The National Surface Transportation Safety Center for Excellence

Towards Developing a US-EU Common Distracted Driving Taxonomy: Updating a Naturalistic Driving Data Coding Approach

Richard J. Hanowski

Lighting Technology
Fatigue Aging

ACKNOWLEDGMENTS

TABLE OF CONTENTS

LIST OF ABBREVIATIONS AND SYMBOLS

IFSTTAR	French Institute of Sciences and Technology for Transport, Development and Networks
INRETS	Institut national de recherche sur les transports et leur sécurité
LTCCS	Large Truck Crash Causation Study
NSTSCE	National Surface Transportation Safety Center for Excellence
US DOT	US Department of Transportation
VTTI	Virginia Tech Transportation Institute

CHAPTER 1. INTRODUCTION

In order to determine to what extent driver distraction contributes to crashes, near-crashes and incidents, it is essential to properly define and categorize the potential sources of distraction that exist inside and outside the vehicle[1]. There is, however, no commonly accepted definition of distraction, although there have been several attempts to derive one[1].

Given that distraction has been inconsistently defined, it is not surprising that there has been considerable variation across studies about what may be regarded as sources of distraction and how these are categorized. As outlined in Regan et al.[1], some studies regard daydreaming, for example, as a source of distraction while others do not; some regard various driving-related activities (e.g., avoiding glare from the sun to maintain lane keeping) as sources of distraction while others do not. Consequently, a common taxonomy of driver distraction does not currently exist[1]. This lack of agreement in categorization makes it difficult and often impossible to make comparisons across studies between sources of distraction and their impact on performance and safety. It can also lead to gross over- or underestimates of the role of distraction in crashes and near-crashes.

The naturalistic driving study method has yielded among other items data about the role of distraction and inattention in crashes. While extensive effort has been made about the instrumentation of host (subject) vehicles and the development of efficient techniques for automating the detection of events and the analysis of data, relatively minimal effort has been made about the development of valid taxonomies that can be used to (a) define the sources of distraction to be recorded, (b) code the data collected, and (c) accurately quantify the relative impact on driving performance and safety of different sources of distraction.

CHAPTER 2. OBJECTIVES

The initial aim of this project was to validate an existing taxonomy of distraction using video data collected during naturalistic driving studies. If validation using naturalistic driving data could be accomplished, the resulting taxonomy could be used as the basis for the collection, analysis, and reporting of data gathered during future naturalistic driving studies. The initial study plan was to start with a promising taxonomy and use a top-down approach to develop data collection and coding protocols. However, as will be described, this initial study plan did not perform as expected. The initial study plan was predicated on the successful validation of the selected taxonomy using naturalistic driving data. When this was not sufficiently achieved, an alternative study approach was implemented that included revising the existing Virginia Tech Transportation Institute (VTTI) driver distraction coding scheme based on a pragmatic and validated definition (and not taxonomy) of driver distraction. That is, beginning with a top-down approach (i.e., starting with an existing taxonomy and developing a coding approach) was not at this time successful. As such, the project evolved into first focusing on the coding approach from which alternative taxonomies could later be applied. In the end, this provided a taxonomic-neutral approach and led to the development of a refined coding scheme designed to assess driver distraction during naturalistic driving studies. This scheme can be re-configured to support various alternative taxonomies that may either currently exist or are yet to be developed. For example, a taxonomy developed by Regan et al.[2], which served as the focus of this study, is one of the taxonomies that can be applied to the revised coded data. However, a comprehensive coding scheme of distraction must be developed that is flexible enough to allow for the application of multiple taxonomies, including those currently in development[3]. A single taxonomy of driver distraction is unlikely to be universally accepted.

CHAPTER 3. METHOD AND RESULTS

Part of the impetus behind this National Surface Transportation Safety Center for Excellence (NSTSCE) project was a US Department of Transportation (US DOT)-supported effort that involved an international US-EU collaboration of driver distraction experts. The six-panel expert group (ongoing) comprises:

- Dr. Richard Hanowski, VTTI
- Dr. Bill Horrey, Liberty Mutual
- Prof. John Lee, University of Wisconsin
- Prof. Mike Regan, French Institute of Sciences and Technology for Transport, Development and Networks (IFSTTAR; formerly the Institut national de recherche sur les transports et leur sécurité [INRETS])
- Dr. Alan Stevens, TRL
- Dr. Trent Victor, Volvo

