PD ISO/TS 15007-2:2014

BSI Standards Publication

Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems

Part 2: Equipment and procedures

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National foreword

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TECHNICAL SPECIFICATION

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Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems —

Part 2: **Equipment and procedures**

Véhicules routiers — Mesurage du comportement visuel du conducteur en relation avec les systèmes de contrôle et d'information sur le transport —

Partie 2: Équipement et procédures

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

This second edition of ISO/TS 15007-2 cancels and replaces the first edition (ISO/TS 15007-2:2001), which has been technically revised.

ISO/TS 15007 consists of the following parts, under the general title *Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems*:

— *Part 1: Definitions and parameters*

— *Part 2: Equipment and procedures* [Technical Specification]

Introduction

This Technical Specification supports ISO 15007-1, which defines key terms and parameters for the assessment of the visual impact on driver visual behaviour of TICS (Traffic Information Control Systems), and other vehicle tasks or on-board systems.

ISO/TS 15007-2 supports ISO 15007-1 by giving guidance on equipment and procedures that can be used in a practical TICS evaluation, with recommendations on how to interpret selected metrics (standards of measurement) of visual behaviour.

Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems —

Part 2: Equipment and procedures

1 Scope

This Technical Specification gives guidelines on equipment and procedures for analysing driver visual behaviour, intended to enable assessors of transport information and control systems (TICS) to

— plan evaluation trials;

— specify (and install) data capture equipment, and;

— validate, analyse, interpret and report visual-behaviour metrics (standards of measurement).

It is applicable to both road trials and simulated driving environments.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15007-1, *Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems — Part 1: Definitions and parameters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15007-1 apply.

4 Evaluation and trial planning

4.1 Subject selection

Evaluation trials of TICS applications should use a representative sample from the target population for the specific TICS. This driver sample should be categorized by age, gender, visual ability (including colour vision deficiencies, as well as whether and what type of corrective lenses are required to drive) and driving experience.

4.2 Trial procedures

4.2.1 General

Assessment of driver visual demand can be carried out in relation to many forms of TICS applications and road environments. Therefore, consideration should be given to the following factors influencing driver visual behaviour.

4.2.2 Roadway/traffic specification

An appropriate operational environment for the specific TICS application under evaluation should be chosen. The type of roadway and likely traffic conditions to be encountered should be defined within the trial (or study). This may entail defining and documenting the roadway geometry, signals, and surroundings – as well as describing the driving scenarios that participant will experience (including speeds of travel, manoeuvres, traffic densities, movement of traffic, and so forth).

4.2.3 Vehicle specification

Experimental apparatus used to represent the driving task should be described as fully as practicable.

EXAMPLE Document the make and model of the road vehicle employed or the driving simulator characteristics employed (including key parameters of the vehicle dynamics model, whether the simulator has a fixed- or moving-base, the breadth of its field of view, etc.).

4.2.4 TICS specification

The characteristics of the TICS should be reported.

EXAMPLE Type, position and image quality of a visual display (resolution, contrast, colour-rendition, reflectivity/glare).

4.2.5 Subject training

Trial objectives will determine the need for subject training in the use of the TICS. Assuming that some form of training is required, subjects should receive clear and consistent guidance. The tasks and subtasks associated with the TICS should be fully explained to the subject and the limitations of responsibility and pacing of these between the driver and experimenter should be specified. Each subject's familiarity with the TICS prior to the trial should be reported. When determining the usability of the TICS device, consideration should be given to the level and assessment of training required.

4.2.6 Data exclusion

Control procedures for individual evaluation trials within an experimental programme should include guidelines for the conditions under which the trial is to be terminated.

EXAMPLE Trial aborted for failure to complete a task or subtask: document how this is to be recorded or how the trial is to be re-scheduled.

4.2.7 Experimental conditions, tasks, subtasks, sub-subtasks, and relationship

4.2.7.1 Experimental condition

This is considered to encompass all visual behaviour of the driver during an experimental session.

EXAMPLE The distributions of visual scanning to all specified areas of interest of the visual scene (including the TICS), from the specified start of a test route to its specified end.

Researchers will need the flexibility to define experimental conditions that are relevant for their research goals. However, when studies involve examining glance patterns for secondary tasks while driving, the following experimental conditions may be useful for planning and for performing the research. The following terms are introduced because they define intervals of time and behaviour that may be of particular interest when evaluating a TICS – and, hence, in analysing the glance data associated with a TICS.

