

Horrey and Wickens (2003) considered three levels of primary task (automobile driving) difficulty as well as three levels of in-vehicle technology (secondary task). The Demand Vectors for each of these tasks is presented in Table 1.

Task	Demand Vector								Demand Scalar
	Perceptual				Cognition		Response		
	Vf	Va	As	Av	Cs	Cv	Rs	Rv	
(A) City Driving	2	1	0	0	2	0	1	0	6
(B) Rural Straight Driving	1	1	0	0	1	0	1	0	4
(C) Rural Curved Driving	1	2	0	0	1	0	2	0	6
(D) IVT HUD Adjacent	1	0	0	0	0	1	0	1	3
(E) IVT HDD Console	2	0	0	0	0	1	0	1	4
(F) IVT Auditory	0	0	0	2	0	2	0	2	6

Table 1. Demand Vectors for primary and secondary task conditions. IVT = In-Vehicle Task, HUD = IVT Head-up display, HDD = IVT with Head-down display; Auditory = IVT with sound display.

References

[Horrey, W.J. & Wickens, C.D. \(2003\)](#). Multiple resource modeling of task interference in vehicle control, hazard awareness and in-vehicle task performance. *Proceedings of the 2nd International Symposium on Human Factors in Driving Assessment, Training and Vehicle Design*. Park City, UT.

[Wickens, C.D. \(2002\)](#). Multiple resources and performance prediction. *Theoretical Issues in Ergonomic Science*, 3(2), 159-177.

[von Engelen, D. \(2011\)](#). Attention Drivers! Analyzing Driver Distraction. Diploma Thesis, Computer Science Department, RWTH Aachen University, Germany

Predictions of Model versus Real-World Observations (Horrey & Wickens, 2003)

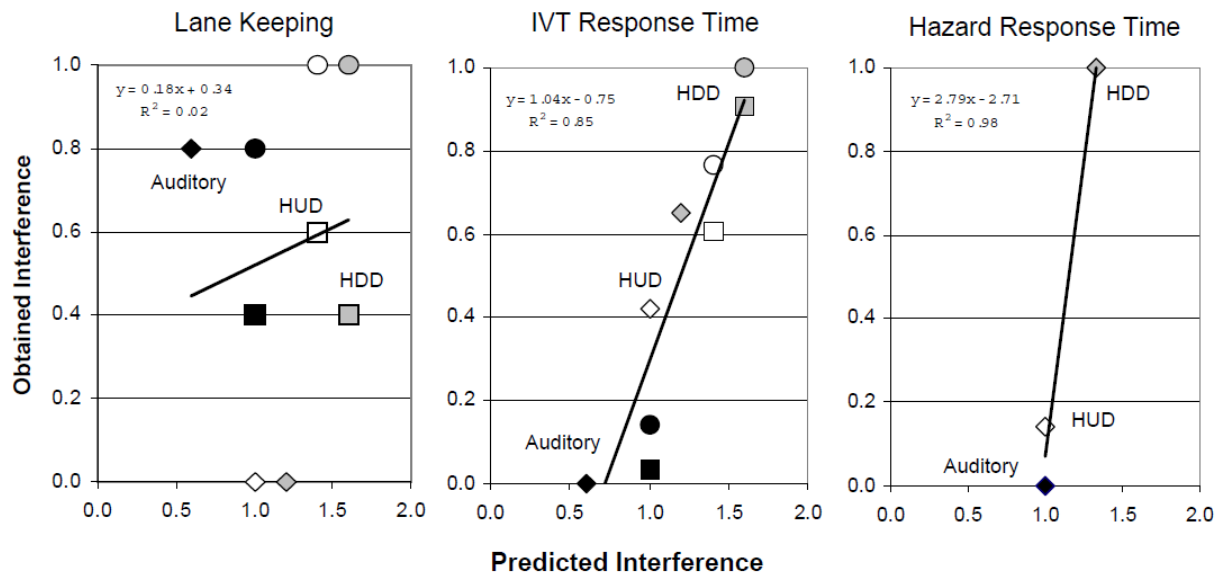


Figure 1. Obtained interference as a function of model-predicted interference for the (a) lane keeping (driving) task, (b) response times to the IVT task, and (c) hazard RTs. The HUD condition is represented by white markers, the HDD condition by light gray, and the auditory by black markers. Diamonds represent the straight rural roads, circles represent curved rural roads, and squares indicate straight urban roads.