The initial effort of this group was to develop a common definition of driver distraction and to outline a list of research needs about this topic. The resulting report has been published and can be found online[3]. As noted in this report, one of the products of this expert group's efforts was the following definition of driver distraction: "*Driver distraction is the diversion of attention from activities critical for safe driving to a competing activity*." (p.4)

The current NSTSCE effort endeavored to build upon the work of the larger US-EU collaborative group, and Mike Regan agreed to participate in this project. As Regan et al.[2] had recently developed a theoretical taxonomy of inattention, this taxonomy was used as the starting point for the current NSTSCE project. The taxonomy developed by Regan et al.[2] can be found in Appendix A.

In comparison to the definition developed by the US-EU Bilateral ITS Technical Task Force[3], Regan et al.[2] developed a broader definition of "inattention" in which "distraction," or "diverted attention" as termed by the authors, was included (Appendix A). The Regan et al.[2] inattention taxonomy was developed from a theoretical perspective and was subjected as part of the current NSTSCE project to validation using naturalistic driving events (highlighted in Objective A in the next section). During this validation process, it was determined that not all of the categories in the Regan et al.[2] taxonomy were orthogonal. Orthogonality for a taxonomy means that categories within the taxonomy cannot overlap. Though it may be argued that orthogonality may not be a significant issue from a theoretical perspective, it is problematic from a pragmatic, operational perspective as will be described.

The taxonomy validation process involved reviewing video events and classifying events/behaviors/actions into categories using the taxonomic categories developed in the Regan et al.[2] taxonomy. However, it was learned during this process that some events/behaviors/actions could be classified into more than one category, which effectively diminished the utility of the theoretically developed taxonomy for pragmatic purposes. That is, non-orthogonality does not readily guide the development or refinement of a lower-level coding scheme in which the individual elements must be operationally defined such that data analysts

can reliably classify the event. For example, one of the naturalistic driving videos collected from the VTTI 100-Car Naturalistic Driving Study involved a driver following another driver on a highway. The vehicles were coupled on the highway (i.e., driving in tandem). Vehicle 1 (lead) and Vehicle 2 (instrumented and following) both exited the highway; at the end of the exit ramp was a yield sign. While both vehicles were moving forward, the driver of Vehicle 2 conducted a shoulder check to look for vehicles that could be present that would have the right-of-way of the lane into which the driver of Vehicle 2 merged. No vehicles were approaching, and the Vehicle 2 driver continued forward. However, Vehicle 1 stopped at the yield sign, and Vehicle 2 experienced a rear-end crash with Vehicle 1. Based on the Regan et al.[2] taxonomy provided in Appendix A, this crash event could potentially fit into three different categories:

- **Misprioritised attention** – "Insufficient or no attention to activities critical for safe driving brought about by the driver focusing attention on one aspect of driving to the exclusion of another, which is more critical for safe driving." (p. 18)
- **Neglected attention** – "Insufficient or no attention to activities critical for safe driving brought about by the driver neglecting to attend to activities critical for safe driving." (p. 18)
- **Cursory attention** – "Insufficient or no attention to activities critical for safe driving brought about by the driver giving cursory or hurried attention to activities critical for safe driving." (p. 19)

Consider that the driver of Vehicle 2 was in a merge situation and had focused his/her attention on potential traffic of the lane into which he/she would merge. However, the more critical threat was Vehicle 1. Therefore, the driver of Vehicle 2 misprioritised his/her attention to the less critical activity for safe driving (i.e., misprioritised attention). Why did the driver of Vehicle 2 experience this misprioritised attention? Given that he/she had been following Vehicle 1 and there were no other vehicles in the traffic stream into which both vehicles merged, his/her expectations were that the driver of Vehicle 1 would continue forward and not stop at the yield sign. However, these expectations of the behavior of the driver of Vehicle 1 were not met (i.e., neglected attention). Finally, this event could also be classified as cursory attention given that the definition of this category involves the driver providing, "Insufficient or no attention to activities critical for safe driving brought about by the driver giving cursory or hurried attention to activities critical for safe driving."

To develop a coding scheme for events, it is important that the taxonomy direct what elements to code (top-down approach; i.e., mapping the taxonomy categories to coding data elements). However, because a measurable, operational distinction in this case cannot be made between the three categories of inattention, there is no guidance for what elements must be included in the coding scheme so as to distinguish in which taxonomic category the event should be included.

