Simulating Equity

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Simulating Equity

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Simulating Equity

Systems of injustice are preserved through patterns of individual action within the context of a policy environment. School segregation is one of those systems that is created and maintained through residential choices and school choices that separate people by class and race. Challenging the normalization of these problematic actions requires a fundamental shift in viewpoints and values. My work uses an interactive simulation to challenge the acceptance of actions that maintain the status quo by revealing consequences of user choice on the community and facilitating the imagining of alternate futures.
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Mr. Banksters and Shmoo for providing adorable distractions.

For Carl and Sonya LaMarr
Protest march against the segregation of U.S. schools from National Archives, via Wikimedia Commons.
Introduction

How do we challenge inequity in society? We may first think of strikes or marches but protest and political action does not just come in the form of mass demonstration. Every day, we make decisions within and influenced by constructed systems of society. These could be physical things like public transportation or they could be intangible like the tax code but they all influence our set of options and the structure aligns with a set of value judgments. For example, funding and maintaining robust public transportation values environmental behavior while a lower tax rate for dividends rewards the financial ability to invest in the stock market. Sometimes the values built into the system create inequity. Correcting inequity requires changes to the policy as well as changes to the individual behaviors.

Our everyday actions can be a form of protest. Every choice we make either challenges the problematic aspects of the status quo or maintains those aspects. Policy efforts to correct systemic inequities often face barriers from those benefiting from the status quo. In the case of school segregation, most, if not all, policy efforts to counteract school segregation have been met with significant opposition from white families unwilling to send their kids to integrated schools, due to racism or stereotypical associations with poor quality. In many cases where policy was enacted despite opposition, those families either moved to suburban neighborhoods or left the public school system entirely, removing resources from the schools and creating the poor quality that those parents feared. The failure of policy efforts to anticipate and address that potential outcome has left public schools more segregated and with fewer options ultimately resulting in the abandonment of the issue.

As I explored the school segregation topic, I realized that this is an issue we as a society have created, allowed, and maintained for a long time. Through research and reflecting on my own experience, I saw how, despite public awareness of the existence of segregation, there was an unwillingness to change the behaviors that promote it. So, instead of working to “reveal” patterns of segregation through visualization, I decided to do something different. In this thesis I explore how interactive simulation can be used to engage the public and support the process of public opinion and political behavior change. By showing how different scenarios affect the viewer personally and the community collectively, there is opportunity for an intervention that can help to do the necessary work of shifting viewpoints and value assumptions.

A note about the audience for this thesis: Too often we put the brunt of challenging unequal systems on the backs of those most burdened by the system rather than those who are benefiting from it and creating it. This thesis is targeted towards those who benefit from the status quo, those who have the resources to make choices. While we claim to value freedom of choice in this country, many do not have that luxury and do not deserve to be blamed for an inability to move the barriers that are put in their paths.
Identifying “Wicked” Policy Problems

In the wake of protests from the civil rights movement, the student movement, the women’s movement and anti-Vietnam mass protesters in the 1960s, Horst Rittel and Melvin Webber recognized that the traditional way of addressing social problems had failed the public (Rittel and Webber 1973). They argued that the efficiency test method was not the right approach. This problem-solving strategy, widely regarded in the fields of science and economics and gaining popularity with policymakers, was focused on getting the best result for the least effort. Efficiency tests work quite well for “tame” problems, those that have a clear definition and provably right solution such as selecting a building material. However, these approaches to problem solving have shown to be inadequate for the types of social problems that policymakers face. Rittel and Webber’s revolutionary idea was to create a new category of problem — one that many social problems fall into. They called them “wicked” problems.

Wicked problems have the following characteristics:

- The problem definition depends on the solution
- There is no stopping rule
- Solutions are not true or false but better or worse
- There is no test for the full consequences of any solution
- Every solution is a ‘one-shot operation’
- There are an infinite number of potential solutions
- Every wicked problem is unique
- Each problem can be considered a symptom of another problem
- The problem can be explained in numerous ways

Additionally, elements of “super wicked” problems, developed by a group of researchers focused on climate change, are relevant to complex issues of social inequity (Levin et al. 2012). In addition to the characteristics of wicked problems above, these include the following four elements:

- Time is running out
- Those who cause the problem also seek to provide a solution
- The central authority needed to address it is weak or non-existent
- Policy responses discount the future irrationally

These problems such as climate change or the refugee crisis cannot be solved through a simple cost-benefit analysis so how do we solve them? Some of the most difficult problems we face stem from the growing gap between class and race. The interconnected nature of our socio-economic political systems means that changes in one area affects multiple other unforeseen areas which could include housing inequity, policing and the criminal justice system, access to credit, unequal employment opportunities, education inequity. All of these things and more contribute to the problem of race and class inequality.
Segregation as an Underlying Problem

“It is necessary to dismantle the mechanisms that perpetuate unjust social inequality in order to realize the promise of a democratic state, one that is equally responsive to all citizens. The persistence of systematic group inequalities along race, ethnic, class, and gender lines occurs when certain groups have greater access to desirable, necessary, but scarce resources that range from quality education to political power. Segregation is essential to the perpetuation of privilege through the norms and structures of spatial separation among groups, and subsequent stratification that ensures that where contact occurs, it is on terms of domination and subordination. Integration negates segregation by comprehensively restructuring intergroup associations on the basis of equality, inclusion, and full participation in all dimensions of public life, but especially in education, the economy, and politics. Multiethnic democratic nation-states across the globe increasingly turn to education as the catalyst necessary (though not sufficient) to set in motion the dynamics that foster a cohesive society”

Political philosopher Elizabeth Anderson (Mickelson and Nkomo 2012)

Race and class segregation exists in all aspects of life from our neighborhoods, to our schools, to our workplaces. Research has shown that patterns of segregation and isolation perpetuate and exacerbate race and class gaps. Segregation is a phenomenon created through collective behaviors that separate groups. This behavior is learned early in life — in our schools. In this thesis, I focus on school segregation as an underlying cause for race and class inequity.

We are increasingly living in a pluralistic society with black and Latino communities becoming a growing part of the population. The dramatically lower “economic mobility and wealth accumulation for those households will increasingly reflect America’s aggregate economic and social vitality” (J. H. Carr and Kutty 2008). The levels of wealth inequality we see today, with the top the top 1% owning 34% of the nation’s wealth and the richest groups receiving the greatest share of income growth in the past several decades, is simply not sustainable.

**Figure 1.** Household incomes and wealth are growing strongly only at the top (J. H. Carr and Kutty 2008)
The achievement gap has been cited as the problem leading to educational and employment gaps between whites and minorities (Cohen 2015; Tavernise 2012; Brownstein 2016). Education policymakers have used market-based problem-solving methods appropriate for “tame” problems to tackle this gap such as tying student performance to funding, calls to change parenting styles, and improving teacher efficiency (Darling-Hammond 2014; Snow 2001; Haycock 2001; Mathewson 2017). Through these methods, we have seen an emphasis on testing and blaming the individuals involved rather than on genuine efforts to end segregation in schools. These solutions have not worked, in fact, they have been widely reported as failures (Freedberg 2015; R. Mickelson et al. 2011).

Testing was not the only failed strategy. In an investigation of Chicago school reform, researchers found that improvements to school program curricula, teacher-principal collaboration, and parent involvement can increase progress but these changes have no impact on schools dealing with concentrated poverty. These schools present a wicked problem for which a tame solution will be ineffective. They concluded that “our findings about schooling in truly disadvantaged communities offer a sobering antidote to a heady political rhetoric arguing that all schools can be improved” (Rothstein 2013). It seems that something else is causing this gap, making it another symptom to a deeper problem. Race and class school segregation is the real problem.

**FIGURE 2.** Recreated Model of the Influences of School Desegregation on African Americans
(Braddock and Eitle 2004)
Desegregation has positive benefits for student academic achievement and long-term life outcomes are positive as shown in Figure 2 (Braddock and Eitle 2004). This is especially true when the integrated school experience occurs early in life in elementary school (Mickelson 2015). In addition to positive benefits for minorities, desegregation also has positive benefits for the community as a whole. The Urban Institute found that higher levels of economic and racial segregation are associated with lower median income for blacks, lower levels of college degree attainment for both blacks and whites, lower life expectancies for all, and higher homicide rates (Acs et al. 2017).

**TABLE 1.** Short- and Long-Term Academic and Nonacademic Outcomes of School Integration (Mickelson and Nkomo 2012)

<table>
<thead>
<tr>
<th>Short-Term</th>
<th>Long-Term</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academic</strong></td>
<td>Test scores, grades, high school graduation, educational aspirations</td>
</tr>
<tr>
<td><strong>Nonacademic</strong></td>
<td>Cross-race peers, multicultural navigation, reduction in racial fears</td>
</tr>
</tbody>
</table>

Academic researchers on education, Roslyn Arlin Mickelson and Mokubung Nkomo, write that social cohesion, “the integration of the individual and the group” which comes from “collective individual attitudes and behaviors” is necessary for society to function (Mickelson and Nkomo 2012). This cohesion, however, is not possible as the richest households have used their wealth to separate themselves into wealthy enclaves, effectively concentrating and multiplying wealth among themselves and removing the possibility of shared social experience. The authors suggest that schools play a critical role in “preparing a society’s children for their adult responsibilities as workers, parents, friends, neighbors, and citizens” (Mickelson and Nkomo 2012). They continue to cite philosopher Martha Nussbaum who argued that “diversity is necessary for adequately educating youth to be citizens of the complex, interlocking world in which they exist.” Nussbaum contends that by excluding certain students, their life experiences “are also excluded from the domain of knowledge” (Mickelson and Nkomo 2012). Integrated schooling has short-term and long-term effects on academic and nonacademic areas of development which are listed in Table 1. The segregation of our nation’s schools has exacerbated the race and class inequality and integration will be necessary to solve that problem.
Solving Wicked Problems through Double-Loop Learning

School desegregation policies have consistently been challenged and avoided. In order to have success with these policies, we need to generate behavior change and compliance from those currently benefiting from the status quo. This will require a shift in viewpoint and values, which can be likened to business theorist and “Thought Leader” Chris Argyris’ work teaching business managers to solve problems by engaging in double-loop learning (Argyris 2003).

“Single-loop learning occurs when a mismatch is detected and corrected without changing the underlying values and status quo that govern the behaviors. Double-loop learning occurs when a mismatch is detected and corrected by first changing the underlying values and other features of the status quo. Single-loop learning remains within the accepted routines. Double-loop learning requires that new routines be created that were based on a different conception of the universe.”

Argyris found that managers typically looked to “[identify] and [correct] errors in the external environment” (Argyris 1991). While this, can work for tame problems, it does not go far enough for wicked problems of a complex systemic nature such as school segregation. In order to achieve true organizational change, Argyris proposed that managers needed to “reflect critically on their own behavior, identify the ways they often inadvertently contribute to the organization’s problems and then change how they act.” He then goes on to say that “in particular, they must learn how the very way they go about defining and solving problems can be a source of problems in its own right” (Argyris 1991).

In order to achieve double-loop, we have to shift our assumptions and be willing to redefine the problem. The ability to do this depends on an embrace of vulnerability by allowing openness to ourselves and to others. Instead of reacting in a defensive manner, we have to be open to the possibility that our actions are contributing to the problem.

If we apply double-loop learning to school segregation then one starting point for behavior change could be redefining the goals of education. The first assumption is that one need only consider the educational success of their own child. The second assumption is that a diverse education is ideal but “quality” defined in terms of test scores is the highest priority. What if we were to shift those assumptions? What if the goal were to make education decisions in a way that emphasized the pluralistic nature of society? If we valued experiences and critical thinking over competition to have perfect test scores? What if education weren’t viewed as a competition for the individual success of our own child but rather the community’s collective success? After all, that community is one in which our children will ultimately have to live.
Imagining the Future: A Space for Visualization Solutions

Climate change is a classic example of a wicked problem. Communication on this issue is difficult because the effects are slow to appear and often go unnoticed in daily life. When trying to communicate public complicity in the problem, advocates found success engaging with the public through interactive simulations. Researchers at Indiana University developed an interactive simulation tool they called the Institutional Analysis and Development (IAD) framework which they found could help them to “understand the preferences that will make or break policy goals while also informing the public about the need to change the status quo” (J. Carr and Never 2013).

In another example, interactive educational game Future Delta was developed by the Collaborative for Advanced Landscape Planning (CALP), Centre for Culture and Technology, educators, students and other community partners. This game allows the user to test different approaches to solving the problem of climate change using visualization and simulation to show the results of those alternate future scenarios (Schroth et al. 2014). The game’s introduction reads “The year is 2100 and you live in a dystopic future where the City of Delta has failed to address climate change adequately — it has been affected by sea-level rise, storm surges, heat waves, & fires, and communities are facing food shortages, high-prices, increased traffic and pollution. Travel back in time to present day and see if you have what it takes to change the future...for better or for worse” (Collaborative for Advanced Landscape Planning (CALP) and Centre for Culture and Technology 2014). Reaction to this game showed that the imagery was effective in shifting opinion toward more local responsibility. In a final example, Stephen Sheppard analyzed the “potential of visual communication to accelerate social learning and motivate implementation of the substantial policy, technological, and life-style changes needed” in relation to climate change. He found that realistic landscape visualizations were an effective way to make the effects of climate change more real for the viewer (Sheppard 2005).