4.2.7.2 Task

refers to a sequence of interactions undertaken to achieve a goal glance behaviour may be measured over the duration of a task.

EXAMPLE All visual behaviour occurring during the task of entering a destination into a route guidance system.

4.2.7.3 Subtask

A sequence of interactions undertaken to achieve a sub goal of the task (often one specific interaction). Glance behaviour may be measured over this (shorter) duration of the subtask.

EXAMPLE When entering a destination into the route guidance system, all visual behaviour associated with entering the "city name" portion of the destination.

4.2.7.4 Sub-Subtask

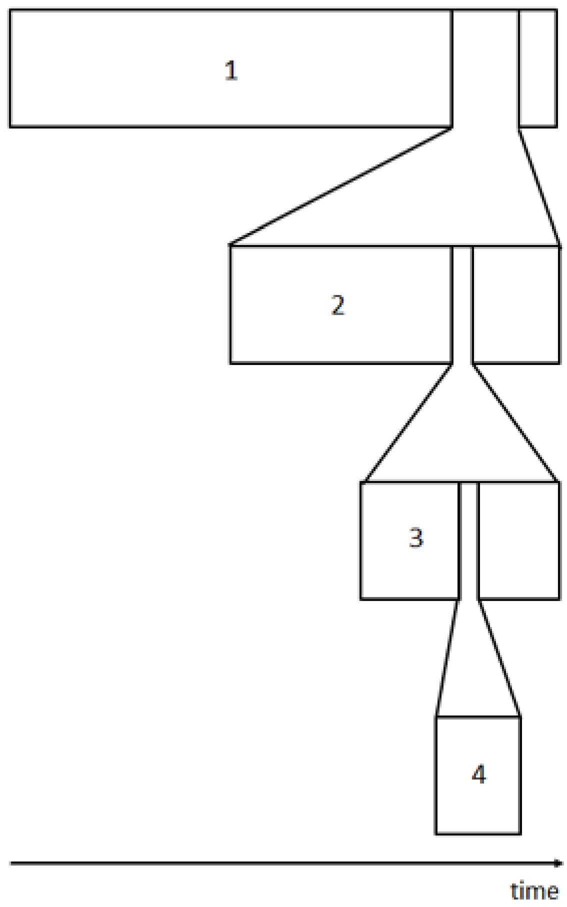
Operations or interactions with lower-level subtask elements (e.g. individual controls or screens).

EXAMPLE On the route guidance system, glance behaviour associated with the sub-subtask of "verify the city name appeared" on destination entry screen.

4.2.7.5 Relationship

The relationship between an experimental condition, a task, a subtask and a lower level subtask element is graphically represented in Figure 1.

Annotation: Users of this standard may wish to consult references on hierarchical task analysis for guidance on how to decompose a task (e.g. see Reference [4]).



Key

1 experimental condition

2 task

3 subtask

4 sub-subtask

Figure 1 — Experimental condition, task and subtask — Relationship

5 Recording equipment

5.1 General

The following gives practical advice on the use of data recording equipment to monitor driver visual demand.

5.2 Eye-Tracking equipment

In general, there are two different methodologies for recording eye-tracking data:

— Head-mounted eye-tracking systems.

— Remote eye-tracking systems.

5.2.1 Head-mounted eye-tracking systems

With head-mounted eye-tracking systems, the subject wears components of the eye-tracking system directly on the head. The components necessary for the eye-tracking are mounted on a helmet, a cap or on a device similar to glasses. Head-mounted eye-trackers may consist of the following components:

— Scene camera: this camera records what the subject can see.

— Eye camera: this camera records at least one eye.

NOTE 1 The eye can be recorded directly or via an infrared (IR) reflective mirror.

NOTE 2 Calibration of eye camera to scene camera is necessary to transform the x- and y-coordinates from the eye camera coordinate system to the scene camera coordinate system. Thereby the head-mounted eye-tracking system is able to indicate in the scene camera view where the subject is looking.

— Infrared LED: the infrared LED typically makes the eye visible in the infrared spectrum. Thereby the system becomes more independent and robust from the surrounding lighting conditions.

5.2.2 Remote eye-tracking systems

With remote eye-tracking systems the glance behaviour is recorded by at least one camera mounted in some location that can record the driver's eyes, such as the dashboard.

Remote eye-trackers (and/or image recording systems) may consist of the following components:

— Eye camera: at least one camera is directed to the drivers face to capture where the subject is looking

— Scene camera: the scene camera records the road scene ahead.

