Not So Fast
Better Speed Valuation for Transportation Planning

4 November 2021
Todd Litman
Victoria Transport Policy Institute

Summary
Planning decisions often involve trade-offs between travel speed and other goals. Because the amount of time people spend travelling tends to maintain equilibrium – most people devote about 80 daily minutes to personal travel – higher traffic speeds generally increase vehicle travel, described as mobility. It is important to consider all impacts when making speed-related decisions. This report examines why and how to do that. It identifies various benefits and costs of faster travel; describes how speed valuation affects planning decisions; and provides guidance for comprehensive evaluation of these impacts. Conventional planning tends to exaggerate the benefits and understate the costs of higher travel speeds. This favors faster modes, such as automobile travel, over slower but more affordable and resource-efficient modes such as walking, bicycling and public transit; favors higher roadway design speeds; and favors sprawl over compact development. Increasing the speed of slower modes tends to provide more benefits than increasing the speed of faster modes. Changing consumer needs and community goals are increasing demand for slower modes. Serving these demands requires more comprehensive analysis of speed-related trade-offs.
Key Findings

- Transportation planning often involves trade-offs between speed and other goals. It is important to consider all speed-related impacts in a planning process.

- Higher speeds are inherently costly. Faster modes require much more expensive vehicles and infrastructure, more space and energy, and impose greater health risks and environmental damages, often by an order of magnitude. Because travel speeds tend to increase with wealth, speed-prioritizing planning tends to be inequitable; it increases costs that affluent travellers impose on disadvantaged groups.

- Planners often assume that faster travel provides time savings, but people tend to maintain fixed travel time budgets, they devote about the same number of daily minutes to personal travel regardless of speed. As a result, faster travel increases travel distances rather than saving time. This causes mobility inflation, it ratchets up the amount of travel people require to meet their needs, which is costly to communities and unfair to people with limited mobility.

- Current planning practices tend to exaggerate the benefits, underestimate the costs, and ignore the inequities of faster travel. Current planning generally recognizes trade-offs between speed and safety, but overlooks other impacts such as reduced affordability, public health, and mobility for non-drivers. This results in overinvest in faster modes and higher roadway design speeds, which over the long run increases total vehicle travel and sprawl.

- Higher travel speeds do not necessarily support economic development. Faster travel can increase productivity if it increases overall accessibility, but those benefits are often offset by the additional costs of increased vehicle travel and sprawl.

- The inefficiency and inequity of speed-prioritizing planning are evident if transport performance is evaluated using effective speed, defined as travel distance divided by the time spent travelling and earning money to pay travel expenses. Measured this way, automobile travel is often slower than bicycling and public transit, and is regressive because it benefits affluent motorists who value time more than money, but harms lower-income people who prefer lower-cost modes.

- Faster travel is not bad, but it is costly and often unfair. For efficiency and equity sake planning should favor affordable, inclusive and resource-efficient modes over faster, costly modes, and traffic speeds should be set to optimize community livability. Travel time savings for slower modes should be weighted higher than travel time savings to faster modes.

- To their credit, many policy makers and planning practitioners support slower modes and traffic speed reductions more than their economic models justify; they realize intuitively that slower modes play important roles in an efficient and equitable transportation system, and so deserve public support. However, this occurs despite rather than supported by standard analysis practices. Reforming these practices can justify much more support for slower modes.

- More comprehensive speed analysis is likely to result in less investment in urban highways, more investments in active and public transport modes, lower roadway design speeds, more planning to improve travel comfort and convenience rather than speed.

- Of course, every traveller has unique needs and preferences. Many choose faster modes, such as automobiles, despite their higher costs, for convenience or status sake. However, current demographic and economic trends – aging population, increasing urbanization, plus growing affordability, health and environmental concerns – are increasing demand for slower modes and livable neighborhoods. Given better options, many people would choose slower travel modes for many trips. Everybody benefits if our planning practices respond to these demands.
“Haste makes waste.”

**Introduction**

Travellers often make trade-offs between speed and other goals such as affordability, comfort and safety. For example, travellers can choose between slower and faster routes or modes that differ in their financial costs, convenience and comfort. For example, motorists can sometimes choose a slower but more attractive route, or pay a toll to drive on a higher speed highway. Similarly, travellers can sometimes save money by using a slower mode, such as bicycling or public transit, rather than driving. Many planning decisions also involve trade-offs between speeds and other goals. For example, transportation agencies can invest in facilities for automobiles, or in facilities for slower but more affordable and resource-efficient modes such as walking, bicycling and public transit. The question explored in this report is whether current planning practices accurately reflect travellers’ and communities’ preferences when making such trade-offs.

Faster travel has both benefits and costs, as summarized in Table 1. It increases the destinations that affected travellers can access in a given time period, and therefore their economic and social opportunities, but inevitably increases many costs to users and communities, and often harms people who cannot use the faster mode, such as when wider roads and increased traffic speeds degrade walking and bicycling conditions, or if automobile-oriented planning stimulates sprawled development.