What climate change researchers discovered was that interactive simulation, unlike other forms of communication, allows the user to envision alternate futures and to understand how his or her actions contribute positively or negatively. This imagining of something new by looking at the world differently is engaging in the process of utopianism. As Marxist philosopher Ernst Bloch defines utopianism, this is the process of “[redefining] problems and tasks” (Anderson 2006). This means rejecting the status quo and turning toward the “not-yet.” There is an opportunity to use interactive visualizations and simulation, as was done for climate change, to reveal complicity in an unjust school system and to facilitate the vision of what the system could be.
**Case Study: Visualization for Double-Loop Learning around School Segregation**

In this thesis, I investigate the potential for interactive visualization and simulation to facilitate double-loop learning around problems of social inequity. Through this method, I hope to create more positive attitudes and behaviors towards acting in the collective social interest. I’ve focused my case study on school segregation and have created a simulation that allows the user to see how the system works against poorer minority children and how actions on the part of wealthier families and policy changes can make the system more equitable.

**MY PERSONAL CONNECTION TO CHICAGO**

I’ve limited my data for the simulation to Chicago elementary public schools because Chicago represents the extremes of both school and residential segregation and because of my own personal connection to the area. I grew up in a wealthy white Chicago suburb where my sister was the only other black student in my elementary school. My parents — influenced by their own parents who were educators — prioritized education above all else and they knew that the best schools were in the wealthiest areas. So, when it was time for us to begin school, they worked long hours almost every day, sacrificing along the way — digging into savings and neglecting retirement — to move us from our diverse neighborhood to an almost completely while neighborhood that was surrounded by good schools. Despite the confusion that came along with being different from everyone around us, my sister and I received wonderful educations that allowed us to go on to good colleges. As I got older, however, I realized just how rare my story was.

I grew frustrated and disappointed coming to terms with the fact that our education system is such that it is often only by managing to break into these wealthy white enclaves, leaving behind almost all other children who look like them that minority children are able to succeed. Increasingly, parents have to choose between a diverse community and a quality education. While I will always be grateful and in awe of the work and sacrifices that my parents made, I also recognize that they too participated in a system that rewards those with resources who isolate themselves, making decisions in their own individual interest. By choosing to live in an area that concentrates wealth, we were complicit in a system that necessarily concentrates poverty.

As I contemplate my future, I have to wonder what kind of world I want my kids to grow up in. This thesis project has given me the opportunity to think about how I want to raise my children and how my decisions will affect them, their values, and the other children in our community. Parents, as the ones raising the next generation, have a great deal of responsibility for what kind of future we will see. Will the future continue to have such extreme wealth and poverty or can our children, the leaders of the future, be brought up in diverse communities, value the rights of all, and create new communities that are inclusive and support the many instead of the few? These are the questions that drive my work and on which I hope to have a positive impact.
A LEGACY OF FAILURE IN CHICAGO PUBLIC SCHOOLS

In their report on deepening segregation, Orfield, Kucsera, and Hawley say that "Chicago is noteworthy for its extremely unequal schools and virtually no effort to offset the problems in one of the nation's most segregated states" (Orfield, Kucsera, and Siegel-Hawley 2012). Based on their research, Chicago has the third most segregated school system following New York and Los Angeles. In the larger metropolitan area, the black student percentage is 22.3. Of those black students, 71.8% are in 90-100% minority schools.

This concentration of minority students is a Chicago tradition that goes back for decades. In 1961, 160 black children were denied transfers from overcrowded black schools to nearby white schools with open classrooms. During the 1963-1964 school year, hundreds of thousands of students boycotted by staying out of school on various days. Protests focused attention on Superintendent Benjamin Willis. At the time, he had been compared to Alabama's segregationist governor George Wallace, who used the state police to stop integrated schools from opening and declared "segregation now, segregation tomorrow, segregation forever" (Moore 2016). Superintendent Willis kept black students in segregated, overcrowded schools in order to avoid integration with half empty white schools nearby by building mobile classrooms right in front of black schools. These classroom units came to be known as "Willis Wagons" (Karp and Vevea 2016).

Willis was supported in his efforts by the Chicago political machine. In 1967, the Department of Health, Education and Welfare (HEW) reported violations of the Civil Rights Act by Chicago Public Schools (CPS). HEW planned to defer $32 million in exchange for cooperation with desegregation. In response, mayor [Richard J.] Daley threatened to pull out support for federal education from the Chicago congressional delegation and Senate GOP leader Everett Dirksen, of Illinois. Under pressure, HEW backed down (Moore 2016). Willis' successor, James Redmond, tried to shift the tide by proposing a desegregation plan, which included busing of black students to white schools. White parents picketed, and the busing plan failed due to the city's fear of white flight from the city.

In another attempt to reverse school segregation in 1971, the Illinois State Superintendent of Public Instruction filed rules mandating that each school had to stay within 15 percent of the racial make-up of the school district. This was not implemented. In a further blow, the governor signed a bill in 1973 that prohibited mandatory busing to alleviate school segregation (Moore, 2016).

A 1979 report by the Illinois Advisory Committee to the U.S. Commission on Civil Rights said of CPS:

"The Chicago Public School officials often mention the impossibility of desegregating a school system with too few white pupils. They continue to attach responsibility for segregated schooling to residential patterns and housing preferences, occurring supposedly independent of government action. The Office for Civil Rights, HEW, has however documented ... a long history of actions and/or commissions by the Chicago Board of Education over the years that contributed to or caused segregation."
Rather than follow desegregation efforts pursued at the federal and state level, Chicago officials “dragged their feet and continually issued voluntary plans calculated to stymie rather than promote desegregation.” All of this has led to fewer white students and the clustering of those students into a small number of schools (Moore 2016).

Natalie Moore, author of *The South Side: A Portrait of Chicago and American Segregation* reflects, “today, no one talks about integration in CPS. In school reform debates, the topic is not in vogue. Integration has been replaced by charter schools and yearly standardized testing as the nation’s go-to strategies for improving education for black children. Soon I realized: Why would anyone talk about integration? Over the course of 50 years, the white population in CPS dropped from 50 percent in the early 1960s to 9 percent in 2014. While city demographic changes occur in many neighborhoods, Chicago remains diverse. White people live here but do not send their children to public schools.”

(Moore, 112)
THE NATION'S CAPITAL
A SYMBOL OF FREEDOM AND EQUALITY?

A NEGRO TRAVELING FROM NORTH TO SOUTH
MUST CHANGE TO JIM CROW TRAINS IN WASHINGTON, D.C.

NORTH
WASHINGTON, D.C.

IF HE DECIDES TO REMAIN IN D. C. OVERNIGHT HE WILL FIND THAT:

HE CANNOT EAT IN A DOWNTOWN RESTAURANT
HE CANNOT ATTEND A DOWNTOWN MOVIE OR PLAY.
HE CANNOT SLEEP IN A DOWNTOWN HOTEL.

IF HE DECIDES TO STAY IN D. C.
HE USUALLY MUST FIND A HOME IN AN OVERCROWDED, SUB-STANDARD, SEGREGATED AREA:

NEGRO-占 OCCUPIED DWELLINGS
40% SUBSTANDARD

WHITE-占 OCCUPIED DWELLINGS
12% SUBSTANDARD

HE MUST SEND HIS CHILDREN TO INFERIOR JIM CROW SCHOOLS:

WHITES
NEGROES
CAPACITY EXCEEDS ENROLLMENT BY 27%
ENROLLMENT EXCEEDS CAPACITY BY 8%

HE MUST ENTRUST HIS FAMILY'S HEALTH TO MEDICAL AGENCIES WHICH GIVE THEM INFERIOR SERVICES:

HOSPITALS IN THE DISTRICT OF COLUMBIA EITHER DO NOT ADMIT NEGROES OR ADMIT THEM ON A SEGREGATED BASIS

Civil Rights in the Nation’s Capital from The Report of the President’s Committee On Civil Rights
Context: Understanding & Visualizing Segregation

“It took much time and effort to create the pattern of segregation by class and race that we see around us today. It will take much time and effort to unravel it, if we wish to do so.”

Richard Rothstein, *For Public Schools, Segregation Then, Segregation Since: Education and the Unfinished March*
School segregation stems from Jim Crow laws of the late 1800s, which prohibited blacks from using the same facilities as whites, affecting employment, healthcare, housing, and education (Nittle 2018). Under these laws, segregation was law in the South, but unequal access was also common practice in the North. The Supreme Court upheld these laws in their *Plessy v. Ferguson* decision allowing for separate facilities, as long as they were equal in quality (Weingroff 2015). Despite protests by parents, the NAACP and the ACLU, this system legally remained in place until the *Plessy* decision was unanimously overturned in the unanimous 1954 *Brown v. Board of Education* Supreme Court ruling (Reardon et al. 2012).

In Topeka, Kansas in 1950, Rev. Oliver Brown tried to enroll his 7-year-old daughter Linda in the school four blocks from his home. He was told that Linda would not be allowed to attend the all-white school because of the color of her skin (Brown 2018). The following year, Rev. Brown headed a group of thirteen black parents and, together with the Topeka NAACP, sued the Board of Education calling for a reversal of the district’s segregation policy. The District Court ruled in favor of the Board of Education since the facilities for each were of equal quality. The case was brought to the Supreme Court. In their decision, the justices noted the negative effects that segregation had on black children and determined that *de jure* racial segregation violated the fourteenth amendment of equal protection. This was a major victory and set the groundwork for the Civil Rights Act of 1964 which led to school desegregation programs across the country.

Push back to these programs was strong. Several states resisted desegregation by doing nothing, opting to close schools entirely, or resorting to violence and protests (Klarman 2004). In order to avoid integration, many white parents moved their families from urban to suburban areas, which had whiter and wealthier schools. This trend, often referred to as “white flight” further exacerbated the already distinct pattern of residential segregation (Klarman 2004).

A series of legal decisions also set up roadblocks to the efficacy of desegregation programs. In *Milliken v. Bradley*, the Supreme Court determined that, despite the large racial imbalance in the Detroit-area schools due to white affluent families moving across city lines and leaving behind a 90% black student population, Detroit had to address the imbalance without crossing district lines. This ruling overturned the lower court’s decision which had said that district lines “are simply matters of political convenience and may not be used to deny constitutional rights,” replacing it with the viewpoint that school district lines are sacrosanct and must not be breached (EdBuild 2016). The 1991 *Board of Education of Oklahoma City v. Dowell* Supreme Court decision said that school districts could return to segregated neighborhood schools as long as they met certain conditions. The following year, in *Freeman v. Pitts*, the court made it easier to end desegregation orders even when elements of the order had not been completed. In 1995, the *Jenkins* Supreme Court decision determined that court-ordered programs to make segregated schools equal and to encourage voluntary desegregation were temporary and could be discontinued (Orfield, Kucsera, and Siegel-Hawley 2012).
Impacts of Residential and School Segregation

Rucker C. Johnson analyzed the impact of court-ordered school desegregation on adult outcomes for children born between 1945 and 1968. Johnson finds that black students in desegregated schools had higher educational attainments and adult earnings. Additionally, they were less likely to face incarceration or poor health. White students in these schools saw no effect higher or lower (Johnson 2011). Further research has shown that, while desegregation had no impact on the academic performance of white students, it did increase empathy and showed that diverse groups learn broader problem-solving skills (Kamenetz 2015). One reason parents avoid neighborhood public schools is based on concern that exposure to poorer children in school will lower their child’s achievement. Contrary to that belief, disadvantaged children do not bring the top students down but rather, high-achieving students bring the others up (Kozol 2012).

Desegregation can positively impact students through:

- Increase in school resources (per-pupil spending, class size, and teacher quality)
- Exposure to high-achieving and highly-motivated peers
- Higher parent, teacher, and community expectations

Johnson created two categories of students (Johnson 2011). Those who turned 17 in the first year of the desegregation court order in their school district were not affected by desegregation so he labels them “unexposed”. Those who turned 16 or younger during this time were “exposed.” For both of these groups, he considered the results individually for black and white students and compared results across exposed and unexposed.

The Dissimilarity Index

This is the most common way of measuring segregation. It measures the distribution of two groups. For the level of residential segregation in a city, the index compares the racial make-up of the neighborhoods against the racial make-up of the city. It can also be used to calculate the level of segregation in schools within the same school district.

If the distribution is exactly the same, meaning no segregation, the index is 0. In highly segregated areas, where each neighborhood consists of only one race, the index is 1.

This number can also be used to show how many individuals from one group would need to move in order to achieve 0 segregation. So, a number level of 0.45 would mean that 45% of residents would have to move to achieve a balanced city.

In the following formula:

\[
\frac{1}{2} \sum_{i=1}^{N} \left| \frac{b_i}{B} - \frac{w_i}{W} \right|
\]

\(b_i\) = the black population of the school/neighborhood
\(w_i\) = the white population of the school/neighborhood
\(B\) = the black population of the district/city
\(W\) = the white population of the district/city
He hypothesized that black students who were exposed longer, those who were youngest when the court order was established, would have the greatest benefit of desegregation. These children did not have to adjust socially as much as the older students, had increased learning at a younger age leading to improved learning at an older age, and were less likely to be placed into the further segregating tracking systems of the secondary schools.

