



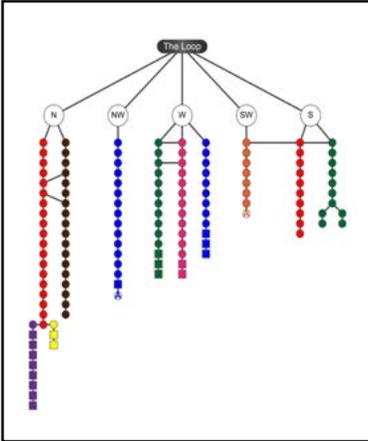
DESIGN in

PUBLIC HEALTH



Summer 2016

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In this review, editor Claire Vernon muses about the relevance of Christopher Alexander's ideas of city design to Chicago's transit structure.



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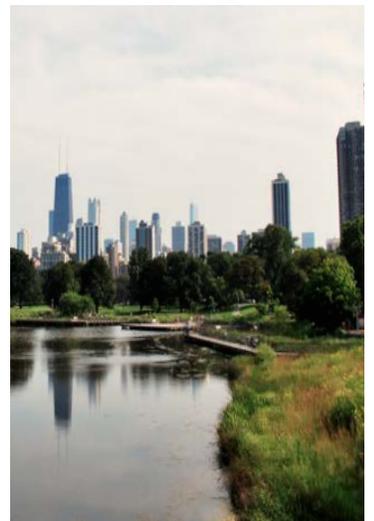
Schwartz Design as a Tool for Public Health Innovation

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Letter From The Editors:

We are very excited to welcome you to the Summer 2016 edition of the NPHR. In this issue we focus on the impact of design on public health. While design historically takes a back seat during public health conversations, relegated to the tool shed, good design has often served as the inflection point towards a successful public health campaign—from John Snow’s 1854 Cholera epidemic control in London to global Ebola messaging campaigns in 2015.

The perception and experience of design often means different things to different people; it can be artistic, aesthetic, fashionable, or purposeful. Furthermore, design can cover a broad range and scope of applications from creating beautiful living communities to skillfully crafting an effective message to reach a target audience. Every moment of our lives is influenced by design—accidental or intentional, consciously or unconsciously. Remarkably, we rarely recognize the integral role of design in our lives until we encounter very bad design, such as a street sign pointed in the wrong direction.

In this summer issue, we pause to ask: how does design impact public health and can we improve public health through better design? Our contributing authors take a broad look at how design impacts health choices, city planning, and automobile safety among other issues. While these essays only address a tiny sliver of the broad scope of designs that impact public health, we hope they plant seeds of curiosity for readers to seek out design and recognize the impact of good design in our lives and communities. It is only when we notice the designs that impact our lives, communities, and health that we can work to improve them.

We want to thank all our collaborators, contributors, and sponsors for supporting us through another beautiful volume. We specifically want to thank the UIC Biomedical Visualization Program for partnering with us again to help illustrate this issue.

Best,
Claire Vernon and Osefame Ewaleifoh
NPHR Editors-in-Chief



Claire Vernon
PhD Candidate, NU



Osefame Ewaleifoh
PhD Candidate, NU

Cover Artist Statement

The field of medical illustration combines two seemingly disparate disciplines: medical science and naturalistic art. After entering this field, I was able to appreciate how powerful such a combination can be. It is for this reason that I was attracted to Dr. Amy Schwartz's article describing design as a tool for public health, and how powerful this pairing was, is, and could be. When the goal is to encourage healthy behaviors by making them more intuitive or attractive, design can aid by gently guiding the viewer, simplifying the complex, and creating beauty.

In my illustration, I juxtapose literal tools from each field. The viewer's eye bounces back and forth between the two desks, seeking out the parallels between shape, color, and function. Recognizing the relationship between health and art tools easily relays the utility of connecting design with a message of health. All of the tools are laid out and accessible, ready to be picked up and used, much the same way the article advertises design as a resource ready to be called upon.



2016 © Ellen Weiss (UIC Biomedical Visualization graduate student)



Ellen Weiss

About

Ellen Weiss is a Chicago-based medical illustrator. Originally from Kansas, she received a Bachelor of Fine Arts in Printmaking with minors in Biology and Art History from Emporia State University in 2013. She is currently a graduate student at the University of Illinois at Chicago working on a Master of Science in Biomedical Visualization, a field that allows to her communicate complex science and biological topics through the power of illustration. In her free time, she enjoys being in nature, cooking, and painting.

DESIGN as a Tool for Public Health Innovation

Amy Schwartz, PhD

Public Health challenges require systemic solutions that drive change at the individual, community, and societal levels. Design Thinking can help create innovative solutions by inspiring new ways of framing problems and expanding the public health armamentarium with new tools and methods. Design thinking is a problem-solving approach used across design disciplines from product design to architecture. This approach leads to human-centered solutions by direct engagement with end users throughout the process, blending research, design, and prototyping in iterative cycles. Design Thinking has been applied to a wide range of complex problems and helps multidisciplinary teams balance technology, desirability, and feasibility to achieve integrated and effective systemic solutions (see Brown, 2008).



Amy Schwartz

Several conceptual areas from the design domain are especially relevant to Public Health: Visualization and Affordances, Design for Healthy Behavior Framework, and Design Research Methods. I'd like to introduce Public Health practitioners to these concepts to start a dialogue about how we can partner in creating and sustaining innovative solutions to achieve better public health.

Visualization and Affordances

John Snow was a physician and is credited with being the father of epidemiology. I would say that he was also a designer. His famous map was an incredibly effective visualization that revealed an important insight into the relationship between cholera cases and drinking water pumps in London. This visual design convinced the city of London that there could be a link between the Broad Street pump and the disease. Visualization is an effective way to present quantitative information so that anyone—even those without scientific training—can take it in. It is a way to tell a story about relationships, and visual storytelling is an act of design.



John Snow's map (1854)

But while visual design was great at getting the city’s attention, it was not enough to change behavior. This required an intervention. It was a simple and effective intervention that did not require a change in belief for the users or an acceptance of germ theory by the scientific community. They removed the pump handle. This uncomplicated intervention was also an act of design.

Snow started with a visual design that told a story (the map) and then went to modifying a design affordance (the pump handle). A design affordance is a property of a physical design that engenders a behavior “naturally”—i.e., with little or no learning or instruction. Don Norman, in his important book, *The Design of Everyday Things*, uses the example of a door that opens in only one direction. If the door has a fixed handle, then it is asking to be grasped and pulled to open the door. This affordance is so strong that we pull rather than push on a door that has the natural design wrong—even if we use the door all the time. (Thus, the need for signs on doors that have the affordance wrong.)



Pump handle

cc search



Poor Design: requires further explanation



Good Design: appealing and intuitive (Odenplan subway stairs)

Thoughtful application of design affordances in the built environment can help drive healthy behaviors. Consider the example of a stairway in the Stockholm Odenplan subway station. Stepping on the stair plays a musical note to encourage use of the stairs over the escalator. This creates a design affordance for walking up the stairs, rather than riding the escalator.

Another interesting example of a design affordance was created to address a problem with Alzheimer’s patients. Alzheimer’s patients can wander, get confused, disoriented, and agitated. Many facilities place patients in locked areas or put electronic tracking devices on them. The Benrath Senior Center nursing home in Germany used the affordance of a bus stop as a waiting place in an attempt to solve wandering in a more humane way. They designed an affordance for controlled wandering. Patients can wander around the grounds, but end up sitting at the bus stop as a natural resting place. They are safe to stay there until the staff brings them back to their rooms.

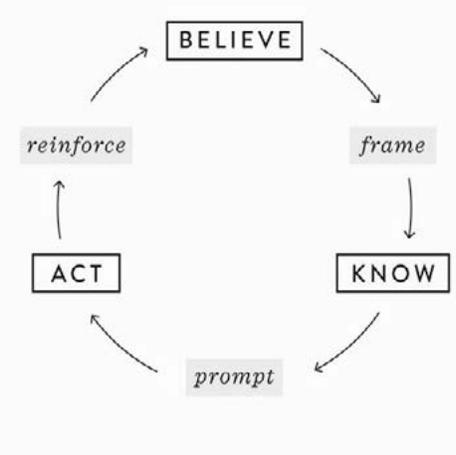
“Stepping on the stair plays a musical note to encourage use of the stairs over the escalator.”