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Costs</th>
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<tbody>
<tr>
<td>• People sometimes enjoy the experience of speed.</td>
<td>• Reduced traveller comfort and increased driver stress.</td>
</tr>
<tr>
<td>• Short-term travel time savings.</td>
<td>• Increased user costs and reduced affordability.</td>
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<tr>
<td>• Long-term increases in travel distance, expanding the destinations</td>
<td>• Increased traffic congestion and barrier effects.</td>
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<tr>
<td>motorists can reach.</td>
<td>• Increased road and parking infrastructure cost.</td>
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<td></td>
<td>• Increased crash risk, particularly for vulnerable modes.</td>
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<td></td>
<td>• Increased energy consumption and pollution emissions.</td>
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<td></td>
<td>• Reduced community livability and cohesion.</td>
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<td></td>
<td>• More automobile dependency and sprawl.</td>
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<td></td>
<td>• Over the long run, faster travel leads to sprawled development</td>
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<td>patterns that reduce accessibility.</td>
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<td></td>
<td>• More inequity. Increased disparities between advantaged and</td>
</tr>
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<td></td>
<td>disadvantaged groups.</td>
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*Higher speeds provide user benefits and increase various user and community costs.*

Conventional planning often assumes that higher speeds provide travel time savings, giving people more time to spend on other activities, but over the long run people tend to maintain fixed travel time budgets (daily minutes devoted to out-of-home personal travel), so speed increases usually cause proportionate increases in travel distances. For example, if a road improvement increases traffic speeds by 30%, affected motorists tend to drive about 30% more vehicle-miles. Although the additional mobility provides user benefits, these tend to be modest because it consists of marginal value vehicle-miles that users are most willing to forego if their travel time costs increase, and the additional vehicle travel increases external costs such as roadway costs, congestion, crash risk, and pollution emissions.
The value placed on speed significantly affects planning decisions, and therefore various benefits and costs, as illustrated in Figure 1. Conventional planning considers some of these impacts but often overlooks or undervalues others, particularly long-term effects caused by changes in accessibility, total vehicle travel, and development patterns. To the degree that a planning process exaggerates the benefits or overlooks some costs of speed, it results in faster traffic, more vehicle-miles, and higher total costs than travellers and communities actually want.

**Figure 1  Travel Speed Valuation Impacts**

<table>
<thead>
<tr>
<th>Speed Priority</th>
<th>Planning Decisions</th>
<th>Travel &amp; Development</th>
<th>Ultimate Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher value placed on speed in planning analysis</td>
<td>Higher roadway design speeds (wider lanes, grade separation, longer blocks, etc.)</td>
<td>Higher traffic speeds</td>
<td>Benefits</td>
</tr>
<tr>
<td></td>
<td>More investments in faster modes (automobile and aviation), less in slower modes (walking, bicycling and transit)</td>
<td>More total vehicle travel (induced travel) and less active and public transport</td>
<td>• Improved access to dispersed destinations</td>
</tr>
<tr>
<td></td>
<td>Automobile-oriented development policies (less density, more parking)</td>
<td>More sprawled development</td>
<td>• Increased productivity</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Costs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Reduced access for non-drivers</td>
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<td>• Inequity</td>
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<td>• Higher user costs</td>
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<td>• Higher infrastructure costs</td>
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<td></td>
<td></td>
<td></td>
<td>• More traffic crashes</td>
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<td></td>
<td>• Less public fitness and health</td>
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<td></td>
<td></td>
<td></td>
<td>• More pollution emissions</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Sprawl-related costs</td>
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</tbody>
</table>

*Higher values placed on speed favors faster modes, higher traffic speeds and dispersed development, which reduces non-auto modes, and increases total vehicle travel and sprawl.*

Optimal travel speeds vary widely depending on conditions. Compact, multimodal communities minimize the amount of mobility required to access services and activities, so optimal speeds are low. Sprawled, automobile-dependent communities require more travel to access services and activities, and therefore have higher optimal speeds. These approaches often conflict: higher traffic speeds are unsuitable in compact communities, while automobile-oriented communities require wide roads, higher traffic speeds and large parking lots, which makes them unsuitable for non-auto modes.

Conventional planning tends to favor higher-speed modes. Consider these examples.

1. In a typical community, 10-20% of trips are made by slower modes (walking, bicycling and public transit), 20-40% of residents rely on these modes at least sometimes, surveys indicate that many travellers want to use slower modes more, and accommodating this latent demand helps achieve many economic, social and environmental goals. Yet, most communities devote much less than 10% of transportation funds and road rights-of-way to these modes, less than their mode shares.

2. Most urban streets have design speeds and speed limits over 30 miles per hour (mph), although research indicates that this is excessive for the safety and comfort of walking and bicycling.

3. During the last century many high-accessibility urban neighborhoods were displaced by freeways. This improved suburban motorists’ access to city jobs and services, but degraded urban neighborhoods and reduced non-auto access.
These examples illustrate how planning that prioritizes speed contradict other community goals such as efficiency, equity, health and safety, and environmental quality. Although faster vehicle travel improves accessibility for some people, it reduces accessibility for others, particularly non-drivers. There are many ways to explain why such practices are common. They may reflect consumerist assumptions that automobile travel is better than slower modes and suburbs are better than cities; the political influence of vehicle and petroleum industries; the biased experiences of policy makers and planning professionals who themselves lead automobile-dependent lifestyles; and racist assumptions that considered urban neighborhoods as “blight” to be displaced. These are all legitimate critiques. However, the *mechanism* that causes planning processes to favor faster modes over slower modes and sprawl over compact development is the excessive value placed on speed, plus a tendency to overlook many of the external costs of faster modes and higher traffic speeds.

This report investigates these issues. It examines how the benefits of speed are valued compared with other goals (Figure 2), and how this affects planning decisions. It explores various benefits and costs of faster travel, how this valuation affects planning decisions, and the resulting impacts on people and communities. This should be of interest to policy makers, planning professionals, advocates of slower modes, and anybody interested in creating more sustainable communities.

**A Short History of Speed**

Until recently, transportation progress consisted of faster modes, from walking to horse travel, sailing ships, bicycles, trains, automobiles, airplanes, to supersonic jets, as illustrated in Figure 3.

![Figure 3](image-url)  
**Figure 3** New Modes’ Initial Availability and Typical Operating Speed (Various Sources)  
For most of history, transportation progress consisted of the development of faster modes. Increased travel speeds provided many benefits, but also imposed many costs. Note that speed is indicated on a logarithmic scale so small increases in height indicate large increases in speed.