Johnson’s analysis showed that there were significant reductions in school segregation districts under court order between 1968—72 (Johnson 2011). The dissimilarity index dropped 36%. For each year of exposure, black students gained a 0.1 increase in years of education. In his data, the gap between black and white students was one year which meant that integrated schools could close the black-white educational attainment gap in 12 years of education.

Court ordered desegregation increased adult earnings and occupational attainment while decreasing poverty. Each additional year of exposure adds a 2% increase in wages. These increases in income have larger community effects. Not only do we see an increase in the individual student’s future income, we also see an increase in other spousal income and an increase in the income of their children. Each year of exposure results in a 1.3% reduction in annual incidence of poverty. On average, after 5 years of exposure, there was a 25% increase in annual family income and an 11-percentage point decline in annual incidence of poverty (Johnson 2011).

School Readiness and Socioeconomic Differences

“Education, then, beyond all other devices of human origin, is the great equalizer of the conditions of men, — the balance-wheel of the social machinery.”

Horace Mann (Education 1849)

Today, education is playing catch-up as the outcomes of American children are increasingly being determined before they even enter kindergarten (Lahey 2014). On average, poorer children hear 30 million fewer words than their affluent peers. This has a direct impact on learning. This drought in heard words leads to a vocabulary that is half the size of affluent children by age three (Shankar 2014).

Even as early as 18 months of age, there is a noticeable difference in language processing skill. Researchers from Stanford University found that “toddlers from disadvantaged families are already several months behind more advantaged children in language proficiency” (Fernald, Marchman, and Weisleder 2013). By two years of age, this gap reflected a six-month difference between children from high-income families and those from low-income families. Researcher Fernald says, “what we're seeing here is the beginning of a developmental cascade, a growing disparity between kids that has enormous implications for their later educational success and career opportunities” (Fernald, Marchman, and Weisleder 2013). By the time children reach kindergarten they are showing a two-year difference in performance on standardized language development tests.
Julia B. Isaacs of the Center on Children and Families at the Brookings Institution analyzed data from The Early Childhood Longitudinal Study — Birth Cohort (ECLS-B) “which follows a nationally representative sample of children from birth (in 2001) through entry into kindergarten” (Isaacs 2012). She found that only 48% of poor children are school ready by five years old and that this measure increases to 75% for children from families with moderate or high income. This reflects a “27-percentage point gap in school readiness between poor children and those from moderate or high-income families.” The near poor category represents household income between 100% and 185% of poverty and the moderate or high-income category represents income above 185% of poverty. The ‘school ready’ classification is based on a measure that includes “early math and reading skills, learning-related and problem behaviors, and overall physical health … Children are rated as ‘school ready’ provided they do not score ‘very low’ on any of these underlying measures; ‘very low’ is defined here as poor/fair on health, and more than one standard deviation below average on the academic and behavioral measures” (Isaacs 2012).

Family household income affects access to resources like healthy meals high-quality child care and health care, and “enriched home environments” (Isaacs 2012). Additionally, the stress from living in poverty can negatively impact parent interactions with children on a
psychological level, from things like depression or anxiety. Income is also an indicator of a parent’s level of education. Isaacs found that “children’s early academic skills are higher, on average, when parents have more years of schooling, and this association persists even after controlling for parents’ inherent abilities” (Isaacs 2012).

This readiness gap has significant effects including success in grade school, graduation from high school, and adult earnings. “Entering school ready to learn can improve one’s chances of reaching middle class status by age 40 by about 8 percentage points” (Isaacs 2012).

Residential and school segregation concentrates children who are not school ready in the same schools, making it “more difficult to raise their achievement than when these children are integrated into the middle-class population” (Rothstein 2013). Concentrating low-performing students means that the pace of instruction has to slow down for everyone, rather than letting teachers work with struggling students individually. Overall, “children learn less from each other if few come from homes where large vocabularies and more complex language are used and where they were often read to when young.”

Residential Segregation

Since school districts typically assign students into schools near their homes, residential segregation is an influential cause of school segregation.

Structural Bias

Geographic segregation did not happen by chance. Before the Great Migration of black families from the south in the first decades of the 1900s, northern cities were overwhelmingly white and the few black residents were scattered throughout the city. As blacks started to enter the city in greater numbers, white families created suburbs and put up layers of *de jure* and *de facto* fences around their neighborhoods (Badger 2016). Covenants were written into deeds saying that home owners were not allowed to sell their homes to black families. Minority neighborhoods were redlined, meaning banks would not issue mortgages to black families, making it much more difficult to buy a home. Realtors systemically refused to show homes in white areas to black families. Zoning restrictions were put in place that established minimum lot sizes, making the barrier to entry much more expensive. All of these things effectively contributed to the separation of white and black residents but most terrifying of all was the violence. Against all odds, when some black families were able to move into a white neighborhood, they often faced hostility, in fact several homes were even bombed by white neighbors and those violent actions were met with silence from law enforcement.

The *Mapping Inequality* project is a collaboration between teams at Johns Hopkins University, Virginia Tech, University of Maryland, and the University of Richmond’s Digital Scholarship Lab. The teams collected, arranged, and made available in digital form over 150 maps created by the Home Owner’s Loan Corporation (HOLC) between 1935 and 1940. HOLC was an important New Deal agency that used these “security maps” to shape the mortgage lending market and expand the opportunity for home ownership for millions of white Americans while establishing barriers to home ownership for black Americans. As said in the introduction to this project, “more than a half-century of research has shown housing to be for the twentieth century what slavery was to the antebellum period, namely the broad foundation of both American prosperity and racial inequality” (Nelson, Winling, Marciano, Connolly, et al. 2017).
"Located between 35th and 67th, west of Cottage Grove to State, a blighted area, 100 per cent negro, predominantly apartment buildings; 3’s, 6’s and up, few 2’s. Single homes are of the 6-10 room type, average age 40 years. In this area under construction is the Ida B. Wells US Housing Project, extending from 37th to 39th between South Parkway and Cottage Grove. This project is expected to house 1,662 negro families and, of course, will be taken off the tax rolls with the exception of taxes for police, fire and school purposes. This venture has the realtors guessing as to what the ultimate result will be when so many of this race are drawn into this section from the already negro-blighted district; particularly its effect on the section east and south of Cottage Grove, and to park and water frontage on Lake Michigan. Already Washington Park at the south, a very fine park, has been almost completely monopolized by the colored race. Criticism is heard of the location of the project, some believing it should have been located north of Oakwood and west of Indiana in order to keep the colored influence as far as possible from further encroaching on park and lake water frontage..."
The maps color code areas with a rating system based on the attractiveness of the neighborhood. Figure 15 is a view of Chicago with the redlined maps overlaid from the Mapping Inequality site. In his book, Crabgrass Frontier, historian Kenneth Jackson said that HOLC “devised a rating system that undervalued neighborhoods that were dense, mixed, or aging,” and, “applied [existing] notions of ethnic and racial worth to real-estate appraising on an unprecedented scale”.

The interactive site reveals motive behind the color coding by providing the descriptions that went with the maps. As seen in Figure 15’s caption, many poor ratings were a function of race. The Mapping Inequality team notes that, “scholars have characterized HOLC’s property assessment and risk management practices, as well as those of the Federal Housing Administration, Veterans Administration, and US. Housing Authority, as some of the most important factors in preserving racial segregation, intergenerational poverty, and the continued wealth gap between white Americans and most other groups in the U.S.” (Nelson, Winling, Marciano, Connolly, et al. 2017).

**Individual Actions**

Though neighborhood preferences have changed quite a bit in the past 40 years, the resulting actions have not. In the abstract, we all profess to value diversity. When asked what type of neighborhood they would like to live in, white, black, and Latino individuals all say they would ideally like a diverse neighborhood. However, when it comes time to search for that neighborhood, white families search for homes in majority white (68%) neighborhoods and end up living in strongly white neighborhoods (74%) while black and Latino families search in diverse neighborhoods but then end up living in majority black and Latino neighborhoods (Chang 2017). It turns out that for white families, their claimed ideal neighborhood does not align with their search.

In the 1976 Detroit Area Study, participants were shown a series of 5 cards representing potential neighborhoods and asked about their comfort level in each of the neighborhoods. Whites were first shown a card with an all-white neighborhood and then progressively shown cards with more and more black homes. These are recreated in Figure 16. Once the respondent said they would feel uncomfortable, they were asked whether they would try to move out of the neighborhood. They were then shown all cards and asked, given there was an attractive new home in each neighborhood, which they would be willing to move into (Farley, Fielding, and Krysan 1997).

Since blacks didn’t care whether whites moved into their neighborhoods, cards as shown in Figure 17 were used that ranged from all black to all white and they were asked to arrange the cards in order of preference. Then they were asked which, if any, they would not be willing to move into. The study revealed that 42% of whites were uncomfortable with a 1/5 black neighborhood and 27% would not move into a neighborhood that was 1/15 black. Black respondents strongly favored integrated neighborhoods — 82% reported that their first choice was the 50/50 neighborhood (Farley, Fielding, and Krysan 1997).
Farley, Fielding, and Krysan used data from the Multi-City Study of Urban Inequality (MCSUI), a replication of the Detroit study in 1992-94 on 4 cities: Atlanta, Boston, Detroit, and Los Angeles to investigate whether the 1976 results could be extended to other locations and what impact demographic factors such as age, educational attainment, gender, and income made a difference. For those four sites, Census Block Group data revealed high levels of residential segregation between blacks and whites. Detroit was the most segregated city in the study. On average, black residents of Detroit live in block groups where 83% of the residents are black.

As shown in Figure 18, the majority of whites in all sites reported being uncomfortable in a majority black neighborhood and in Detroit, even minimal integration is found objectionable by 16% of white respondents. Education level and age were linked to increased levels of comfort with integrated neighborhoods. For black respondents, Figure 19 shows that highly integrated neighborhoods (50/50) were preferred by the majority (57%). The next most popular neighborhood was a 10 black and 4 white household area These trends are similar across all categories, however Atlanta and Boston stand out in terms of site and we can also see that education and income are negatively associated with the all black neighborhood.

The researchers concluded that responses from Detroit were not appropriate for nationwide generalizations. The responses in general were strongly related to location and in Detroit, whites showed a high preference for white neighborhoods and blacks had a high aversion to moving into white neighborhoods. They note that neighborhood preferences reinforce and may be influenced by a history of discrimination. Additionally, increasing tolerance levels reported by whites are inconsistent with the levels of residential segregation that we see reported in the Census numbers (Farley, Fielding, and Krysan 1997).
**FIGURE 18.** Comfort of Whites if Their Neighborhoods Came to Have Indicated Densities of Black Residents
*Graph recreated from original*

- Uncomfortable if 7% of residents are black
- Comfortable in 8% to 10% black neighborhood
- Comfortable in 20% to 32% black neighborhood
- Comfortable in 33% to 52% black neighborhood
- Comfortable in majority black neighborhood

**FIGURE 19.** Distribution of Blacks by Racial Composition of Most Preferred Neighborhood
*Graph recreated from original*

- All White
- 2 Blacks, 12 Whites
- 7 Blacks, 7 Whites
- 10 Blacks, 4 Whites
- All Black
Visualizing the Racial Divide

The legacy of housing segregation continues to break cities apart today as we can see through the before (Figure 20) and after (Figure 21) of this animated visualization (Vallandingham 2011). Using tract level data from the 2010 Census, designer Jim Vallandingham compared the differences in racial make-up between tracts that border one another. At first the reader sees a recognizable shape of the city with choropleth shading to indicate the white-black ratio in each census tract. Then the animation begins and the city starts to break apart. The distance between each tract is proportional to the amount of racial difference in the population of the neighboring tracts. When describing his visualization, Vallandingham says:

“I wanted to come up with a more visual and perhaps more visceral way to show these racial divides and how they serve as real boundaries in and around communities [...] These longer connections create rifts in the map and force areas apart, in some ways mimicking the real-world effects of these racial lines.”

Vallandingham visualizes the concept of the isolation index, which calculates the level of isolation of a group in a city. Where the dissimilarity index simply compares the difference in racial distribution across an area, a high isolation index means that, not only is there a high concentration of one race in a small part of the city, there is also a very low chance that anyone living in that concentrated area will encounter anyone of a different race in their day-to-day activities. Therefore, despite the fact that these tracts border one another, in reality there is little opportunity of interaction and the lived experience is more like the broken apart city with wide gulfs between differing tracts.
The Relationship Between Residential Segregation and School Segregation

Erica Frankenberg, author of *The Role of Residential Segregation in Contemporary School Segregation*, examines the reciprocal nature of this relationship and reflects on legal and policy measures for integration that may impact residential and, therefore school segregation. She suggests that the school to residence influence can be explained by two phenomena. The first, that school composition acts as a proxy for neighborhood composition, especially when schools of different compositions are close to one another. For example, a case study found that “splinter” school districts which formed after the *Brown v. Board* decision “were able to recruit a more ‘advantaged’ population than before the formation of their district.” Additionally, research suggests that students of integrated schools go on to live in more diverse neighborhoods (Frankenberg 2013).

Frankenberg uses data from diversitydata.org and measures segregation with the index of dissimilarity across the three largest racial groups: White-Black and White-Hispanic. She focuses on public primary schools for three reasons. The first is that they are an early sign of neighborhood transition. Second, their small size and priority on having younger children stay closer to home means that they reflect the neighborhood better than high schools would. Third, research shows that the benefits of integration are highest when integration happens at an early age.

