3.10 Comparison of Driver Performance With a Crash Alert Versus Without a Crash Alert Under Alerted Conditions

In both Study 2 and Study 4, all drivers had previously participated in Study 1 (although no drivers participated in both Study 2 and Study 4). Hence, driver's braking behavior with a crash alert during both Study 2-Alerted Stationary Trials and Study 4-Alerted Moving Trials could be compared to previous data obtained under nearly the same conditions without a crash alert for the same driver (Study 1). (Recall, during alerted trials, the driver is asked to brake in response to the anticipated alert.) It should be noted that this comparison is more straightforward with respect to Alerted Stationary Trials, since drivers were more likely to be closer to the exact same conditions with a crash alert (Study 2) versus without a crash alert (Study 1) than under Alerted Moving Trials. In the latter case, the time headways prior to the lead vehicle braking introduce inherent variability in the timing of the crash alert onset, and subsequent braking onset by the driver. Furthermore, since the Steady HHDD + Non-Speech and the RDP crash alert timing were the only crash alert type and timing conditions that were used in both Study 2 and Study 4, data from this combination of conditions was examined so that unconfounded comparisons could be made across Alerted Stationary Trials and Alerted Moving Trials relative to the corresponding baseline (Study 1) trials. Finally, since the main interest here is in driver performance with versus without crash alerts under alerted conditions, only statistically significant effects involving alert presence (i.e., Study) effects will be discussed below.

3.10.1 Alerted Stationary Trials - With Versus Without a Crash Alert

In this comparison of driver behavior with versus without a crash alert under alerted conditions, drivers were selected who had participated in both Study 2 and Study 1. An Analysis of Variance (ANOVA) was performed for each of the following measures: SV speed at SV braking onset, SV acceleration at SV braking onset, range at SV braking onset, required deceleration at SV braking onset, actual deceleration, peak deceleration, minimum TTC-Case 1, and minimum range. Each of these measures were previously defined in Table 3-3. The criterion set for statistical significance was $p<0.01$. Unless otherwise noted, all statistically significant results indicated met (and often exceeded) these adopted criterion. The within-subjects variables analyzed were Study/Alert Presence (Study 1/no crash alert, Study 2/"Steady HHDD + Non-Speech" alert) and (approach) speed (30 and 60 mph), and the between-subjects variables analyzed were age (younger, middle-aged, or older) and gender (male or female).

Results indicated main effects of alert presence on SV acceleration at SV braking onset, required deceleration at SV braking onset, actual deceleration, and peak deceleration. These main effects are shown in Table 3-38. The results for the SV acceleration at SV braking onset are due to drivers sometimes hovering over the brake during "last-second" braking judgments in CAMP Study 1, whereas drivers in Study 2 braked in "crisp", firm manner in response to the alert. The results for the remaining main effects indicate that with the alert present, drivers were attaining

shorter braking distances (higher actual decelerations), using more controlled braking (lower peak decelerations). With respect to the latter "controlled braking" finding, a significant Alert Presence x Speed interaction suggests this effect was more prominent in the 30 mph condition. In the 30 mph condition, the mean peak decelerations in Study 1 (no alert) and Study 2 (alert present) were –0.82 and –0.60, respectively. In the 60 mph condition, the corresponding means were –0.85 and –0.72, respectively. The interpretation of these effects is not straightforward. On one hand, one could argue that the presence of the alert resulted in a "more controlled" braking profile, which would be beneficial under certain conditions. However, another possibility, which cannot be ruled out, is this pattern of results is due to a practice effect, since Study 1 was completed before Study 2, and drivers may have felt more comfortable braking the test vehicle and whole experimental set-up in the latter study.

3.10.2 Alerted Moving Trials - With Versus Without a Crash Alert

In this comparison of driver behavior with versus without a crash alert under alerted conditions, drivers were selected who had participated in the both the Study 4-"Steady HHDD + Non-Speech" crash alert type condition and Study 1. An Analysis of Variance (ANOVA) was performed for each of the following measures: time headway at POV braking onset, SV speed at SV braking onset, SV acceleration at SV braking onset, range at SV braking onset, required deceleration at SV braking onset, actual deceleration, peak deceleration, minimum TTC-Case 2, minimum TTC-Case 2, minimum headway, and minimum range. Each of these measures was previously defined in Table 3-3. The criterion set for statistical significance was $p<0.01$. Unless otherwise noted, all statistically significant results indicated met (and often exceeded) these adopted criterion.

The within-subjects variables analyzed were Study/Alert Presence (Study 1-no crash alert, Study 4-"Steady HHDD + Non-Speech" alert), speed (30, 45, and 60 mph), and POV braking profile (light, moderate, hard), and the between-subjects variables analyzed age (younger, middle-aged, or older), and gender (male or female). With respect to POV braking profile, there is somewhat of a confound between Study 1 and Study 4, which will be revisited in the reporting of these results. In the former study, the three POV braking profiles were -015, -0.28, and -0.39 g's. In the former study, the three corresponding POV braking profiles were -015, -0.27, and -0.36 g's.

Results indicated main effects of alert presence on SV speed at SV braking onset, SV acceleration at SV braking onset, and peak deceleration. These main effects are shown in Table 3-39. Once again, as explained above, the results for the SV acceleration at SV braking onset are artifactual in nature. The results for the remaining main effects indicate that with the alert present, drivers were at slightly higher speeds (1 mph difference across studies), and using more controlled braking (lower peak decelerations). As mentioned above, one could argue that the presence of the alert resulted in a "more controlled" braking profile, which would be beneficial under certain conditions. However, another possibility is that this pattern of results is once again due to a practice effect, since Study 1 was completed before Study 4.

3.10.3 Summary of "With" Versus "Without" Crash Alert Comparison

Overall, during these expected braking conditions, these results suggest that, relative to drivers without a crash alert, drivers with a crash alert reached lower peak decelerations without extending their braking distances. In remains unclear whether this effect is due to the presence of the alert or to a practice effect, since all drivers participated in the baseline study (Study 1-no alert) prior to a study where they experienced a crash alert (Study 2 or Study 4).

Table 3-38 Significant Main Effects of Study (Alert Presence) on Various Variables Measured at SV Braking Onset During Alerted Stationary Trials (Comparison of Study 1 Versus Study 2 Results)

Study/Alert Presence	Mean Current Dec. (g)	Mean Required Dec. (g)	Mean Actual Dec. (g)	Mean Peak Dec. (g)
Study 1/Without Alert	-0.05	-0.33	-0.40	-0.84
Study 2/With Alert	-0.03	-0.37	-0.48	-0.66

Table 3-39 Significant Main Effects of Study (Alert Presence) on Various Variables Measured at SV Braking Onset During Alerted Moving Trials (Comparison of Study 1 Versus Study 4 Results)

Study/Alert Presence	Mean SV Speed (mph)	Mean Current Dec. (g)	Mean Peak Dec.(sec)
Study 1/Without Alert	44.4	-0.05	-0.86
Study 4/With Alert	45.3	-0.03	-0.67