The utility of a taxonomy to guide a coding scheme (top-down approach, from taxonomy to coding scheme) is in its ability to distinguish between events/behaviors/actions observed during the naturalistic video such that specific coding elements can be identified. An alternative bottom-up approach, however, was used for this project in which a comprehensive coding scheme was developed such that the Regan et al.[2] taxonomy and alternative taxonomies could be applied. Therefore, if the basic elements of events/behaviors/actions are determined first, then the coding

approach elements can be reconfigured (e.g., combined or collapsed across) to support various higher level taxonomies. The description of the project objectives, methods and results highlights this modified approach.

OBJECTIVE A- TAXONOMY DEVELOPMENT/VALIDATION

One of the objectives of the current effort was to validate the Regan et al.[2] taxonomy using video events gathered during VTTI's naturalistic driving studies. To this end a meeting was held in Lyon, France, at the IFSTTAR headquarters to review videos and categorize them per the Regan et al.[2] taxonomy. During this effort and a subsequent effort designed to review video examples and apply them to the taxonomy, it was determined that the taxonomic categories were not orthogonal. Therefore, events/behaviors/actions observed in the videos (e.g., a crash) could be classified into multiple categories of the taxonomy given an absence of specific and distinct features of a category to distinguish it from other categories. In taxonomies the orthogonality of categories means that membership (in this case, an event/behavior/action) can fall into only one category. Therefore, the classifications are mutually exclusive. That is not to say that multiple factors (or coding elements) cannot be coded as attributes of the single event (e.g., a driver can be involved in multiple behaviors/actions as observed during the video [a driver can be "drowsy" and "distracted"]). Rather, a single event cannot be coded as multiple events. It must be noted that related work to develop an inattention taxonomy has been taken up as a task by the US-EU Bilateral ITS Technical Task Force.

OBJECTIVE B- CODING SCHEME

The second objective of the current project was to use the taxonomy to develop a coding scheme for distraction that can be employed for naturalistic driving data. However, as noted, the process of exercising the selected taxonomy using naturalistic video data highlighted inconsistencies of the taxonomy and provided insight into the idea that, in order to be broadly applicable, the coding scheme should reflect basic elements but should not be directed by a specific taxonomy. Therefore, as an alternative approach, the coding scheme currently used by VTTI to code distraction during naturalistic driving studies was refined to reflect considerations developed from the US-EU group collaboration and from some insights raised during the Regan et al.[2] taxonomy. This refined coding scheme can be found in Appendix B and is the primary output of this NSTSCE project.

OBJECTIVE C- USING PREVIOUS APPROACHES BASED ON CRASH DATA

To explain the refinements made to VTTI's existing driver distraction coding scheme, it is important to consider the third objective of this project: examine "sources of distraction that have been previously identified in selected in-depth crash studies, naturalistic driving studies and Police-reported databases." Such a definition of driver distraction was utilized to guide the refinement of the classification guide that is specifically directed at driver distraction. Pettit et al.[4] developed a definition of distraction with taxonomic properties based on an in-depth analysis of crash data. In this comprehensive and pragmatically developed definition of driver distraction, Pettit et al.[4] defined the construct in terms of both the driver behavioral components (e.g., what the driver is doing while driving [eating, texting, etc.]) and the driving

performance components (i.e., resulting errors). In accounting for four key components of driver distraction, Pettit et al.[4] noted that distraction occurs (p. 11):

- When a driver is delayed in the recognition of information necessary to safely maintain the lateral and longitudinal control of the vehicle (the driving task) (*Impact*);
- Due to some event, activity, object or person, within or outside the vehicle (*Agent*);
- That compels or tends to induce the driver's shifting attention away from fundamental driving tasks (*Mechanism*); and
- By compromising the driver's auditory, biomechanical, cognitive or visual faculties, or combinations thereof (*Type*).

From a practical standpoint, this definition provides researchers with the beginnings of a clear protocol for identifying driver distraction as a contributing factor during safety-critical events as recorded in naturalistic video.