As shown in Figure 22, public school student population has increased for minorities, particularly Latinos, and decreased significantly for Whites from 2000 to 2010. School and residential segregation between blacks and whites remains higher than for Latinos and whites.

Frankenberg notes that integration policies were likely behind the slightly lower school segregation than residential segregation that we see for blacks in 2000. We can see that after many of these efforts ended, the school and residential segregation for blacks is about the same in 2010. She also found that Hispanics were more segregated in school than in their neighborhoods.

![Figure 22](image-url)
Figure 23 and Figure 24 reveal that the relationship between residential and school segregation increased from 2000 to 2010. The slope of the 2000 fitted line is 1.029 and for 2010, it is 1.041 and the R² is increased close to 1. Frankenberg notes that some of the outliers that had low school segregation despite high residential segregation were districts that expanded to cover the entire county. This structure allows for more significant integration efforts. She suggests that county-wide structures could have potential for reducing school segregation and also mentions potential for policy efforts to reduce residential segregation, commenting that enforcement of the Fair Housing Act and less restrictive zoning policies would reduce residential segregation and lead to more integrated schools.
School Segregation

Residential segregation, through important, does not entirely explain school segregation. When comparing dissimilarity across city lines, neighborhoods, and districts, it is clear that school district borders and attendance zones act to reinforce segregation. The location and enrollment of schools increases the effect. Efforts meant to increase diversity such as creating city-wide or inter-district schools often result only in moving high performing students from affluent families into specialized schools and draining resources from the neighborhoods that are left behind. Affluent parents are also able to attract more city money and favor and, rather than send their children to a neighborhood school with a higher than comfortable minority or low-income population, they petition the city to build a new school with new district boundaries for their children. In Chicago, it is not unusual to find nearby schools just blocks apart that have wildly different student bodies. Additionally, the more minority students there are in the district, the more likely white parents are to send their children to private schools. Despite the fact that the city’s school-age population is 17% white, 35% black and 43% Hispanic, the school district enrolls ~ 90% black and Latino children and ~ 9% white children (Chicago Public Schools 2017).

FIGURE 25. Illustration from School segregation didn’t go away. It just evolved, Vox (Chang 2017)
Between-District Segregation

As mentioned earlier, the *Milliken v. Bradley* case severely crippled integration efforts by restricting integration to within district strategies, removing the option for across district strategies. In 1970, black parents partnered with the NAACP to sue the state of Michigan for the government’s role in racial segregation in the Detroit school system. The problem was that Detroit’s population was so predominately black that there were not enough white children to have any meaningful integration and the judge worried that integration efforts in the city would trigger the remaining white families to leave. The court ordered state officials to create a desegregation plan that included the surrounding suburbs. The District Court wrote “School district lines are simply matters of political convenience and may not be used to deny constitutional rights” (EdBuild 2016).

The suburban districts fought this order and, together with the state, they appealed to the Supreme Court. “In a 5-4 decision, the justices overturned the lower court’s ruling, finding that Detroit was indeed segregated, but neighboring districts could not be compelled to take part in a solution. Chief Justice Burger wrote that school districts were autonomous entities and their boundaries should be considered sacrosanct; as long as the neighboring districts had taken no specific action to further Detroit’s segregation, they could decline to take part in a solution. The walls separating Detroit from its suburbs—and separating all majority-minority districts from their mostly-white neighbors—could not be breached” (EdBuild 2016). Additionally, the decision did not include any requirement for periodic evaluation of the boundaries based on changing demographics.

EdBuild is a nonprofit organization with the aim of bringing "common sense and fairness to the way states fund public schools" (EdBuild 2016). They have put together a report identifying the top 50 situations where high-poverty school districts are bordered by much more affluent ones. This is shown in Figure 26 and the most segregating border, the focus of the *Milliken v. Bradley* case is shown in Figure 27. Through spatial network analysis, EdBuild identified each district border and compared the difference in childhood poverty for each side. They found that the average school district border has districts on either side whose student poverty rates differ by seven percentage points. For the 50 most segregating borders, that difference ranges from 34 to 42 points. In addition, the more affluent districts are typically much smaller, on average serving 15,000 fewer students. Since schools are funded through property tax and funds are kept within the district, the wealthier districts end up being worth $131,000 more, creating $4,500 more per student even though many of the higher-poverty districts tax themselves at a higher rate (EdBuild 2016).
**FIGURE 26.** Map of the 50 most segregating district borders (EdBuild 2016)

**FIGURE 27.** The most segregating border, Detroit and Grosse Pointe school districts in Michigan (EdBuild 2016)

*Detroit’s border with Grosse Pointe is the most segregating in the country, embodying the tragic legacy of the Supreme Court case Milliken v. Bradley.*

The most segregating school district border in the country separates Detroit and Grosse Pointe, two municipalities with a long history of inequality. The 1974 Supreme Court case *Milliken v. Bradley* dealt with a desegregation plan that included majority-black Detroit and its nearly all-white, suburban neighbor districts, Grosse Pointe among them. In that case, the Court held that desegregation could not be ordered across the school district lines drawn by state and local governments. In essence, the Court declared school district borders to be impenetrable, even when cross-district efforts are necessary to achieve meaningful integration.

When the case was filed in 1970, the poverty rate among all residents of Grosse Pointe was 3%. Detroit’s poverty rate was five times that. Things have only worsened since; Detroit’s poverty rate is now 7.5 times Grosse Pointe’s.

The fact that the Detroit/Grosse Pointe border is the most segregating in the country is not surprising, but it is unfortunate. The legacy of the Supreme Court’s ruling in *Milliken* extends far beyond the school districts named in the case. Today, we contend with its impact not only in Detroit, but all across the country.

<table>
<thead>
<tr>
<th>Name</th>
<th>Enrollment</th>
<th>Poverty Rate</th>
<th>Local Revenue Per Pupil</th>
<th>Median Property Value</th>
<th>Median Household Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grosse Pointe</td>
<td>8,328</td>
<td>6.52%</td>
<td>$4,605</td>
<td>$220,100</td>
<td>$90,542</td>
</tr>
<tr>
<td>Detroit</td>
<td>49,043</td>
<td>49.18%</td>
<td>$4,780</td>
<td>$45,100</td>
<td>$26,087</td>
</tr>
</tbody>
</table>
Within-District Segregation

When we look at economic segregation by school attendance boundary, we see that the percentage of poor children in public neighborhood schools is greater than the percent living in the catchment area. This is evidence that wealthier students are attending non-neighborhood schools like private, charter, and magnet schools and, as a result, there is a much higher concentration of poor and minority children in neighborhood public schools (Saporito and Sohoni 2007).

Saporito and Sohoni conducted a study that focused on 21 of the largest U.S. school districts and used maps of elementary attendance boundaries and data from the 2000 Census, the Common Core of Data (CCD), and the 1999 Private School Survey. Poverty is measured through eligibility for free school lunch. The goal was to determine whether affluent families leave public neighborhood schools due to racial composition and how their choice to leave affects the concentration of poverty that is left behind.

The authors note that, in discussion on the topic of school choice, socioeconomic status is often viewed separately from race, though the connection between the two is widely accepted. School choice advocates say that decisions based on class are misrepresented as motivated by race. If this were true, then white families in higher minority areas would be equally likely to send their children to public schools as white families in mainly white areas.

FIGURE 28. Distribution of White, Black, and Hispanic Children Across School Attendance Boundaries of Varying Poverty Rates (Saporito and Sohoni 2007)

FIGURE 29. Distribution of White, Black, and Hispanic Children Across Neighborhood Public Schools of Varying Poverty Rates (Saporito and Sohoni 2007)
The bar charts in Figure 28 and Figure 29 illustrate the distribution across attendance boundaries and enrolled in neighborhood schools by race. While neighborhoods with “extreme concentrations of poverty” (over 70%) account for only 5% of minority children, about 60% of minority children attend schools that have extreme concentrations of poverty.

In Figure 30, the dotted line shows what would happen if all children attended their assigned neighborhood school. The actual data, plotted in the solid and dashed lines reveal two important findings. The first is that, for all racial ratios, the curvilinear relationship between poverty in the neighborhood and in the school, means that “poverty rates in schools and neighborhoods are the smallest in areas that are economically homogeneous and the greatest in areas where poor and non-poor children are present in equal proportions” (Saporito and Sohoni 2007).

**FIGURE 30.** Percent Free Lunch in School by Percent of poor Children in School Attendance Boundaries (Saporito and Sohoni 2007)
“What seems unmistakable, but, oddly enough, is rarely said in public settings nowadays, is that the nation, for all practice and intent, has turned its back upon the moral implications, if not yet the legal ramifications, of the Brown decision. The struggle being waged today, where there is any struggle being waged at all, is closer to the one that was addressed in 1896 in Plessy v. Ferguson, in which the court accepted segregated institutions for black people, stipulating only that they must be equal to those open to white people. The dual society, at least in public education, seems to be unquestioned.”

Jonathan Kozol, Savage Inequalities: Children in America’s Schools, page 4
Changing the behavior and attitudes of beneficiaries of the status quo is a crucial component to solving a wicked problem that has to do with issues of social injustice. This thesis explores the potential for using interactive simulations to do that by facilitating single- and double-loop learning. Through the simulation, the user is able to place him or herself within the situation, encouraging the user to envision a different, more equitable solution. First though, it is important to understand the dynamics of attitude and behavior change through the lens of desegregation policy.

**Community Social Change**

Christine Rossell writes about the unique issue of social change through desegregation policy (Rossell 1978). She notes that school desegregation has three elements which make it different from the typical type of social change examined by political scientists and sociologists. These are:

1. School desegregation change is initiated from the top down, rather than from the bottom up. “Instead of the masses mobilizing and obtaining their demands, school desegregation is the result of a relatively powerless minority convincing an influential policymaking body — the courts — that desegregation is required by the Constitution. As a consequence, the white majority must be forced to comply.”

2. Costs vary from individual to individual, class to class, and community to community. “Therefore, many residents of a school district undergoing desegregation feel extraordinary resentment because they are bearing costs not borne by other communities.”

3. School desegregation does not only need compliance, but also a “change in attitude of the most fundamental kind-how one feels about one's self, one's identity, one's place in society, and the value of other individuals, their identity, and their place in society. No matter how much behavioral compliance is obtained, school desegregation will not be successful until it obtains this fundamental attitudinal change.”

Rossell defines school desegregation as busing children to achieve racial balance and notes that this is not viewed favorably by the white population (Rossell 1978). This type of policy is “forced” community social change and she notes that there are no social change theories that are applicable. While balance theory, consistency theory, and cognitive dissonance theory have been used to understand attitudinal change, they have not sufficiently been connected to complex issues of policy and community social change.

Rossell’s model of community social change includes three phases that are based on dissonance theory, which suggests that people try to maintain consistency between their attitudes or beliefs and behavior. “Individuals try to avoid information or situations that will increase dissonance. If they are in contact with or experiencing something with which they do not agree, they either rid themselves of the experience or come to believe in it” (Rossell 1978).
The first phase is triggered by the announcement and enactment of the policy. In this phase, individuals will attempt to achieve consistency by working to rid themselves of the disagreeable experience. Some will not experience dissonance from desegregation if the policy aligns with their beliefs. But others who oppose desegregation, will use actions such as protest-voting to remove the policymakers responsible or leaving the public school system if protest-voting is unsuccessful. The ability to remove oneself from the school system depends on financial ability, making this option class-based. This dynamic adds to the community polarization. Protest behavior can become more complex if the desegregation is court-ordered versus voluntary. Some, regardless of their own beliefs against desegregation, may feel obligated to comply with the decisions of a “legitimate and powerful” body. The controversy of contrasting opinions may result in protest demonstrations in addition to individual actions (Rossell 1978).

In the second phase, “individuals who are forced to comply with this counter attitudinal behavior will try to reduce cognitive dissonance by changing their attitudes in the direction of liking the experience” which should result in a reduction of prejudice and increased support for integration. The degree of attitudinal change in the second phase depends on what happened in the first phase. Dissonance theory says that “the greatest amount of attitudinal change will come about when the pressure put upon the individual is the least, and when there is some element of choice involved in the behavior.” If the policy change results in a highly controversial environment with a great deal of protest, violence, and white flight, the change will feel very forced and there will be fewer shifts in attitude. After complying, some parents who disagreed with the policy may force themselves to “believe that the decision to comply was correct.” In order to do so, though, they have to feel that the decision was binding. A reversible decision does not produce cognitive dissonance. Another complication with this policy is that the “stimulus to change one’s attitudes is indirect—it is the children of the community who are desegregated, not the adults. The process is actually a reciprocal one, whereby adult attitudes and opinions are influenced by their children’s perceptions of their experiences and vice versa. The children’s perceptions may also be related to the first phase of social change, the adult reaction to the decision to desegregate.” Attitude change may also develop over time. It is “conceivable that the original element of force or coercion has to be forgotten before any significant change in attitude can take place” (Rossell 1978).