![Figure 2](image-url)  
**Figure 2** Balancing Goals  
This report examines whether speed is overvalued compared with other planning goals. Current practices often give speed more weight than all other impacts combined.
Motorization significantly increased people’s average speed and distance, as illustrated below. During the Twentieth Century, motorization increased average travel speeds from about 4 to 30 mph, and per capita travel from about 1,000 to 10,000 annual miles or 12,000 annual miles per motor vehicle.

**Figure 4  Estimated Annual Passenger-Miles by Mode** (Litman 2020, Exhibit 8)

![Graph showing estimated annual passenger-miles by mode from 1900 to 2010.](image)

Before 1900 travel people travelled primarily of walking, with occasional bike and rail trips. During the Twentieth Century, motor vehicle travel grew. This increased average speeds from about 3 to 30 mph, mobility from about 1,000 to 10,000 annual miles per capita, and reduced travel by other modes.

Increased motor vehicle travel increased various costs, as illustrated below.

**Figure 5  Estimated Vehicle and Infrastructure Costs** (Litman 2020, Exhibit 36)

![Graph showing estimated vehicle and infrastructure costs from 1900 to 2000.](image)

As vehicle travel increased during the Twentieth Century, transportation costs increased significantly. Per capita inflation-adjusted expenses are estimated to have increased from less than $200 in 1900 to more than $6,000 dollars in 2000.
Increased vehicle traffic degraded urban areas and faster vehicle travel encouraged sprawled development, illustrated in Figure 6.

**Figure 6  How Transportation Affects Urban Development** (English 2019; Mouzon 2012)

Ancient Rome and Paris were compact walking cities. London and Chicago expanded along rail lines to create transit-oriented suburbs. Greater Atlanta is a sprawled, automobile dependent city where it is difficult to get around without a car.

These examples illustrate how faster travel encourages urban dispersion – sprawl – which increases the travel distances required for a given level of accessibility, and reduces non-auto access. As a result, speed increases do not usually provide travel time savings; over the long run they generally cause people to travel more.

**The Demand for Speed**

*Travel demand* refers to the type and amount of travel that people would choose in a particular situation. A key question in this analysis is the degree that consumers demand speed relative to other goals, and the degree that planning reflects these preferences.

Of course, people are sometimes willing to pay a high price for faster travel, for example, in an emergency or when delivering valuable, time-sensitive goods, but travellers often have other priorities. For example, motorists often choose slower but more scenic routes, and commuters sometimes choose to bike or ride transit for affordability, health or enjoyment sake.

Some highways have tolled express lanes that test motorists’ demand for faster travel. They indicate that, although some motorists are willing to pay cost-recovery tolls (tolls sufficient to finance highway expansions), most would rather save money than time (Howard and Williams-Derry 2012; Parsons Brinckerhoff 2012; Prozzi 2009). For example, on the Katy Freeway, only about 10% of motorists are willing to pay tolls to avoid congestion delays, indicating that 90% of motorists value their time at less than $8 per hour (Burris 2016). In other words, travellers want faster travel if it is subsidized, but not if they must pay the costs.

In addition, many communities recognize new planning goals such as affordability (cost burdens on lower-income households), equity (impacts on disadvantaged groups), public health, community livability, and environmental quality, which slower modes and traffic speeds tend to support.
**Speed Benefits and Costs**

This section examines various benefits and costs of increased travel speed.

**Increased Access**

Faster travel expands the area that people can access. In 20-minutes a pedestrian can typically reach an area of about 3 square miles, a bicyclist or transit passenger about 30 square miles, and a motorist averaging 30 mph about 300 square miles as illustrated to the right.

However, vehicle speeds are just one of many factors that affect accessibility; others include the quality of non-auto travel, network connectivity, development density and mix, and mobility substitutes such as telecommunications (Levinson, Marshall and Axhausen 2018). Development density tends to affect accessibility more than vehicle travel speed (Levine, et al. 2012). There are often trade-offs between these factors: money and road space invested in faster modes are unavailable investment in slower modes, designing roadways for maximize traffic speeds tends to reduce their connectivity and local accessibility, and highway-oriented sprawl increases the distances between destinations.

New accessibility models can evaluate and compare these factors (Sundquist, McCahill and Brenneis 2021). For example, the Metropolitan Chicago Accessibility Explorer indicates that with a half hour maximum commute, central neighborhood residents can access more than 700,000 jobs by bicycle and 500,000 jobs by transit, which is more than many suburban motorists can reach in the same amount of time. On average, urban residents spend less time travelling than suburban residents, as illustrated in Figure 8. This indicates that traffic speed is less important than other accessibility factors, so more compact development with greater proximity and slower modes tends to maximize accessibility overall.
Travel Time Savings
Transportation planners often assume that higher travel speeds save time, and often value these savings at 35% to 60% of wages (“Travel Time,” Litman 2018; USDOT 2011). This approach tends to overvalue speed gains and undervalue slower modes. In practice, people tend to maintain fixed travel time budgets (Ahmed and Stopher 2014). Studies around the world indicate that most people devote 60-80 daily minutes to out-of-home personal travel, called Marchetti’s Constant (Marchetti 1994). As a result, over the long run, travel speed increases usually result in more mobility rather than saving time. For example, when searching for a home or job, workers usually look for a 30 minute maximum commute, and shoppers generally choose stores they can reach in less than 15 minutes. If traffic speeds increase, commuters and shoppers expand their destinations, increasing vehicle travel. The resulting benefits tend to be modest since the increased mobility consists of marginal-value vehicle-miles that motorists are most willing to forego if their time costs increase, and the additional vehicle travel increases external costs. The value of travel time can vary significantly depending on preferences and conditions: under favorable conditions, time spent travelling can have positive value, while under unpleasant conditions it has high unit costs (Mokhtarian 2005).