“Bus station” at the Benrath Senior Center

Design for Healthy Behavior Framework

Visualizations and affordances are relatively simple design tools that help us tell a story about relationships and foster behavior change. But not all behavior change challenges are addressed as easily as taking a pump handle off. To the right is a design framework that has been used to develop innovative interventions for more complex behavior change challenges ranging from medication adherence to saving money to preventative health screenings.

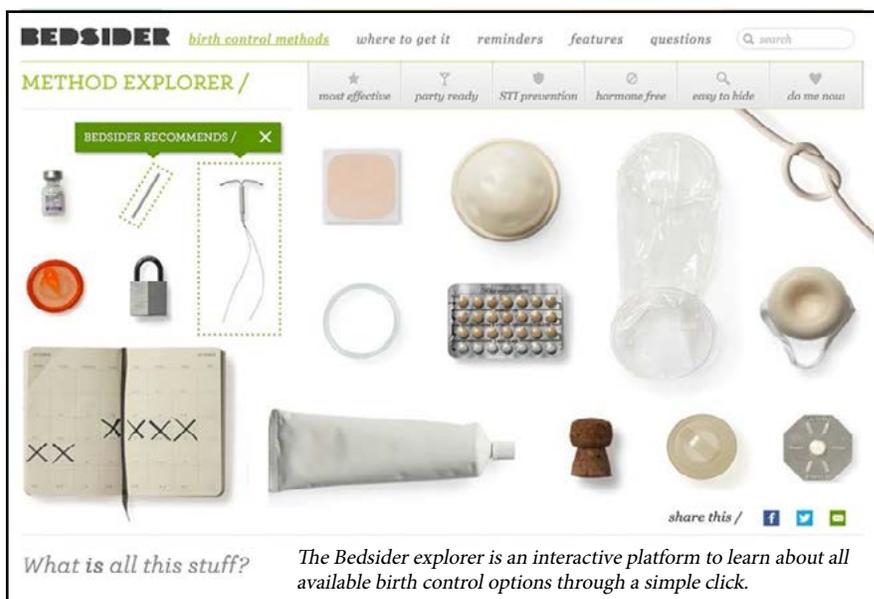


This framework is useful for both diagnosing and generating potential solutions to behavioral challenges. Behavior change challenges will differ in where the sticking points are in terms of both the specific challenge and the individual.

Design for Healthy Behavior Framework
(adapted from Klein, Wustrak, & Schwartz, 2006)

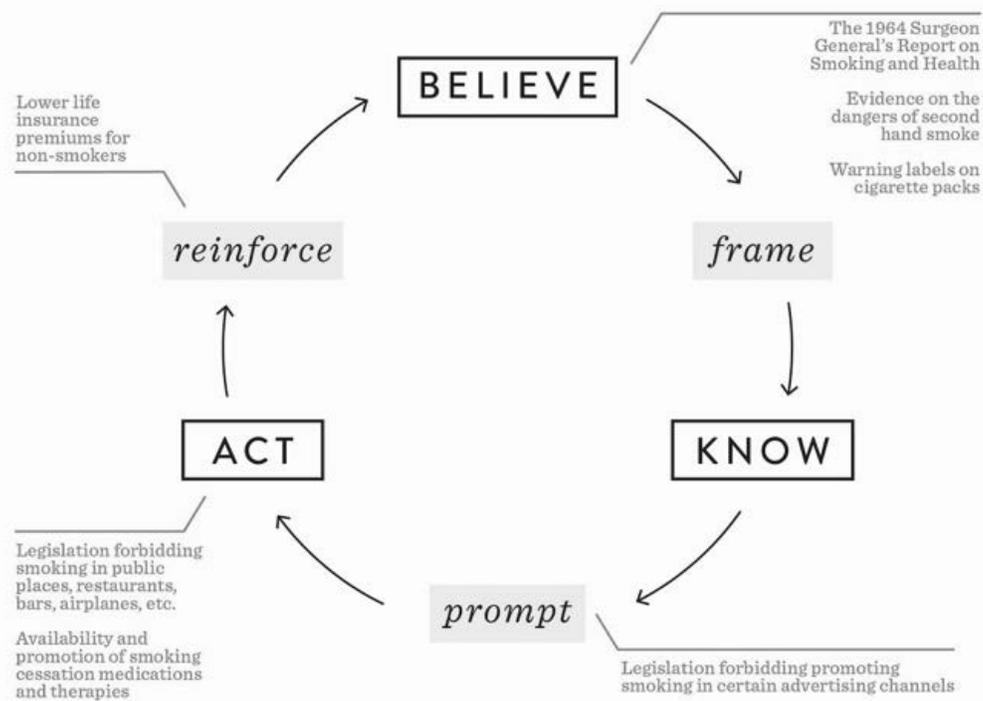
Consider a simple example like flossing your teeth. You probably *believe* that flossing your teeth leads to better health—both dentally and beyond. You have a mental model or *frame* about how flossing does this. You *know* what to do. (How many times has the hygienist demonstrated this to you?). You *prompt* yourself to floss when you brush your teeth by leaving the floss out right next to your toothbrush. But the problem with flossing is with the *act*. It is awkward and kind of unpleasant. When we do it, it does feel good afterwards, so there is some *reinforcement* here. But if we want to get more people to floss their teeth more regularly (and not just the week before they go to the dentist), we need to tackle the design of the flossing act itself—not better prompting or evidence that it is important.

Flossing is a relatively simple example. Most health challenges need design responses for many, if not all, of the links in this framework. We want people to get into a virtuous loop of healthy behavior that becomes habit. The Bedsider system to prevent unplanned pregnancy used this framework to drive research and design activities. The final design thoughtfully addresses all of the links through a website, a text messaging system, and print materials.

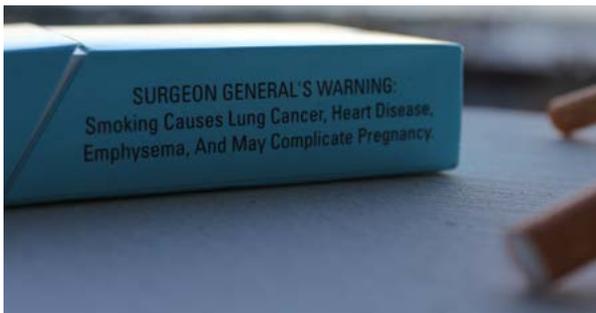


Good design in health communication: screenshot from www.bedsider.org

“Most health challenges need design responses...”



Smoking reduction intervention components



cc Lindsay Fox

This design framework can be useful for analyzing public health stories—both successful and unsuccessful ones. Consider the success of the reduction in smoking in the US that has been achieved in the last 50 years.

Belief that smoking led to health problems was addressed through the 1964 Surgeon General's report linking smoking to lung cancer. Warning labeling on cigarette packs also drove belief. Additionally, evidence about the dangers of secondhand smoke was important here. Legislation preventing advertising on television helped attack the **prompt** link. Advertising

messaging can be an effective prompting mechanism to drive people to certain behaviors—either healthy or unhealthy. The **Act** link was addressed in multiple ways, through legislation against smoking as well as creation and promotion of smoking cessation methods and medications. **Reinforcement** is given to non-smokers through lower life insurance.

This framework can help drive better holistic design consideration of all the elements in the creation of new public health interventions. We can also look at unsuccessful interventions and gain insight into where we went wrong.

Design Research Methods

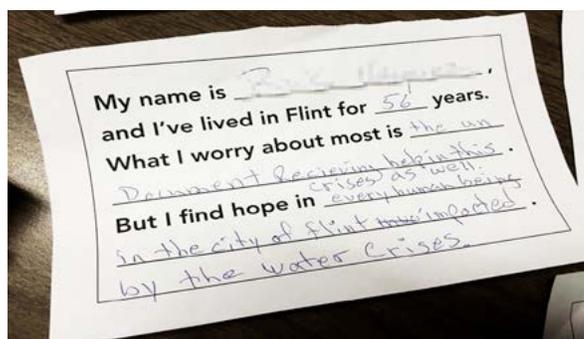
Design research methods inspire new ways to learn about and engage individuals and communities in their health. These methods are mostly qualitative and are adapted from diverse fields like psychology, anthropology, and journalism.

