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# WHERE DO DRIVERS LOOK WHEN STEERING IN STRAIGHTS AND HORIZONTAL CURVES ON HIGHWAYS?

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## ABSTRACT

The manner in which drivers direct their gaze plays a pivotal role in the operation of a vehicle. As information acquisition and processing while driving form the basis for action decisions, their implementation and control in road traffic, the driver's gaze behavior largely determines his driving behavior and is therefore of central importance for traffic safety. With the help of modern measurement technology, eye movements can be precisely registered and gaze behavior can be recorded in real time while driving. The analysis of gaze behavior thus represents a new method for considering the perceptual-psychological factor in the interaction between driver, vehicle, and road. The gaze behavior of drivers is largely determined by the layout geometry of the road. It has been found that gaze patterns are significantly different when a vehicle is steered along straight sections and within horizontal curves. On highways, the fixation position and the standard lateral deviation from the main gaze axis exhibit notable differences between straight sections and curves, as well as between left and right curves. The number of fixations in the area surrounding the road center, also referred to as the primary attention area or the vanishing point, is markedly higher on curves than on straight sections. This indicates an increased level of attention and concentration, as well as elevated stress levels for drivers. Additionally, there is a notable concentration of gaze on the vanishing point of the road on right curves compared to left curves.

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# 1. Introduction

It is estimated that over 90 % of the information received when driving is via the visual channel. The eye is the only long-range sensory organ that can be specifically directed by eye movements and allows the detection of objects that are spatially ahead [1]. The gaze behaviour of drivers is a highly selective, dynamic process that ensures precise perception of moving or stationary objects, speeds and spatial dimensions. The analysis of gaze behaviour allows the temporal and spatial course of detailed information inflow, together with shifts of attention, to be explored.

The specific locations and times at which the driver directs their gaze can be identified through the use of gaze behavior analysis. By focusing on areas of the highway that are rich in information, typical gaze behavior patterns can be identified. A variety of temporal and spatial gaze behaviour measures are available for the examination and interpretation of the temporal behaviour of visual attention distribution, the spatial concentration of gaze and the intensity of information intake. In the present work, those measures are selected from the wide range of these measures that are the most meaningful with respect to the desired interdependencies.

The gaze behavior of drivers is largely determined by the layout geometry of the road. Previous research has demonstrated that the conditions under which a driver steers a vehicle along a straight route and within curves are not equivalent in terms of the physiological strain on the driver and the concentration of attention. The stress experienced in curves is higher than on straights, which leads to an increased level of attention. The gaze behavior observed in left and right curves is characterised by specific gaze patterns that differ significantly from one another.

# 2. Background

## 2.1. Drivers’ visual perception

The process of optical information acquisition is described by the terms "seeing," "perceiving," and "recognizing." The term "seeing" is used to describe the act of looking at something without conscious awareness, such as gazing into space. In contrast, the term "perceiving" denotes the act of directing one's attention towards the surrounding environment or specific objects within it. Ultimately, recognition represents the process of observing and identifying a perceived visual object. In the process of information absorption, the visual sensory channel is the dominant conduit. The contribution of the eyes to the intake of information is estimated to exceed 90 % by [2] and [3], and may even reach 99 % by [4]. The eye is the only sensory organ that can be specifically aligned via eye movements and enables the detection of objects lying spatially ahead. This is the reason why [5] coined the slogan "driving is seeing". The remaining information intake of 1 to 10 % occurs through the other three sensory perceptions and only serves a controlling function. In particular, the sense of acceleration and speed are supported via the haptic and acoustic sensory channels.

## 2.2. Physiological characteristics of the human eye

The visual system is the most active of the sensory modalities, with activity expressed through eye movements. The physical stimulus is recorded by the receptor cells of the retina. The fovea centralis is the region of the retina that permits the sharpest vision. Only within this range is the resolution sufficient to enable the clear perception of imaged objects at a visual angle of up to 2° around the fixed viewing location. This indicates that when attempting to record and process complex visual stimuli, it is not feasible to capture them in their entirety with a single observation. The entire field of view of the eye can be described as a cone with an approximate angle of 100° [6]. The eye's ability to move enables the sharp vision within the cone-shaped area of the visual field. A distinction is made between foveal vision and parafoveal vision, which allows for relatively good resolution (approximately 30 % of foveal vision) and has an extent of 2° to 10°. A deviation of merely 3° from the fixation location results in a reduction of visual acuity by half [7]. The remainder of the visual field is referred to as the peripheral vision. The resolution there is notably poor. The area of peripheral vision extends beyond the 10° cone opening angle, and the perception there is monochromatic and blurred. Peripheral vision is primarily responsible for the perception of movements and changes in brightness, as well as static and dynamic orientation in space. It is of great importance in estimating the size and direction of movement of distant objects. When driving a car, foveal vision plays the most important role, as it guarantees quick and precise information acquisition, which is essential for driving vehicles, especially at high speeds. However, it should not be overlooked that foveal vision can only be closely linked to peripheral vision.