This has important implications for speed valuation (Metz 2015; Standen 2018). For example, although speed gains sometimes provide large benefits (motorists would pay a lot to save a few minutes), other factors, such as affordability and comfort are also important (Burris, et al. 2016). In many situations, travellers will choose slower modes if they are cheaper or more enjoyable, and improving travel comfort, for example, by reducing transit crowding or building nicer stations, may provide greater user benefits than increasing travel speed (Litman 2017).

Economic Development and Opportunity
Faster travel can sometimes increase economic productivity and opportunity, for example, by allowing commercial vehicles to reach more destinations per shift, expanding the pool of workers available to employers, and increasing the jobs and services available to residents (Ewing, et al. 2016; Smart and Klein 2015). However, slower mode improvements often provide similar productivity gains with lower total costs, for example, if more compact development increases agglomeration efficiencies, or bicycle and transit improvements expand labor pools with lower total costs than roadway expansions. Since faster modes, increased vehicle travel, and sprawl increase many economic costs, it is unsurprising that productivity tends to decline as per capita vehicle travel increases, as shown in Figure 9 (Chatman and Noland 2013). This suggests that improvements to slower modes and Smart Growth development policies often increase economic development more than automobile-oriented improvements.
**Traveller Comfort and Stress**
Although some motorists enjoy the thrill of speed, higher traffic speeds generally reduce travel comfort and increase driver stress. Motorists often choose slower roads, such as tree-lined city streets, windy country lanes, and scenic highways, over higher speed arterials and highways. Commuters who drive long distances tend to be less satisfied and more stressed than those who walk, bike, use comfortable public transit, or have shorter car trips (Wei 2015). This suggests that the quality of travel should be valued as much as speed, which justifies more investments in active and public transport, with particular attention to user convenience and comfort, plus lower roadway design speeds and more streetscaping.

**User Expenses**
Faster travel tends to increase user expenses. A typical pedestrian spends an extra $100 per year on shoes to walk about 1,000 miles; a typical bicyclist spends $200 extra per year to ride 2,000 miles; a typical transit user spends $600 on fares to ride 3,000 annual miles; and a typical motorist spends about $5,000 to $8,000 annually on vehicles and residential parking to drive 5,000 to 15,000 annual miles.

![Figure 10](Typical User Cost (Litman 2020))

Figure 10 compares slower and faster mode expenses. Figure 11 compares per-mile and annual costs. Faster modes generally cost users five to ten times more than slower modes, considering all expenses.

![Figure 10](Typical User Expenses (Litman 2020))

Faster modes tend to have higher costs per-mile, and much higher costs per year due to their greater annual miles.
These costs can be evaluated using *effective speed*, which measures distance travelled divided by time spent traveling and earning money to pay for travel (Tranter 2010), illustrated in Figure 12. Blue bars show time spent travelling and red bars show time spent earning money to pay travel expenses.

**Figure 12** Effective Speed by Income and Mode (Litman 2020)

Measured by effective speed (time spent travelling and earning money to pay travel expenses), bicycling and transit are often faster than driving for lower-wage workers. (Assumes bicycling 12 mph, 10¢/mile; Public Transit 15 mph, 30¢/mile; Auto 25 mph, $5,000 and 4,000 annual miles for $15/hr. motorists and $7,000 and 12,000 annual miles for $35/hr. motorists.)

Since lower-wage workers must spend more time earning their travel expenses and drive fewer average annual miles, effective speeds increase with income, as illustrated in Figure 13. Measured this way, automobile travel is regressive, and improvements to slower modes increase affordability and equity.

**Figure 13** Effective Speed by Income

Effective speed considers time spent traveling and working to pay travel expenses. It therefore increases with income. For lower-wage workers, bicycling and public transit are often faster than driving.

As a result, planning practices that favor automobile travel over more affordable modes are regressive, they favor higher-income over lower-income travellers.

**Infrastructure Costs**

Faster modes, higher travel speeds, and the additional vehicle travel they generate increase the size and costs of transportation infrastructure (Mouzon 2012). Building and maintaining sidewalk and bikeways typically costs $20-50 annual per capita, public transit services typically cost $50-100 annual per capita, while public road cost about $800 and off-street parking facilities $2,000 to $4,000 annual per capita (FHWA 2018, Table HF10; Litman 2018). Higher speeds require more *shy distance* (clearance between vehicles and other objects), which requires more and wider traffic lanes, and more complicated intersections. For example, at 20 mph a car requires approximately 500 square feet (sf) of road space, but at 60 mph requires about 1,500 sf, as illustrated below.
Figure 14  Road Space Requirements by Vehicle Speeds

<table>
<thead>
<tr>
<th>MPH</th>
<th>Road Space Required</th>
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<tbody>
<tr>
<td>20</td>
<td>15’ x 3 x 11’ = 490 sf</td>
</tr>
<tr>
<td>40</td>
<td>15’ x 5 x 12’ = 900 sf</td>
</tr>
<tr>
<td>60</td>
<td>15’ x 7 x 14’ = 1,470 sf</td>
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</tbody>
</table>

As traffic speeds increase vehicles require more shy distance (clearance from other objects) ahead and to the side. An increase from 20 to 60 mph approximately triples a vehicle’s road space requirements.

Higher travel speeds require more space for road and parking facilities, as illustrated below.

Figure 15  Road and Parking Space Required by Travel Modes

Faster modes and higher speeds require more space for travel and parking, plus more complex intersections, more road maintenance, and more traffic safety programs. As a result, higher speeds increase infrastructure costs.

Faster modes, higher speeds and more vehicle-miles increase infrastructure costs, as illustrated below.