OBJECTIVE D- CODING SCHEME REFINEMENT

Although the Pettit et al.[4] definition was developed and applied to crash report data, a question that arose was whether this definition could be applied to naturalistically collected data. After reviewing numerous videos in the context of the definition, the answer was determined to be "yes" (i.e., the definition originally developed for crash data can also be applied to naturalistic data). An example of this is the Olson et al.[5] study that used the Pettit et al.[4] definition to guide the assessment of driver distraction in the naturalistic videos. However, the specifics of the Pettit et al.[4] definition were not coded in the VTTI driver distraction approach used in Olson et al.[5]. To address Objective D, this integration was conducted and is included in the recommended coding refinement outlined in Appendix B (additions 50-59, noted in bold).

CHAPTER 4. SUMMARY AND NEXT STEPS

The efforts of VTTI and IFSTTAR during the current NSTSCE project used an inattention taxonomy as a starting point with the purpose of developing a coding scheme for driver distraction that could be either mapped to the taxonomy or would evolve from the taxonomy (i.e., a top-down approach). The validation did not perform as planned; therefore, an alternative project goal was implemented that was designed to develop a coding scheme that could be applied to alternative taxonomies. It is unlikely that, in the near term, researchers will come to an agreement about a single taxonomy of distraction. As such, a more pragmatic approach was used at the coding level, which could subsequently be employed to develop taxonomies (i.e., bottom-up approach). It is believed that by taking a bottom-up approach and by first detailing the individual coding elements, various taxonomies can be applied. This strategy of applying a taxonomy to code naturalistic driving data elements has previously been successfully conducted. Bocanegra et al.[6] used the taxonomy from the Large Truck Crash Causation Study (LTCCS) to investigate strengths and limitations of crash data and naturalistic event data. However, this approach was applied to the entire naturalistic coding scheme. As such, further review of the driver distraction sub-section of the coding scheme is recommended.

Additional collaborative research is anticipated between VTTI and Mike Regan (now with the University of New South Wales in Australia) to further examine the Regan et al.[2] inattention taxonomy. Additionally, it is noteworthy that the broader US-EU Task Force[3] has assumed the task of developing a taxonomy and a driver distraction coding scheme for naturalistic driving data. As was learned during the current study, it will be important for projects aimed at developing taxonomies (high level) and coding schemes (low level) to begin with the low-level elements of what can feasibly be collected or identified during naturalistic studies and use a bottom-up approach. The risk of using a top-down strategy is that the coding elements will be limited to the initial taxonomy, and there may be little room for changing the coding elements to support alternative taxonomies. However, if a broad spectrum of coding elements is included at the outset then there is flexibility to fit the coding scheme to various alternative taxonomies.

APPENDIX A: DRIVER INATTENTION TAXONOMY (SOURCE: REGAN ET AL.[2])

1	**Restricted attention** – "Insufficient or no attention to activities critical for safe driving brought about by something that physically prevents (due to biological factors) the driver from detecting (and hence from attending to) information critical for safe driving." E.g., change blindness; eyes closed or closing due to fatigue; eyes wide open when fatigued and "looks but cannot see."
2	**Misprioritised attention** – "Insufficient or no attention to activities critical for safe driving brought about by the driver focusing attention on one aspect of driving to the exclusion of another, which is more critical for safe driving." E.g., driver does shoulder check when merging and, in doing so, fails to see car in front stopping and hits car in front.
3	**Neglected attention** – "Insufficient or no attention to activities critical for safe driving brought about by the driver neglecting to attend to activities critical for safe driving." E.g., fails to look for trains at level crossing and drives straight though without looking because trains are rarely or never seen; neglects to scan for motorcycle when turning left at intersection because they are less expected than cars and trucks.
4	**Cursory attention** – "Insufficient or no attention to activities critical for safe driving brought about by the driver giving cursory or hurried attention to activities critical for safe driving." E.g., driver does hurried shoulder check when merging and collides with unseen vehicle when merging on freeway; driver fails to do a complete head check when backing out of a car park.
5	**Diverted attention** (i.e., **distraction**) – "The diversion of attention away from activities critical for safe driving toward a competing activity, which may result in insufficient or no attention to activities critical for safe driving." The <u>competing activity</u> can be: • driving-related – i.e., driver diverts attention away from activity critical for safe driving toward another driving-related activity that is less critical (e.g., driver attends to erratic behavior of another driver and, in doing so, hits pedestrian; driver attends to a low fuel warning buzzer that suddenly sounds and while looking at it hits a car in front). • non-driving related – i.e., driver diverts attention away from activity critical for safe driving toward a non-driving-related activity (e.g., driver sends a text message and, while doing so, runs off the road and hits a tree). NB 1. In this taxonomy, "driving-related" activities correspond to those activities involving driver engagement in "primary" and "secondary" driving tasks, as defined in the VTTI taxonomy.