Methods can be especially useful when we want to explore and develop a wide range of early design ideas for new interventions. Assessment of the interventions through quantitative research studies should be a later step in the process.

Some relevant design research methods include:

- **Behavioral Archeology:** looking for evidence of people's activities inherent in placement, wear patterns, and organization of places and things.
- **A Day in the Life:** participants catalog the activities and contexts they experience throughout an entire day.
- **Draw the Experience:** participants visualize an experience through drawings and diagrams.
- **Behavior Sampling:** participants record and evaluate their current situation whenever they get a text.

The US Surgeon General's Office is currently experimenting with design research and innovation methods. Shown here is an example from a community meeting that was recently held in Flint, Michigan. As community members entered the meeting, they were asked to fill out a "MadLibs" sheet. This was a simple way to "break the ice" and get some input from each community member to feed smaller group discussion and education sessions. Many design research methods engage through participation and can complement the Community Based Participatory Design methods used in public health, expanding the public health toolkit.



Good design in survey research: MadLibs feedback sheet from Flint community meeting

Partnering to Innovate in Public Health

Public health challenges represent some of the most complex and important issues in any society. There have been many successes, but there is a long way to go. Viewing these challenges through a design lens can lead to new ways of engaging individuals and communities, new insights, and new interventions. Designers are passionate about making change in the world and are eager to partner with public health practitioners to drive innovation.

Amy Schwartz's current focus is to bring human-centered design thinking to health and wellness problems today. Amy holds a PhD in cognitive psychology from Yale University.



2016 © Molly Huttner (current UIC Biomedical Visualization graduate student)

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Design and Health in Historical Perspective:

American City Parks in the Late 19th Century

Samuel Kling



Lincoln Park, Chicago; commons.wikipedia.org

Design and public health have intellectual linkages that stretch at least to the mid-nineteenth century, and involve ideas and people that public health professionals would scarcely recognize as their predecessors. In the United States, a high point in this relationship took place during the wave of rapid urbanization during the late nineteenth century. Over the course of the century, unprecedented urban growth transformed the nation. In 1800, New York City had sixty thousand residents, making it by far the biggest city in the country; by 1880, it boasted 1.2 million. Chicago was the fastest growing

city in the history of the world, growing from four thousand in 1840 to 500,000 in 1880 and 1.7 million in 1900 [1]. With this physical transformation came a host of social transformations brought by industrialization: extreme poverty and extreme wealth, multiethnic populations, and astounding physical chaos. As one historian writes, epidemics of disease, social strife, and the prospect of class conflict proved so threatening to Americans in the late nineteenth century that many viewed the modern city as synonymous with disorder [2].

Civic leaders facing these threats in the late nineteenth century made few distinctions between physical health and moral health. In their eyes, the two went hand-in-hand—the product of dark and congested tenements or dilapidated frame housing. Bad physical spaces created bad social outcomes, whether vice and crime or epidemics of disease. Lawrence Veiller, a prominent New York City housing reformer, described the process. “Environment leaves its ineffaceable records on the souls, minds, and bodies of men,” he told municipal officials in 1911. A child growing up in a dark and congested urban environment “does not grow up to be a normal healthy person, but is anaemic, weak, sickly”—much like a houseplant in similar conditions [3]. Veiller believed, quite literally, that lack of sunlight and fresh air was the main reason Manhattan’s tenement districts had turned into “centres of disease, poverty, vice and crime” [4]. Veiller was not alone in these beliefs. Other observers wrote of the “nervous strain” caused by the artificiality and excessive stimulation of the big city: early sociologists noted high rates of mental illness in urban areas, which they blamed on the constant and unnatural bombardment of sights, sounds, smells, and people [5]. To them, and to civic leaders and reformers, the root of the city’s health and social problems lay in its physical features.

Convinced that cities’ ills derived from their environment, civic leaders and activists turned to careful design to improve this environment. Park construction served as the centerpiece of their program. Beginning in the 1850s, designers such as Frederick Law Olmsted and H.W.S. Cleveland built parks to address the specific social and health problems facing American cities. They eschewed the rigid, geometric plans of formal gardens favored by European designers, instead creating landscapes whose naturalism and informality contrasted with the disorderly, artificial industrial city. Such designs were supposed to present a tamed and bucolic vision of nature, but they were in fact just as artificial as the city itself. In Chicago, for example, landscapers in Lincoln Park in the 1860s faced the ambitious task of turning the site’s flat, dreary prairieland into the lush, undulating landscape that they believed could best address urban problems. They replaced existing vegetation with thousands of foreign and native plants, demolished the lake front sand

“the root of the city’s health and social problems lay in its physical features.”

dunes, dug artificial lagoons, built up hills, and even released European house sparrows into the wild [6]. Above all, the landscape was to present a verdant serenity completely unlike the modern cityscape.

Landscape designers intentionally avoided creating “awe-inspiring” beauty, lest it excite visitors in ways at odds with their goal of calming frayed nerves [7].

Advocates focused so intently on design because they considered aesthetics a tool for solving urban health and social hazards. They believed parks to be the “lungs of the city,” a term that suggested both their role in providing fresh air and in purifying urban society from bad influences [8]. They saw the environment of the park as the critical salve for urban spaces that degraded residents’ bodies and minds. For Olmsted, who viewed modern society’s central problem as the decline of opportunities for reflection and repose, park landscapes served as an important mechanism for preserving residents’ mental health and ensuring good behavior [9]. Some took these views of parks’ uplifting power to extreme lengths: one writer in the reform journal *Social Hygiene*, for example, insisted that with a bigger parks budget, he could reduce prostitution in his city by 98 percent [10].

A second aim for park advocates was to strengthen the urban body politic by bringing diverse groups of people together in a common space. To be



Lincoln Park Conservatory, Chicago

cc Rob Walsh

certain, park builders' perspectives were inflected with their class position: though they sought to create spaces for the mingling of different classes, they did not intend for it to take place on equal grounds. Chicago's South Park (today called Washington Park) serves as an illustrative example. There, Olmsted built promenades—wide paths for strolling—to serve as visual focal points for visitors. As moneyed men and women strolled along, Olmsted believed poorer visitors would observe their social betters and, as if by osmosis, adopt their respectable behaviors [11]. Olmsted even tried to prohibit such “disreputable” behaviors as playing ball and walking on the lawns, punishing the latter with a hefty \$20 fine [12]. Such structured inter-class mingling reflected reformers' model for the urban body politic—a society open to most, as long as they played by the rules of those in charge.

Urban park-building campaigns count as one of the most visible legacies of late-nineteenth century public health reform. By 1900, such spaces had become ubiquitous in American cities: Olmsted's firm alone designed major parks in Boston, Brooklyn, Buffalo, Chicago, Detroit, Manhattan, Montreal, and Rochester, among other places [13]. Such parks reveal the breadth of reformers' vision, which made few distinctions between public health and civic health,

or physical ailments and moral ones. At the same time, they reveal its limits. Restrictions against ball playing and working-class leisure proved unrealistic, as many visitors enjoyed parkland without engaging in quiet reflection [14]. Nor could parks solve the crises of industrial capitalism—poverty, social disorder, and disease epidemics—while reformers and civic leaders failed to confront underlying issues in the economic system.

But against other measures, urban parks played an important role in lessening the negative effects of the modern city. They brought fresh air to crowded urban neighborhoods and served as public, democratic spaces open to all. In putting their faith in the uplifting power of the landscape, park builders fashioned essential and beloved social institutions for city residents, respites of sunlight and foliage amid an inhumane city. The enduring popularity of such spaces speaks to the movement's successes.