Figure 16  Estimated Infrastructure Costs (Kockelman, et al. 2013; Litman 2019)

Walking and bicycling have low infrastructure costs. Transit travel requires a few hundred dollars in annual subsidies. Automobile travel requires a few thousand dollars a year in road and parking facility costs, most of which are funded indirectly through general taxes, rents and the prices of other goods.
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**Congestion and Barrier Effect Costs**

As previously mentioned, automobiles require far more travel space per passenger-mile than slower modes, and their space requirements increase with speed. Roadway capacity, the number of vehicles a road can carry per hour, tends to peak at 30-50 mph on highways and less on surface streets, as illustrated below. Wider roads and increased traffic speeds also increase the delay and risk imposed on walkers and bicyclists, called the *barrier effect* (Litman 2018). This harms active travellers and causes some to shift to motorized modes, which increases traffic problems. As a result, higher speeds increase the congestion costs a vehicle imposes on other road users.

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**Figure 17  Speed Flow Curves** (based on Hall 1994)

![Speed Flow Curves](image)

Although details vary depending on roadway design and conditions, traffic capacity (vehicles per hour) is maximized, and therefore traffic congestion is minimized, at moderate traffic speeds, typically 20-40 miles per hour.

As a result, speed reductions tend to increase peak-period roadway capacity and reduce congestion.

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**Crash Costs**

Crash risk increases with speed for reasons described in the box to the right. Most traffic safety studies only categorize crashes as “speed related” if drivers exceed speed limits, which overlooks the risks of higher posted speeds and underestimates speed risks.

Extensive research by the International Transport Forum indicates that crash frequency and severity increase exponentially with traffic speeds: a 1% increase in average traffic speed results in approximately a 2% increase in injury crash frequency, a 3% increase in severe crash frequency, and a 4% increase in fatal crash frequency (ITF 2018). Elvik (2009) found that crash casualty rates increase exponentially with speed, so a 1% change in speed causes more than 1% change in crashes. Using U.S. data, Redelmeier and Bayoumi (2010) find that the travel time savings provided by higher speeds are more than offset by reduced longevity and increased crash delays. Total traffic casualty rates tend to decline with more compact development, reduced vehicle travel, lower traffic speeds, and increased active and public transit travel (Ewing and Hamidi 2017; Larson 2018; Welle, et al. 2018), as illustrated on the following page.

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**Traffic Risks** (NACTO 2020)

Higher speeds increase crash risk in these ways:

1. Reduces drivers’ field of vision, reducing their chance of seeing and avoiding hazards.
2. Increase reaction and braking distances, reducing the chance of avoiding crashes.
3. Increase crash severity. For example, pedestrian crash survival rates decline from 90% at 20 mph to just 10% at 40 mph.
4. Increases total vehicle travel and therefore total risk exposure.
5. Automobile dependency and sprawl reduce traffic safety program effectiveness. For example, anti-impaired driving programs are more effective in multimodal communities where drinkers have alternatives to driving.
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**Figure 18** Traffic Risk Versus Walking and Bicycling (Jacobson 2003; Litman 2019)

Total (all mode) crash rates tend to increase as traffic speeds and total vehicle-miles increase, and decline as walking, bicycling and public transit mode shares increase in a community, an effect called “safety in numbers.”

To optimize safety, experts recommend maximum speed limits of 30 km/h in built up areas where vulnerable road users mix with motor vehicle traffic; 50 km/h in areas with intersections; and 70 km/h on rural roads without median barriers to prevent head-on collisions (ITF 2018; NACTO 2020).

**Energy Consumption and Pollution Emissions**

Under typical highway conditions, motor vehicle fuel economy peaks at 50 to 80 kilometers per hour (kph, about 30 to 50 mph), and less under stop-and-go conditions (Figure 18). One study estimates that reducing highway speeds from 120 to 110 km/h could reduce fuel consumption and related emissions by diesel cars by 12% and gasoline cars by 18% (EEA 2020). Motor vehicle noise also increases with speed (Figure 19). Although electric cars produce less noise than internal combustion engines at low speeds, the differences decline at speeds over 20 kph, as tire and wind noises increase.

**Figure 19** Fuel Economy Versus Speed (Nasir, et al. 2014)

Under typical highway conditions, motor vehicle fuel economy peaks between 50 and 80 kph (30 to 50 mph). Although electric and hybrid cars are use less energy they have similar efficiency curves

**Figure 20** Noise Versus Speeds (Salleh, Md zain & Ishak 2013)

Vehicle noise increases with speed. Although electric cars produce less noise than internal combustion engines (ICEs), the differences decline with speed.
**Community Livability and Cohesion**
Higher traffic speeds tend to reduce community livability, local environmental qualities such as safety, quiet, air quality, and attractiveness (AARP and CNU 2021), and community cohesion, the quality of interactions among residents in a neighborhood, as illustrated to the right. Higher travel speeds offer fewer opportunities for social interaction, such as unplanned conversations that occur among residents, businesses, pedestrians and transit passengers. Cortright (2017) found a negative correlation between travel speeds and transportation system satisfaction: residents in lower speed regions tend to be more satisfied than those in higher-speed regions.

**Automobile Dependency and Sprawl**
Speed-prioritized planning tends to increase automobile dependency and sprawl in the following ways (Brinkman and Lin 2019; Ewing and Hamidi 2017; Shill 2020):

- Roadway expansions and higher traffic speeds degrade walking and bicycling conditions and make urban areas less attractive relative to sprawled locations.
- Parking minimums increase the costs of urban infill development, which encourages sprawl.
- Many urban highways displaced high-accessibility urban neighborhoods.
- Public expenditures on faster modes leave less money to invest in slower modes.