Horrey and Wickens (2003) attempted to validate their computational MRT model by evaluating how well it predicted the reaction time response to the in-vehicle technology (IVT) information request shown in the center panel of their Figure 1 (above). The “obtained interference” depicted on the y-axis was derived from the increase in dual-task RT compared to baseline single-task performance in each condition. The resulting RT differences were then normalized (max = 1.0). These values were recovered from their Figure 1 via graphical interpolation and are reported in the column labelled “observed” in my Table 2 (see below).

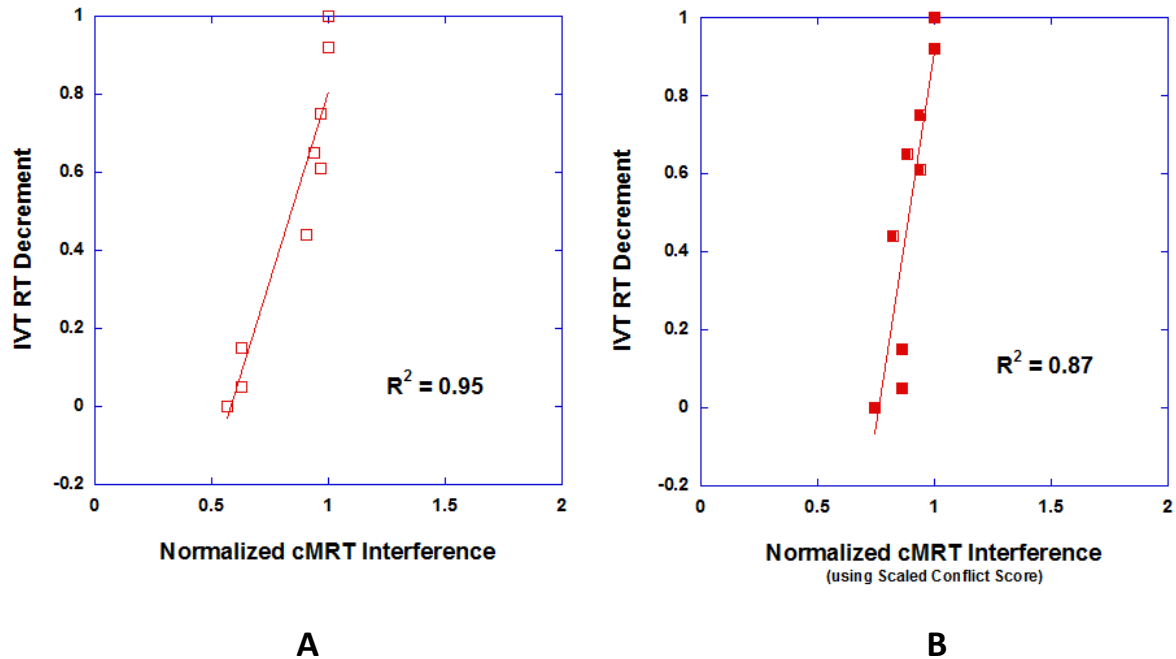


Figure 2. Some plots of the cMRT predictions versus the observed data reported by Horrey & Wickens.
(A) Depicts predictions based upon normalized (Interference = Total Task Demand + Raw Conflict Score)
(B) Depicts the relationship between normalized (Interference = Total Task Demand + scaled Conflict)

Linear fits between predictions of the cMRT model and Horrey & Wickens' (2003) observed performance data were generated at USD Heimstra Lab using the procedure outlined herein. cMRT predictions based upon Total Demand + raw (unscaled) conflict yielded an R^2 of 0.95 (see Fig 2A). However, predictions using Total Demand + scaled Conflict (where max. conflict is scaled to 6) yielded an R^2 value of 0.87.