The last phase includes “positive attitudinal changes resulting in other positive behavioral changes beyond sending one’s child to an integrated school.” These include electoral and residential changes. “School desegregation might be followed by the election of black officials and defeat of antibusing candidates and by an increase in residential integration.” Rossell bases this on dissonance theory and on contact theory which says that contact with other races will lead to individuals treating each other as equals and reduce racial discrimination. These additional changes can be encouraged through the policy. For example, since most parents do not want to participate in busing programs, “a citywide busing plan where integrated neighborhoods are excluded from busing would provide an incentive for residential integration. In short, school desegregation might produce desegregated residential neighborhoods because it changes attitudes and because it provides an incentive for congruence of attitude and behavior” (Rossell 1978).
### Theoretical Phases of Individual Attitudinal Change

<table>
<thead>
<tr>
<th>Phase</th>
<th>Community/Group Manifestation</th>
</tr>
</thead>
</table>
| Phase I | Attempt to rid community and individual of undesired experience  
Individual attempt to avoid undesired experience  
“White flight” |
| Phase II | Attempt to change one’s evaluation of experience  
Pro-integration attitudinal change, reduction in prejudice |
| Phase III | Attempt to achieve congruence between attitudes and behavior in complex cross-pressured environment where individuals are pro-integration but anti-busing  
Election of blacks, residential integration |

The process of attitudinal change to comply with court ordered or voluntary desegregation plans can be supported through the theories of double-loop learning, utopianism, and vulnerability.

### Double-Loop Learning, Utopianism, and Vulnerability

Efforts to change behavior and attitude can benefit from work done on understanding organizational learning, applied forward reasoning, and utopianism.

### Challenging Status Quo Assumptions Through Double-Loop Learning

Discussing organizational learning, Chris Argyris identifies two models of learning and behavior which are shown in Figure 33 (Argyris 1977). Model I behavior results in single-loop learning, where a mismatch in understanding simply needs to be corrected. This means that we change our actions when what we expect to happen does not match the actual outcome. In single-loop learning “we observe our present situation and face problems, errors, inconsistencies or impractical habits. After that we adapt our own behavior and actions to mitigate and improve the situation accordingly” (“Single and Double Loop Learning” 2014). One major problem with single-loop learning is that it only addresses the symptoms, leaving the root causes to become new problems in the future. For example, on an organizational level, a single-loop solution to the achievement gap would be an emphasis only on teacher training or funding in minority schools. “By using only single-loop learning we end up making only small fixes and adjustments” (“Single and Double Loop Learning” 2014).

Model II behavior allows for double-loop learning, which involves a complete change in viewpoint by “changing the underlying status quo assumptions that govern the behaviors” (Argyris 1977). “In double-loop learning we also correct or change the underlying causes
behind the problematic action” (“Single and Double Loop Learning” 2014). These causes could include “norms, policies, ways to work or individuals’ motives, assumptions or even informal and ingrained practices which prevent inquiry on these cases.” Double-loop learning requires the skills of self-awareness to identify our unconscious or habitual qualities, honesty to recognize mistakes and share them with others, and responsibility for our actions. Issues arise when single-loop learning is applied to wicked problems, resulting in a cover-up of the problem rather than an addressing of the actual problem.

**FIGURE 32.** Single- and Double-loop Learning (“Single and Double Loop Learning” 2014)

**FIGURE 33.** Theories of Action (Argyris 1977)

<table>
<thead>
<tr>
<th>Governing variables for action</th>
<th>Action strategies for actor</th>
<th>Consequences on actor and associates</th>
<th>Consequences on learning</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Achieve the purposes as I perceive them</td>
<td>Design and manage environment so that actor is in control over factors relevant to me</td>
<td>Actor seen as defensive</td>
<td>Self-sealing</td>
<td></td>
</tr>
<tr>
<td>2 Maximize winning and minimize losing</td>
<td>Own and control task</td>
<td>Defensive interpersonal and group relationships.</td>
<td><strong>Single loop learning</strong></td>
<td>Decreased</td>
</tr>
<tr>
<td>3 Minimize eliciting negative feelings</td>
<td>Unilaterally protect self</td>
<td>Defensive norms</td>
<td>Little testing of theories publicly</td>
<td></td>
</tr>
<tr>
<td>4 Be rational and minimize emotionality</td>
<td>Unilaterally protect others from being hurt</td>
<td>Low freedom of choice, internal commitment, and risk taking</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Model II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Valid information</td>
<td>Design situations or encounters where participants can be origins and experience high personal causation</td>
<td>Actor seen as minimally defensive</td>
<td>Testable processes</td>
<td></td>
</tr>
<tr>
<td>2 Free and informed choice</td>
<td>Task is controlled jointly</td>
<td>Minimally defensive interpersonal relations and group dynamics</td>
<td><strong>Double-loop learning</strong></td>
<td>Increased</td>
</tr>
<tr>
<td>3 Internal commitment to the choice and constant monitoring of the implementation</td>
<td>Protection of self is a joint enterprise and oriented toward growth</td>
<td>Learning-oriented norms</td>
<td>Frequent testing of theories publicly</td>
<td></td>
</tr>
<tr>
<td>4 Bilateral protection of others</td>
<td>High freedom of choice, internal commitment and risk taking</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Characteristics of Model I include: “(1) to define in their own terms the purpose of the situation in which they find themselves, (2) to win, (3) to suppress their own and others’ feelings, and (4) to emphasize the intellectual and deemphasize the emotional aspects of problems” (Argyris 1977). This set of assumptions results in unilateral behavioral strategies and a failure to recognize the inconsistency between what they say they want and what they actually do. This behavior derives from fear of losing control or letting someone else win. The lack of contact/intimacy/vulnerability leads to incomplete feedback loops and single-loop learning (covering up the problem rather than addressing the underlying assumptions) being applied. Argyris says that learning is inhibited because “people are taught to have a limited set of maps for how they must act, and they erect elaborate, defensive smoke screens that prevent both themselves and anyone else from challenging either their actions or the assumptions on which they are based.”

Model II’s aims are: “to help people to produce valid information, make informed choices, and develop an internal commitment to those choices. Embedded in these values is the assumption that power (for double-loop learning) comes from having reliable information, from being competent, from talking on personnel responsibilities, and from monitoring continually the effectiveness of one’s decisions.” Model II also emphasizes the building of trust and risk taking, plus stating of positions in such a way that they are publicly testable so that self-sealing processes can be reduced.” He suggests that the bottom line is not a good evaluative measure for double-loop learning and rather one should ask whether the company can continue making a profit. Similarly, with education, it is not enough to measure whether one school is doing well but to look overall at the sustainability of having some good schools with many other failing schools.

To give a simple analogy: a thermostat that automatically turns on the heat whenever the temperature in a room drops below 68 degrees is a good example of single-loop learning. A thermostat that could ask, ‘Why am I set at 68 degrees?’ and then explore whether or not some other temperature might more economically achieve the goal of heating the room would be engaging in double-loop learning.

Chris Argyris, *Teaching Smart People How to Learn*

**Utopian Solutions Using Applied Forward Reasoning**

When organizations use double-loop learning to solve problems, they are engaging in the process of utopianism — they are envisioning a new, better way of doing things. Utopianism creates “space for challenging what is, for disrupting dominant assumptions about social and spatial organization, and for imagining other possibilities and desires” (Anderson 2006). Marxist philosopher Ernst Bloch defines the practice of utopianism as “a re-definition of the problems and tasks” and as inseparable from hope. An ethos of hope is contrary to single-loop learning because if rejects action based on fear.

Thomas More invented the word ‘utopia’ five centuries ago to describe an idyllic island that represented everything that his 16th century European home lacked (Duncombe and Lambert 2017). Utopia had equity among all people, a democratically elected government, and common property shared by all citizens. This place, however was not real. The word itself, ‘utopia’ is a combination of two Greek words. ‘ou’ means ‘not’ and ‘topos’ means ‘place’ — no-place.
Stephen Duncombe and Steve Lambert are driven by utopianism in their work at the Center for Artistic Activism. Their “interest in Utopia is far from naive — it is based in a serious, grounded and realistic assessment of how power works, and why change happens ... the dominant system does not dominate because most people agree with it; it dominates because we cannot imagine an alternative” (Duncombe and Lambert 2017). Another theory that builds on utopianism is civic imagination, described by Henry Jenkins. He and his co-authors say that civic imagination is “the capacity to imagine alternatives to current social, political, or economic conditions. One cannot change the world unless one can imagine what a better world might look like, and too often, our focus on contemporary problems makes it impossible to see beyond immediate constraints. One also can’t change the world until one can imagine oneself as an active political agent” (Jenkins et al. 2016).

D'Ignazio suggests that there is an opportunity to “intentionally cultivat[e] civic imagination, and by extension political hope, personal agency, and design thinking about social and political concerns, as a gateway to civic activity” through civic art. She notes that civic art is concerned with “processes of governance, dissent and protest, citizen participation in political processes, and the production of collective, explicitly political imaginaries” (D'Ignazio 2017). She goes on to advise that in order to cultivate civic imagination, we must “offe[r] people a low-stakes opportunity to try on a new kind of authorship, to perform a new kind of political agency, and to envision a new ... world.”

Martin Luther King’s memorable ‘I Have a Dream’ speech was so powerful because he didn’t stop at highlighting the struggles of the black community. He went further to describe his version of the promised land where his children would not be judged by the color of their skin but by the content of their character. In his conclusion he says “one day this nation will rise up and live out the true meaning of its creed: “We hold these truths to be self-evident, that all men are created equal” (Martin Luther King, Jr. 1963). Dr. King’s dream was of utopia but it was also grounded in reality. The Civil Rights movement understood the nature of social change. In addition to making the public aware of the injustices of white supremacy, they also filed cases against racist laws, and pressured politicians to protect the rights of all citizens. “But King and the other activists of the Civil Rights movement understood that revealing and resolving problems is not enough to build a movement. In order to organize and orient a campaign, inspire and motivate people, to get them off the curb and keep them walking, you need a dream on the horizon. They kept their eyes on the prize; Utopia” (Duncombe and Lambert 2017).
APPLIED FORWARD REASONING

This utopic process rejects acceptance of what is and instead embraces the concept of the “not-yet,” which refers to the notion that a good or better way of being is “still not.” Bloch’s utopia is not based in idealism because it begins from reality — the good new is never completely new — but a dynamic reality. He suggests that “other forms of static realism forget the ‘perspective horizon’ and this ‘reality only appears as become, as dead.’” What is currently reality has the capacity and the potential to become some other form of future reality. The utopic process imagines “divergent trajectories within the present” by engaging in hopeful attitudes.

How do we create a lasting version of that better future reality? All too often, we attempt to affect reality and only achieve a few years of impact. Due to the nature of political cycles, policies are often created with a short time frame in mind for quick results. This approach has been shown to be ineffective for creating lasting impact. If we consider the issue of segregated schools, desegregation was only truly attempted for a decade and over the past 15 years, court orders requiring districts to comply with integration policies have been removed and schools have returned to their original (and in some cases worse than the original) segregated state. In order to craft and implement policies with a long life-span, high levels of compliance, and benefiting long-term collective interests, “applied forward reasoning” is required (Levin et al. 2012). This is a process that emphasizes forward looking strategies to discover ways that path dependencies can create the desired policy outcomes. Path dependency means that future choices are limited by and influenced by past choices (Boas 2007).

Applied forward reasoning emphasizes stickiness, durability, and expansion of the interested population as a way to “understand policy choices that ‘constrain our future selves’” and then to “generate new policy tools that set in motion these choices, consistent with long-term collective and individual interests.” Stickiness involves making immediate reversibility difficult. Durability means that the costs of reversing the policy increase over time or that the benefits increase over time. In the case of the ACA, the publicly supported redefinition of appropriate health care makes the policy’s reversal difficult. Expansion of the population is necessary and can be done through positive feedback. The applied forward reasoning method will serve to “counteract the tendency of our political institutions, as reinforced by our individual tendencies as consumers and voters, to make decisions that give greater weight to immediate interests and to delay required behavioral changes, even when doing so is clearly contrary to our long-term interests.” By engaging in double-loop learning both on an individual and institutional level, policies can be created that support forward-thinking, hopeful solutions for problems of inequity.
Vulnerability and Collective Action

To hope “is to enter into a relation with something outside oneself that is defined by a relation of trust” (Anderson 2006). Trust and vulnerability are also key components of double-loop learning.

Herb Stevenson writes about a dynamic between presence and vulnerability that can lead to moments of insight or intimacy. At the other end, however, is the chance that the vulnerable state can lead to embarrassment, humiliation, or shame. He says that contact is awareness of the line between ourselves and what is outside of ourselves. The boundary allows for interaction and exchange but keeps the self and the other apart. Contact requires vulnerability, which is an openness to oneself and others, and it also requires presence to support the vulnerability and engage with the other. “Without adequate presence (a form of internal authority/significance that allows us to both meet and be oneself), vulnerability will increase anxiety and ... lead to embarrassment, a sense of humiliation, and potentially, shame” (Stevenson 2014).

