Cycle Streets

Encouraging Cycling through Design

Janina Albrecht, Andreas Blitz, and Peter Eckart

The installation of cycle streets—streets where cycle traffic takes precedence over motorized traffic—can be understood as cycling marketing translated into infrastructure: [01] bicycle traffic from the surrounding streets is bundled in such a way that the increased ratio on a cycle street results in a sense of heightened security, while also increasing real security through enhanced visibility. The repurposing of cycle streets also generates increased attention to the topic of cycling within a given municipality. But the concept of the cycle street also makes it possible to completely reconceive the street space from one façade to the other, with the aim of creating an inclusive infrastructure that gives due consideration to everyone who moves along the street, spends time there, or lives there. The dominance of the automobile is opposed by a concept that integrates all users and reanimates the street as a public space. In practice, however, this potential impact is often weakened by the fact that many cycle streets are open to automobiles, which might result in high levels of motorized traffic traveling at excessive velocities. Oftentimes, unfamiliar or ambiguous markings and signage represents a challenge as well. Can mobility design make a fundamental difference by using design decisions to mediate between users and the mobility system while positively influencing user experience and user decision-making?

For a number of years now, Offenbach am Main has been working to expand its network of cycling routes, and in 2018, the city launched the project »Bike Offenbach« with the aim of creating six cycle streets for a total length of nine kilometers (see Stadt Offenbach am Main 2018). In city-center zones with higher structural density in particular, the reconfiguration of the street space is designed to reduce car traffic, leading to an enhanced amenity quality. On these cycle streets, comprehensive design measures with high recognition value are intended to ensure adequate visibility. Certainly, the »Guidelines for Bicycle Traffic Infrastructure« issued by the German Road and Transportation Research Association recommend such a structural clarification of the function of cycle streets but contain no precise Germany-wide design requirements (see Becker 2019; FGSV 2010). This increases the usual leeway when it comes to municipal traffic planning, a circumstance illustrated by the diversity of designs for cycle streets in various German cities and communities (see Graf 2018).[02] At the same time, the absence of clear guidelines can lead to the use of ambiguous markings. This became clear when a 500-meter-long test route was laid out on Senefelderstraße in Offenbach. In response to persistent public discussions and misunderstandings with regard to utilization, the »Bike Offenbach« project management decided to call on the specialist competency of designers at the University of Art and Design Offenbach (HfG). This approach meant an opportunity to analyze the test route from a design perspective, while developing new concepts and deploying these findings directly in practice. Central concerns were the creation of intuitively comprehensible markings and factors designed to enhance the amenity quality. At the same time, social scientists from the Goethe University in Frankfurt conducted a comprehensive written household survey around Senefelderstraße (n=701) and interviews with residents to investigate empirically levels of acceptance of the cycle street and its public perception as well as to discover which role mobility design could play in promoting nonmotorized mobility. Designers and social scientists engaged in an intensive exchange of ideas,[03] as well as with the relevant protagonists of Bike Offenbach, which included the project management (»Offenbacher Projektentwicklungsgesellschaft«), the office for city planning, the transportation authority, and the bicycle planning agency

01 This text is based in large part on the extensive documentation compiled under the title »Design- und Forschungsprojekt Fahrradstraßen: Mobilitätsdesign im Kontext von Verkehrswende, Aufenthaltsqualität und Intermodalität am Beispiel Offenbach am Main,« authored by Janina Albrecht and Peter Eckart, 2020 (https://project-mo.de/de/portfolio-item/fahrradstrasse-offenbach/).

02 As with other municipal roads, the respective municipality is responsible for installing cycle streets (Kregel 1983).

Fig. 1 Cyclists riding on safety demarcation lines of the test route, instead of in bike lane (Source: Janina Albrecht)

»Radverkehr-Konzept.« Foregrounded in the following account are design aspects in particular (for detailed information about the social scientific research, see Baumgartner et al. 2020; Blitz 2020; Blitz et al. 2020; Blitz et al. in this volume).

The Baseline Situation: Analysis of the Test Route

The local characteristics of the test route were first analyzed: the allocation of traffic space, traffic volumes, parking zones, intersections, visibility at crossings, green spaces and roadside trees, access to shops and residences, as well as routes and the requirements of the various user groups (see Albrecht and Eckart 2020: 13–27). Central here were the perspectives and the safety of cyclists. The following aspects were given special preeminence: the marking of safety dividers, markings at crossing zones, unobstructed view axes as well as surface allocation and traffic volume.

