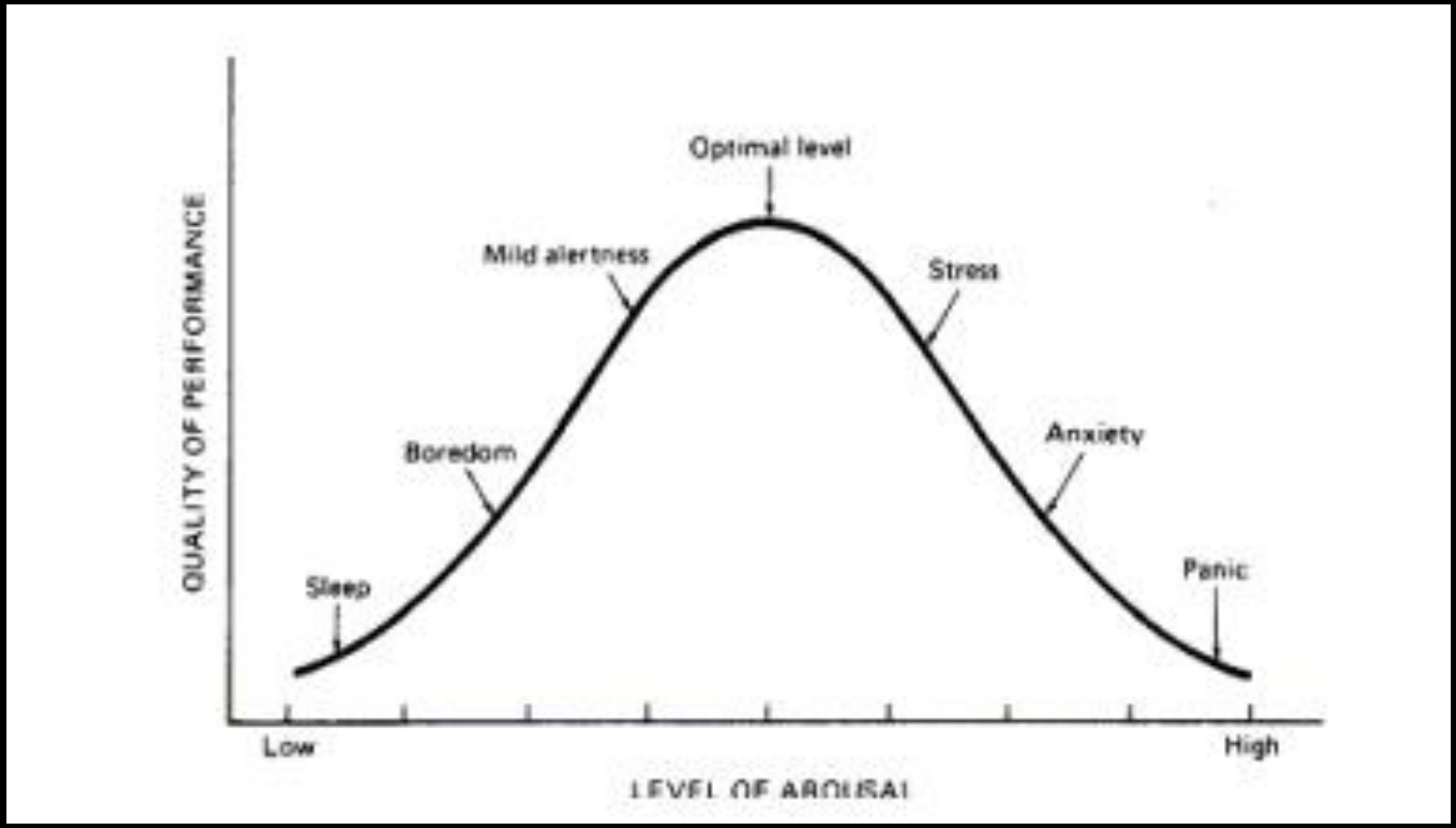
- Traditional Cruise Control
- Adaptive Cruise Control
- Radial tires
- Automatic transmission
- Improved Road Surfaces
- Limited Access Roadways
- Reduction of In-vehicle sound level
- Improved braking
- Improved steering
- Electronic stability control
- Radar detectors
- GPS
- Idiot lights (versus monitoring of round dials)
- Lane departure warning

Yerkes-Dodson Curve



Yerkes-Dodson Curve

Alternate Format



Hypotheses

- Traditional workload reduction techniques focus on the **WHAT**, not the **WHY**
- Increased “driver distraction” is **not** the result of multiple alternative tasks competing for driver attention (i.e., electronic entertainment or communications devices)
- The level of workload imposed by driving for an experienced operator is now typically considerably **below** optimal level or arousal
- Performance of multiple tasks while driving represents a subconscious attempt by drivers to return themselves to an ***optimal*** arousal level

Automation
Levels of Control

(1) Human does the whole job up to the point of turning it over to the computer to implement

(2) Computer helps by determining the options

(3) Computer helps to determine options and suggests one, which human need not follow

(4) Computer selects action and human may or may not do it

(5) Computer selects action and implements it if human approves

(6) Computer selects action, informs human in plenty of time to stop it

(7) Computer does whole job and necessarily tells human what it did

(8) Computer does whole job and tells human what it did only if human explicitly asks

(9) Computer does whole job and decides what the human should be told

(10) Computer does the whole job if it decides it should be done and, if so, tells human, if it decides that the human should be told.

Problems with Vehicle Automation

- **Issue #1: Loss of situation awareness**
  - Aviation examples
  - Train examples
- **Issue #2: Detection of automation failures**
  - Operators do **not** monitor automation well
  - Tendency is to SAMPLE rather than continuously monitor
  - Sampling rate largely mimics the expected failure rate of the system
  - Catch-22—the better the automation, the lower the likelihood that the operator will be monitoring when a failure occurs
- **Issue #3: Resumption of manual control**
- **Issue #4: Litigation/Liability/Political Climate**

Alternative Approaches

1. Shifting from reduction of workload focus to *optimization* of workload focus
2. Shifting from full automation to adaptive automation

- ***Same issues largely apply to fatigue reduction technologies***