Samuel Kling is a History PhD candidate at NU. His dissertation, “Taming the Crabgrass Frontier: Regional Planning and the Metropolitan Idea in Chicago, 1900-1935,” rethinks the origins of mass suburbanization and metropolitan inequality in the US, focusing on the influential regional planning movement in Chicago.

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Transport Policy and Well-Being: Curing a New Pathology of the Urban Traveler

Alec Biehl and Amanda Stathopoulos, PhD

What are the components of a well-functioning society? This is a simple question with a tremendously intricate set of possible answers. Let's explore it by contemplating what should be regarded as a vital public good: the provision of shelter and health services? What about formal education and safe environments? These are all reasonable considerations. But if we may be so bold to ask one more question, where on this utopian priority list does transportation fall?



cc Kristoffer Trolle

An increasing number of studies in recent decades have addressed the factors impacting health and well-being of urban residents while systematically examining how public policy interventions could address associated deficiencies [1]. Mobility, or people's travel patterns, is rarely considered in these analyses. Instead, transportation has traditionally been viewed as a derived demand, affording opportunities to participate in essential activities (work/school, shopping, engagement in leisure, etc.) that fuel the vibrant cadence of our lives. Viewing travel as an experience that enables physical and psychological needs to be met, rather than something that is undesirable in itself, unlocks new potential for enriching the quality of life of residents. Thus, by delving into and emphasizing the connections between mobility and well-being, the idea of "happiness optimization" emerges as a new guiding principle in transport policy design.

In modern-day urban planning, there exists a myriad of concepts and metrics designed to promote and assess the use of active transport modes in everyday travel. For example, the well-known Walk Score—for the United States, Canada, and Australia—is a quantitative indicator of how pedestrian-friendly a city or neighborhood is. For people who seek a "happier [and] healthier" lifestyle and for policymakers who

desire to create places offering better commutes [2], the Walk Score methodology provides not only a ranking and geographic comparison of walkability, but also transit- and bike-friendliness. Another notable metric is the biannual Copenhagenize Index, which evaluates bicycle travel. The appeal lies in its infusion of "human-oriented" design principles with traditional engineering and planning practices [3]. An article published by the BBC in 2013 also encapsulates a growing desire to shift cities away from automobile dominance—in favor of healthier mobilities—by highlighting several efforts from around the world that aim to provide citizens with the necessary digital and infrastructural resources to learn, and engage in, new travel behaviors [4].

Nonetheless, the transformation of U.S. cities, in accordance with a shift of the American Dream away from the domineering "house + land + vehicle" ownership paradigm, is an onerous task that requires active citizen participation in a revamped planning process. The expansive mosaic of suburbia is rooted in a transportation network that caters to the automobile, thus hampering movements supporting compact development and more efficient public transportation systems. These elements are certainly necessary to make investment in walking and cycling infrastructure feasible.



According to the 2014 American Community Survey, the estimated breakdown of the daily work commute by transport mode is:

- 86.2%** by private vehicle, including motorcycle (89.1% of these trips were made by single drivers)
- 5.1%** by public transportation
- 2.8%** by walking
- 0.6%** by bicycle

The numbers, of course, vary with geographic context: restricting the search to residents of Cook County (IL), the breakdown is respectively 71.2% (87.6%), 18.1%, 4.4%, and 1.0%. It is therefore clear, even when only considering this one trip purpose, that a high rate of private vehicle use is still prevalent—and it is due to urban sprawl. Although considerable debate exists on how (or if) we should effectively and appropriately manage sprawl (see [5] for a brief overview), research has shown that it not only limits physical mobility options, but also upward socioeconomic mobility. This is because communities with limited economic and infrastructural resources experience greater implicit constraints on their access to opportunities elsewhere [6].

Under free market ideologies and principles of individualism, one might argue that transportation investments should adhere to the will of the rational and self-interested consumer (as defined by microeconomics)

rather than seeking to influence travel behaviors for the sake of socially-beneficial initiatives. Indeed, car use makes sense for purposes of convenience and minimizing travel time, especially when coupled with the excitement surrounding cleaner fuels, autonomous vehicle capabilities, and novel shared-ride programs. However, amidst the growing recognition of “irrational and inconsistent thinking” governing our choices (thanks to behavioral economics), there are equally strong arguments to be made that:

- 1) altruism and community-mindedness are legitimate inputs in our decision-making processes and, accordingly,
- 2) urban planning should aim to introduce fairer land-use patterns and transportation infrastructure development.

In light of this train of thought, we present an array of research efforts to illustrate the ways in which mobility contributes to physical and psychological well-being. Not only are there clear environmental and community benefits from mobilities engendering higher levels of walking and cycling, but also possibilities for invaluable individual gains.

Physical Well-Being

Numerous campaigns and organizations exist to improve the overall physical health of the U.S. population. Leading examples include the Let’s Move campaign, sponsored by Michelle Obama [7], and PHIT America, an organization launched in 2013 [8]. Both programs aim to combat the “inactivity epidemic” and high obesity rates in our country by explicitly calling for family and community involvement in promoting physically active lifestyles, predominantly in children. A similar strategy is critical for policymakers to consider in promoting the adoption of active transport modes; objectives focused on analyzing and changing habitual behavior (especially car travel) are still prominent in transportation research. In addition to the relatively low political importance of transportation issues—for instance, deteriorating infrastructure—funding shortages plague governments on all scales across our nation.



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Yet, a significant amount of research illustrates the favorable impact of investment in active transport modes. A comprehensive literature review [9] shows that public transit does, in fact, induce significantly higher levels of physical activity in its users compared to non-users; however, achieving this requires individuals to hold positive perceptions of travel to and from train stations and bus stops. To better understand the associated health benefits, the authors call for a refinement in data collection methods as well as well-being indicators that consistently measure potential health cost savings. These become more feasible as GPS and mobile technologies become more advanced. A related study conducted in Canada demonstrates the importance of coordinated land-use and transit planning in promoting pedestrian travel: walking trips are more frequent and exhibit greater variance in trip purpose when destinations are more accessible within a “comfortable” travel range [10]. This finding is consistent with the philosophies of transit-oriented development. Researchers and policymakers must exhibit caution, though, since it is tempting to exaggerate the potential physical health benefits of engaging in active transport. This warning is echoed by Schauder and Foley [11], where analysis of the National Health and Nutritional Examination Survey (NHANES) III reveals that weight loss and reduction in cholesterol levels, due to increased travel as a pedestrian or cyclist, are noticeable (yet small) only in individuals that otherwise have physically inactive lifestyles.

What this means is that, when designing behavioral interventions, it is of utmost importance to be cognizant of the notorious self-selection problem. In other words, policies must ensure that, if there is to be an increase in the number of trips made via active transport modes, this increase should focus on converting travelers who are not habitual pedestrians or cyclists. The bigger picture of physical well-being extends beyond individual considerations. Another extensive literature review examines numerous methodologies for conducting a Health Impact Assessment resulting from a mode switch to active transport. The authors illuminate the risks these travelers face regarding safety (traffic

“**achieving [higher levels of physical activity] requires individuals to hold positive perceptions of travel...**”

accidents at intersections) and air/noise pollution (exposure to vehicle emissions) [12]. Although cost-benefit analyses tend to indicate that the potential physical health benefits for individuals outweigh the above costs, the uncertainties behind the estimation of these benefits are of great concern. Accordingly, we must also consider physical health as pertaining to the natural environment in order to strengthen our argument. As Nakamura and Hayashi suggest through their categorization scheme, there are numerous incarnations of low-carbon transport policies in existence [13].

- 1) **AVOID** (behavior-preventing) strategies rely on land-use control and compact urban development.
- 2) **SHIFT** (behavior-changing) strategies promote diversification through hierarchical transport systems, such as pedestrian and cycling infrastructure as feeder mechanisms for public transport, in addition to car traffic exclusion zones and road pricing schemes.
- 3) **IMPROVE** (behavior-refining) strategies endorse hybrid and electric vehicle creation, taxes on vehicle emissions, and the advancement of real-time information systems through connected vehicle-to-vehicle and vehicle-to-infrastructure sensing technologies.