NOTE 1 Calibration of eye-camera to scene-camera is necessary to transform the x- and y-coordinates from the eye-camera coordinate system to the scene-camera coordinate system. Thereby the remote eye-tracking system is able to indicate in the scene-camera view where the subject is looking.

— Infrared LED: the infrared LED typically makes the eye visible in the infrared spectrum. As a result, the system becomes more independent and robust from the surrounding lighting conditions.

NOTE 2 Remote systems include conventional methods of capturing glance behaviour on video.

5.2.3 Additional components

The following additional components are typically required:

— Computer unit for storage and control

— Eye-tracking software: the eye-tracking software records, processes and stores the data

5.3 Additional recording equipment

5.3.1 Cameras

Additional cameras should be used for capturing the road scene ahead and in-vehicle activities. These cameras should be as small and unobtrusive as is practicable. All recorded videos and the recorded eye-tracking data should be synchronized using a single time code (as well as documentation of degree of accuracy obtained), preferably the same time code from the eye-tracking equipment. If an experiment includes acquisition of other types of data such as driving performance data consideration should be given to applying the same time code or synchronization of eye-tracking, videos and any remaining data.

5.3.2 Video monitor

A video monitor is needed for examining the quality of the recorded videos. Ideally, such a monitor should be positioned such that the experimenter is able to observe the recorded data periodically during an experimental condition.

5.3.3 Microphones

Microphones can be readily interfaced into the video data-capture system and audio recordings can be made. This option should be considered for capturing any verbal protocols from the experimenter or subject. Auditory event markers may also be recorded to facilitate cueing during data reduction.

5.3.4 Event markers

After defining experimental conditions, tasks, subtasks and sub-subtasks event markers should be used to mark these task intervals during the experiment in the recorded data. Clearly marked task intervals will facilitate data reduction after the experiment.

5.3.5 Head tracker

When using head-mounted eye-tracking systems, they can be supplemented by adding technology for head-tracking to transform the x- and y-coordinates from the scene camera coordinate system to a car coordinate system.

5.4 Installation

Although the specific conditions of an experiment will vary, the following general principles should be applied.

The installed data collection system and employed procedures should not obscure the driver's view of the roadway or any in-vehicle equipment, and should not cause the driver any unnecessary distraction.

These criteria also apply to any experimenters who may be present within the test vehicle.

6 Data reduction

6.1 General

Reducing experimental records of visual behaviour into metrics of visual demand requires that several assumptions be made. Guidance on the suggested steps to be performed in data analysis following a practical TICS evaluation are given in the following (Quality and artefact issues are given in Annex A). Data reduction can be done manually or can be partially or fully automated.

6.2 Sample interval

Two regimes may be adopted in the reduction of visual behaviour records:

— reduction of the entire experimental session, for all identified areas of interest of the visual scene;

— reduction of the forward view and areas of interest relevant for the study (e.g. TICS display).

For manual reduction, the data analyst should be trained to carry out the following steps:

a) Advance the record of visual behaviour to the start of a sample interval (experimental condition, task or subtask) of interest.

b) Examine the first frame of the information on gaze direction to determine the glance location, then record this as the area of interest applicable and the starting time for that glance.

c) Advance the record of visual behaviour frame-by-frame until the driver's eyes start to move to another specified area of interest. When this occurs, record the glance duration for the previous area of interest, record the new area of interest and the time code for that frame.

d) Repeat the previous steps frame-by-frame until the sample interval has been fully reduced.

An example of a reduction record is given in Table 1.

Table 1 — Example reduction record — glance durations are in seconds

Clock time	Driver mirror	Right region	Left region	Into car	Notes
54:51:31	0,6				
54:52:44		0,5			
54:56:22	0,8				
etc.				1,5	Looks at the instruments.

6.3 Summary data

Data that summarizes the trial, encompassing the information as given in Tables 2 to 5, should be reported.