## 2.3. Gaze Behavior Parameters

Gaze behavior can be simplistically understood as a chain-like sequence of saccadic eye movements and fixations. The alternation of saccades and fixations reflects the course of information intake from the environment and defines gaze behavior.

### 2.3.1. Saccades

Saccadic eye movements are very fast, abrupt rotational movements of the eyeball, facilitating the rapid transfer of blurred objects from the periphery to fixation on the fovea. At the beginning of this rotation, the movement is characterized by a very high acceleration. The saccades reach a speed of up to 1000°/s [8, 9, 10], have durations between 10 and 80 ms, amplitudes between 2° and 50°. This makes eye movements the fastest movements that take place within the human body. Each saccade guides the eyes to a new fixation. Since the shift of the entire image that takes place on the retina is not perceived, almost no information is absorbed during a saccade [11, 12].

### 2.3.2. Fixations

Fixations are the movements of the eyes that allow information to be taken in. To take in information, the target object is fixed between saccades. During a fixation, the eyes are at a relative standstill with respect to the viewed location. The fixated object is imaged in the foveal area of the retina for a certain amount of time. The duration of fixations varies between 100 and 2000 ms and their concentration is between 200 and 600 ms [13, 14]. The minimum fixation duration of 100 ms seems plausible because of saccadic suppression, since no information can be perceived with even shorter fixation durations.

Fixation durations are often interpreted as a measure of load. However, the interpretation as a measure of load depends on the type of task. When a task requires predominantly centrally controlled processing, an increase in fixation duration is an indicator of greater stress. On the other hand, in tasks that require quick reactions (such as driving a car), shorter fixation durations can be observed with greater stress [15, 16].

When analyzing fixation durations in traffic, [17] found that fixations lasted between 300 and 400 ms. Fixation durations are shorter when the traffic situation is more "complex".

## 2.4. Fixation distribution and fixation duration on straights and horizontal curves

There are numerous studies in the literature on the gaze behavior of drivers on the road. Gaze behavior is different on country roads or in urban traffic than it is on highways. In terms of stress, the conditions for steering a vehicle are not the same on straight roads and in horizontal curves (called just curves). The driver tries to compensate for the increased stress in curves compared to straight roads by increasing his attention [18].

A concise source of information about the direction of the road is available for monitoring the traffic area when driving freely on straight stretches of highways. This is the so-called vanishing point of the road (VP), i.e. the most distant point on the road, which ideally lies on the horizon. On straight stretches, the vanishing point remains in the same position and thus serves as a constant reference point that determines the direction of travel (Fig. 1a). For lane keeping, there is a relatively large tolerance for driving errors because lateral acceleration is low and the driver must maintain a chosen lane.

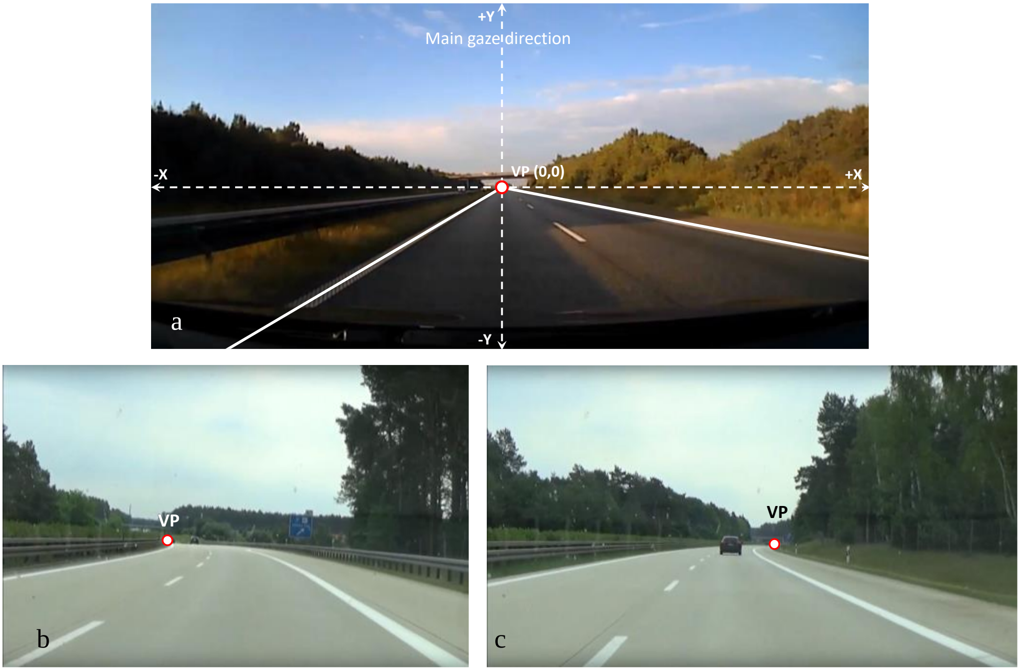


**Figure 1. Vanishing point with main gaze axes X and Y on straight sections (a), VP on left curves (b) and right curves (c)**

