John Forester, M.S., P.E.
Cycling Transportation Engineer
Consulting Engineer, Expert Witness, and Educator in
Effective Cycling, Bicycles, Highways and Bikeways, Traffic Laws
7585 Church St., Lemon Grove, CA 91945-2306
619-644-5481 forester@johnforester.com

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Low-Stress Bicycling and Network Connectivity

by Maazaa C. Mekuria, Peter G. Furth, Hilary Nixon
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1 Introduction and Concept

The subject paper has appeared in several different guises, some in which Furth claims sole authorship, some not; in some the title gives pride of place to Low-Stress, in others to Connectivity. The official publication appears to be as given above with publication through the Mineta Transportation Institute.

In this review I refer to the author as Furth, since he sometimes refers to himself as lead, or sole, author.

The concept behind this paper is that people's bicycle trips are limited by the maximum traffic stress that the cyclist will feel along a given trip. If a given high-stress location is modified to reduce the level of stress, then more people will choose to make bicycle trips through that location.

The number of locations that need to be modified is presented by an analysis of the streets of a modern suburban city, San Jose, California. This analysis shows that most of the city is composed of islands of low-stress streets connected by high-stress connectors. Identifying and modifying high-stress connectors enables much greater areas to be reached without the cyclist feeling under stress.

It is well accepted that American cyclists and potential cyclists are strongly affected by traffic stress. It is another matter to assume that reducing traffic stress will produce a great switch from motor trips to bicycle trips. The validity of that assumption is not discussed herein, but it obviously serves as the motivation for the paper and its recommendations.

1.1 Lack of Definitions

Furth liberally uses the terms "traffic stress" and "separation from traffic", but he fails to provide useful definitions.

Traffic stress is an emotional condition without a defined cause and is not measurable.

Separation from traffic is not defined.

Furth's failure to understand the most important subjects in his paper present difficulties later.

2 Traffic Stress

Traffic stress is an entirely subjectively reported mental condition. There has been no way to measure it. In a way it is what subjects say they feel when considering particular traffic situations. But that is nothing more than a reflection of how that particular subject feels about traffic; some people are more frightened than others. Several ways have been used to try to correlate emotions with particular facility designs, but they do not appear to correlate with each other and have complications.

A rather different way of classifying cyclists is that of Portland, OR. Cyclists are assigned to one of three categories by whether they say they would ride with different degrees of bikeway installation: Strong and Fearless; Enthused and Confident; Interested but Concerned.

In this paper, Furth has decided to use the three Portland classes plus one more to account for children. But he has labeled these classes with numbers, 1 indicating lowest stress, 4 indicating highest stress. But these classes have no more validity than the Portland classes which they origi-

nally were. They are nothing more than rather vaguely stated preferences about traffic cycling and facility types.

In this way, Furth has admitted that his system is based on typical American feelings about cycling and traffic. There is nothing naturally inevitable about those feelings; some people have them and some don't. In America, these feelings were created by Motordom's campaign, starting about 1925, to reserve the roadways for motor traffic. Motordom's campaign was supported by two arguments:

1: Cyclists are unable to obey the rules of the road
2: The greatest danger to cyclists is same-direction motor traffic

Motordom's campaign succeeded in creating feelings that cyclists are inferior to motorists and must fear ever getting in motorists' way. America being a motoring society, these arguments were accepted without evidence, but when they first underwent scientific scrutiny, about 1975, they were both thoroughly disproved.

Furth's view is nothing more than the typical American cyclist-inferiority view that cyclists have status inferior to motorists, are incapable of obeying the rules of the road, and must fear ever getting in the way of motorists.

But Furth further muddles the system by introducing a third plan for traffic. He bases his program on his Level of Traffic Stress 2 (LTS 2) list of facilities, which he states largely copies the normal Dutch system.

"This is the level of tolerance that is mapped to the mainstream, traffic-intolerant adult population, those who are "interested but concerned." Dutch standards have been proven on a population basis to be acceptable to the mainstream population, since bikeways built according to those standards attract essentially equal male/female shares and high levels of bicycle use for all age groups."

This argument is based on two assumptions.

1: The Dutch feelings about cycling and traffic are equal to the American feelings about cycling and traffic
2: The effects of particular designs of traffic facilities are independent of the society in which they function

Furth offers no evidence that American and Dutch feelings about cycling and traffic are equivalent. Some evidence against Furth's hypothesis is that these two sets of feelings were created through two different, largely opposite, histories. The American feeling was created in a motoring nation, by its Motordom, in a campaign to frighten cyclists off the roadways. The Dutch feeling was created in a cycling nation, by its cycling public, in revolt against the recent excessive intrusion of motoring, to regain the place that cycling had occupied. Feelings produced in such opposite ways can hardly be expected to be equal, without some compelling evidence that they are equal. No such evidence is known to me.