The double broken lines on both sides of the roadway are meant to serve as safety demarcation lines and lane markers on the cycle street. They indicate the minimum distance between cycle lanes and parked cars and are intended to prevent accidents caused by car doors that open suddenly and by inadequate distances between bicycles and stationary vehicles (»door zone«). In the beginning, these lines were frequently misinterpreted as designating bicycle lanes, and cyclists rode in the door zone rather than in the actual cycling lane—the reverse of the intended effect (see Kuhn 2018; Baumgartner et al. 2020: 19–20; ↳Fig. 1).

At crossings, the traffic lane of the cycle street was colored red, with a white dotted line alongside the red surface to additionally highlight the crossing roadway. A lack of stop lines on the intersecting streets, however, meant that road users at crossings drove right up to the dotted crossing line. This made it difficult for cyclists to tell whether their right-of-way was being respected, diminishing a sense of safety. The numerous staggered and variegated markings seemed unsettled and were not intuitively legible (see Albrecht and Eckart 2020: 18; ↳Fig. 2).

The start of the cycle street was also marked by a red area. This occupied the entire breadth of the roadway. Given its extension, cyclists were often forced over toward the side of the road (↳Fig. 3).

This conversion to a cycle street entailed only minimal alterations to the roadway and to the allocation of surface areas for the respective modes

Fig. 2 Markings at a crossing area along the test route (Source: Janina Albrecht)

of transport, although from that point onward, only neighborhood residents were permitted to drive cars on that street. Speed measurements showed that the majority of automobile drivers exceeded the thirty-kilometers-per-hour limit by a considerable degree (see Büttner 2019). Excessive speed, the large share of other traffic, and the car parking areas all underscored the disequilibrium that prevailed on the cycle street. Bicycle use was also discouraged by the perceived and actual risk of being hit by opening car doors, the failure of cars to observe right-of-way, and the experience of close calls when cars passed cyclists (on perceptions of the test route, see also Baumgartner et al. 2020: 15–19).

The Development of Intuitively Intelligible Roadway Markings

How, then, can the roadway be configured in such a way that the various user groups intuitively understand street markings, particularly when there exists no tried-and-tested, unified standards for cycle streets? In order to develop concepts for the Offenbach cycle streets, international best practice examples and scientific studies were examined alongside the analysis of the test route. These demonstrated how markings can be used in order to support traffic infrastructure and the observance of traffic regulations. Straight lane markings and median strips have an accelerating effect, while wavy or zigzag longitudinal markings can draw attention to hazards, encouraging deceleration. Lane lines can also aid orientation or serve other functions. An important role is played as well by pictograms: they permit intuitive recognizability, quickly conveying traffic signs and hazards. Site-specific designs can add to the graphic enhancement of cycling infrastructure.

Along the Offenbach test route, the erroneous interpretation of the marked door zones as designated bicycle lanes made it clear that no learned semantics were available to indicate their

03 This collaboration between designers and social scientists took place under the context of the research project »Infrastruktur–Design–Gesellschaft,« which was funded between 2018 and 2021 by the Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz (LOEWE) in the German Federal State of Hesse. The project partners were the HfG Offenbach University of Art and Design (design, consortium management), the Frankfurt University of Applied Sciences (transportation planning), the Goethe-University Frankfurt (social sciences mobility research), and the Technical University of Darmstadt (multimedia communications; architecture/urban design).

Fig. 3 Markings at the beginning and end of the test route (Source: Janina Albrecht)

function as a passive surface that needed to be free of travelers. On the contrary, cyclists are all too habituated to being pushed toward the edge of the roadway, and hence toward parked cars, by excessively narrow safety dividers. For this reason, the marking should convey the function of a demarcated door zone intuitively while pointing to the area that should be used. A number of design variants were developed and discussed with the involved parties of Bike Offenbach, among them diagonal hatching lines and fanned lines (↳Fig. 4). The hatching lines run diagonally and follow the semantics of a keep out area, reinforced by their orientation in opposition to the travel direction (always on the right-hand side of the roadway). With the fanned-out variant, the markings, which visually refer to the arc of an opened car door, begin from the parked car and are oriented against the cyclist's direction of travel. With both variants, the haptic and acoustic effect of the markings also called attention to their function as safety lines when they are ridden on in error (unlike markings involving lines running parallel to the roadway). Both variants were included in the household survey, along with the existing design of the demarcated door zone on the test route.

The survey results showed that the majority of people favored the hatched lines, which were deemed the most appealing markings, as well as the most intelligible. Moreover, they appeared to be the most feasible solution for Bike Offenbach.