A combination of these approaches must rely on effective communication, social marketing, and policy implementation to successfully stimulate the desired improvements in the quality of life, while effectively addressing climate change concerns [14]. It is evident from the discussion so far that designing for healthy mobility is an integral part of redesigning the urban fabric as a whole, but there is still a need to delve deeper into the often-overlooked mental and emotional components of well-being to fully comprehend the significance of its role.

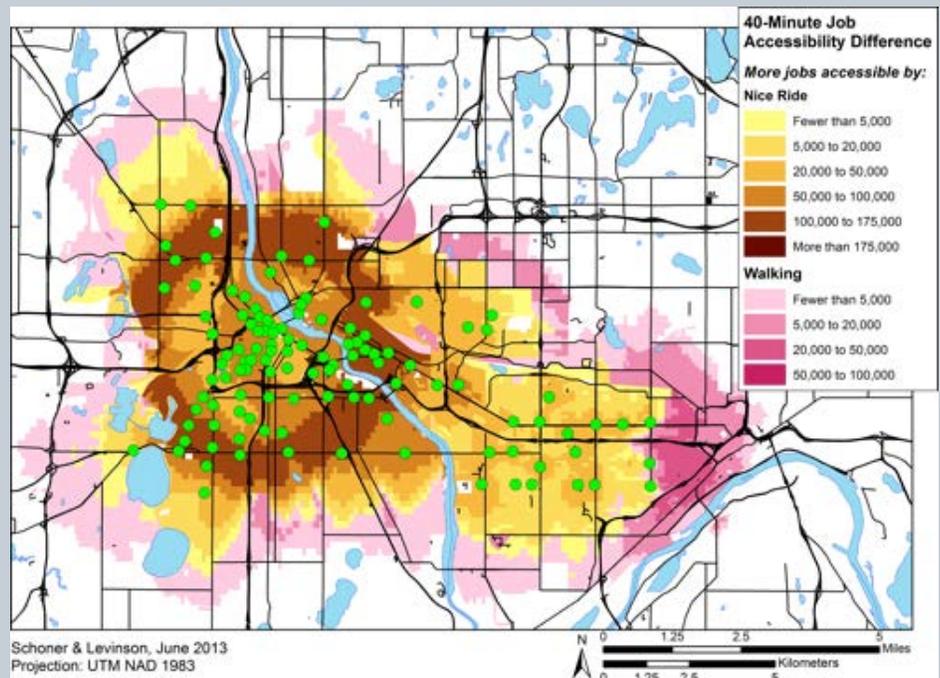


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SECTION HIGHLIGHT: Minneapolis, Minnesota

In the 2015 version of the Copenhagenize Index, Minneapolis is the sole U.S. city that appears in the Top 20 rankings. The accolades do not stop here, though. The League of American Bicyclists gave Minneapolis a gold rating for bicycle-friendliness, one of only thirteen U.S. cities with a population of at least 100,000 to achieve this ranking in 2015 [15]. Furthermore, the city has the second highest share of bicycle commuters (behind Portland, OR) among the 70 largest U.S. cities based on 2014 American Community Survey data [16]. Another source of praise is *Bicycling Magazine*, which placed Minneapolis as the number three city for cyclists in 2014, behind Chicago (2nd) and New York City (1st) [17]. Thus, due to its four-season climate, Minneapolis is an exceptional model for any U.S. city seeking to improve its active transport network. Researchers should view Minneapolis (and its metro area) as an opportunity to develop more holistic travel behavior models that emphasize the latent factors, particularly those related to well-being, underpinning decision-making processes.

Pictured here is a map showing improved job accessibility due to Nice Ride Minnesota, the bike-sharing system for Minneapolis. Minneapolis is a medium-sized city, however, the potential insight from analyzing healthy mobility patterns is relevant to cities of all sizes.



<http://streets.mn/wp-content/uploads/2014/04/40min1.png>

Mental and Emotional Well-Being

Mobility and transportation are necessary to bridge distances and access employment, activities, and essential services. This accessibility has been a fundamental element in understanding well-being from a physical perspective. However, mobility also enables individuals to participate in social and community life, as well as to gain autonomy. From this perspective, mobility also relates to psychosocial desires. Despite the growing emphasis on the importance of psychological well-being in the broader public debate, little attention is devoted to how the transportation system is capable of contributing to greater levels of life satisfaction.



cc Eric Mueller

The daily commute is a fundamental activity with strong implications for well-being. Numerous studies have revealed commuting to be among the most negative of daily activities. Travelers generate paradoxical outcomes because they are *chronically underestimating* the (everyday) disadvantage of a longer commute, while *overestimating* the (long-run) rewards from a higher income or nonurban residence [18]. One explanation stems from a cognitive “mistake” in that we tend to overlook how choices related to residential location will influence daily travel. The so-called commuting paradox is based on the finding that people who live farther from their work, thereby having longer commutes, on average have lower life satisfaction. If commuting leads to reduced well-being, an inquiry into the underlying mental and emotional causes is important.

“we tend to overlook how choices related to residential location will influence daily travel.”

Research has shown that mobility is related to well-being in numerous ways. Firstly, increased mobility correlates with a lower risk of social exclusion, which has strong ties to well-being [19]. Additionally, Vella-Brodrick and Stanley found that transportation enhanced well-being by satisfying human needs such as environmental mastery and social interaction [20]. Equally notable are the variations in negative affect dependent on mode use. Active commuters are less likely to report a commute as being stressful [21]. Drivers, on the other hand, are the most likely to report feeling stressed.



cc Garry Knight

Similarly, particular stressors vary by transport mode, which could carry over into other life domains. Driving is consistently found to be the most stressful mode, chiefly because drivers must budget considerable buffer times to deal with unexpected delays; the mean buffer time is 21 minutes [22].

Promoting mental and emotional health relates fundamentally to enabling the type of favorable environmental conditions that allow people to adopt and maintain healthy lifestyles [23]. The above findings highlight several indirect links between the quality of the transportation system and quality of life. This suggests that initiatives for improving transport systems should be considered as another critical component of enhancing well-being. Doing so will allow people to participate in and contribute to society, access resources, and interact with others.

Travel Behavior Pathology: Causes and Solutions

Transportation research has traditionally focused almost exclusively on objective indicators of mobility, such as travel time, safety, and physical access to transport. In this article, we argue that mobility provides a much broader value in terms of allowing people to enrich essential life dimensions and permit physical and psychological needs to be met. To illustrate, Susilo et al. [26] investigate travel satisfaction using five thematic categories that could assist urban and transportation planners with anticipating the needs of travelers. These categories (with an example subcategory) are: individual attributes (mobility behavior); attitudes (travel-related opinions); contextual variables (subjective well-being); foundational aspects of travel (past experience); and travel experience factors (travel time productivity). A

key finding from this research is that high levels of travel satisfaction tend to be positively correlated with multimodal environments; that is, a larger transport mode choice set allows travelers to experience variety and, thus, trips themselves are no longer construed merely as means to an end.

“a larger transport mode choice set allows travelers to experience variety and, thus, trips themselves are no longer construed merely as means to an end.”

Improving well-being should be the ultimate goal in transport policymaking, with measures related to accessibility and increased mobility as part of the designer's toolbox. From this frame of reference, the idea of "healthier cities" takes on a new meaning. Scholars from various disciplines view the city as an organism because of the immense number of complex elements whose interactions form a continuously-growing organic entity. Organisms, however, embody the struggle between preservation and ruin, a phenomenon that is perceptible throughout the natural world. One outcome arising from our desire to grasp this struggle is the field of pathology, originally defined as the causal study of disease. Pathologists investigate and determine possible threats to standard biological functioning through extensive medical diagnostics, in addition to devising solutions to counter the effects of such threats. Psychologists and sociologists have adopted this concept to study abnormalities in human behavior, often rooted in disrupted mental and emotional states. Pathological behaviors are historically popular topics in urban settings. Research from the Chicago School of Urbanism has argued that the vast collection of stimuli and the proximity to disparities in cities (due to high population density levels) could lead to unbearable cognitive tension and potential overload. With the increasing recognition that cognitive and psychosocial factors are essential for groundbreaking transportation research, a similar paradigm is necessary for studying the interaction between well-being and transport policy.