Traffic engineering contains a much larger proportion of social science than do disciplines such as structural engineering or dam design, in which the human factors are largely eliminated. Traffic engineering concerns the movements of people steering themselves along journeys that they determine. The movements that people make combine the discipline that traffic engineers try to impose with the views of the individuals about how they choose to respond to that discipline. Different societies, different nations, produce different sets of traffic operations.

For example, both Britain and the USA base their use of the public roads on the ancient common-law right to use the public roads. In Britain, that right has been retained, but in the USA that right has been reserved to motorized traffic, as much as is possible. The American result has been that the American public, both motorists and bicyclists, look on bicycle traffic as being a barely tolerated intrusion into motoring territory. From two so similar social histories we see radically different views of, and feelings about, how to consider bicycle traffic.

Now consider how likely it is that two so greatly different histories as that of the USA and the Netherlands would produce similar feelings about traffic and similar reactions to similar traffic-engineering features, which is a key part of Furth's arguments. Of course, this is completely unlikely.

3 Traffic Stress and General Facility Characteristics

3.1 Levels of Traffic Stress

Furth now describes what he misleadingly calls the following levels of traffic stress (LTS).

LTS 1

Presenting little traffic stress and demanding little attention from cyclists, and attractive enough for a relaxing bike ride. Suitable for almost all cyclists, including children trained to safely cross

intersections.

On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a slow traffic stream with no more than one lane per direction, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where cyclists ride alongside a parking lane, they have ample operating space outside the zone into which car doors are opened. Intersections are easy to approach and cross.

LTS 2

Presenting little traffic stress and therefore suitable to most adult cyclists but demanding more attention than might be expected from children. On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a well-confined traffic stream with adequate clearance from a parking lane, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where a bike lane lies between a through lane and a right-turn lane, it is configured to give cyclists unambiguous priority where cars cross the bike lane and to keep car speed in the right-turn lane comparable to bicycling speeds. Crossings are not difficult for most adults.

LTS 3

More traffic stress than LTS 2, yet markedly less than the stress of integrating with multi-lane traffic, and therefore welcome to many people currently riding bikes in American cities. Offering cyclists either an exclusive riding zone (lane) next to moderate-speed traffic or shared lanes on streets that are not multi-lane and have moderately low speed. Crossings may be longer or across higher-speed roads than allowed by LTS 2, but are still considered acceptably safe to most adult pedestrians.

LTS 4

A level of stress beyond LTS3

These are not Levels of Traffic Stress.They are lists of traffic conditions that are presumed, by someone, to cause similar but unmeasured levels of traffic stress in the minds of different classes of cyclists classified by Portland's classification of enthusiasm for transportation cycling.

3.2 Traffic Stress and Specific Facility Characteristics

Someone has then attached lists of facility characteristics to each of the levels of traffic stress. There is no indication of how the relationships between facility characteristics and levels of traffic stress were determined. The paper asserts: "Criteria for LTS 2 are based on Dutch bicycle facility planning and design standards. The Dutch norms have proven to attract a large percentage of the population to cycling (80 percent of the population rides at least once a week), including high participation rates among women and seniors. Criteria for the other levels of traffic stress require either more separation from traffic (for LTS 1) or progressively less (for LTS 3 and 4)."

I think that it is not useful to argue whether Characteristic X should be listed in LTS 2 or LTS 3. The system depends on unmeasured emotional conditions that make such discussion useless.

However, Furth states explicitly that the relative positioning within the system depends on the degree of separation from traffic. "Criteria for the other levels of traffic stress require either more separation from traffic (for LTS 1) or progressively less (for LTS 3 and 4)." This is an explicit claim whose validity can be tested.

Right-Turn-Only Lanes.

Furth is careless in his terminology, calling these right turn lanes.

From the cyclist's point of view, typically being to the right of the motor-traffic stream, RTOLs are an advantage. They provide length, well before the intersection, to separate the straight-through from the right-turning traffic, thus avoiding the tangle when they are trying to separate from each other at the intersection.

There are two types of RTOLs. In one the RTOL is an added lane at the right-hand edge of the roadway. In this, the right-turning motor traffic changes lanes across the straight-through bicycle traffic. In the other, the existing outside lane becomes the RTOL, and the straight-through bicycle traffic has to change lanes to reach the new straight-through lane. Furth's words and his Table 4 giving types of RTOLs show that he fails to understand the distinction between these two. Indeed it requires considerable thought to determine the proper assignment for the six types he lists. We shall make the distinction according to which party changes lanes, motorists or bicyclists.