Table 2 — Subject summary information

Parameter	Information required
Age	Range, mean and standard deviation
Gender	Number of each gender
Distance (kilometres or miles/ year during the previous five years)	Range and mean
Years of driving	Range, mean and standard deviation (if absolute values are reported)
Visual legal compliance	Statement that all subjects comply with relevant legal requirements for minimum driving visual ability
Visual ability	Definition of range of subjects visual ability relevant to the experimental design
Exclusion criterion	Description and frequency of exclusions

Table 3 — Experimental design summary information

Parameter	Information required
Experimental conditions	Number and description
Duration of condition	Range, mean and standard deviation
Independent variables	Number and description
Dependent variables	Number and description
Vehicle environment	Public road, test track or simulator
Type of roadway	Arterials, Collectors, Locals (see FHWA functional classification system
Traffic density	Use Level of Service (A-F)
Exclusion criterion	Description and frequency of exclusions

Table 4 — TICS and control condition summary information

Parameter	Information required
System	Description of system including functions, controls and displays
Tasks	Number and description
Subtasks per task	Number and description
Task, subtask and sub-subtask pacing	Frequency (number of tasks and subtasks and subsubtasks/per time unit) and description
Subject experience of TICS	Categorization of experience
Exclusion criterion	Description and frequency of exclusions

Table 5 — Visual data classification summary information

Parameter	Information required
Number of regions	Number and boundaries (forward view, driver mirror etc.)
Calibration of areas of interest with respect to driver's glances	Statement that all subjects instructed to fixate on each areas of interest prior to experimental condition, including relevant subject instructions
Start of experimental conditions, tasks and subtasks	Time (and definition of environmental cue if any)
Stop of experimental conditions, tasks and subtasks	Time (and definition of environmental cue if any)
Basic unit of observation for data reduction	Data recording resolution
Exclusion criterion	Description and frequency of exclusions

7 Data analysis and presentation

7.1 General

Likely glance areas of interest may fall into four high level categories which can be further subdivided if necessary:

a) Road scene ahead;

b) Other traffic related areas of interest (left road scene, right road scene, left side mirror, right side mirror, inside rear view mirror, speedometer);

c) Displays and Control devices of interest;

NOTE Special care is required when using transparently overlapping areas of interest such as Head-Up Display and symbols superimposed on the inside rear view mirror, the left side mirror or the right side mirror (e.g. warning symbols of a lane departure warning system).

d) Other non-traffic related areas of interest (e.g. billboards, sky, and so on).

The fundamental glance metrics that should be considered for visual demand assessment (as defined in ISO 15007-1) shall be calculated in relation to the above listed key areas of interest. From these, a number of derived metrics of visual behaviour have been defined and interpreted from the standpoint of visual demand.

NOTE To gather valid results, one has to care about Quality of Eye-Tracking Data and potential Artefacts in the recorded data. For more information about these issues see A.1 and A.2.

7.2 Interpretation of findings from analyses of glance metrics

Example interpretations of some of the commonly applied glance metrics follow.

7.2.1 number of glances: The number of glances is an indicator for how often a subject looks at a certain area of interest (AOI). A high number of glances to an area of interest may indicate a high importance of the area of interest or may indicate visual intensity of the display, such that multiple glances are needed to extract information.

7.2.2 total glance time: Total glance time associated with an area of interest (e.g. in-vehicle device) provides a measure of the visual demand posed by that location. As visual demand increases, total glance time should increase.

7.2.3 mean glance duration: The mean glance duration describes how long a subject has to look at a certain area of interest (e.g. a TICS display) to perceive information from it. Shorter mean glance durations are an indicator that information can be perceived fast from an AOI and longer mean glance durations indicate the opposite.

7.2.4 glance rate: The glance rate is an indicator for how often a subject looks at a certain AOI. A high glance rate to an area of interest may indicate a high importance of the area of interest, or visual intensity/information density at that area of interest.

This measure has also been related to event detection. Research has indicated that the largest decrements in event detection tend to occur when glance rate is very high (the eyes are moving a lot, in other words, making many transitions). During transitions, vision is suppressed – and perhaps the continuity of situation awareness is also disrupted as the number of glances increases (and, hence, the number of transitions increases). This is the only glance metric that correlates significantly with event detection, besides task-related glance metrics (percent and durations for glances to task) (see Reference [1]). Together, these metrics account for between 66 % and 82 % of the variance in specific aspects of on-road event detection. It may be important to include this metric for distraction assessment whenever there are conditions that could lead to high levels of scanning (such as with some types of visual-manual tasks), or very low levels of scanning (which are sometimes associated with states of cognitive load).

7.2.5 percent Time on AOI: The percent time on AOI describes the visual demand of an area of interest (especially when operating a TICS). A high percent time on AOI combined with a long mean glance duration while operating a TICS may indicate that the task's design does not allow it to be visually interrupted and resumed easily without loss of information. Design improvements to this aspect of the task may reduce its visual demand.

NOTE The above mentioned glance metrics should be interpreted in conjunction for the TICS evaluation and not isolated from each other, because this may lead to wrong conclusions (see 7.3 Interpretation of multiple glance metrics).