In curves, the position of the vanishing point is constantly changing (Fig. 1b, Fig. 1c). The driver must constantly search for newer sources of information to adjust the direction of travel to the curvature of the road. Within a curve, where there is no constant source of information about the direction of the road ahead, the driver must be able to acquire and process relevant information from many locations over time. Unlike on a straight road, the lateral acceleration in a curve is high and the tolerance for error is much lower than on a straight road. According to [19], in curves, which are themselves critical points in the road network, the demands of the driving task are much higher than on straight roads due to reduced visibility and higher loads. Peripheral vision is no longer sufficient to take in traffic information, and the driver must use his central vision to take in information as accurately and quickly as possible.

When driving on highways, there is a close interaction between peripheral and central vision. As the environment becomes more complex, the driver must use his central vision more frequently to take in traffic-related information. An accumulation of fixations on relevant elements of the road is an indication of the driver's effort. On such routes, most of the relevant information is extracted from a few road elements. These are mainly road markings and the vanishing point. On straight roads, the driver focuses far ahead, near the visual vanishing point of the road. From this point, the driver receives information about the direction of the road. The vanishing point is therefore particularly important for long-distance orientation and lane keeping, which is also controlled by peripheral vision.

[19] confirms that fixation points are concentrated at different distances along the right side of the road in right curves. The lateral range of variation is between the center lane and the right edge of the road. Information is primarily recorded from the right side of the road. In left curves, however, the fixation points are distributed over the entire width of the road at different distances. The spread of fixation points was greater for left-hand bends than for right-hand bends. In both curve directions, there was a smaller spread of fixation points around the vanishing point of the road compared to straight sections of the same route. [20] also finds clear differences in gaze behavior between right and left curves, with the road boundary on the inside of the curve being predominantly fixated in right curves as opposed to left curves. According to [21 – 23], the optical density between the tangent point (TP) and the vanishing point (VP) of the road plays an important role in the estimation of curve curvature and lane keeping (Fig. 2).

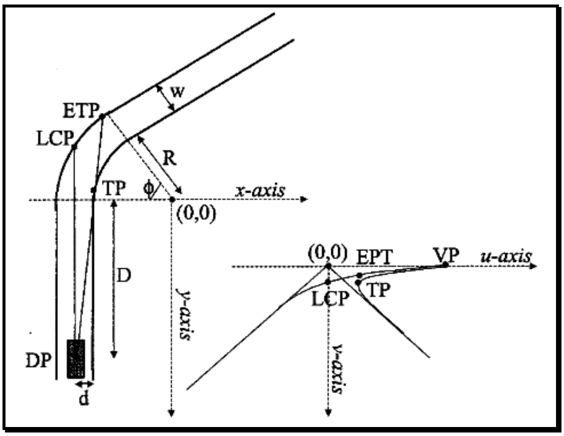


**Figure 2. Bird's eye view and driver's view of approach and curve area [17]**

It was found that for both straights and curves, approximately 85 % of all fixations were in an angular range of ± 4° in the horizontal direction and ± 2° in the vertical direction around the vanishing point (Fig. 3). Therefore, the vanishing point is defined as a window 8° wide and 4° high.

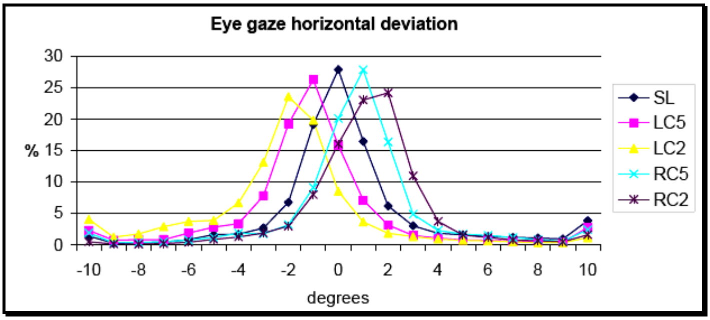


**Figure 3. Horizontal angular distance of the fixations with respect to the vanishing point according to [24]**

## 2.5. Temporal and spatial measures of gaze behavior

The following measures were identified from the existing literature and were utilized in this study.