The first two items in Table 4 [Table 4 con-

tains 7 items, and I use these numbers although they are not shown.] are described as “Single right turn lane ... starting abruptly while the bike lane continues straight.” These are clearly motorist changing RTOLs. Furth assigns LTS 2 to short ones, less than 150 feet, and LTS 3 to longer ones. Quite clearly, the longer length gives the motorists more chances to cross the bicycle traffic easily and smoothly, while short length increases the probability of sharp disconcerting movements, but Furth prefers the short length. Furthermore, Furth distinguishes the turning speed of the right-turning motor traffic, assigning LTS 2 when it will be less than 15 mph, LTS 3 when it may reach 20 mph, LTS 4 when it may be over 20 mph. This is absurd. The traffic in the RTOL must be turning right, away from the straight-through cyclist, which is exactly the improvement desired, and it doesn’t matter to the cyclist how fast that traffic makes its turn.

The next item in Table 4 (Item 3) is described as “Single right turn lane in which the bike lane shifts to the left ... “, which clearly is a cyclist changing lane. But this, for LTS 3, is limited to a turning traffic speed of 15 mph, while if this speed exceeds 15 mph, as in the next item (item 4), the LTS is raised to 4. Again, this is absurd, because once the cyclist has made his lane change he has no concern with the traffic to his right, all of which is turning away from him. And there is no mention of length, either minimum or maximum, to provide the cyclist sufficient length to comfortably make his lane change.

Items 5 and 6 and 7 in Table 4 are described as “Single right turn lane ... with turning speed less than 15 mph” I conclude that these have to be cyclist changing lanes to get out of a lane that becomes an RTOL lane. If this lane is less than 75 feet long, it has LTS of No Effect; if it is between 75 and 150 feet long, its LTS is 3, and if longer its LTS becomes 4. Again, notice Furth’s predilection for forcing the cyclist to hurry his lane change, indeed so that an RTOL of very short length doesn’t warrant an increase in level of stress, while the longer forms, which give the cyclist distance, and therefore time, to make his lane change comfortably, are rated LTS 3 and LTS 4.

Furth explicitly stated that higher LTS numbers reflect lower degrees of separation. Therefore, he considers longer RTO lanes to produce lower degrees of separation. Well, each RTO lane separates the straight-through from the right-turning traffic, regardless of the length of the RTO lane. And each RTO lane requires only one merging movement, regardless of its length. Therefore, the degree of separation is independent of the length of the RTO lane, contrary to Furth’s explicit claim about his system.

Furth’s argument for his recommendations is that “They aim to create a low-stress environment by making the cyclist’s right of way at the merge point unambiguous.” In short, Furth is upsetting the long-standing rules of the road about merging movements. Instead of using the merging movement, he is installing a forced cross at a point. Furthermore, instead of having the party making the lateral movement yield the right of way, as is standard, he assigns the right of way always to the cyclist.

Furth demands that the cyclist swerve across motor-vehicle traffic in the expectation that the motorists will yield to his swerve. Call this low-stress cycling? It scares the hell out of me.

And how is any road user, motorist or cyclist, expected to know when to obey the standard rules of the road for drivers of vehicles and when to obey Furth’s conflicting rules? I don’t know the answer, but the conflicts frighten me.

Number of Lanes

In Table 4 Furth lists the LTS numbers for different number of lanes in a road and different speeds of traffic. In each case, the LTS number increases with the number of lanes in each direction. This is absurd. Once there are two lanes in each direction, no additional lanes should bother the cyclist because those additional lanes are well separated from him by at least one lane of motor traffic. Furthermore, Furth claims that a road with only one lane in each direction is less stressful than a road with two lanes in each direction. Again, this is absurd. With only one lane in each direction, the traffic in the only other lane is coming in the opposite direction, with all the additional problems involved in overtaking and wrong-lane use. I see no reason to rate roads with only one lane in each direction as being less stressful than roads with two lanes in each direction.

The same absurd logic appears in Tables 2 and 3 regarding streets with bike lanes.

Sidepaths

Furth likes sidepaths; he lists them as LTS 1 between intersections, but says no more. In this he is ignoring that sidepaths are crossed by motor traffic at driveways and intersections, that sidepath/roadway intersections are among the most dangerous there are, and that crossing and turn-

ing movements cause about 95% of car-bike collisions.

Pedestrian Traffic

Furth explicitly accepts the stress and speed reductions produced mixing bicycle and pedestrian traffic. “While there can be some stress in sharing a path with pedestrians, it is not in the same class as traffic danger; it is more akin to congestion which can force a traveler to go slow, and, unlike traffic danger, is rarely a factor that keeps people from riding a bike.”