These factors contribute to a self-reinforcing cycle of automobile dependency and sprawl, as illustrated to the right. Together they reduce non-auto travel options and create more dispersed communities where people must travel farther to reach services and activities, reducing accessibility, particularly for non-drivers. This tends to be costly (Handy 2020). People who live or work in automobile-dependent, sprawled areas must drive more, spend more money on transportation, require more costly infrastructure, and spend more time travelling than residents of compact, multimodal neighborhoods. These additional costs can be considered indirect, long-term impacts of speed-prioritizing planning.
Social Equity Impacts

Social equity refers to the distribution of impacts (benefits and costs) and the degree that those are considered fair and appropriate. Travel speed valuation can have the following equity impacts:

- Speed-prioritizing planning favors motorists over travellers who use slower modes. It results in far more public spending per motorist than on users of slower modes, as illustrated in Figure 16. This is unfair, and since vehicle travel tends to increase with income, it is regressive.

- Faster modes and higher speeds increase external costs, as illustrated below. This is inequitable. For example, it is unfair that walkers and bicyclists bear excessive risks imposed by automobiles, and urban residents bear noise and air pollution caused by suburban commuters. Since physically, economically and socially disadvantaged groups tend to rely on non-auto modes and live in urban neighborhoods, these impacts tend to be regressive.

Figure 23 Estimated External Costs (Kockelman, et al. 2013; Litman 2019)

- Over the long run, speed-prioritizing planning tends to create automobile-dependent, sprawled communities where it is difficult to get around without a car. This increases the disparity in economic opportunities and quality of life between drivers and non-drivers (Frederick and Gilderbloom 2018).

Conventional planning often assumes that everybody benefits from higher travel speeds, but in practice, speed-prioritizing planning harms many people, as indicated in the table below, including disadvantaged groups who tend to rely on slower modes and are harmed by external traffic costs.

Table 2 Speed-Prioritizing Planning Equity Impacts

<table>
<thead>
<tr>
<th>Who Benefits</th>
<th>Who is Harmed</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Wealthier suburban motorists</td>
<td>- People who cannot drive.</td>
</tr>
<tr>
<td>- Automobile industries and suburban developers</td>
<td>- People who prefer slower modes.</td>
</tr>
<tr>
<td></td>
<td>- Lower income households that spend more on vehicles than is affordable.</td>
</tr>
<tr>
<td></td>
<td>- Urban residents harmed by wide roads and increased vehicle traffic.</td>
</tr>
</tbody>
</table>

Speed-prioritizing planning tends to benefit suburban motorists, but harms many physically, economically and socially disadvantaged groups. Comprehensive analysis recognizes these inequities.
Summary of Impacts

Table 3 summarizes these impacts. Many of these effects are exponential, so modest increases in speed can cause large increases in congestion, crash risk, noise and air pollution costs.

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Effects of Higher Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>Increases the area that motorists can reach in a given time period.</td>
</tr>
<tr>
<td>Travel time costs</td>
<td>Allows travellers to save time, although over the long run they usually travel farther.</td>
</tr>
<tr>
<td>Economic development and opportunity</td>
<td>Increase productivity and opportunity in some ways but reduces it in others.</td>
</tr>
<tr>
<td></td>
<td>Automobile dependency and sprawl tend to reduce productivity overall.</td>
</tr>
<tr>
<td>Traveler comfort and driver stress</td>
<td>Generally reduces comfort and increase stress.</td>
</tr>
<tr>
<td>Vehicle costs</td>
<td>Faster modes and speeds usually increase vehicle costs.</td>
</tr>
<tr>
<td>Infrastructure costs</td>
<td>Faster modes require much more costly roads and parking facilities.</td>
</tr>
<tr>
<td>Congestion and barrier effect</td>
<td>Requires more road space, which increases congestion delays.</td>
</tr>
<tr>
<td>Crash costs</td>
<td>Significantly increases crash frequency, severity and exposure.</td>
</tr>
<tr>
<td>Energy consumption and pollution emissions</td>
<td>Beyond optimal speeds (30 to 50 mph on highways and less on surface streets) increased speed increases energy consumption, noise and pollution emissions.</td>
</tr>
<tr>
<td>Community livability and cohesion</td>
<td>Faster traffic tends to reduce community livability factors including safety, quiet, and community cohesion (positive interactions among people).</td>
</tr>
<tr>
<td>Automobile dependency and sprawl</td>
<td>Contributes to a cycle of automobile dependency and sprawl, which increases driving, reduces non-auto modes, and disperses destinations.</td>
</tr>
<tr>
<td>Social equity</td>
<td>Speed-prioritizing planning tends to be unfair and regressive by reducing affordable travel options and increasing external costs imposed on other people.</td>
</tr>
</tbody>
</table>

Higher speeds have various impacts on travellers and communities.

Conventional planning tends to overlook or undervalue many of these impacts. It evaluates road performance using indicators, such as roadway Level of Service (LOS) and the Travel Time Index (TTI), which assume that faster is better. A major portion of transportation funding is allocated based on the degree that projects increase traffic speeds. The *Manual on Uniform Traffic Control Devices* applies the “85th Percentile Rule,” which means that speed limits are often set by the 15% of drivers who exceed posted limits (Bronin and Shill 2021). The Transportation Research Board’s *Development of a Posted Speed Limit Setting Procedure and Tool* (TRB 2021), consider trade-offs between travel time and crash rates, but overlooks other community goals (Frith 2012; OECD 2020; Standen 2018). Transportation data sources, such as census and surveys, tend to undercount, and therefore undervalue, slower modes. Most models overlook or undervalue induced travel impacts, and so exaggerate the benefits and underestimate the full costs of highway expansions and higher traffic speeds (Sundquist 2020).

Conventional planning tends to ignore the inequities that result from speed-prioritizing planning. It seldom analyzes the allocation of public resources between drivers and non-drivers, and ignores the external costs that vehicle travel imposes on other people, and the harms that automobile dependency and sprawl impose on physically, economically and socially disadvantaged groups.
Table 4 summarizes the degree that various impacts are considered in transportation planning.