7.2.6 maximum glance duration: Long maximum glance durations to a TICS display while operating it may be a sign for high visual and mental demand caused by the TICS. This may be due to human factors problems such as unexpected or delayed reaction from the TICS.

7.2.7 glance location probability: glance location probability on a given area of interest reflects the relative visual demand associated with that area of interest. Across a mutually exclusive and exhaustive set of areas of interest, fixation probabilities capture where the eyes were fixated throughout a sample interval. Given such a distribution, visual demand assessment might statistically compare two such distributions (under two experimental conditions or tasks).

EXAMPLE If device use were to induce a relative decrease in the fixation probabilities associated with the driving scene, such as road scene or rear-view mirrors, this would be considered indicative of the visual demand associated with the device.

7.2.8 link value probability: Link value probabilities represent the relative number of transitions between one AOI and another and thus the strength of their relationship. The greater the link value probability, the stronger the need to time share attention between the two locations. In visual demand assessment, the link value probabilities may be analysed to assess how visual attention has been affected by TICS use or the driving conditions.

7.2.9 total eyes off road time (TEORT) and percentage of eyes off road time (PEORT): Increasing TEORT and PEORT indicate that the subject may be distracted by TICS. It can also be a sign for low primary task workload which may have the effect that the driver starts operating TICS in the car (which can in turn also lead to increased TEORT and PEORT).

7.2.10 percentage of transition times: A transition time is roughly a linear function of the distance from one area of interest to another. During the transition time, there is relatively little new visual information acquired by the driver. Thus increased transition times reflect reduced availability for driver information-gathering.

7.3 Interpretation of multiple glance metrics

When drawing conclusions about visual behaviour and driver workload, users should examine multiple visual metrics.

EXAMPLE 1 Glance frequency and mean glance duration may be traded off within a fixed sample interval. That is, very long glance durations (indicative of high workload demand) may be associated with fewer rather than more glances. Thus it is important to consider the two measures together, especially if the sample interval is fixed rather than allowed to reflect task completion time.

EXAMPLE 2 When comparing the speed gauge in a head up display (HUD) with a conventional speedometer in the instrumental cluster one may find that subjects have a higher number of glances and a higher glance frequency to the speed gauge in the HUD than to the speedometer in the instrumental cluster. When only taking into account those two metrics this might lead to the conclusion that the HUD is more distracting. When also taking into account that the mean glance duration to the HUD is shorter than to the instrumental cluster and that the total glance time to both areas of interest for the same time interval is the same one will draw the conclusion that subjects control their speed more often with the HUD without being more distracted which leads to an increase in safety (see Reference [2]).

EXAMPLE 3 The HUD also offers an opportunity to highlight another example of where multiple metrics should be examined. Because the HUD is typically located high in the field of view and closer to the driver's line of sight to the forward roadway, transitions to nearby areas of interest on the roadway are shorter – and the probability of noticing events in nearby regions (such as unexpected roadway events like pedestrians or braking vehicles) is increased, with response times to them facilitated (see Reference [3])

NOTE Another consideration in interpreting glance metrics for new technologies (such as HUDs) is that they may have a novelty effect, which often results in increasing the number of glances to the AOI containing the new technology or display. This was the case for HUDs, and it was found that the novelty effect of increased glances to the HUD declined across 4-days of use (1 session of use per day). Thus, it is important to disentangle 'novelty effects' on glance metrics from effects that are more stable and representative of long-term use of a display once novelty has worn off.

Offering standard interpretations is a challenge because the context can have a strong effect on their meaning. For example short mean glance duration might indicate efficient uptake of information, but it might also indicate the presence of many short, useless glances and consequently an inefficient uptake of the visual information

Annex A
(informative)

Supporting information for performing and analysing experiments to determine driver visual behaviour

A.1 Quality of Eye-Tracking Data

Ensure the quality of eye-tracking data by performing the following checks:

A.1.1 Check of calibration

The calibration check makes ensure that the eye-tracking system has calculated the point of fixation correctly after the calibration and that there is no drift in calibration during the experiment.

The required procedure is as follows:

— At the beginning of each participant session a two-step check should be used:

  — Use the calibration procedure provided by the eye-tracking system in use (e.g. matrix of 4, 9 or 16 dots)

  — Once calibrated have participant glance to each area of interest important to the study and verify that each glance is properly displayed/calculated

— At the end of the experiment a single step check should be used:

  — Have participant glance to each area of interest important to the study and verify that each glance is still properly displayed/calculated. If it is not, it is a sign that there's a drift in calibration that occurred. The experimenter needs to determine whether the shift is still acceptable or not.