With the new concept (concept NOW), just as along the original test route, surface markings at all intersections along the cycle street were intended to call attention to the altered traffic environment. The household survey presented a selection of the colors red, green, and blue. The results showed that a large majority of participants perceived the red markings as being far more recognizable than the other options, so this color was deemed advisable for subsequent implementation. Unlike the original test route, the new concept envisioned red markings only for areas where bicycles were actually meant to be ridden. An interval of separation from the curb having the width of a door zone produces a buffer zone (protected space) along the roadside. Additionally, the red surfaces at the start of the cycle street are extended further into the roadway, creating a tapered shape that is designed to contribute to the deceleration of traffic. Because an even ending of the red marking acts as the end of a stretch several designs were

Fig. 4 Design variants for the demarcated door zone: the double dotted lines of the test route, diagonal hatching lines, and fanned-out lines (Source: Janina Albrecht; see Albrecht and Eckart 2020: p. 47)

considered (including hatchings, waves, zigzags) to convey its meaning to the unmarked surface. Finally, a diagonal transitional shape was selected, as it was seen to embody dynamism while calling attention to the right-hand side of the roadway, hence having a decelerating effect. The slanting lines are highly conspicuous, yet their straightforward formal arrangement avoids creating a distraction from what is happening on the road (see Albrecht and Eckart 2020: 44; ↳Fig. 5).

Furthermore, in the course of the road a bicycle symbol is painted within a white rectangle and the text stating »cycle street« to indicate the street's special status (Zeichen 244 (StVO)).

Improvement of Usability and Amenity Quality through the Design of the Streetscape as a Whole

Research into examples of best practices along with numerous studies have identified the factors that make a transportation infrastructure for bicycles more appealing: a reallocation of road space, use of materials, forms of traffic calming, bodies of water and green areas, markings, informative guidance systems and recognizable icons, attractive illumination, and routes with sound effects while cycling along can all give rise to a safe infrastructure with high experiential quality. Indispensable, moreover, is the spatial integration of cycle streets into the surroundings, ensuring intuitive utilization.

With a point of departure in these research results and the test route in its above-described form, designers at the HfG developed three concepts for cycle streets. They focus on the routes and needs of nonmotorized road users, and take into account aspects like safety, acceptance, amenity quality, convenience, and consistency as well as social value and integration into the urban fabric (see Albrecht and Eckart 2020: 42f.; Vöckler and Eckart in this publication). While concept NOW, presented in the preceding section, uses a variety of roadway markings that intervene only minimally in the prior street structure and can be implemented in the short term, the FLOW and SHARED concepts (↳Fig. 6) go somewhat further.

FLOW is based on a familiar subdivision—dedicated zones for pedestrian traffic, parking, and moving traffic—but it alters the street layout, using curved lane markings, islands and crossing aides, green areas, and special offers for cyclists such as repair stations. Functional densification decelerates traffic and encourages an intuitive and diversified utilization of the street that respects the needs of pedestrians and residents. SHARED, in turn, pursues the idea of a fundamental reconfiguration, and abandons the concept of an express cycling lane. The focus is on amenity quality and inclusion and is based on research into the routes of various traffic participants that was performed at the start of the analysis. SHARED dissolves the boundaries between sidewalk and roadway, emphasizing the breadth of the street from one façade to the other (rather than the customary division of the surface area parallel to the direction of traffic flow). This promotes relaxed, comfortable cycling, offers more space for pedestrians, and invites people to relax and linger on benches