This is in sharp contrast to those of us who recognize the ease of operating in motor traffic that obeys the rules of the roads for drivers of vehicles instead of the frustration and worry of operating amidst chaotic pedestrian traffic that can dump a cyclist with any step.

4 Conclusions

Two Different Views of Traffic

Furth’s view of traffic is the cyclist-inferiority, bikeway-cycling view that has been described above.

The vehicular-cycling view of traffic is that cyclists have the ability to obey the rules of the road for drivers of vehicles, and that when they do so traffic operates around them just as it does other vehicles. “Cyclists fare best when they act, and are treated, as drivers of vehicles.”

The supposedly scientific arguments supporting cyclist-inferiority were long ago completely disproved. The arguments supporting vehicular cycling were demonstrated to be correct: people as young as eight years can obey the rules of the road, and understanding how to obey the rules of the road avoids a large portion of car-bike collisions.

Small Conclusions

Furth claims to be acting in conformity with the feelings of most Americans with respect to cycling in traffic. However, he presents no data to support his claim. As a key example, Furth urges cyclists to charge across a stream of motor traffic at a specific point, instead of merging through that stream by negotiating over a convenient distance. The nearest data concerning almost this question are in Forester’s study of cyclist behavior in Davis, Palo Alto, Berkeley, in which between 93% and 100% of the observed lane changes were done without looking. (http://johnforester.com/Articles/Facilities/bikelane.htm)

I also suggest that there is considerable similarity between Furth’s view and that disclosed by analyzing the designs in the new NACTO bikeways guide.

I think that it is reasonable to conclude that Furth’s view of cycling in traffic is a reasonable reflection of the most popular view, and that assumption is assumed to be true herein.

Furth’s view has little to do with cyclist safety. One would think that cycling traffic stress would be aligned with either, or both, of the following: the difficulty of making a movement, or the likelihood of a car-bike collision. Cross’s study shows that about 95% of car-bike collisions are caused by crossing or turning movements by one or both parties, and less than 5% by direct hits from straight-ahead motorists hitting straight-ahead cyclists. Furth’s view pays practically no attention to the problems caused by crossing and turning movements, paying almost all of its attention to the supposed problems of straight-ahead cyclists and straight-ahead motorists.

Furth’s view is supposedly based on levels of traffic stress created in the minds of those who believe Furth’s view of traffic. Those persons who don’t believe in Furth’s view of traffic do not perceive the supposed stress to which Furth refers. In short, the stress is a product of a particular belief rather than of a particular situation.

Furth’s levels of traffic stress are not measurable or, at least, have not been measured.

Nowhere does Furth define degrees of separation from motor traffic, but he claims that his system ratings are supported by degrees of separation from traffic. His own ratings prove that his claim is false. He claims that additional lanes to the road increase the TSL, when it is obvious that those additional lanes are well separated from the cyclist by one, or even two, lanes of traffic. Also, Furth claims that a two-lane road is less stressful than a four-lane road. But a cyclist on a two-lane road has to deal with the problems of poor overtaking by both same-direction and opposite-direction motor traffic, which are of much less significance to the cyclist on a four-lane road.

But whatever Furth happens to believe about degrees of separation, we can confidently conclude that these are largely irrelevant to the 95% of car-bike collisions caused by turning and crossing movements, because Furth largely ignores these movements.

It is also reasonable to conclude that these internal incoherences and defects have been produced by an obsession with the relatively small

dangers of same-direction motor traffic. This obsession is so strong that it entirely overwhelms consideration of the real dangers and requirements of cycling in traffic.

The Big Conclusion

The conclusions so far stated refer to technical criticisms of the internal aspects of Furth's paper, which have been created by Furth's exaggerated obsession over the relatively small dangers of same-direction motor traffic.

However, the defects so considered are significant because they produce the most important conclusion to be drawn from Furth's paper. This most important conclusion to be drawn from Furth's paper is that its internal incoherences and defects produce a design for bicycle operation that has neither empiric nor logical basis and is inconsistent with traffic-engineering knowledge.

To further his anti-motoring ideology, Furth has attempted to insert a traffic program based on Dutch feelings about bicycles and traffic, and Dutch social policy limiting motoring, into the American environment that is based on American feelings about bicycles and traffic and American policy supporting motoring. Forcing Furth's design into the American environment distorts the American operation into dangerous contradictions in traffic feelings, social attitudes, driving habits, and traffic law.

Such results have to be expected when attempting to design a traffic system according to the feelings of fearful, ignorant, and incompetent road users. But this is the American policy regarding bicycle transportation. Those cyclists who are not fearful, ignorant, and incompetent must be allowed to escape the inconveniences, dangers, and indignities of this system by being allowed, and expected, to obey instead the rules of the road for drivers of vehicles.