To evaluate whether too much drift in calibration has occurred Table A.1 may be helpful:

Table A.6 — Criteria for calibration quality

Good	Glance is inside AOI
Satisfactory	Glance is near border of intended AOI and not in another AOI
Poor	Glance is far from intended AOI and/or in adjacent AOI

If the shift in calibration is poor there are two options:

— Re-calibrate at the moment of drift;

— Discard the data of the participant and replace with a new participant.

A.1.2 Validity and validation of data

Issues specific to the experimental work which may limit the validity of findings should be reported. For example, distributions of visual scanning during day and night driving may be different. Criteria for exclusion of data, such as non-relevant driver behaviour or non-relevant vehicle behaviour or equipment malfunction, should be carefully defined and documented in the report of driver visual behaviour.

Before data analysis is performed one should make a validation of data and check the following criteria:

— Confirm data availability over segments to be analysed (e.g. task interval). This means, for each segment to be analysed, to calculate the percentage of valid frames (e.g. the pupil is correctly detected). See Table A.2.

Table A.2 — Criteria for quality of data availability

	Percent of valid frames
Excellent	≥ 95 %
Good	≥ 85 %
Poor	≥ 70 %
Unacceptable	< 70 %

If there are drop outs that decrease data availability there are three options:

— Improve the data availability (e.g. by frame by frame manual eye-detection)

NOTE Filters do not improve data availability within a segment

— Improve the data availability by reconstruction of visual behaviour data by other valid data channels (e.g. by physiology, other behavioural data)

— Discard the data segment of the participant from the analysis

It is recommended to document data availability on the subject level or at least the experiment level.

A.2 Artefacts

When automatically analysing eye-tracking data, be especially careful of potential artefacts in the data set. These artefacts are very short glance durations to areas of interest and they can occur for different reasons:

— Fly-throughs: When the eye makes a saccade from one area of interest to another, but passes through a third area of interest on the way, the eye-tracking system might detect a short glance as an artefact to that third area of interest that was crossed. The Head-Up Display is an area of interest for which this might occur because it is always crossed when the gaze is directed from the road scene ahead to the instrument panel and backwards. Fly throughs should not be treated as glances, but as part of a saccade.

— Pupil detection errors: An eye-tracker mistaking other objects/attributes for the pupil can result in an erroneous gaze location. Some examples are eye-lashes with mascara or the reflection of a tree on the cornea. Those pupil detection errors lead to erroneous gaze locations.

NOTE In most current eye-tracking systems it is not possible to determine when this has occurred. If however an eye-tracking system does provide a method of identifying those pupil detection errors they may be corrected manually.

A.3 Blinks

The exact definition of blinks can be found in ISO 15007-1. Below it will be described how to handle blinks in data analysis.

The following classification and treatment applies (classification according to Reference [5]):

Normal blinks: ≤300 ms (mean duration 257 ms; standard deviation 11 ms)

If a glance to an area of interest is divided by a “normal blink” shorter or equal than 300ms, the glance shall be treated as continuous glance (not two). The glance has to be within the Area of Interest before and after the blink.

Long close durations: 300 ms to 500 ms

If a blink with a long close duration ranging from 300 ms to 500 ms occurs during a glance to an area of interest shall be treated as continuous glance (not two). The glance direction/point of fixation has to be within the Area of Interest before and after the blink. Some eye-tracking systems can’t distinguish between a blink and a non-detection of the pupil, whereby both effects look the same in the data set. Due to that and due to the fact that 300 ms to 500 ms could be enough time for a short glance/fixation to a different area of interest one can ensure by other analysis procedures (probably manually) that the subject did glance to somewhere else (somewhere outside the area of interest or to a different area of interest). In this case the glance may be divided into two separate glances.

Eye-lid closures: ≥500 ms (indicating microsleeps)

If eye-lid closures appear during an experiment in which the subject has to interact with TICS, this can be a clear sign for fatigue. In this case the data should not be used for the evaluation of a TICS if fatigue is not an intended experimental condition. If these dropouts are due to issues with the quality of eye-tracking data A.1 gives advices how to treat those issues.

A further effect can be that the subject blinks and then performs a transition during that blink from one area of interest to another one. In that case the last valid data point before the blink defines the end of the glance to the area of interest which was left and the next valid data point defines the beginning of the glance to the area of interest towards which the transition was made.

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