	NB 2. A driving activity is defined here as being "driving-related" if it "directly supports the functional requirements of driving." That is, one or more of the following driving functions identified by Brown (1986)*: Route Finding; Route Following; Velocity Control; Collision Avoidance; Rule Compliance; and Vehicle Monitoring.
6.	**Unsustained attention****- "Insufficient or no attention to activities critical for safe driving brought about by a decrement in vigilance induced by a monotonous driving task."

*Brown, I. (1986). Functional requirements of driving. Paper presented at the Berzelius Symposium on Cars and Causalities, Stockholm, Sweden; Unpublished Manuscript.

**The definition of Unsustained attention was developed during the course of this project and will not be found in the paper by Regan et al.[2].

APPENDIX B: REFINED CODING APPROACH
(Additions in bold, from 50-59)

1. **Driver Distraction**

    <u>Note</u>: You may code up to four distractions from the following list, with the primary distraction coded as such[1]; you will mark whatever behaviors occur within the 5 s prior to the **event onset** and 1 s after.

    INTERNAL DISTRACTION: Person or Object **(i.e., *AGENT*)**

    01 =   Talk/sing/dance with no indication of passenger – Driver appears to be vocalizing either to an unknown passenger, to self, or singing to the radio. Also, in this category are instances where the driver exhibits dancing behavior or is whistling.

    02 =   Interact with or look at other occupant(s) – Driver is talking to a passenger sitting in the passenger's seat or in the sleeper berth that can be identified by the person encroaching into the camera view or the driver is clearly looking at and talking to the passenger.

    03 =   Look at internal object – Driver removes attention from the forward roadway to look at an object inside the vehicle. This option should only be marked if the driver is not engaging in any other behavior at the same time (e.g., reaching for object, eating/drinking, etc.).

    04 =   Reach for object in vehicle (including cell phone, CB/other communications device) – Driver may or may not remove attention from the forward roadway to reach for an object inside the vehicle. This option should only be marked if it is unknown what the object is or if driver only reaches for object and does not perform any other behavior (e.g., if driver reaches for cell phone and then dials, then only "dial cell phone" would be marked).

    05 =   Look back in Sleeper Berth – Driver turns body to look behind him/her into the Sleeper Berth.

    06 =   Use calculator – Driver uses hand-held calculator. Assumes driver is looking at and may reach for object.

    07 =   Read book, newspaper, paperwork, etc. – Driver reads a book, newspaper, paperwork, etc, which is visible in the driver's hands, on the driver's lap, on the driver's steering wheel, or on the passenger seat. Assumes driver is looking at and may reach for object.

    08 =   Look at map – Driver reads a book, newspaper, paperwork, etc, which is visible in the driver's hands, on the driver's lap, on the driver's steering wheel, or on the passenger seat. Assumes driver is looking at and may reach for object.

    09 =   Write on pad, notebook, etc. – Driver reads a map which is visible in the driver's hands, on the driver's lap, on the driver's steering wheel, or on the passenger seat. Assumes driver is looking at and may reach for object.

---

[1] A coding change is recommended to allow the analyst to identify the primary factor.

10 =   Put on/remove/adjust seat belt – Driver puts on, removes, or adjusts his/her seat belt. Assumes driver is looking at and may reach for object.

11 =   Put on/remove/adjust sunglasses or reading glasses – Driver puts on, removes, or adjusts his/her sunglasses. Assumes driver is looking at and may reach for object.

12 =   Put on/remove/adjust hat – Driver puts on, removes, or adjusts his/her hat. Assumes driver is looking at and may reach for object.

13 =   Put on/remove/adjust clothing – Driver puts on or takes off an article of clothing (including gloves). This may also include unbuttoning/buttoning or unzipping/zipping a shirt, adjusting a collar, etc. Assumes driver is looking at and may reach for object.

INTERNAL DISTRACTION: Electronic Devices

14 =   Dial cell phone – Driver dials a cell phone. This may also include answering the phone or hanging up the phone, if the driver presses a key during this time. Assumes driver is looking at and may reach for object.

