What Is the Difference between Induced Demand and Induced Traffic?

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The terms[1] 'induced demand' and 'induced traffic' are often used interchangeably, and often used incorrectly. In most cases, they refer to the increase in traffic volumes on transportation facilities where capacity has been increased. For example, a lane is added to a freeway corridor, initially improving flow (reduced congestion and delay) but eventually approaching prior conditions that called for the capacity expansion in the first place. Thus, we have the folk expression "You can't build your way out of congestion." The assumption is that capacity increase somehow induces travel that otherwise would not have occurred.

How are these terms different? I prefer that the term induced demand be used at only the highest level, the number of trips made, and not referring to the dimensional characteristics of these trips. Unfortunately, it's probably not as simple as defining VMT-increasing activity and focusing on capacity expansion. Consider the following dimensions defining traffic after capacity expansion:

1. **New Activity**. Is the region growing in terms of higher levels of economic activity, including population and employment? If so, there will be more traffic[2]. Historically, this is why we have added capacity but the 'induced demand' is induced by growth, not by capacity.

2. **New Trip Generation**. Are people traveling more frequently? One factor is income, which is highly correlated with travel demand. Such a change would be induced by the income change, not necessarily the capacity expansion. But trip generation has always been shown to be quite stable over time and socio-economic characteristics. Changes in the dimensions of trip generation can induce increases (or decreases) in overall demand, but these changes are captured in conventional travel forecasting models[3]. If demographics and socioeconomics have not changed, and there is no appreciable growth, then the only demand increase that could result from capacity expansion is a prior level of suppressed demand[4] (if people were traveling less than suggested by theory and empirical results, then it is possibly due to higher trip cost, a cost that would be relieved by a capacity expansion). For example, people living in poverty eat more when prices drop or food is subsidized. While this is demand, I do not believe that measurable increases in trip rates can occur under constant activity and socio-economic levels unless prior rates were already suppressed.

3. **Spatial and Temporal Dimensions**. Unlike the first two factors which can be deemed 'induced demand' these dimensions describe observed traffic and should be called traffic, induced or otherwise. These include destination, mode, time-of-day, and path. Each of these dimensions are explicitly part of standard travel forecasting methods[3]. When a capacity expansion is made, flows will tend toward a new equilibrium pattern. This will incorporate shifts in destination, mode, time-of-day, and path, but these shifts will not change the total number of trips (demand), just the observed traffic. This is what most people mean when they say that a capacity expansion has 'induced traffic.' But any shift is not only a shift *to* but also a shift *from* a prior dimension. The results can be increased VMT (new destinations and mode shifts to private vehicles, and much less likely changes in VMT due to time-of-day or path choice[5].

So, what's the bottom line? First, *demand* can clearly be induced by growth and increased affluence. Demand can also increase is it had previously been suppressed and it is here where the impacts of capacity increase might be most obvious. The cost of travel decreases so travel that was suppressed can now occur, and can continue to increase until either the desired level of travel is reached (demand is no longer suppressed) or the cost approaches the suppression threshold. In either of these two cases where demand increases so do the negative impacts, including increased VMT, GHG, and emissions. There can also be positive equity benefits, such as increased accessibility and mobility for suppressed demand groups.

Second, capacity increases can readily induce changes in *traffic* patterns, This is why we adjust signal timing, improve traffic management, add public transit, and reduce bottlenecks. Traffic increases precisely where the improvement was completed (whether new lanes, new signal timing, etc.) and it does so by shifting traffic from prior destinations, modes, times, and paths. It would be improper to simply claim that the new traffic on an improved roadway was demand induced by the expansion when it is most likely traffic induced by rational behavior. Models that reflect appropriately scaled networks can explicitly evaluate induced traffic via sub-models for destination, mode, time, and path choice[6]. The total number of trips in the network will remain the same (note that spatial zoning can have distributional influence as destination choice models shift trips from between to within zones, or vice versa, resulting in an apparent change in total trips on the network).