“Improving well-being should be the ultimate goal in transport policymaking.”

Therefore, we propose that researchers and policymakers should collaborate to rigorously define and develop the concept of travel behavior pathology for the urban traveler. This would allow for the creation of both (1) specific analytical tools to help identify transportation problems that pose a threat to any aspect of well-being and (2) treatment procedures to effectively build proactive and reactive solutions for avoiding, shifting, or improving particular behaviors. Accordingly, we recognize the need to advance causal models and frameworks in developing a "happiness threshold" in order to make sense of the dynamic forces that constitute the urban landscape.

SECTION HIGHLIGHT: Sweden



<https://www.takvandring.com/wp-content/uploads/2014/03/C.jpg>

Pictured here is an example of *takvandring*, an extension of the “walkable cities” concept in which travelers traverse the rooftops of buildings in Stockholm, the capital of Sweden.

Significant progress in incorporating well-being concepts with transport policy can be found in Sweden, which is recognized for its comprehensive and human-oriented planning practices. For example, research based out of Karlstad University has examined the role of subjective well-being (SWB) as a fundamental principle in travel behavior modeling.

Ettema et al. [24] outline the important distinction between the anticipated overall benefit of a decision and the actual benefit experienced as a result of the decision made. While traditional models inherently capture the former, they perform poorly in encapsulating the latter. Hence the use of SWB in the analysis of travel behavior offers hope for gaining deeper insights that could improve travel demand forecasts and policymaking practices. It consists of a cognitive component that is associated with life satisfaction and goal-directed behavior enabled by travel, in addition to an affective component that consists of both positive and negative emotional factors (since they are not direct antitheses of one another). As demonstrated in Ettema et al. [25], the construction of rigorous measures for SWB is a hot research topic, and this is not restricted to the field of transportation.

This, however, posits a great challenge, for it is extremely difficult to tease out directional causality in any research design. An example of this is found in Widener and Hatzopoulou [27], which provides a proof of concept regarding the impact of various transportation factors on personal health, including the effects of infrastructure on travel behavior. Given the limitations in our collective knowledge and awareness, it is clear that the time is ripe to consider the inclusion of well-being, in addition to traditional aims and indicators. Ideally, this will result in a unified front to plan, design, and construct transportation systems that generate happy and healthy mobilities, for both individuals and communities. As a result, these

efforts would make a meritorious contribution to the shift towards environmentally-friendly and socially-equitable cities.

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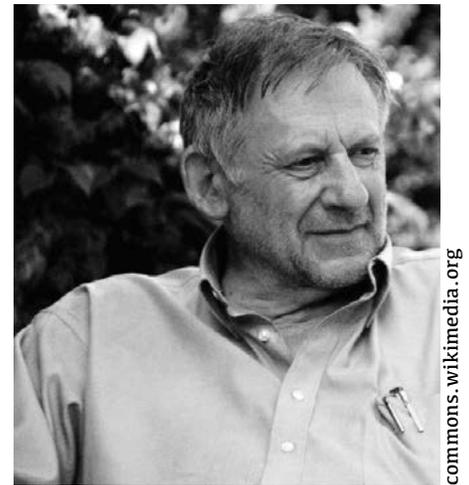
REVIEW: A City is not a Tree, Christopher Alexander

Claire Vernon

A City is not a Tree, an essay by Christopher Alexander, is a concise yet critical look into the social and structural overlap of communities that continues to be relevant to city design over 50 years after its publication. Alexander argues that patterns of overlap in both social and built structures are natural, essential, healthy components of communities. In this review, editor Claire Vernon muses about the relevance of Alexander's ideas to Chicago's structure.

THE ESSAY AND ITS AUTHOR

A City is not a Tree, an essay published in 1965, is a concise yet critical look into the social and structural overlap of communities. The author, Christopher Alexander, is a Professor Emeritus of Architecture at the University of California, Berkeley. Over the course of his career Alexander has contributed thought-provoking ideas and many buildings to the architectural field, and his critical awareness of pattern and logic heavily influenced computer science and computer languages. Alexander argues that patterns of overlap in both social and built structures are essential, healthy components of communities. When natural social overlap is ignored in our built design, we push communities towards dissociation and isolation.



Christopher Alexander

STRUCTURES: TREE VS. SEMI-LATTICE

Alexander's essay examines connectivity in human social interactions and in deliberately designed, physical elements of cities. He insightfully describes what he calls the Tree structure of designed construction and the Semi-Lattice structure of social interactions, offering rich examples that allow his readers to access and apply his thesis. A Semi-Lattice pattern of connectivity recognizes all elements of overlap, both complete overlap and partial overlap. Two coinciding elements within a Semi-Lattice set do not have to be disjoint from the same set of other elements. This contrasts with the Tree structure of the title, where the items within the Tree either overlap completely or not at all.

“building ourselves into a Tree structure forces unnatural separation of normally intertwined aspects of life”

Visual depictions of Semi-Lattice and Tree structures are shown in Figure 1. Alexander argues that building ourselves into a Tree structure forces unnatural separation of normally intertwined aspects of life. Despite our lives and communities being foundationally connected in a Semi-Lattice structure of complex relationships, we build the physical aspects of our home cities as simple, well-organized Trees.

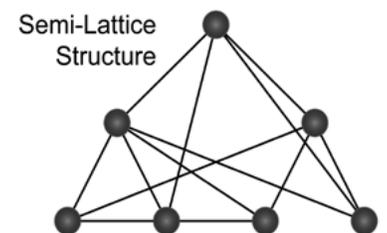
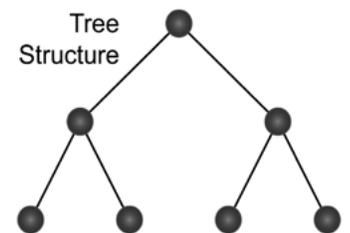


Figure 1. Tree and Semi-lattice structures

THE CHICAGO TREE

As Alexander delved into Tree-example city plans, the maps conjured the image of Chicago's El Train map in my mind. The CTA train lines form a very simple Tree, with the downtown Loop serving as the central "common element" for the city and each line reaching out to one set of neighborhoods. The **Brown** and **Red** Lines connect the Loop to the north neighborhoods and to the **Yellow** and **Purple** Lines in the nearest north suburbs. The **Green** and **Red** Lines connect neighborhoods south of the Loop to downtown but do not connect southern suburbs. The **Blue**, **Green**, and **Pink** Lines serve neighborhoods west from the Loop, and each extends into the very near west suburbs. The **Orange** and **Blue** Lines run through the Southwest and Northwest segments of the city, respectively, and connect the two major airports to the Loop and the public transit system. From each of these neighborhoods, a person is easily connected to other neighborhoods along "their" line, but in most cases they must travel to the city center Loop/Downtown in order to access neighborhoods served by a different line.

As visualized by both the CTA map and my own structural rendition of the train lines, the city trains tell the connectedness of both neighborhoods and city regions to the business center—the Loop/Downtown. The north slice of city connects to the Downtown with 35 city and 10 suburban stations; by contrast, the south connects with 21 city and no suburban stations. To the west, 30 city stations and 8 suburban stations link people to the Loop. The diagonally radiating Orange and Blue train lines tell a similar story of disproportionate connections: 6 neighborhood stations to the southwest and 10 stations to the northwest over an equivalent distance west, 7 and 16 total stations to the southwest and northwest, respectively. Chicago's public transport trains form a tree, and its branches are not all equally leafy.