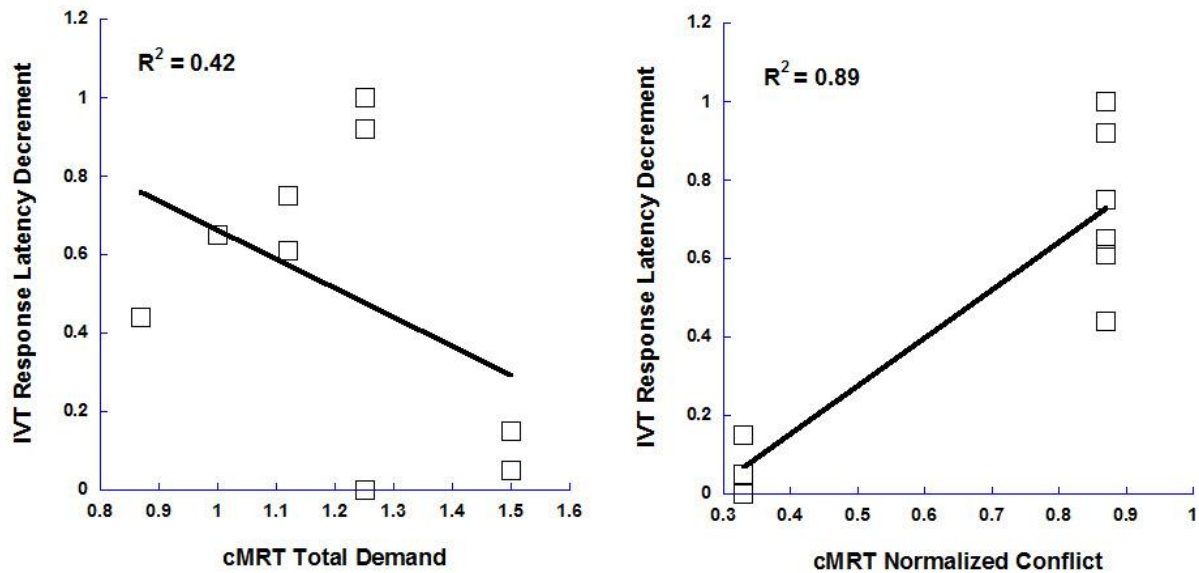


Figure 3. Predictions based upon Total Demand only (left panel) and normalized Conflict only (right).

Performance on Horrey & Wickens (2003) IVT task as a function of either the cMRT Total Demand component or the cMRT Scaled Conflict component. Note the strange, but complementary way these components combine to constrain the overall prediction of Total Interference in the dual task paradigm.

Table 2.
Modeling Validation Data

Driving	IVT	Observed*	Total	Raw	Prediction	Normalized			
			Demand	Conflict		Prediction	Scaled Conflict	Scaled Prediction	Scaled Predict
City	HUD	0.61	1.12	2.9	4.02	0.967	0.87	1.99	0.938
City	HDD	0.92	1.25	2.9	4.15	1.000	0.87	2.12	1.000
City	Audio	0.05	1.50	1.1	2.60	0.626	0.33	1.83	0.863
Rural-Straight	HUD	0.44	0.87	2.9	3.77	0.908	0.87	1.74	0.820
Rural-Straight	HDD	0.65	1.00	2.9	3.90	0.939	0.87	1.87	0.882
Rural-Straight	Audio	0.00	1.25	1.1	2.35	0.566	0.33	1.58	0.745
Rural-Curve	HUD	0.75	1.12	2.9	4.02	0.968	0.87	1.99	0.938
Rural-Curve	HDD	1.00	1.25	2.9	4.15	1.000	0.87	2.12	1.000
Rural-Curve	Audio	0.15	1.50	1.1	2.60	0.626	0.33	1.83	0.863

*Interpolated from center panel of Horrey & Wickens (2003) Figure 1.