15 =   Talk or listen to hand-held phone – Driver holds a hand-held phone to ear, appears to be talking and/or listening (if driver dials cell phone and then talks on cell phone, both options are marked).

16 =   Talk or listen to hands-free phone – Driver talks or listens to a hands-free phone. This is apparent by an earpiece in the driver's ear.

17 =   Adjust earpiece/headset – Driver adjusts, or puts on/takes off, an earpiece/headset that is being used to talk on a hands-free phone. Assumes driver is looking at and may reach for object.

18 =   Text message on cell phone – Driver appears to be text messaging on a cell phone. Driver is focusing on the cell phone for an extended amount of time while continuously pressing keys. Assumes driver is looking at and may reach for object.

19 =   Talk or listen to CB microphone – Driver talks or listens to a CB microphone. Assumes driver is looking at and may reach for object.

20 =   Interact with dispatching device – Driver interacts with or looks at a dispatching device. The driver usually keeps the device on the passenger seat or on the floor between the two seats and holds the device on his/her lap or steering wheel while in use. Assumes driver is looking at and may reach for object.

21 =   Interact with GPS – Driver interacts with an after-market GPS device that is mounted on the instrument panel or dash (does NOT include an in-dash satellite radio). This may involve the driver hooking up the system or pressing buttons. Assumes driver is looking at and may reach for object.

22 =   Interact with Satellite radio – Driver interacts with an after-market Satellite radio device that is mounted on the instrument panel or dash (does NOT include an in-dash satellite radio). This may involve the driver hooking up the system or pressing buttons. Assumes driver is looking at and may reach for object.

23 =   Use camera – Driver uses a camera (may be a cell phone camera) to take a picture from inside the cab. Assumes driver is looking at and may reach for object.

24 =   Use/reach for other device – Driver reaches for or uses an alternate electronic device; does not include any of the devices listed above such as cell phone, camera, etc. Assumes driver is looking at and may reach for object.

INTERNAL DISTRACTION: Dining
25 =   Eating – Driver eats with, or without, a utensil (i.e., fork or spoon). This also includes the driver opening a food bag or anything closely related to eating just prior to or after the trigger. Assumes driver is looking at and may reach for object.
26 =   Drink from a container – Driver drinks from a container, either covered or uncovered. This also includes the driver opening/closing a drink container or anything closely related to drinking just prior to or after the trigger. Assumes driver is looking at and may reach for object.

INTERNAL DISTRACTION: Smoking-Related
27 =   Smoking-related behavior – reaching, lighting, extinguishing – Driver is reaching (ashing), lighting, or extinguishing a cigarette. May include behaviors such as driver reaching for a lighter or reaching for a pack of cigarettes. Assumes driver is looking at and may reach for object.
28 =   Smoking-related behavior – cigarette in hand or mouth – Driver has a cigarette in hand or mouth.
29 =   Use chewing tobacco – Driver is using chewing tobacco. This may include putting tobacco into mouth or spitting into container. Assumes driver is looking at and may reach for object.

INTERNAL DISTRACTION: Grooming
30 =   Personal grooming – Driver is grooming him/herself. This may include combing/fixing hair, applying make-up, shaving, and brushing teeth. Assumes driver is looking at and may reach for object.
31 =   Bite nails/cuticles – Driver is biting nails and/or cuticles. Assumes driver is looking at hands.
32 =   Remove/adjust jewelry – Driver is removing or adjusting jewelry. This may include, watch, bracelet, necklace or earrings. Assumes driver is looking at and may reach for object.
33 =   Other personal hygiene – Driver is conducting some kind of other personal hygiene. This may include rubbing eyes/face, scratching face/neck, or picking nose.
34 =   Adjust in seat – Driver adjusts his/her position in the driver's seat.

INTERNAL DISTRACTION: Vehicle-Related
35 =   Adjust instrument panel – Driver is adjusting something on the instrument panel. This may include, radio, climate controls, head lights, and other switches to the front and right of the driver. Assumes driver is reaching for and/or looking at the instrument panel while adjusting.

36 =   Pull air horn – Driver reaches up and pulls the air horn on the truck. The air horn is usually located in the upper left corner of the cab. Assumes driver is looking at and may reach for object.