Third, very few current model systems can explicitly account for induced demand unless they have integrated land use models and trip generation models that are sensitive to system performance[7]. To properly assess induced demand, one would first need to assess how much induced traffic is present since these trips reflect trips that were already being made prior to the capacity expansion. Any additional trips that are measured would be due to induced demand, which in a growing area would most likely be due to actual growth (and not current residents joyriding on newly uncongested roadways).

Fourth, there's at least one important factor that's often ignored. Even under the 'worst case' scenario that most or all of the increased capacity is consumed by induced demand (it can only get worse is there is growth or increased affluence), two things have to be recognized. First, more people are traveling and, all other things constant, this is a good thing (with the exception of our current pandemic). Second, unless the worst case scenario occurs (and we're back to where we started in terms of congestion), traffic will be flowing better than before, meaning relatively lower GHG and emissions rates. The actual total GHG and emission can be higher or lower depending on the associated total travel, suitably factored by the lower emission rates.

Induced demand is now more of a rallying cry than the prior demon 'sprawl.' Consider the following quote: "In Walkable City, Jeff Speck says that induced demand is the thing that everyone in city planning understands but doesn't talk about. I think that it is more accurate to categorize induced demand as the thing that everyone in city planning talks about but doesn't understand." So which is it? The overly simplistic definition that has an anti-auto bias is that induced demand is the increased demand that appears when highway capacity is increased. I hope my above comments have provided some depth and breadth to this issue.

Technical Notes

1. I define the following transportation terms. *Demand* is a theoretical relationship between cost of travel and quality of travel. *Travel* is a generic term for movement of people. *Trips* are the units of travel corresponding to a movement from one location to perform and activity at another location. *Traffic* is what results and is often termed *volume*: a level of people and/or vehicles moving on some transportation facility at a particular time and location. Note: In freight forecasting, the term *flow* is used in place of *travel*.
2. We live in a society where the economy drives everything. Currently, travel (freight and personal) drives the economy. Economic growth is fundamental to capitalism, so travel growth has historically been part of this. By design, the economy 'induces' travel demand. All activity, all travel, and all travel impacts are induced by economic activity.
3. We should refer to our analytical procedures as travel forecasting and **not** travel demand forecasting. The latter is misleading in that we are actually forecasting equilibrium demand and performance under hypothesized and estimated demand and performance procedures. My comments apply to both trip-based and activity-based travel forecasting models. Despite the promise of activity-based models, I think that data limitations and model complexity are such that ABMs are giving us a false sense of improvement quality over trip-based models.
4. *Latent* demand is demand for goods and services that is not realized, either due to cost, knowledge, or other limitations. This would include what I've termed 'suppressed demand.'
5. There are various biases that have evolved in our field, competing for both attention and resources. Right now, including at CARB, there is an appropriate focus on GHG emissions and climate change, but in some sectors there is also an unfortunately focus on automobiles as being the source of all our ills, GHG and many others. The source of these biases are manifold, but once decision-makers bite, laws and policy can result in distorted perspectives. Some of this would be clear in a retrospective review of California lobbying and legislation.
6. There are also, in my opinion, some fundamental technical biases. The first is the economist's depiction of supply and demand on the simple cost and quantity Cartesian axes. The bias is that, first, the cost axis, as represented in virtually all forecasting models, is defined at the link level, a level that has no direct connection to demand (an individual may demand a particular product but virtually no one demands use of a particular section of roadway. The parallel bias is trying to define what's being demanded, the other axis, and at what spatial and temporal level. Over the course of a day, individuals demand a certain number of activities that are typically satisfied by a number of trips. But there are many dimensions to this demand, and most are not at all compatible with the link level on the cost axis.
7. There are other technical biases including the 'No Build' bias. Standard long range forecasting references are potential system changes to the base 'No Build' scenario. The problem is that it is assume that the No Build option of continued growth in activity and travel is sustainable and will occur regardless of any action or inaction. In many if not most cases, this is simply not plausible since population and employment will react if system operators do not. Nevertheless, all future predictions are compared to this quite unlikely future and thus many preferred alternatives are inherently biased.