### 2.5.1. Measures of visual processing

- **Number of fixations (NFix)**

The number of fixations is similar to the number of components the driver has to process, but not to the depth of processing. When searching for a single object, a large number of fixations indicates that many other objects are fixated until the gaze reaches the searched object. [25] find that the percentage of mean fixation durations greater than 2,0 s is significantly lower in curves than on straight sections.

- **Average fixation duration ($FixDur_m$) – a measure of the depth of visual processing**

Longer fixations indicate a longer interpretation time. Thus, fixation duration is a measure of the depth of visual processing. [25] find that average fixation duration increases as a function of the difficulty of the secondary visual task. Significantly shorter mean fixation durations were calculated for curves than for straight lines. [26] found that drivers fixated longer on straights than on curves (0,60 s vs. 0,41 s). In difficult situations and in curves, shorter average fixation durations are expected.

- **Percent of fixation time in the main area of attention (Percent Road Center)**

PRC is the percentage of all fixations that are directed to an area around the center of the road, also called the primary area of attention. Thus, PRC is a measure of forward orientation that is dependent on gaze direction. The method developed by [26] was used to determine the percentage of fixations in the main area of attention (PRC). The authors defined a 20° wide and 15° high window near the vanishing point, which was modified and reduced to 15°×10° in this study (Fig. 4). During analysis, each fixation was checked to see if it was within this window. It is expected that the gaze will be more focused on the vanishing point of the road in curves than in straights. It is also assumed that the PRC value increases with decreasing visibility.


**Figure 4. Percent Road Center (a) and fixation point with its duration (red circle) on highways (b)**

### 2.5.2. Measures of visual search

- **Standard deviation of gaze angle (SD)**

The standard deviation of the gaze angle is the square root of the sum of the squared horizontal and vertical gaze angles. [26] find that there is a noticeable tendency to focus more on curves than on straights, and on country roads than on highways. As strain increases, the dispersion of gaze decreases. A smaller standard deviation of the gaze angle is expected as the driver's load increases on straights and on right and left curves.

- **Mean fixation location of all fixations in the Field of View ($FixLoc_m$)**

The mean fixation position of all fixations in the Field of View is directly related to the geometry of the highway layout and shows the position of the mean main fixation point in relation to the main gaze axis.

For the analysis of the fixation distribution the mean fixation position ($FixPos_m$) and the number of fixations on the vertical main gaze axis $NFix(X)_M$ were also used for both sides of the vertical main gaze axis as well.

## 3. Research methodology

### 3.1. Measurement system design and functionality

The gaze behavior measurements in real driving were performed by test persons driving a test vehicle. The test vehicle was a BMW 525d Touring, which was available at the Chair of Road Design at the TU Dresden. The vehicle was equipped with a modern and highly accurate "Smart Eye Pro 2.5" system. The system works contactless (remote tracking) and records eye movements based on the principle of corneal reflection. Two so-called eye cameras with active infrared spots are mounted on the windshield of the vehicle and record the pupil movements. The infrared spots of the two cameras (Fig. 5) ensure that interference from changing lighting conditions is avoided. An additional scene camera captures the field of view from the driver's perspective. A central computer in the trunk processes the eye-tracking data and the GPS positioning data from the APPLANIX system.


**Figure 5. Eye-tracking system in the measurement vehicle (a) and central computer in the trunk (b)**

### 3.2. Selection of test routes and test subjects

The A72 federal highway between Hof and Chemnitz, one of Germany's oldest highways with inhomogeneous route characteristics, was chosen to investigate driver gaze behavior and accident occurrence. In the 1930s, the A72 was originally planned as a "corner connection" of the basic network routes Berlin-Nuremberg and Frankfurt-Dresden. Today, the A72 is a major link between the A4 (Bad Hersfeld – Erfurt – Chemnitz – Dresden – Poland) and the A9 (Munich – Nuremberg – Leipzig – Berlin). The A72 was rebuilt between 1990 and 1995, with the axis and gradient closely following the original design from the 1930s. The aim of the design was to retain the existing alignment as much as possible and to complete the widening within the existing property boundaries. Improvements to the layout and elevation plan were limited. The seven sections had a total length of 56,0 km in each direction. Curves and straights accounted for 49,5 % and 50,5 % of the total length, respectively. Of these, 24,3 % were left curves and 25,2 % were curves.

[27] writes that the homogenized group of test persons (subjects) for such studies should be kept as small as possible for economic reasons and recommends a sample size of 10 test persons. It is particularly important that the test persons have the same knowledge of the road and the same level of familiarity with the test vehicle. Therefore, 10 test persons between the ages of 26 and 39 were selected. All were employed at the TU Dresden. Each had to have at least 60000 km of driving experience. All subjects should have had their driver's license for at least six years and own their own car.