37 =   Turn on/off cab light – Driver turns on/off overhead cab light. Assumes driver is looking at and may reach for object.

38 =   Clean cab interior – Driver uses some kind of cleaning material(s) to clean/dust the instrument panel, dash, interior windows, etc. Assumes driver is looking at and may reach for object.

39 =   Put up/down window – Driver either manually rolls up/down the window or uses a button on the door.

EXTERNAL DISTRACTIONS

40 =   Look at outside vehicle, person, animal, object – Driver looks outside the vehicle to another vehicle, person, animal, object or undetermined. May be out the front windshield or side window. Must be apparent that driver is focused on outside vehicle, person, animal, object.

41 =   Look out rear window (day cab only with visible rear window) – Driver turns around and looks out the rear window on the cab. Must be apparent that driver is looking out window.

42 =   Wave to passing vehicle/driver – Driver looks at and waves to a passing vehicle, either overtaking (same direction) or passing in the opposite direction.

DRIVING-RELATED INATTENTION TO FORWARD ROADWAY

43 =   Look at left-side mirror – Driver looks at the left-side mirror (west coast/convex mirror or fender mirror).

44 =   Look at right-side mirror – Driver looks at the right-side mirror (west coast/convex mirror or fender mirror).

45 =   Look at left-side monitor – Driver looks at the left-side monitor.

46 =   Look at right-side monitor – Driver looks at the right-side monitor.

47 =   Look at center monitor – Driver looks at the center monitor.

48 =   Check speedometer – Driver glances directly down to the speedometer. Must be apparent that the driver is looking at the speedometer and not in lap.

OTHER

49 =   Other – Other potentially distracting behavior.

Note: Adapted from Hanowski, Olson, Perez & Dingus, 2001 and Olson, Hanowski, Hickman & Bocanegra, 2009.

IMPACT TO DRIVING TASK

50 = Latitudinal error (e.g., steering wheel control error leading to unintended lane deviation/violation)

51 = Longitudinal error (e.g., acceleration/deceleration error leading to headway maintenance violation)

52 = Other (specify in drop-down box)

URGENCY

53 = Urgent (e.g., lit cigarette in lap)

54 = Not-urgent (e.g., texting)

55 = Urgency Unknown (e.g., responding to dispatcher message)

TYPE (can be more than one)

56 = Visual distraction (eyes off road and to distracting Agent)

57 = Manual distraction (hands off wheel and on distracting Agent)

58 = Cognitive distraction (mind off driving and on distracting Agent). (NOTE: Serves as placeholder as video, without audio, may not be sufficient to determine. CAUTION: Future sensors, procedures may be required.)

59 = Auditory distraction (hearing off driving and on distracting Agent). (NOTE: Serves as placeholder as video, without audio, may not be sufficient to determine. CAUTION: Future sensors, procedures may be required.)

REFERENCES

1. Regan, M.A., Lee, J.D., and Young, K.L. (2009). *Driver distraction: Theory, effects, and mitigation.* CRC Press: Boca Raton, FL.

2. Regan, M.A., Hallett, C. and Gordon, C.P (2011). Driver distraction and driver inattention: Definition, relationship and taxonomy. *Accident Analysis & Prevention*, 43, pp 1771-1781.

3. US-EU Bilateral ITS Technical Task Force (2010). *Expert focus group on driver distraction: Definition and research needs.* http://ec.europa.eu/information_society/activities/esafety/doc/intl_coop/us/eg_driver_distract.pdf

4. Pettit, M., Burnett, G., and Stevens, A. (2005). Defining driver distraction. *Proceedings of the 12th World Congress on Intelligent Transportation Systems*. San Francisco, CA.

5. Olson, R.L., Hanowski, R.J., Hickman, J.S., & Bocanegra, J. (September, 2009). *Driver distraction in commercial vehicle operations, final report*. Report No. FMCSA-RRR-09-042. http://www.fmcsa.dot.gov/facts-research/research-technology/report/FMCSA-RRR-09-042.pdf Washington, DC: Federal Motor Carrier Safety Administration.

6. Bocanegra, J., Hickman, J.S., & Hanowski, R.J. (2010). *Comparative Analysis of the Large Truck Crash Causation Study and Naturalistic Driving Data*. Contract# DTMC75-07-D-0006. Federal Motor Carrier Safety Administration: Washington, DC.