<table>
<thead>
<tr>
<th>Impacts of Higher Speeds</th>
<th>Consideration in Conventional Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased motorist access</td>
<td>Often described and sometimes quantified.</td>
</tr>
<tr>
<td>Travel time savings</td>
<td>Often quantified. Is generally the largest impact considered.</td>
</tr>
<tr>
<td>Economic development and opportunity</td>
<td>Often exaggerates the benefits and overlooks the costs of speed, and underestimates the economic benefits provided by slower modes.</td>
</tr>
<tr>
<td>Reduced traveler comfort and increased driver stress</td>
<td>Generally ignored. Seldom considers the discomfort and stress of higher speeds.</td>
</tr>
<tr>
<td>Increased vehicle costs</td>
<td>Generally ignores the increased user costs of shifts from slower to faster modes, and from induced travel and sprawl.</td>
</tr>
<tr>
<td>Increased infrastructure costs</td>
<td>Considers direct costs but not the added costs from induced travel and sprawl.</td>
</tr>
<tr>
<td>Congestion and barrier effect</td>
<td>Congestion costs are considered but barrier effect costs are generally ignored.</td>
</tr>
<tr>
<td>Crash costs</td>
<td>Considers how speed changes affect distance-based crash rates, but generally ignores the increased per capita crash rates caused by induced travel.</td>
</tr>
<tr>
<td>Energy consumption and pollution emissions</td>
<td>Considers how speed changes affect fuel consumption and emission rates, but generally ignores the impacts of induced vehicle travel and sprawl.</td>
</tr>
<tr>
<td>Community livability and cohesion</td>
<td>Generally ignored. Seldom considers qualitative factors.</td>
</tr>
<tr>
<td>Automobile dependency and sprawl</td>
<td>Generally ignored. Integrated transportation and land use models can predict these impacts, but they are seldom used for individual project evaluations.</td>
</tr>
<tr>
<td>Social equity</td>
<td>There is little analysis of the fairness of investments in faster vs. slower modes.</td>
</tr>
</tbody>
</table>

Conventional evaluation tends to describe and quantify the direct user benefits of increased speeds but overlooks or undervalues many costs, particularly the indirect and long-term costs of induced vehicle travel and sprawl.

The demand for mobility is virtually unlimited: if travel becomes faster and cheaper people travel more, although the marginal benefits decline. For example, if electric self-driving cars make vehicle travel cheaper and more convenient people will choose longer distant commutes and more cross-country trips. The increased vehicle travel provides small user benefits but imposes large external costs. As a result, as vehicle speeds increase a growing portion of vehicle travel is economically inefficient; its benefits are smaller than its total costs, including external costs such as infrastructure, congestion, crash and pollution costs, as illustrated to the right.

As travel time and vehicle operating costs becomes cheaper people tend to drive more, even if the additional vehicle-miles provide minimal user benefits that are less than its external costs.
Changing Demands and Goals

Vehicle travel speeds and per capita vehicle travel increased steadily during the Twentieth Century, but have peaked in most developed countries (Figure 4, OECD 2012), indicating that the demand for mobility is saturating, and many current demographic and economic trends support slower travel options (Boarnet 2013). Aging population, rising poverty, increased urbanization and increasing health and environmental concerns are increasing demand for walking, bicycling and public transit travel. New technologies, such as e-bikes and telework, improve alternatives to vehicle travel. Although few motorists want to give up driving altogether, surveys indicate that many want to drive less, use slower modes, and reduce their transportation costs. The National Association of Realtors’ Community Preference Survey (NAR 2017) found that 80% of respondents like walking, 53% like bicycling, 58% report driving because they lack alternatives, and most respondents prefer walkable neighborhoods over automobile-dependent areas.

During the 1950s through the 1970 U.S. motorists paid about four times current fuel taxes per vehicle-mile in inflation-adjusted dollars to finance faster highways, but there is no longer political support for such projects, indicating declining demand for speed. Traffic speeds could increase if citizens were willing to pay more taxes or tolls but there appears to be little support; few protest, “Raise my taxes to finance urban roadway expansions!”

In addition, community values are changing in ways that reduce the value of traffic speed. Planning increasingly evaluates transport system performance based on accessibility, not just mobility, which places a higher value on slower modes, lower traffic speeds and compact development (Levinson and King 2020). Many communities have goals to increase affordability, equity, public health, traffic safety, livability, and environmental protection, which justify more support for slower but more efficient travel options. The table below compares the range of benefits provided by various speed-related planning decisions indicating that slower modes and lower roadway design speeds tend to support a broad range of community goals. As a result, many jurisdictions have targets to increase walking, bicycling and public transit travel, and reduce vehicle travel (ACEEE 2019; Litman 2021).

Table 5  Comparing Transportation Improvement Options

<table>
<thead>
<tr>
<th>Community Goals</th>
<th>Improve Auto Travel</th>
<th>Expand Roadways</th>
<th>Improve Slower Modes</th>
<th>Reduce Road Design Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Vehicle Travel</td>
<td>Increased</td>
<td>Increased</td>
<td>Reduced</td>
<td>Reduced</td>
</tr>
<tr>
<td>Increase motorists’ speed and access</td>
<td>✓</td>
<td>✓</td>
<td>✓/x</td>
<td>✓</td>
</tr>
<tr>
<td>Increase non-drivers’ speed and access</td>
<td>x</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Consumer savings and affordability</td>
<td>x</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Traffic safety</td>
<td>x</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Physical fitness and health</td>
<td>x</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Road and parking cost savings</td>
<td>x</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Energy conservation reduced pollution</td>
<td>x</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Community livability and cohesion</td>
<td>x</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reduce sprawl-related costs</td>
<td>x</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Improving automobile travel and expanding roadways increases motorists speed and access, but tends to contradict other community goals. Improving slower modes (walking, bicycling and public transit) and reducing traffic speeds improves non-drivers’ access, and by improving affordable and resource-efficient mobility and reducing total vehicle travel, these help achieve a wide range of goals. (✓= supports goal. x= contradicts goal.)
Recommendations
To be fair and efficient, transportation planning should consider all impacts when evaluating decisions that affect travel speeds, including external and long-term effects. Impact analysis should account for induced vehicle travel and the additional external costs – increased downstream congestion, infrastructure costs, crashes and pollution emissions – that result. Impacts should be described, and if possible, quantified and monetized.