Stevenson references work done by Erving and Miriam Polster on gestalt therapy which is based on the idea that our self-concept “is constructed from our experiences, which are in part determined by the range or our capacities for assimilating new or intensified experience” (Stevenson 2014). The degree to which we expand or contract our contact boundaries, determines our “style of life, including choice of friends, work, geography, fantasy, lovemaking, and all the other experiences which are psychologically relevant to ... existence” (Polster and Polster 1974). They also found that the same person may be able to expand in some areas while putting up a resistance toward growing in other areas. “Conscious and unconscious emotions, symbols, and thoughts that are typically split off from the self and/or projected onto others” can affect the boundaries by “containing (framing and holding in place) anxieties.” (Stevenson 2014).
**Herb's Contact Model**

**EXPOSED:** High level of vulnerability and low sense of presence (self) leading to an experience of being exposed

- Shamed
- Humiliated
- Embarrassed
- Over-sensitized
- Loss of Self
- Overwhelmed
- Other Aware
- Defensive
- Confused
- Separated

**NUMB:** Low or no vulnerability and low or no sense of presence leading to a numbing or zoning out, dissociating, etc.

**LEARNED/HABITUAL/FAMILIAR/REACTIVE**

**INTIMATE:** Balanced or measured degrees of presence combined with vulnerability leading to moments of intimacy

- Sensual
- Present-Centered
- Alert
- Self & Other Aware
- Excited
- Connected
- Safe
- Sense of Self
- Comfortable
- Engaged

**RATIONAL:** Low or no vulnerability and high sense of presence leading to a strong rational experience of self and other

**ENGAGED/FRESH/NEW.UNFAMILIAR/ACTIVE**

**FiguRe 34.** Herb’s Contact Model (Stevenson 2014)
Utopian Visualization: Imagining the “Not-Yet” through Interactive Simulation

“Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.”
Herbert Simon (Simon 1988)

Imagining something new — utopianism — can also be thought of as design. One of many models aimed at understanding the design process is the analysis-synthesis bridge model created by Dubberly Design to illustrate how designers identify the needs of an organization and take steps to discover and implement solutions (Dubberly, Evenson, and Robinson 2008). The process begins in the lower-left where we research the current situation. Next, we analyze, interpret, and frame the problem, representing it in an abstracted form in order to “see how it might be different, better, or new.” Next, we use that representation to develop alternatives and “models of what could be.” Dubberly, Evenson, and Robinson suggest that “it is in the realm of abstraction — by thinking with models — that we bridge the gap between analysis and synthesis.” Finally, we make our improved model real. Getting to this last quadrant when dealing with social issue problems requires the cooperation of the public and the policymakers. Interactive simulation, however, can help those individuals understand what is and what could be through the abstracted models.

Through the design process, we see how design can be characterized as a form of learning (Dubberly and Evenson 2011). Interactive simulations, where the user has the ability to take part in the design, encourages learning. This kind of learning — one that is built through loops between decision-making and feedback — is different from learning by reading or viewing static charts and graphs. Visualization of possible futures through simulation applies principles from forward reasoning by using scenarios that “recogniz[e] contingency, the need to consider multiple alternative futures, and the development of plausible plot lines based on contingent causal mechanisms and critical uncertainties” (Levin et al. 2012).

Simulations and games have been used within business organizations and within classrooms to aid learning and decision-making, and are increasingly being used as an approach for environmental and social policy problems (Haug, Huitema, and Wenzler 2011). In these realms, participants explore the interaction of multiple variables and the results of various tactics in
a risk-free environment. For example, in the effort to combat climate change, Future Delta, an interactive educational game, uses visualization and simulation to show approaches to dealing with climate change and the results of those future scenarios (Schroth et al. 2014). The results of this game showed that the imagery was effective in shifting opinion toward more local responsibility. Additionally, situating the user in multiple perspectives, especially those that are typically marginalized and underrepresented, promotes empathy and double-loop learning through a literal change in viewpoint. Researchers at Indiana University found that simulation could help to “understand the preferences that will make or break policy goals while also informing the public about the need to change the status quo” (J. Carr and Never 2013). All of these aspects of games and simulations make them an ideal visualization tool for creating policy and challenging problematic assumptions and norms upheld by the general public.

Agency In Interactive Visualization

“Because the designer and user share creation of the interactive graphic, it is as if the fisher is inviting the man to go fishing instead of giving him a fish. Together they make decisions about where to fish, what methods and equipment to use, and what to do with the fish they catch. Certainly, the fisher is still the expert and may make many of the decisions in advance, but the man is an active participant in the process. They share agency in the creation of the graphic.” (Rawlins and Wilson 2014)

Unlike static visualizations, interactive simulations are collaborative between user and designer. In Agency and Interactive Data Displays: Internet Graphics as Co-Created Rhetorical Spaces, John Rawlins and Gregory Wilson discuss degrees of user agency in interactive data visualizations, suggesting that in an environment where the user has to make decisions, “they become active participants who can shape, refine, and construct meaning, ultimately becoming co-creators of the visualization with the designer” (Rawlins and Wilson 2014). However, those user decisions are “influenced and limited by the exercised agency of the original designer, which is expressed and preserved” in the interactive visualization.

The user is forced to act within constraints, a parallel to the real-world experience of trying to educate a child. Just as the options are limited in the simulation by the designer, the options are limited in the real-world experience by policymakers reacting to the community. Rawlins and Wilson go on to note that “defining agency has been a difficult task for rhetoricians and cultural theorists because the literature on (and history of Western thought regarding) agency has been tethered to two seemingly opposing explanations. On the one hand, the humanist tradition claims that we have direct control over our actions. On the other hand, cultural studies explanations claim that we are overdetermined by social forces that shape what choices are available to us, or what choices are even thinkable” (Rawlins and Wilson 2014). They propose that both of these dynamics can be true. We can simultaneously affect the world around us while also being limited in our actions by outside forces.
Interactive data visualizations vary in degree of user agency as shown in the balance of agency graph above. The five levels of interactivity each include three elements: the data, the design, and the message. On one extreme, represented by the left column, the designer controls all aspects and as we move to the right, the user is allowed more control until we reach the other extreme of full user control. Zoom and pan graphics, like the Mapping Inequality project (Figure 15 on page 20), maintain control over all three elements with the designer. In the constrained category, users can filter data or input limited data to make the design slightly more relevant to him or herself. Shared graphics provide the user with designer-created tools but allow the user to enter the data, generate, and manipulate the final design. An example of this type of graphic would be the Gapminder application. At the unconstrained level, the designer creates platforms like Google Charts, for the user to create designs with full freedom.

**Empathy and Understanding Through Games**

Empathy has been shown to improve the way that people think about and behave around individuals of other groups. Research also shows that there is a link between negative thoughts and behaviors and a lack of empathy (Belman and Flanagan 2010). The effects of empathy can even extend beyond humans. In a study inducing empathy toward animals and plants, participants “displayed stronger feelings of moral obligation to help animals, plants, and nature as a whole.” When empathy is used for prejudice reduction, it is usually in the form of asking the participant to take the perspective of the target of prejudice. Through this exercise, they “may come to believe that there are fewer differences between themselves and the targets of their prejudice than they had previously taken for granted” making it “difficult or
even uncomfortable to think about the outgroup in the unflattering terms dictated by negative stereotypes.” Indeed, “when one experiences a visceral empathetic response to another group’s plight, this may transform the “emotional lens” through which one views the other group” (Belman and Flanagan 2010).

Games have been shown to influence how players think and feel about different social groups (Roussos and Dovidio 2016). For example, “when Israeli Jews and Palestinians played an educational game about the Israeli-Palestinian conflict, they showed a more nuanced understanding of the conflict and more positive attitudes toward the other group” (Kampf and Cuhadar 2015). In the context of attitudes toward the poor, Roussos and Dovidio reference several studies that show that “being instructed to adopt the perspective of a member of a stigmatized group can arouse a range of sympathetic emotions and “instructing participants to imagine the feelings of a member of a stigmatized group produced more positive attitudes toward the group as a whole” (Roussos and Dovidio 2016). On the other hand, some research has shown the opposite effect. In the case of poverty, the use of agency and control can “lead players to believe that poverty is personally controllable” (Roussos and Dovidio 2016). Specifically, “when a stigma is perceived to be controllable (implying that stigmatized members are to blame for their situation), that stigma elicits more negative attitudes than when a stigma is perceived to be uncontrollable.”

Value-Questioning Design

There is a movement growing in the design community that calls designers to move away from the Tufte-inspired “objective neutrality” style of visualization towards one that brings back the human, emotional side of data. Communication is never neutral and means of communication such as journalism, design, or other types of media are never neutral. Any appearance to appear neutral, in effect, a reinforcement of the status quo. Sam Dragga and Dan Voss, in their article Cruel Pies: The Inhumanity of Technical Illustrations, suggest that “the designer has a responsibility not only to communicate data, but to communicate meaning.” They “want visualizations to be more humane, to communicate human costs rather than simple data points” and “recogniz[e] that data visualization are not simply data; rather they have power to affect user decisions and actions” (Dragga and Voss 2001).

In a similar and more specific vein, Catherine D’Ignazio and Lauren Klein write about ways to incorporate methods derived from feminism in the creation of data visualizations. These methods attempt to reveal the assumptions built into data and the presentation of data around how “identity is constructed, how power is assigned, and how knowledge is generated, as well as how a range of intersectional forces such as race, class, and ability, combine to influence the experience of being in the world” (D’Ignazio and Klein 2016). Their call to “embrace pluralism” in design “would help visualization research move away from its current emphasis on objective presentation in favor of designs that facilitate pathways to multiple truths.” For this thesis simulation project, the values that drive it are: racial equity, class equity, quality education, and communal responsibility.
Illustration from Vox's *We Can Draw School Zones to Make Classrooms Less Segregated.*
*This Is How Well Your District Does*
Simulation Examples

“The world is full of these intractable and complex systems and problems that we seem not to be able to get our heads around using traditional media especially writing, and speech and images and moving images.”

Ian Bogost
In her article, *Visualization for Thinking, Planning, and Problem Solving*, Yvonne M. Hansen argues that words alone are not enough to solve the complex problems that we face today. The nature of these problems, the interweaving elements demand visualization in order to "reveal relationships among parts" (Hansen 2000). The following visualizations are focused on issues related to segregation. They reveal patterns of inequality, let the user engage in the situation, and show what alternate futures could exist.

**Parable of the Polygons**

The Parable of the Polygons game is based on Thomas Schelling’s Dynamic Models of Segregation in which he showed mathematically how small neighborhood preferences can create dramatic differences in race across neighborhoods. Multimedia online storyteller Vi Hart and game developer Nicky Case “built on top of this and showed how a small demand for diversity can desegregate a neighborhood” (Hart and Case 2014). Parables uses appealing animated characters that, in the words of the game, are “slightly shapist.” This quality, however, can be overcome. The main rule for the shapes is that at least one third of their neighbors look like them.

While the one third rule may seem small, it quickly results in a segregated society. Our goal is to move the characters around until they are all happy. We are only allowed to move the unhappy polygons and, depending on how the moves are made, other characters become unhappy as their neighborhoods change. In the first grid of polygons shown in Figure 37, the segregation starts at a low level but many of the shapes are unhappy. Clicking the “start moving” button as we can see in Figure 38 shifts the polygons to their preferred locations which pushes the segregation number up to 57%.

“Small individual bias can lead to large collective bias.”

We can also experiment with the outcomes of a higher or lower bias. Setting the bias to 50% (preference for more than 50% of neighbors to be the same shape) predictably results in higher levels of segregation.
**Figure 37.** Parable of the Polygons (Hart and Case 2014)

**Figure 38.** Parable of the Polygons (Hart and Case 2014)
What is surprising is that a lower bias does not make the polygons unhappy in a segregated neighborhood. When we move the bias to 50%, we get a 76% level of segregation. But then, when we move the bias level down to 10% in Figure 39, none of the polygons move from their segregated position.

**Figure 39.** Parable of the Polygons (Hart and Case 2014)

"In a world where bias ever existed, being unbiased isn't enough! We're gonna need active measures."

In the game, the active measures are “anti-bias” and Parable goes on to show how individual “anti-bias” can work together to reverse segregation. When we set the scales with bias at 10% and anti-bias at 80% in Figure 40, meaning the shapes want to move if less than 10 and more than 80 percent of their neighbors are the same as them, the segregation level goes down to zero (Bliss 2014).
"All it takes is a change in the perception of what an acceptable environment looks like," says "Parable."

The action of playing the game allows the user to participate in the individual actions that collectively result in segregation. The interactive element makes the user aware of how small changes can quickly lead to larger neighborhood change. However, there is not a direct call to empathy or for the user to relate to one shape over another. The entire situation is presented in a very neutral way and, unless the user already valued diversity, this interactive game will not have much of an impact. Those that want to maximize happiness without caring about homogeneous neighborhoods are unlikely to be affected.

Schelling’s algorithm reflects the reported preferences of whites, blacks and Hispanics, but do not reflect their ultimate actions as shown in Farley, Fielding, and Krysan’s research. Different racial groups have different preferences and, while all report wanting to live in a diverse neighborhood, blacks and Hispanics are much more likely to actually look for homes in a diverse neighborhood (Farley, Fielding, and Krysan 1997). This visualization, perhaps with the goal of not offending any readers, assumes that all characters have the same neighborhood preferences. Additionally, Polygons assumes that all shapes have the resources available to move into any area of the grid and that all neighborhoods are available to everyone. In reality, minorities living in segregated neighborhoods have far fewer financial resources, limiting their residential options. Further limiting is the prevalent discrimination in current and previous housing markets.
A Vision for an Equitable D.C.