## 4. Presentation and interpretation of results

As evidenced by the literature analysis, the gaze patterns observed on straight sections, left and right curves are markedly different. Since the gaze behavior on straight sections is characterized by an accumulation of fixations on road elements that are not necessarily relevant to traffic, [19] found that the gaze of drivers on straight highway sections is almost evenly distributed over the entire width of the road and is directed towards the sky. This finding was confirmed in the present study. As shown in Figure 6, the number of fixations on straight sections to the left and right of the main gaze axis Y is almost equal. A total of 46,7 % of all fixations were recorded to the left of the visual axis, while 52,3 % were registered to the right. A substantial number of fixations were positioned above the horizon and directed towards traffic-irrelevant objects. Only 1,0 % of the fixations were precisely aligned with the main gaze direction, occurring above and below the horizontal axis. No significant differences were observed in the mean fixation durations on either side. When all fixations within the field of view (FOV) are considered, the mean fixation location ($FixLoc_m$) is approximately 1,3° to the right of the visual vanishing point of the road, from which they receive information about the direction of the road. The vanishing point is important for long-distance orientation and is also controlled by peripheral vision. This result confirms the finding of [26] that on straight sections the gaze is mostly directed straight ahead in the area of the vanishing point, with the main fixation point situated approximately 1,6° to the right of the main gaze direction.

A significant difference was identified when the mean positions of the fixations on the left and right sides of the main gaze axis were calculated separately. The mean position of all left fixations was observed to be 2,5° to the left of the main gaze axis, while the mean position of the fixations was 4,0° to the right of the main gaze axis. Additionally, the standard deviation of the gaze angle from the main gaze direction in the horizontal plane ($SD_X$) is also smaller on the left side than it is to the right of the main gaze axis. This indicates that there is a greater dispersion of gaze on the right side of the main gaze axis compared to the left. This gaze pattern, which is consistent across all test subjects, serves two purposes: to ensure the correct vehicle position and lane keeping, and to recognize the objects necessary for driving and orientation (e.g., traffic signs). The vertical sequence of fixations at 15° – 16° clearly demonstrates the observation of traffic signs.

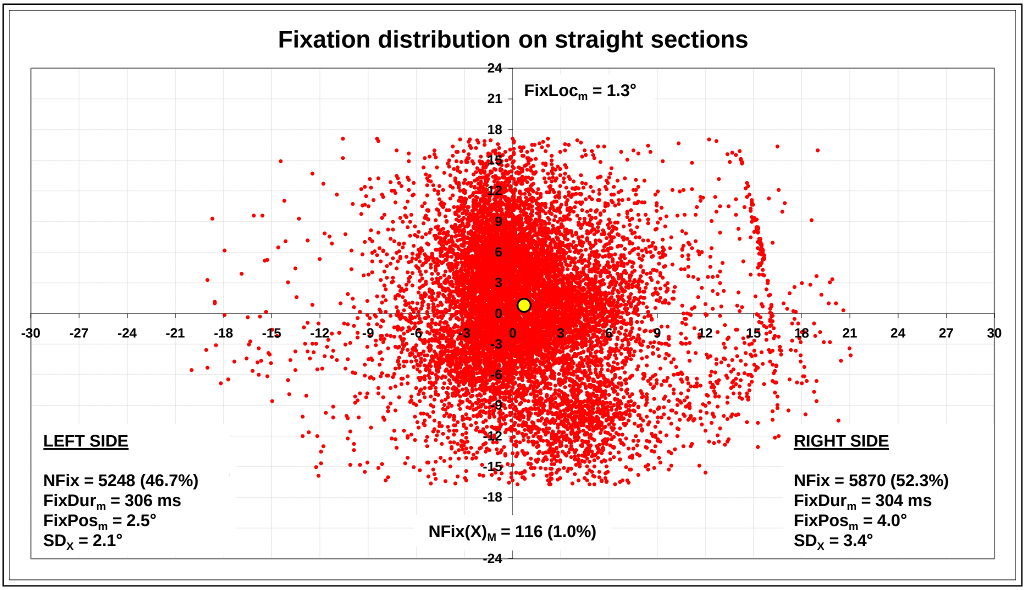


**Figure 6. Fixation distribution on straights. Mean fixation location for all fixations in the FOV (yellow dot), number of fixations, mean fixation duration, mean fixation position, and standard deviation on both sides of the main gaze direction**

On left curves, while driving on the left lane, the number of fixations on the left side of the main gaze axis is significantly higher (67,5 %) than on the right side (32,1 %). The average fixation duration is identical on both sides, though it is slightly shorter than that observed in the straight sections. Here, the mean fixation positions are almost equally distant from the main visual axis on both sides. A review of all fixations within the field of view (FOV) reveals that the mean fixation location ($FixLoc_m$) is situated 1,5° to the left of the main viewing direction (Fig. 7). Furthermore, the standard deviations in the lateral direction are also nearly identical on both sides of the main visual axis. This leads to the conclusion that the gaze on left curves is distributed equally on both sides of the main visual axis, despite a higher concentration of fixations on the left side. This confirms the findings of [19, 26, 28] that people tend to look straight ahead on left curves and that the fixation points are distributed across the entire width of the road. Therefore, information on left curves is gathered from the entire width of the road. As on the straight sections of the route, the vertical arrangement of the fixation points at 15° – 16° to the right of the main gaze axis demonstrates the targeted observation of the traffic signs.