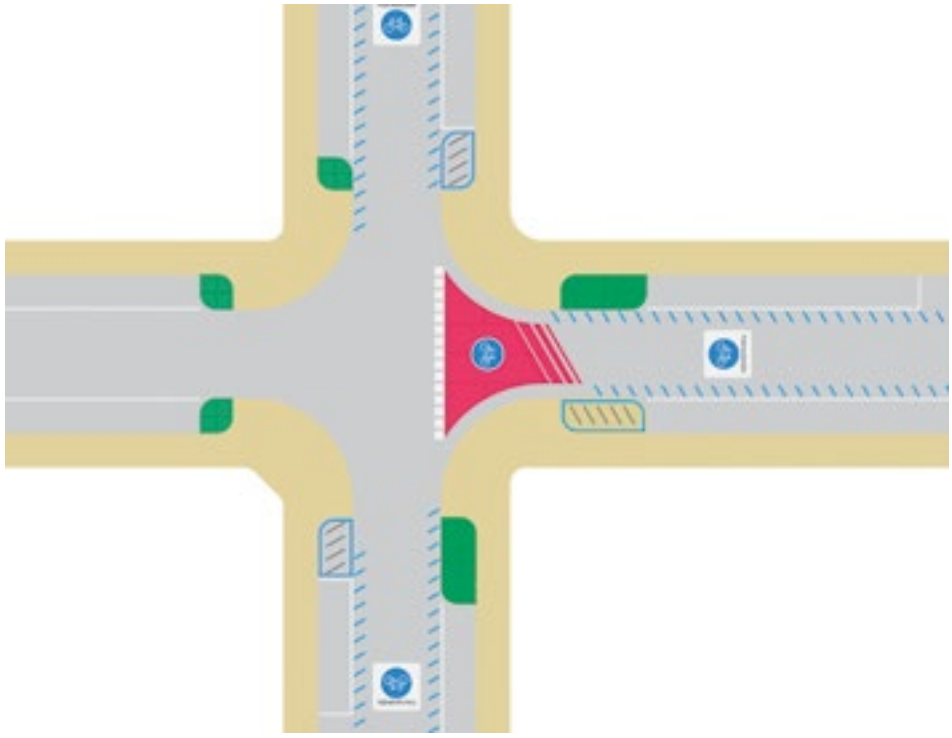

Fig. 5 New concept for demarcating the beginning and end of the cycle street (Source: Janina Albrecht; see Albrecht and Eckart 2020: p. 51, fig. 83)

and green areas. A precondition for the success of this concept is deceleration and a substantial reduction of car traffic (for a detailed presentation of this concept, see Albrecht and Eckart 2020: 52–73).

Together with the original design of the test route, FLOW and SHARED were included in the household survey and interviews with residents that were conducted by social scientists at the Goethe University in Frankfurt. The visualizations made the various conceptual approaches comprehensible, facilitating user anticipations of new forms of mobility. In the interviews, the FLOW concept, with its structural modifications, together with the retention for the most part of the existing space allocation, met with the highest approval from the perspective of bicycle users, since this model ensures the maintenance of rapid cycling (see Baumgartner et al: 24–26). The results of the household survey indicated that—independent of the prioritized mode of transport—both FLOW and SHARED were seen to more likely contribute to the beautification of the cityscape and to safety and a sense of well-being than the test route.

Conclusion

Cycle streets are an effective means for promoting bicycle use and cycling safety but require a design that clearly displays the existing regulations while reducing potential danger to the greatest possible degree. The versions of elements such as the markings of door zones and crossing areas, and bicycle symbols developed in the research project took account of both intuitive associations and efficient implementation in appropriation to the material. Together, they represent a model solution that is to be used for all cycle streets planned in Offenbach (↳Figs. 7+8).[04] It has become evident, for example, that the modified markings for the door zone have actually enhanced an intuitive understanding of its function. At the same time, a ride taken with a focus group revealed that the color blue preferred by the city of Offenbach for the strips was to some extent perceived as lacking in contrast, and hence more difficult to see in lower light conditions (on this group ride and the use of focus groups, see Schäfer et al. in this volume). In accordance with international guidelines, moreover, blue markings are earmarked for parking spaces with certain restrictions (see UNECE 2006).

Fig. 6 The FLOW and SHARED concepts for cycle streets (Source: Janina Albrecht; see Albrecht and Eckart 2020: pp. 58 and 72, figs. 102 and 130)

On cycle streets in German cities and municipalities, meanwhile, the absence of uniform standards represents an impediment to the unambiguous identification of markings. The approaches described here, however, suggest the potential for shaping and improving the usability and amenity quality of streets through intuitive markings, and beyond this, of the overall design of the streetscape. In order to transfer this accumulated knowledge and experience to other contexts, thereby contributing to the implementation of readily identifiable, well-functioning, appealing cycle streets in other communities, it would seem useful to formulate a set of universal design guidelines for cycle streets on the basis of the above approaches, while conducting additional research into the effects of various models. The expertise of specialists in mobility design should be integrated into this process. Required, ultimately, is the political will to oppose purely car-oriented planning and to instead devote greater surface area to cycling and pedestrians, even if this necessitates unpopular decisions such as the reduction of car parking spaces. In the absence of an equitable allocation of space, an implemented cycle street may be perceived by cyclists as a superficial public relations maneuver and may be regarded—as a result of heightened attention in the press and social media—far more critically than other streets. Close collaboration between planners, designers, and politicians with regard to implementation, as well as the inclusion of the citizenry, may nonetheless lead to positive results and a greater degree of acceptance.

04 Because parking places were not eliminated during the installation of the cycle streets, the roadway in some places was so narrow that the blue diagonal lines marking out the door zone have been applied only on one side of the street, substantially reducing safety.