Travel speed and mobility should not be considered ends in themselves, planning decisions should be evaluated based on how they affect overall accessibility, recognizing the various ways that wider roads, faster traffic and more sprawled development can reduce accessibility, for example, by creating barriers to walking and bicycling, reducing roadway connectivity, and increasing travel distances.

Analysis should recognize the diversity of travel demands, including the needs of people who cannot, should not or prefer not to drive. Analysis should recognize the high user costs of automobile travel and the often unmet demands for slower modes by travellers who want to save money, avoid the stress of driving, or exercise. Because slower, resource-efficient modes are so constrained, small increases in their speed can provide large benefits. For example, pedestrian and bicycle shortcuts can benefit users directly and eliminate the need for longer vehicle trips.

Planning should consider social equity impacts. Speed-prioritizing planning devotes most transportation funding and road space to automobile facilities, to the detriment of walking, bicycling and public transit. Analysis should evaluate whether travellers who use slower modes receive a fair share of public investments, and the external costs, including delay, risk and pollution exposure that faster modes and higher speeds impose on disadvantaged groups (Culver 2018).

If communities have goals to increase affordability, equity, public health and safety, and reduce pollution, planners should apply a sustainable transportation hierarchy, as illustrated to the right. This justifies policies that favor more efficient modes and higher value trips.

New tools can help evaluate speed impacts. For example, integrated models can predict how wider roads and increased traffic speeds affect multimodal accessibility, travel activity and development patterns (Levinson and King 2020).

The table at the right illustrates maximum traffic speeds optimized for safety and livability. These are lower than what is commonly used, reflecting often-overlooked benefits of reduced vehicle speeds and travel.
Conclusions

Transportation planning decisions often involve trade-offs between speed and other goals. Faster modes and higher speeds provide user benefits and impose various costs on travellers and communities.

Due to fixed travel time budgets, increases in speed generally cause proportionate increases in mobility, so a 10% increase in speed generally increases affected travellers’ mileage by 10% over the long run. Planning often assumes that higher speeds provide time savings, but over the long run people tend to maintain a fixed travel time budget, so higher speeds increase mobility rather than saving time, and contribute to a self-reinforcing cycle of increased vehicle travel, automobile-dependency and sprawl. This causes mobility inflation, which ratchets up the distances people must travel to meet their needs. This increases total transportation costs and is unfair to people with limited mobility.

During the last century, motorized travel increased people’s average travel speeds and distance by an order of magnitude, but increased many costs by similar amounts. In 1900, most people travelled about one thousand annual miles and spent negligible money on transport. Now, a typical motorist drives more than 10,000 annual miles, but to do so must devote about 20% of their income, and therefore about 20% of their workday, to paying vehicle expenses. When evaluated by effective speed, defined as travel distance divided by the time spent travelling and earning money to pay travel expenses, automobile travel is often slower overall than bicycling and public transit, and it is regressive because effective speeds are low for low-wage workers and increase with income.

In various ways, conventional planning tends to exaggerate the benefits and overlook many costs of faster travel. This has the following results:

- More investment in faster modes (particularly automobile and air travel), and roads designed for higher speeds, and less investment in slower modes (walking, bicycling and public transit).
- Communities become more automobile-dependent and sprawled. More vehicle travel is required to access services and activities.
- More expensive and resource-efficient transportation system. People must spend more on travel, governments must spend more on roads, businesses must spend more on off-street parking, and communities must bear more crash risk and environmental costs.
- A major portion of this additional vehicle travel is economically-inefficient; the incremental user benefits are less than incremental external costs.
- Faster modes receive more public investments than slower modes. This is unfair, and since travel by faster modes tends to increase with income, and people with disabilities and low incomes tend to rely on slower modes, this is regressive.

Conventional planning assumes that travellers place a high value on speed, but when faced with a choice, travellers often choose slower options for affordability, health, enjoyment and livability sake. For some trips, such as urgent errands or delivering time-critical goods, travel speed can have high values, but for many trips users prefer to save money rather than time. As a result, transportation systems become more efficient and equitable if they prioritize higher-value trips and more space-efficient modes over lower-value trips and space-intensive modes using road pricing and priority lanes.

To their credit, many decision-makers support slower modes and traffic speed reductions more than justified by their analysis models; they realize intuitively that walking, bicycling and public transit are
important and deserve more investment. However, this occurs *despite* rather than *supported by* standard planning methods. Reforming these practices can justify much more support for slower modes. More comprehensive analysis of speed impacts is likely to result in less investment in urban highways, more investments in active and public transport modes, lower roadway design speeds, more effort to improving travel comfort and convenience than what currently occurs.

Of course, every traveller has unique needs and preferences. Many will choose faster modes, despite their higher costs. However, current demographic and economic trends – aging population, increasing urbanization, plus growing concerns about affordability, public health and environmental quality – are increasing demand for slower modes and for livable neighborhoods. More comprehensive valuation of travel speeds can better respond to consumer demands and community goals.
References


Paul Tranter and Rodney Tolley (2021), *Slaves to Speed, We’d All Benefit from ‘Slow Cities’*, The Conversation (https://theconversation.com); at https://bit.ly/3ntESTC.


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