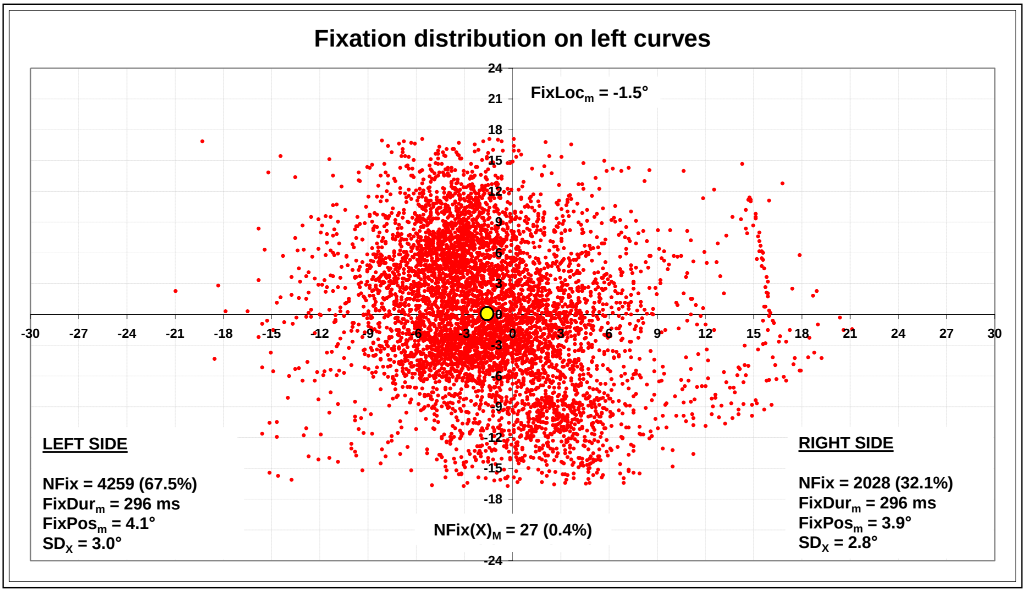


**Figure 7. Fixation distribution on left horizontal curves. Mean fixation location for all fixations in the FOV (yellow dot), number of fixations, mean fixation duration, mean fixation position and standard deviation on both sides of the main gaze direction**

In contrast, when driving on the right lane on a right curve, the majority of fixations (78,9 %) occur on the right side of the main gaze direction. In contrast to the observations made on left curves, no spread of the gaze across the entire width of the road can be observed. While only 20,3 % of all fixations can be registered on the left side of the main gaze axis in right curves, the proportion of fixations on the right side of the road on left curves is 32,1 %. The mean fixation duration on right curves is longer on both the left and right of the main gaze axis (312 ms) than on right curves alone (296 ms). Additionally, the findings of [26] indicate that drivers tend to maintain gaze on the road for a longer duration when navigating right curves compared to left curves. The authors conclude that drivers generally focus their fixations on the side of the field of view (FOV) relevant to the direction of the turn. This is evidenced by the fact that 5 % of the total time is spent fixating on the left side on right curves and 24 % of the total time is spent fixating on the right side on left curves. The present study revealed that approximately 9 % of the total time was spent fixating on the left side of the field of view on right curves. Conversely, drivers fixate on the right FOV side twice more (18 %) on left curves of the time. The driver acquires the majority of the relevant information from the areas of the right edge of the road and the vanishing point, as well as from the right lane itself. Only a few glances reach the left side of the main gaze axis and they primarily serve for orientation. This conclusion was also reached by [19, 26, 28]. In this study, the fixation points were listed from the video recordings and it was found that over 60 % of all fixations were in the area of the right edge of the road at different distances.