TREE-STRUCTURE AND RESTRICTED MOBILITY

Each residential region of the city can access the downtown via public transport, with ease of movement depending primarily on the density of stations near one's home. Accessing residential areas served by a different train line, however, requires multi-leg trips involving complications like multiple train lines, train-bus transfers, and extended walking or biking—a solid time investment. Another option is to drive, which assumes that one has access to a car and can find or pay for parking, both near their home and near their destination. Driving longer distances presents a similar travel challenge to the public transport train lines, as the

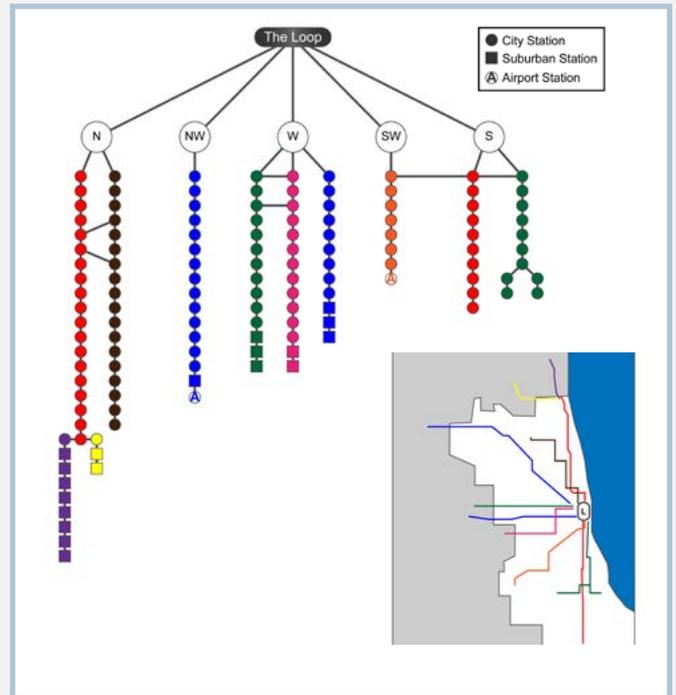
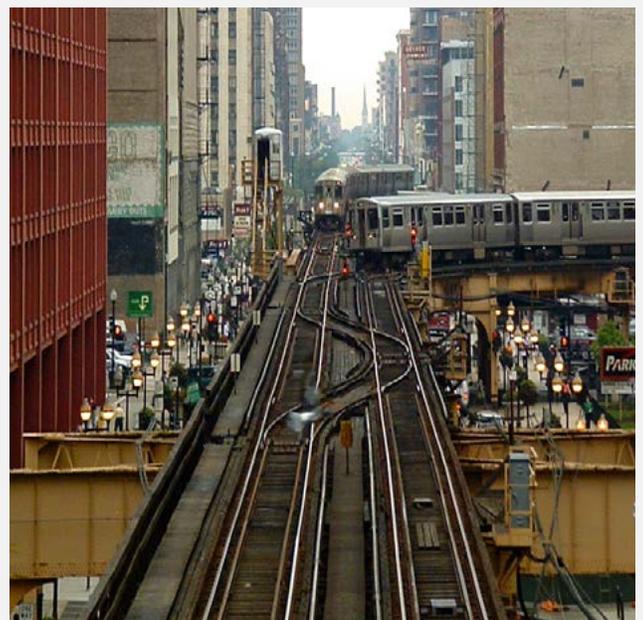


Figure 2. Schematics of CTA map, Claire Vernon

“The CTA train lines form a very simple Tree, with the downtown Loop serving as the central ‘common element’ for the city and each line reaching out to one set of neighborhoods.”



The El tracks



the interstates and highways connecting the City of Chicago to its greater suburban region echo the structure of the El trains—radiating outwards from the Loop in Tree-like fashion. This reductionist view of connections becomes more complex when we consider both local streets and the bus lines running along them, but these connections serve adjacent and within-neighborhood mobility more so than inter-neighborhood mobility. As a larger city, Chicago’s physical connections form a tree. The most mobile we can be is if we live, work, and play along a single branch, a structure that separates us from those people living, working, and playing along the other branches.

Public transport in Chicago bridges essential elements of people’s lives: residential neighborhoods; the business-center downtown; recreational lakefront, park, and museum locations; medical centers; transport hubs like airports, bus stations, and regional train stations. Even disregarding the limitations implicit in a Tree-structure, the south side of the city pales in comparison to the connectedness of the west side and especially the north side. Chicago continues to be one of the most segregated cities in the U.S. [1] , and the Census Dot Map compiled by the Cooper Center [2] shows that much of this segregation aligns to racially homogenous “pizza slices” of city that radiate outward from the Downtown. The unequal distribution of El Train access points further restricts Chicagoans’ mobility when the neighborhood they call home lies along these more bare branches. We would be blind to ignore the intersections of restricted physical mobility with racial segregation and restricted class mobility.

Major components of our mobility infrastructure like train lines, train stations, interstates, and local highways are not easy to change and such an endeavor would certainly be expensive. Additionally, Alexander notes that the Semi-Lattice of social connections in our lives is a fluid, natural reality, and it cannot be forced. This presents an additional challenge to those who aim to combat the social separation, segregation, and dissociation resulting from Tree infrastructure in cities. Simply increasing stations and installing lines of travel in a grid-lattice does not intelligently connect the essential components of people’s lives and communities.

CONCLUSION

So what are we to do? The answer is not simple. Alexander concludes that no modern cities have succeeded in building themselves a Semi-Lattice, though the people within them likely force social Semi-Lattices into existence in their interpersonal interactions and daily routines. Over 50 years later Alexander’s essay remains relevant, and his subsequent career has been devoted to describing observable patterns in life and applying these patterns to architecture and infrastructure. While he argues that the human mind so strongly desires the order and simplicity of Tree structures that we seem incapable of designing a Semi-Lattice, he still advocates that we consider foremost the lives of the people who will live in our built structures. Each day around the world new cities are built and established cities are remodeled. Each time we build around ourselves we have a new opportunity to reflect Alexander’s Semi-Lattice in our cities.

**“We must align
our homes with our
lives.”**

Perhaps we build and renovate our streets with room for bikes to fluidly share these pathways with cars, buses, and taxis. Perhaps we consider pedestrian traffic when organizing neighborhoods and thoroughfares. Perhaps we promote the co-existence of residence and business. The physical organization of these connections dictates which connections are strongest, regardless of the organization that we desire or intend. Whatever the answer to our Tree-structure problem, we must actively choose to build physical connections where there are social connections, rather than building physical connections because they are neat and tidy. We must align our homes with our lives. Not doing so allows the city’s physical connections to sever our lives’ natural connections and as Alexander says: “If we make cities which are trees, they will cut our lives within to pieces.”

Claire Vernon is a PhD candidate in the NU DGP studying neuroscience. Her public health interests include women’s health, mental health, and health disparities.

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FOCUS PIECE

Innovations in Auto Racing Safety to Reduce Head/Neck Injuries

A public health perspective

Lindsey Karavites, MD

The most common cause of fatal injury and long term disability in auto-racing are repeated head injuries [1]. In 2010, the Centers for Disease Control and Prevention estimated that traumatic brain injuries (TBIs) accounted for approximately 2.5 million emergency department visits in the United States either as an isolated injury or in combination with other injuries. Among those individuals who presented for care, approximately 2% died [2]. TBI is most often caused by motor vehicle crashes, sports injuries, or simple falls. Types of head and neck injuries include concussion, skull fracture (basilar skull fracture without penetration of helmet by foreign body), vascular shearing, diffuse axonal injury, other TBI, and spinal injuries. The likelihood of injuries such as TBI is significantly increased in competitive motor vehicle racing, such as in Formula 1(F1), and consequently significant resources have been committed to design improvements that reduce the incidence and severity of injury during competitive racing. Understanding design innovations in competitive racing is invaluable as they form the catalyst, framework, and experimental sandbox for mass market auto safety innovations.



Formula 1 Racing (F1) ;
cc Jose Vivancos

A Brief History of Auto-Racing Safety

Since the inaugural auto race of the 1950s, head and neck trauma remains the single greatest injury risk to drivers due to gravitational force loading in open wheel/open cockpit racing [7]. Fortunately, significant decreases in the overall rate of injury have occurred over the past 25 years. In the early days of F1 during the 1960's, one in eight crashes resulted in a fatality [7]. According to F1 record, safety at the time was merely in the form of a warning sign: "risk of serious or fatal injury". Over time, crash investigation lead to an increase in awareness and focus in research to prevent future fatal injury.