In *A Vision for an Equitable D.C.*, Leah Hendey and Serena Lei explore inequity across race and ethnicity for residents of Washington, D.C. (Hendey and Lei 2016). They pose the question: “what would an equitable DC look like?” They propose that closing the gaps between minority residents and white residents could be one way to imagine equity and they display this utopian alternate future through a series of interactive visualizations that compare the status quo with what could be.

The authors highlight the education gap, the poverty gap, the unemployment rate gap, the income gap and the health care gap between white residents and black residents. For each, they set the target at the white citywide average. For the education gap, they calculate that “in an equitable D.C. where the share of black and Hispanic residents with high school degrees matches the citywide share for whites, roughly 33,000 more black residents and 12,000 more Hispanics would have high school degrees, giving them access to more job options.

To visualize this impact, Hendey and Lei provide the option to toggle between the “reality” scenario and the “with racial equality” scenario to quickly see the disparity between black and Hispanic residents and white residents.

**FIGURE 41.** Poverty status in reality (Hendey and Lei 2016)

**FIGURE 42.** Poverty status with racial equity (Hendey and Lei 2016)
This alternate future does not just affect minority residents. As the authors explain, the increases in income and spending that would result from an equitable society are significant. They cite a National Equity Atlas statistic that says “if people of color earned the same as their white counterparts, D.C.’s economy would have been more than $65 billion larger in 2012.

![GDP in reality](Hendey and Lei 2016)

**FIGURE 43.** GDP in reality (Hendey and Lei 2016)

![GDP with racial equity](Hendey and Lei 2016)

**FIGURE 44.** GDP with racial equity (Hendey and Lei 2016)

**Modified Monopoly**

Muktha Jost, Edward Whitfield, and Mark Jost write about a graduate course covering issues of affirmative action, racial inequality, and privilege for educators of elementary and secondary school students. In this course, students were asked to play a modified version of Monopoly that acted as a metaphor for racial inequities. The game was designed to evoke empathy and understanding and to encourage discussion among the students (Jost, Whitfield, and Jost 2005).

The researchers noticed the following patterns before playing the game:

- Both White and Black teachers lacked basic knowledge on the history of education inequity and both had understandings of the “achievement gap, race issues, institutional racism, and social issues” that were based on stereotypes and overly simplistic explanations.
- Most White teachers “believe that the foundations of our society are fairness, equality, and justice” while Black teachers understand “racism, inequity, and institutional racism at the
gut level, but are reticent about articulating their feelings and have often bought into the same paradigm as their White coworkers.”

- White teachers, reflecting a sentiment widely held in our society, “often close the door to exploring race issues with their heart because of the fallacy of the slippery slope: If we accept the unjust foundations of society, then we may have to give up our privileges that are built exactly on those foundations.”

In this modified game, player entry is staggered and then the ordinary rules of Monopoly apply. Staggered entry was spread across three groups. Group 1 played for about 30 minutes or after completing 7 rounds before Group 2 began. Then Group 3 began after another 30 minutes or an additional 5 rounds had been played. The diversity course used this game for three years with the following results:

- The winner was always from Group 1.
- Groups 2 and 3 never accumulated as many assets as Group 1.
- Later groups become discouraged and frustrated and often lost motivation to continue.

Player reactions to the game reflected frustrations that paralleled real-world experiences.

- Group 1 player: “We had seven rounds to ourselves, and so even before the others started the game, we had plenty of money since we got $200 for going around each time, and we had bought many of the properties.”
- Group 2 player: “It was very frustrating for me because I thought I’m going to land on some good property and buy constantly. I was landing on their property and having to pay them since I couldn’t buy the first round, and they were landing on those that weren’t bought, and then I landed myself in jail and I had to sit there.”
- Group 1 player: “Not only did they start to play after us, but they had to go around once before they could buy anything. Every time we rolled, we could buy. It took them a long time to get through, it was tough for them, and groups coming later had it even worse.”
- Group 3 player: “When I started, these people had their houses and cars and were making fans out of their money. There was no way I could get a lead and I lost interest. The only time I made any money was when I landed on ‘Free parking’ and I had all the money. Then I went to jail and wanted to stay there since I could keep my money.”

After being encouraged to think about the game as “a metaphor for racial inequities,” the teachers viewed the experience in a deeper way that stuck with them, several reporting that they returned to what they learned during the game later on in the classroom.
Can You Live On the Minimum Wage?

This *New York Times* interactive visualization asks the user to estimate their living expenses (Ashkenas 2014). As costs are filled in, the dots on the right, which represent the yearly income for someone making minimum wage decrease. This simple visual representation is effective. The experience of watching green dots fly off the page and get replaced with red dots is surprisingly stressful.

The visualization includes real-time feedback but since it is just a calculator, it doesn’t correct any assumptions about costs. It is easy to see how hard it is to pay for things on a minimum wage salary but the calculator approach seems wrong for this audience. It is clear that someone making more than the minimum wage would not be able to afford their normal expenses but what is important to realize is how unaffordable the real-world costs are for individuals who are living on the minimum wage.

![Figure 45. Starting view (Ashkenas 2014)](image-url)
The SPENT game was created to engage donors and volunteers of the Urban Ministries of Durham (UMD) in North Carolina (McKinney 2011). UMD is an organization that provides services for the homeless and disadvantaged population of Durham. The SPENT game is also being used in training programs for Serve Nebraska, Nebraska’s Volunteer Service Commission. The Training Challenge cites the fact that “there is very limited awareness of the challenges [low income] families and individuals face” and that many people are “misinformed and harbor damaging stereotypes of the ‘poor’ and ‘homeless’” (ServeNebraska 2012). In the game, players start with $1,000 and are challenged to make it to the end of the month while dealing with financial choices every day. It is very difficult to make it the full 30 days as realistic situations pop up from health issues to child care needs.

The game begins by directly asking the player to empathize with the character. The text on screen says: “Over 14 million Americans are unemployed. Now imagine you’re one of them. Your savings are gone. You’ve lost your house. And you’re down to your last $1,000. Can you make it through the month?”
FIGURE 47. SPENT (McKinney 2011)

FIGURE 48. SPENT (McKinney 2011)
FIGURE 49. SPENT (McKinney 2011)

Money may be tight, but you have to eat. Remember: These groceries need to last you a few weeks.

WHAT DO YOU WANT TO BUY?

CLEAR

$13

PAY

SPENT

FIGURE 50. SPENT (McKinney 2011)

YOU RAN OUT OF MONEY ON DAY 23

GIVE $10

to help someone living SPENT.

DONATE NOW

Share your results

SPENT
In a study using the game SPENT, researchers investigated how attitudes towards the poor differed between a group of participants who played the game, a group of participants who watched a video of the game, and a control group who played a game about preparing for natural disasters (Roussos and Dovidio 2016). The results show that participants who watch the video and those who played the game reported more empathic concern than the control group. Those in the video group who simply observed gameplay, however, showed more of a favorable attitude toward the poor than those who actually played the game. In fact, game players ended with the same attitude compared to the control group.

This could be due to the degree of agency that allowed users to feel in control of their decisions in the game. This may have left some thinking the poor have more control over their situation than the do in reality. One of the missing elements in the SPENT game was in showing the systemic creation and maintenance of poverty and the complicity of everyone in the system.

**Vox’s School Segregation Gerrymandering Visualization**

In *We can draw school zones to make classrooms less segregated. This is how well your district does*, Alvin Chang goes through a very detailed description of the causes and history of both residential and school segregation (Chang 2018). Through illustrations and diagrams, the authors cover the topics of demographic shifts and housing inequity but they focus the majority of the discussion on school attendance zones and how they maintain and in some cases add to school segregation. By showing the current process of establishing attendance zones alongside a better more ideal process, Chang is providing the reader with a view of an alternate future for which he or she could advocate.
Midway through the article, Chang includes interactivity, allowing the reader to select a district he or she is interested in and then several sections are personalized for the selected district. In Figure 53 and Figure 54, I've selected the Chicago Public School district. These two graphs show the level of segregation in each school in two different scenarios. First we see the level if students were assigned to their nearest school — which follows the level of residential segregation. Next, we are able to compare to the current zoning patterns. For Chicago, we see that the trend line has not moved, meaning the current zones “recreat[e] the underlying segregation” (Chang 2018).

While this visual comparison is interesting, simply seeing the alternate view of nearest school is not very impactful in a city with such high levels of residential segregation. Other, more effective assignment policies such as redrawing assignment zones or a controlled choice policy would show much lower levels of segregation and provide a meaningful comparison.
**FIGURE 53.** Residential versus school segregation if assigned to nearest school (Chang 2018)

**FIGURE 54.** Residential versus school segregation under current zoning (Chang 2018)
Synthesis and Opportunities

The games and interactive experiences just discussed cover a wide range of approaches to the problem of getting the public to shift their viewpoint, to see the impact of policy and individual choices, and to envision a better society. None of the examples, however, combine the tactics of putting the user in the process and seeing how his/her consequences and policy actions can affect the situation as a whole. The SPENT game is effective in making the user “walk in someone else’s shoes” but it does not explain how this situation could change. Its main goal is to encourage empathy. While donating is good, changing behaviors and policy that creates the situation is better. Parable of the Polygons does a good job of showing how individual actions can lead to larger patterns but it does not introduce policy solutions or ask that the user really have a stake in the game by identifying as one side or the other.

While interactive visualization and simulation has begun to be applied to many types of social justice issues, it has only been applied to school segregation in a limited way. There is an opportunity to use simulation to both shift the user’s viewpoint on school choice options as well as to show how alternate decisions and policies could affect school segregation.
Map illustrating the dominant ethnicities of different areas of Chicago in 1950
The *Educate Your Child* Interactive Simulation

“Every time a parent makes a decision for justice, it makes it harder for other parents not to.”

Nikole Hannah-Jones, *Fear, Complicity, & Guilt Get In Way Of Covering School Segregation, Says NYT Reporter*
This thesis explores the potential for interactive simulation to affect attitude and behavior change around issues of social justice. In the case of school segregation, it is the parents who are making decisions around neighborhood and school choice. These individual decisions add up to create patterns of segregation. In my Educate Your Child simulation, a “player” is asked to act as one of those parents and go through a simplified process of selecting a neighborhood and school for his or her 5-year-old child.

The location is the City of Chicago. The goal is to raise awareness of the individual parental choices and the policy choices that contribute to the high levels of residential and school segregation. The stages of the simulation convey the complex interaction of forces involved in the school decision process. The interactive nature gives the user agency, implicating the him or her in the final outcome.

The issue of school segregation has many actors including the school administration, the board of education, and laws and court decisions. Interactions between all of these individuals and institutions determine how schools are organized. In the simulation, the player will have an opportunity to change some of the policy choices and see how they affect the options that are available.

As players move from one step to the next, the links from race/ethnicity to income inequality to housing inequality to education inequality become apparent. Users can adjust those links by choosing against the status quo to explore other, potentially ‘future,’ versions of reality and see the impact of their decisions within those realities. The goal is that, as in the business operations game, users will build a memory of the future that they will come back to after their experience in the simulation is over and that will affect their views on school choice.

Who Is the Audience?

Parents are the driving force behind school segregation at the local level, and as such, their decisions can affect the creation and success of public policy. Nikole Hannah-Jones, a New York Times journalist who has written about school segregation for the past decade often comments that “parents with resources have many avenues to avoid sending their children to an integrated school. They can choose to live in a different neighborhood, send their child to private school, or take advantage of the wave of charter schools now becoming available in a climate that undervalues the goals of public education. In focusing on individual parent decisions, Hannah-Jones is rejecting the commonly expressed view that parents are only required to do what’s best for their own kids when it comes to school choices for their children. A focus on the common good is not thought to be required in this area” (Russo 2017).

For this reason, current members or potential members (parents) of any elementary school community are the main focus for this project. On a larger scale, all citizens should be concerned about our education system, as it is crucial for advancing as a society and so, the general public is a secondary audience. And finally, while community members play a direct
role in the school choices made, local policy makers and school board administrators are the
“choice architects” (Thaler and Sunstein 2009). Those who control the school attendance zones,
requirements for attendance, school closing and openings, and many other aspects of how
the choices are arranged, should also be aware of how their architecture affects how school
decisions are made. Therefore, they too are implicated in this simulation and are a potential
secondary audience for it.

Data and Technical Details

Data Sources

2016 American Community Survey 5-year estimates:

• Sex by Age: White alone, Black or African American alone, Hispanic or Latino
• Hispanic or Latino Origin by Race
• Median Household Income in the Past 12 Months (In 2016 Inflation Adjusted Dollars)
• Total Population
• Household Type

Chicago Public Schools Data:

• Elementary School Attendance Boundaries School Year 2017-18
• Accountability SQRP Ratings 2017-18
• Racial/Ethnic Demographics 2018
• Membership 2017-18 (Total Attending, Attending/Residing, Residing/Not Attending,
Attending/Not Residing)

The Simulation

The simulation is coded in HTML, CSS, Javascript, and D3.
Simulation Stages

The simulation stages are meant to replicate in the abstract the factors that lead up to a school choice decision and the results of those choices on a city-wide scale.