When all fixations within the field of view (FOV) are considered, the standard deviation (SD) is approximately 4,4° on right curves which is lower than on left curves where it is approximately 5,0°. This indicates that the gaze on right curves is more concentrated than on left curves. On right curves, drivers exhibit a tendency to direct their gaze in a lateral direction, with an average deviation of 2,4° to the left, while on left curves they look 3,9° to the right (Fig. 8 and Fig. 7). The standard deviations on both sides of the main gaze direction clearly demonstrate that the dispersion of the gaze on right curves on the left side is much smaller compared to the right side. In contrast, the gaze on left curves is distributed almost equally on both sides of the main gaze direction. These results confirm the findings of [19, 26], which indicated a greater dispersion of fixations on left than on right curves and a significant difference in the time spent focusing on the road between right and left curves. The mean fixation location ($FixLoc_m$) on right curves is 4,1° to the right of the main gaze axis, suggesting that the right side plays a crucial role in lane keeping, vehicle control, and information collection.

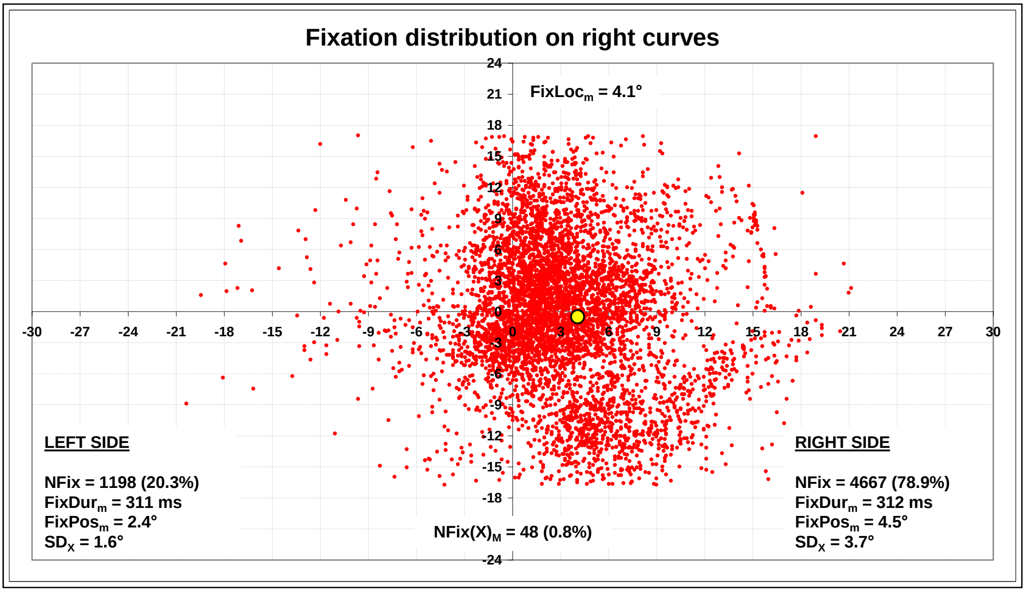


**Figure 8. Fixation distribution on right horizontal curves. Mean fixation location for all fixations in the FOV (yellow dot), number of fixations, mean fixation duration, mean fixation position and standard deviation on both sides of the main gaze direction**

The PRC measure provides very clear results. Figure 9a shows that drivers fixate much more on the area near the vanishing point on curves (22 %) than on straights (10 %). On straights, the vanishing point remains in an unchanged position and serves as a constant reference point that determines long-range orientation, direction of travel, and lane keeping. As soon as the driver notices an approaching curve, he uses his central vision to take in information about traffic-relevant road elements such as road markings and vanishing points. The higher number of fixations in the area around the vanishing point in both left and right curves confirms the hypothesis that significantly higher PRC values are to be expected on curves than on straights due to increasing stress. Also [25] conclude that in curves there is a clear concentration of attention in the area near the VP of the road in curves compared to straights.

There is also a significant difference between left and right curves (Figure 9b). Due to the large distribution of fixation points over the entire road width, the PRC value is much lower in left curves (19 %) than in right curves (25 %).

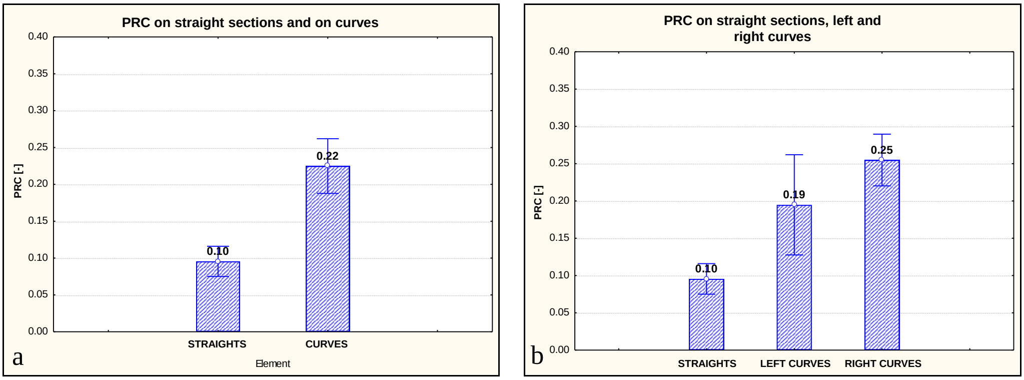


**Figure 9. Proportion of fixations to the main attention area on straights and curves (a) as well as on straights, left and right curves (b)**