As early as the 1940s, researchers at Wayne State University began studying an animal model to relate external load with brain injury

Driver deaths in crashes - F1 alone:



1950-1960: 30
1961-1970: 24
1971-1980: 13
1981-1990: 7
1991-2000: 4
2001-present: 1

to gain insight into the mechanism for which the brain becomes injured in sports and/or motor vehicle crashes [3,4]. Research resulted in an array of safety measures in the form of car design modification, environmental or circuit changes, and driver technology. Perhaps most importantly, crash investigation and research lead to significant regulatory changes in organizational policy with implications for the field of public health.

Policy interventions for driver safety began in 1963 with the mandate of the helmet in all F1 sanctioned races. The helmet was originally made of animal skin and open-faced, but later developed into a hard outer shell meant to ward off external forces combined with a soft inner padding to cushion blows. Unfortunately, since policy intervention, drivers have complained of helmet weight, restricted motion, slower speed due to absence of aerodynamic design, neck fatigue, poor visibility, poor ventilation and difficulty with removal, particularly if unconscious. Due to many of these problems, some race drivers refused to wear the protective gear until a mandate was passed. Over time the design of the helmet evolved based on evidence from both real raceway tragedies and laboratory studies on cadaver/manikin models [8].

The use of manikin models as a substitute for human models has also stirred debate recently. The Snell Memorial Foundation (SMF), a non-profit organization that provides the majority of data for F1 helmet gold standards publishes a report every five years known as the “Protective Headgear for Use with Motorcycles and Other Motor Vehicles” [9]. This report defines the new standard for which F1, among other divisions, uses to make helmet regulations. Yet, the report is based on testing performed on manikin heads and “helmet testing does not seek to precisely reproduce real life situations...it does not include responses of the neck or body as they react with the head to impact” [9]. Thus given that the SMF is the most advanced source of helmet data in the world, there is clearly an urgent need to redefine the testing technology standard to realistically simulate the brain’s response high-speed impact or rotational motion.

In 2004, Olvey and colleagues conducted a pilot study to investigate the use of a new technology to study TBI. The researchers used micro-accelerometers in the ear-buds of all drivers across multiple leagues in a single race season [10]. The study showed that the device could capture precise and reliable data without being dislodged in any of the 1500 crashes observed [10]. Unfortunately, this study has not been transformed into a suitable model for testing the impact of rotational forces on the live human brain, thus the true human tolerance to brain injury has yet to be established [11].

Looking Forward

A crucial question for health care and design enthusiasts, is how can we more effectively leverage the rich environment of competitive auto racing to learn and improve the automobile driving experience.



Development since the 1960s

Types of Injuries

- Concussion
- Whiplash/neck sprain
- Skull Fracture
- Basilar Skull Fracture
- Vascular Shearing
- Diffuse Axonal Injury
- Other TBI
- Cervical spine



Formula 1; cc Christian Sinclair

INJURY PREVENTION

- 1950:** No regulations—*dress code directed toward “elegance”; no medical backup*
- 1960:** first ever safety measure introduced (*disk brakes—shortened braking distance as on every street car now*)
- 1961:** roll-bar
- 1963:** Helmets (*open/leather-invented 1954/Flags/Fireproof suit/FIA*)
- 1970:** circuit inspection/safety
- 1977:** standard helmet
- 1978:** drivers must have super license
- 1984:** fuel tank between driver & engine
- 1985:** initial crash tests for frontal impact
- 1990:** detachable steering wheel
- 1992:** official safety car
- 1999:** wheels must be tethered to chassis (*NASCAR still does not enforce*)
- 2000:** carbon fiber wall of cockpit expanded
- 2004:** new helmet standard
- 2009:** Video analysis improved—**incident report with video evidence must be published**

First, as recommended by Orvey and colleagues, all F1 drivers should be required to use the micro-accelerometer attachment in live racing and during practice laps to gather precise data on the forces placed on the brain during high speed collisions. If effected the F1 division alone would provide sample size of sixty drivers per year. The sample is ideal, as the drivers are already willing participants in an extremely high-risk activity and are already aware that high-speed crashes may be fatal or cause TBI. Data from the micro-accelerometers can be combined with live footage from both car video surveillance and from brain imaging scans performed post-collision to further reduce the numbers of head/neck injuries through awareness and prevention strategies. Further, it can be applied globally to sports related head injuries. Understanding of biomechanics of TBI as a result of high-speed crashes will allow us to evaluate this mechanism of injury to the fullest extent of our technological resources. This information should be published for open educational access, be used to create a novel helmet design for the next Snell revision and for widespread application to other at risk populations. An additional, quick and far less labor-intensive intervention, involves policy change to include existing prevention strategies with known advantages.

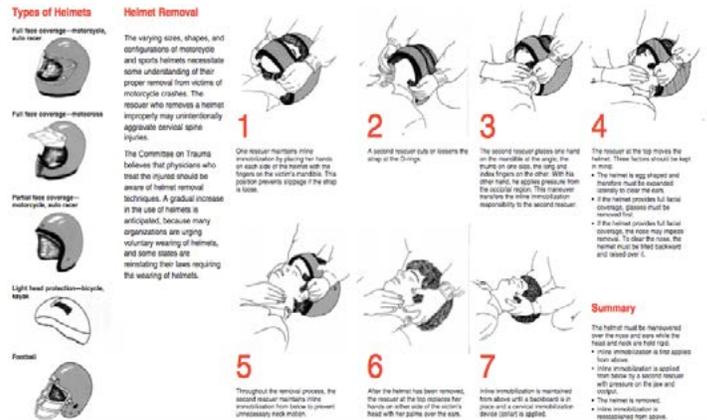
Second, there should be enforced policy requirements in place requiring the use of Eject Helmet Removal Systems (EHRS). The 2015 Snell report on helmet removability states that a helmet must be able to be removed by a single technician from an unconscious victim using simple common hand tools in no more than 30 seconds [9]. Any form of monitoring is not mentioned and Eject helmet removal systems are not included. Since the 1980s, it was accepted as common knowledge that removing an already tight-fitting helmet from an unconscious victim with injury related edema is a dangerous practice capable of worsening existing injuries or creating new, potentially fatal impairments. Despite limited data, the EHRS has been hailed as the preferred method for helmet removal in motorsports by the multiple societies such as the International Racing League, the American Speed Association, and the American Medical Association [12].

Although unbiased data should be collected from independent studies, enough evidence is present to demonstrate potential clinical benefit of the device. Even though it was made compulsory as early as 2010 in some race leagues, such requirements are not in the standard by-laws for racing helmet design [8,9].

Helmet Removal from Injured Patients

By Thomas E. McQueen, Jr., MD, FACS, and Richard J. Owens, MD, FACS
American College of Surgeons
Committee on Trauma
April 1997

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Altering language in the SMF policy to include EHRS in the design of all helmets will encourage leagues to enforce the rules and drivers refusing to comply will not be allowed to race.

In Conclusion

What was once known as a sport where drivers had a fate as certain as death has now experienced only a one loss in the past 15 years as a direct result of safety measures. The collaboration between public health officials, physicians, research scientists, and innovators with a deep understanding of injury mechanism and preventive strategies has helped to build not only a safer sport, but also a safer environment for everyone. Micro-accelerometers and the EHRS have added to the extensive list of technological advancements, environmental/circuit changes, car design modifications, driver regulations and policy standard regulations that have altered the identity of the sport of auto-racing. Understanding the advancements in auto racing is no longer just for the professional racer, design enthusiast, or sports fan. A closer study of advancements, methods, and trends in professional auto racing can provide insight into new strategies to improve automobile safety beyond the race track and thereby improve mass transport safety.

Lindsey Karavites, MD is a general surgeon in residence at Sinai Health System and holds a Master's degree in Epidemiology from Northwestern, Feinberg School of Medicine.

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The Northwestern Public Health Review (nphr.org) was founded in 2013 by Osefame Ewaleifoh and Celeste Mallama, two public health students at Northwestern University. The mission of the NPHR is to stimulate the exchange and cross-pollination of public health ideas, resources and opportunities across the Northwestern community and beyond. Through multiple channels, the student-run NPHR offers opportunities for learning and reporting on public health issues.