Figs. 7+8 The new markings are installed, Taunusstraße Offenbach, May 2020 (Source: Julian Schwarze, Kai Vöckler)

Literature

Albrecht, Janina and Eckart, Peter: *Design- und Forschungsprojekt Fahrradstraßen: Mobilitätsdesign im Kontext von Verkehrswende, Aufenthaltsqualität und Intermodalität am Beispiel Offenbach am Main*. Hochschule für Gestaltung Offenbach am Main 2020, https://project-mo.de/de/portfolio-item/fahrradstrasse-offenbach.

Baumgartner, Annabell; Fischer, Lena; and Welker, Johanna: *Die Wirkung des Mobilitätsdesigns auf die Nutzung und Wahrnehmung von Fahrradstraßen: Untersuchungen anhand eines Fallbeispiels in Offenbach am Main*. Arbeitsgruppe Mobilitätsforschung, Institut für Humangeographie, Goethe-Universität Frankfurt. Frankfurt am Main 2020 (*Arbeitspapiere zur Mobilitätsforschung* 24).

Becker, Thilo: »Die Gestaltung des Erfolgsmodell Fahrradstraße.« In: *Straßenverkehrstechnik* 05. 2019, DOI: 10.26128/2019.1.

Blitz, Andreas: *Methodenbericht zur Haushaltsbefragung »Unterwegs in Offenbach.« Arbeitsgruppe Mobilitätsforschung, Institut für Humangeographie*, Goethe University, Frankfurt. Frankfurt am Main 2020 (*Arbeitspapiere zur Mobilitätsforschung* 22).

Blitz, Andreas; Busch-Geertsema, Annika; and Lanzendorf, Martin: »More Cycling, Less Driving? Findings of a Cycle Street Intervention Study in the Rhine-Main Metropolitan Region, Germany.« In: *Sustainability* 12, 3, 2020, p. 805. DOI: 10.3390/su12030805.

Blitz, Andreas; Lanzendorf, Martin; and Müggenburg, Hannah: »Shaping Mobility through Design? A Transdisciplinary Mobility Research Perspective.« In: Vöckler, Kai; Eckart, Peter; Knöll, Martin; and Lanzendorf, Martin (eds.): *Mobility Design: Shaping Future Mobility*. vol. 2, *Research*, Berlin 2023 (Offenbach Publication Series on Mobility Design 2), pp. 50–56.

Büttner, Jenny Katharina: »Bike Offenbach.« Master's thesis, Hochschule Darmstadt. Darmstadt 2019.

Forschungsgesellschaft für Straßen- und Verkehrswesen (FGSV): *Empfehlungen für Radverkehrsanlagen*. Cologne 2010.

Graf, Thiemo: *Einrichtung von Fahrradstraßen*. Röthenbach a. d. Pegnitz 2018.

Kregel, Bernd: *Örtliche Straßenplanung: Eine systematische Darstellung*. Berlin 1983 (*Schriften zum Öffentlichen Recht* 449).

Kuhn, Martin: »Irritierender Schutzstreifen—Mit erster Fahrradstraße müssen sich alle noch anfreunden.« In: *Offenbach Post* online, Sept. 29, 2018. https://www.op-online.de/offenbach/offenbachs-erster-fahrradstrasse-muessen-sich-alle-verkehrsteilnehmer-noch-anfreunden-10283336.html.

Schäfer, Petra; Stolte, Dana; and Reinfeld, Nicole: »Long-Term Focus Groups as a Mobility Research Method.« In: Vöckler, Kai; Eckart, Peter; Knöll, Martin; and Lanzendorf, Martin (eds.): *Mobility Design: Shaping Future Mobility*. vol. 2, *Research*, Berlin 2023 (Offenbach Publication Series on Mobility Design 2), pp. 98–106.

Stadt Offenbach am Main: *Bike Offenbach: Unsere Stadt neu erfahren* (2018), https://www.offenbach.de/medien/bindata/of/BikeOffenbach-Faltflyer-072018.pdf (accessed on January 18, 2022).

United Nations Economic Commission for Europe (UNECE): *Convention on Road Signs and Signals, of 8 November 1968*, 2006 consolidated version. https://unece.org/DAM/trans/conventn/Conv_road_signs_2006v_EN.pdf.

Vöckler, Kai and Eckart, Peter: »The Offenbach Model: Human-Centered Mobility Design.« In: Vöckler, Kai; Eckart, Peter; Knöll, Martin; and Lanzendorf, Martin (eds.): *Mobility Design: Shaping Future Mobility*. vol. 2, *Research*, Berlin 2023 (Offenbach Publication Series on Mobility Design 2), pp. 32–48.