## 5. Conclusions

Following an evaluation of the results of the gaze behavior on straight sections and left and right horizontal curves, it can be concluded that drivers exhibit a tendency to distribute their gaze across the entire width of the road when driving on straight highway sections, with a notable alignment towards the sky. A higher degree of gaze dispersion was observed on the right side of the main gaze axis in comparison to the left. This gaze pattern serves two purposes: ensuring the correct vehicle position and lane keeping, and recognizing objects necessary for orientation while driving (e.g., traffic signs). The average fixation location is approximately 1,3° to the right of the main gaze direction. This indicates that on straight sections, fixations are concentrated mostly straight ahead in the area of the vanishing point. The latter is of particular importance for long-distance orientation, and it is controlled via peripheral vision as well.

On left horizontal curves, the mean fixation positions and the standard deviations of the gaze angle in the lateral direction are almost equally distant from the main visual axis on both sides. This leads to the conclusion that the gaze on left curves is distributed equally on both sides of the main visual axis. Drivers tend to maintain a straight gaze ahead, and the fixation points are distributed over the entire width of the road.

A distinct gaze pattern has been identified in the case of right horizontal curves. The majority of fixations occur on the right side of the main gaze direction, accounting for 78,9 % of instances. In contrast to the gaze patterns observed on left curves, no spread of the gaze across the entire width of the road can be observed. Drivers tend to focus their fixations on the side of the field of view (FOV) that is relevant to the direction of the road. This allows them to receive the majority of relevant information from the areas on the right edge of the road and the vanishing point (over 60 % of all fixations), as well as from the right lane itself. Only a few glances are directed to the left side of the main gaze axis, which primarily serve an orienting function. It has been demonstrated that drivers dedicate a significantly greater proportion of their attention to the road on right curves than on left curves. The mean fixation location is 4,1°

to the right of the main gaze axis, indicating that the right side is of particular importance for maintaining lane position, controlling the vehicle, and gathering information about the direction of travel.

The percentage of time of fixations in the main attention area (PRC measure) indicates that drivers increasingly fixate near the optical vanishing point on horizontal curves (22 %) compared to straight sections (10 %). This finding leads to the conclusion that in curves, there is a clear concentration of attention on the area near the VP of the road, which is associated with increased strain compared to straight sections on highways. Conversely, a significant difference has been identified between left and right turns with the PRC value being considerably smaller (19 %) on left curves than on right curves (25 %).

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# НАКЪДЕ ГЛЕДАТ ШОФЬОРИТЕ В ПРАВИ УЧАСТЪЦИ И В ХОРИЗОНТАЛНИ КРИВИ ПО АВТОМАГИСТРАЛИ?

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***Ключови думи:*** *поведение на погледа на шофьорите, модели на погледа, автомагистрали, геометрия на пътя, прави участъци, хоризонтални криви, възприятие, разпределение на вниманието, позиция на фиксиране, събиране на информация*

## РЕЗЮМЕ

Начинът, по който шофьорите насочват погледа си, играе ключова роля при управлението на превозното средство. Тъй като възприемането и обработката на информацията по време на шофиране са в основата на решенията за действие, тяхното

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изпълнение и контрол в пътното движение, поведението на погледа на водача до голяма степен определя поведението му при шофиране и следователно е от основно значение за безопасността на движението. С помощта на съвременната измервателна техника движенията на очите могат да бъдат регистрирани прецизно и поведението на погледа може да се записва в реално време по време на шофиране. По този начин анализът на поведението на погледа представлява нов метод за разглеждане на перцептивно-психологическия фактор при взаимодействието между водача, превозното средство и пътя. Поведението на погледа на шофьорите до голяма степен се определя от геометрията на пътя. Установено е, че разпределението на фиксациите се различава значително при управление на превозното средство в прави участъци и в хоризонтални криви. От една страна позицията на фиксациите и стандартното странично отклонение от основната ос на погледа са много различни между правите участъци и кривите, от друга те се различават съществено между левите и десните криви при автомагистрали. Броят на фиксациите в зоната около центъра на пътя, наричана още зона на основно внимание или точка на изчезване, е значително по-голям в хоризонталните криви, отколкото в правите участъци. Това показва повишено ниво на внимание и концентрация, както и повишени нива на стрес за водачите. Освен това, при десните хоризонтални криви се наблюдава значително по-голяма концентрация на погледа в областта на точката на изчезване на пътя, отколкото при левите хоризонтални криви.