Start the Game

The simulation’s initial screen is full of 500 dots floating around. The user is prompted to “Educate Your Child” and instructed to select a dot which represents his or her child throughout the game. The introductory text asks the user to identify as parent that has to make decisions around that child’s education.

“The Chicago public school system has a high level of school segregation as a result of residential and school choices and policy decisions that do not encourage integrated neighborhoods and schools. In this game, you are a parent of a 5-year-old child and now you have to make some decisions. Explore how your choices can have an impact on your child’s education and on the overall education of the city’s children.”

FIGURE S5. Start Page, Educate Your Child Simulation
Race

Once the user selects a dot, the color, representing the race/ethnicity, is revealed. The racial/ethnic distribution of the dots is based on the make-up of school-age (5-14 years-old) children residing in the Chicago Public School system boundaries. This means that the user has a 17% chance of selecting a white child, a 35% chance of selecting a black child and a 47% chance of selecting a Hispanic child (U. S. Census Bureau 2016). In classifying race and ethnicity, I used census data for children who identify as white only (not Hispanic), black only and Hispanic only. As the dot changes color, a caption appears reading, “Your child is [white/black/Hispanic].”

FIGURE 56. Educate Your Child Simulation
On the next page, the dot children arrange in clusters to show the percentage of white, black and Hispanic children. The user’s child is larger to allow for tracking throughout the simulation. As the user reveals character details and makes decisions, the activity is tracked along the bottom. Here, the race/ethnicity is added to the bottom profile section.

**FIGURE 57. Race/Ethnicity Page, Educate Your Child Simulation**
Income

Next the user needs to know how much household income is available to support their child. All of the dots have household income assigned based on the range of household incomes for black, white, and Hispanic families in the city (U. S. Census Bureau 2016). In the simulation, the dots transition to reflect their income in a beeswarm plot. Arranging them in this way reveals the median difference for each group, showing how average household income for black and Hispanic families is less than white families.

School Readiness

In addition to race and income integration in the classroom, school readiness plays a role in education quality. Children from higher socioeconomic households and with parents who have higher educational attainment often have an advantage in the classroom and this influences the children around them. The ‘school ready’ classification is based on a measure that includes “early math and reading skills, learning-related and problem behaviors, and overall physical health” (Isaacs 2012). This advantage is manifested through a knowing a higher number of words, being read to and encouraged to read, etc. Based on income, the children dots are assigned an educational readiness level shown through opacity differences.

Following findings from Julia Isaacs of the Brookings Institution, 75% of the moderate to high income dot children are school ready, 59% of near poor and 48% of poor dot children are school ready (Isaacs 2012). The near poor category represents household income between
100% and 185% of poverty and the moderate or high-income category represents income above 185% of poverty. To determine income levels that represented 100% and 185% of poverty for Chicago, I consulted the 2016 Federal Poverty Guidelines (2016 because that is the household income year that I used) and used the average household size for Chicago, 2.55, to set 100% at $18,710 (U.S. Department of Health & Human Services 2016).

**Neighborhood**

A very influential aspect of school segregation is, of course, residential segregation. The residential decision is based on affordability and access to quality public schools. In the simulation, the residential neighborhoods are represented by public school attendance zones in order to ensure that each one had a school associated with it. These zones are then clustered into similar types of zones based on income and demographic make-up.

Before selecting a neighborhood, the user has to make a decision about what kind of policy environment they want to have. One option is to see what would be available to them with the status quo make-up of each neighborhood type. The other option is to see what would happen with more low-income housing in higher value neighborhoods.

Any school segregation policy in the city of Chicago is going to face difficulties due to the extreme levels of residential segregation. This is why addressing both of those problems at once will likely be the only solution. Chicago has a serious deficit in low-income housing. After the public housing complexes were torn down, residents were not relocated and, as
the city becomes more expensive, there are fewer and fewer neighborhoods in which low-income families are able to live. Therefore, in the simulation, I have also included an option to advocate for more low-income and affordable housing.

For the neighborhood boundaries, I used attendance zone boundaries so that each “neighborhood” has an assigned public school. In order to not overwhelm the user, I grouped neighborhoods into similar types of neighborhoods first based on income and then broken down further by demographic make-up. Social scientists and education researchers say that racial isolation occurs when any area has over 70% of one race (Potter, Quick, and Davies 2016). I classified differently any neighborhoods that crossed the 70% threshold. The goal was to have types of neighborhoods that each player might realistically end up living in based on race and income.
There are 357 elementary public school attendance zones in CPS and the classification breakdown is below. The attendance zones were based on CPS data (data.gov 2017). This data did not include demographic or socioeconomic detail for each zone so, to determine how many school-age children of each race/ethnicity live in each zone and what the household income median is for each zone, I used ArcMap geoprocessing tools to calculate a rough estimate for each using an overlap of census block groups.

<table>
<thead>
<tr>
<th>Income Level</th>
<th>Race/Ethnicity</th>
<th>Combined Neighborhood Type</th>
<th>Count</th>
<th>Black Average</th>
<th>Hispanic Average</th>
<th>White Average</th>
<th>Income Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>19</td>
<td>39%</td>
<td>49%</td>
<td>9%</td>
<td>$24,926</td>
</tr>
<tr>
<td>A</td>
<td>Black</td>
<td>AB</td>
<td>71</td>
<td>92%</td>
<td>4%</td>
<td>2%</td>
<td>$23,269</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>BB</td>
<td>82</td>
<td>17%</td>
<td>41%</td>
<td>30%</td>
<td>$44,350</td>
</tr>
<tr>
<td>B</td>
<td>Black</td>
<td>BB</td>
<td>60</td>
<td>93%</td>
<td>3%</td>
<td>2%</td>
<td>$40,854</td>
</tr>
<tr>
<td>B</td>
<td>Hispanic</td>
<td>BH</td>
<td>46</td>
<td>4%</td>
<td>85%</td>
<td>9%</td>
<td>$40,061</td>
</tr>
<tr>
<td>C</td>
<td>C</td>
<td>C</td>
<td>44</td>
<td>17%</td>
<td>25%</td>
<td>48%</td>
<td>$73,575</td>
</tr>
<tr>
<td>C</td>
<td>White</td>
<td>CW</td>
<td>21</td>
<td>3%</td>
<td>11%</td>
<td>78%</td>
<td>$80,461</td>
</tr>
<tr>
<td>D</td>
<td>D</td>
<td>D</td>
<td>6</td>
<td>17%</td>
<td>9%</td>
<td>63%</td>
<td>$104,495</td>
</tr>
<tr>
<td>D</td>
<td>White</td>
<td>DW</td>
<td>8</td>
<td>2%</td>
<td>10%</td>
<td>80%</td>
<td>$112,836</td>
</tr>
</tbody>
</table>

**FIGURE 61.** Neighborhood Page, Educate Your Child Simulation
The simulation’s low-income housing policy placement is based on moving 15% of the population from A, AB, B, BB, and BH to D and CW then also moving 10% of the population from CW to B. In the simulation, I’ve moved low-income residents to higher value neighborhoods and I have also moved some medium income families to low income neighborhoods based on a Stanford research study that found that building new affordable housing can raise property values and lower crime rates (Diamond and McQuade, 2017).

Once the user selects a neighborhood type, all of the dots transition into their assigned neighborhoods. As the dots move, the residential segregation becomes apparent. There is also a residential segregation level associated with this neighborhood selection which is determined through the entropy index. This index measures the spatial distribution of multiple groups at the same time (Forest 2005). When comparing 3 groups the maximum value is 1.10 which represents each area having an equal proportion of groups. A level of 0 means that each area has only one group. For the purposes of the simulation, I have scaled the entropy index results from 0-100 since that is an easier way to understand and compare results.
School Choice

Each neighborhood type has an assigned public school. This stage starts with all dots still clustered around their neighborhood and with their assigned public school directly below. The user can choose to stick with this default option or choose a charter school, transfer into other public school, or choose a private school.

On hover, users can see information about school standing and average test scores. The school options are based on several factors. First, the previously chosen residential patterns (status quo or more low-income housing) provides the attendance zone starting point. The user is automatically granted access to the school in his or her neighborhood. Up two additional public schools are chosen at random for the user to transfer into. If the child is school ready, then the charter option is available. If the child is school ready and the household income is over $50,000, then the private school option is available.

After a school is selected, the user’s child and all the other dot children move into their schools. Based on the characteristics of those neighborhoods, the game can determine what type of school children of each race/ethnicity from that area are likely to attend. The placement for all of the dot children uses neighborhood assignment as a base and then takes into account the rate of enrollment for each attendance zone type using CPS membership data which tracks residence versus attendance for each school. Status Quo residence assignment is based on the percentages of each race/ethnicity in each neighborhood type as shown above. Again, only school ready dot children are placed into charter and private schools and only those with enough household income are placed into the private school.
The segregation level, here called the non-academic score, is also calculated and displayed across the schools. The segregation level that results from each of these neighborhood assignments is based on the entropy index.

**FIGURE 64.** School Choice Page, Educate Your Child Simulation

For the city-wide controlled choice option, I placed dot children in a way that matched the overall socioeconomic make-up for the city in each school. This kind of balancing would likely be unrealistic in a large city like Chicago but it provides an interesting goal in a simulation.

It is on this final page that users can see the results of their selections. The measurements in the bottom reflect the segregation levels and the academic and non-academic scores that result from choices made throughout the simulation.
Results and Discussion

The Survey Construction

The goal of this research is to measure the effects a simulated experience of school choice on choice behavior and attitudes that contribute to school segregation. The driving question is: Do users have different considerations and exhibit different behavior when shown the consequences of their school choice and the local policies within the community?

In order to capture any shifts in attitude, participants are asked a series of questions listed in the next section. They then are asked to interact with the simulation and respond to the same set of questions afterwards. Additionally, users will have access to contextual information around the history of racial and income segregation in the city.

My hypothesis is that we should see a greater awareness of the existence of school segregation and the factors that contribute to it. We should also see a higher level of support for segregation reducing policies and a greater prioritization of diversity in school.

Amazon Mechanical Turk (MTurk) website was used for recruiting participants and compensating participants following study completion. As a preliminary test, 19 individuals were recruited through MTurk and their results are included in the survey results section.
**Pre-Simulation Questions**

4. How would you rank the importance of the following characteristics? (1-7)
   a. Distance from home
   b. Average test scores for the school
   c. Class and race diversity

2. Without knowing anything specific, how likely are you to consider a public, private, or a charter school? (1-7) Why?

3. How would you rank school segregation as a problem? (1-7) Why?

4. What do you think accounts for race/class school segregation?

5. How likely are you to support low-income housing in high value neighborhoods? (1-7)

6. How likely are you to support a controlled-choice school assignment policy? (1-7)

7. Do you think your child would be negatively impacted in a school with many low-income or minority students? (1-7)

8. Do you think your child would be negatively impacted in a racially isolated school? (No exposure to other races/ethnicities.) (1-7)

9. Do you think individual parent choices can affect school segregation? (Yes/No)

10. Have you made a school choice decision or chosen a residence based on school for your child? (Yes/No)

**Post-Simulation Questions**

Repeat pre-simulation questions 1-9.
Survey Results

For the questions that had 1-7 ranked responses, the results are in the table below.

<table>
<thead>
<tr>
<th>Question</th>
<th>Before</th>
<th>After</th>
<th>Shift in Avg.</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>How would you prioritize:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance from home</td>
<td>4.72</td>
<td>4.17</td>
<td>-8% Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>Average test scores</td>
<td>6.22</td>
<td>6.56</td>
<td>5% Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>Class and race diversity</td>
<td>4.22</td>
<td>5.17</td>
<td>13% Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Likelihood to choose:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>5.67</td>
<td>5.83</td>
<td>2% Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Private</td>
<td>4.28</td>
<td>4.22</td>
<td>-1% Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>Charter</td>
<td>3.33</td>
<td>3.17</td>
<td>-2% Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>School segregation as a problem</td>
<td>3.22</td>
<td>4.22</td>
<td>14% Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Support for low-income housing</td>
<td>4.44</td>
<td>4.61</td>
<td>2% Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Support for controlled-choice policy</td>
<td>4.06</td>
<td>4.67</td>
<td>9% Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Negative impact from low-income/minority students</td>
<td>3.5</td>
<td>3.39</td>
<td>-2% Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>Negative impact from racially isolated school</td>
<td>4.72</td>
<td>4.89</td>
<td>2% Increase</td>
<td>Increase</td>
</tr>
</tbody>
</table>

On almost every question, the change in response was in the anticipated direction. The most significant change was in the degree to which respondents viewed school segregation as a problem. Additionally, the number of respondents who said they thought individual parent choices affected school segregation went up from 10 to 12.

Many participants originally did not view school segregation as a major problem still. After the simulation, they saw that it is still a very prevalent social issue.

Some Written Responses

Likelihood of choosing a public school after the simulation:

“The public schools were way too inconsistent to know what I was getting. It would be better for society as a whole, but it would be hard to make that decision for each individual kid.”

School segregation as a problem after the simulation:

“It is more prevalent than I thought it is.”
Degree to which school segregation is a problem before simulation

“It depends on the area you live in, but I think schools are pretty diverse as long as you live in a diverse area.” And after the simulation: “Too many kids are not able to be exposed to different groups because of school segregation and they aren’t able to receive the same opportunities and other students who may come from financially better off backgrounds.”

What accounts for school segregation after the simulation:

“Family income/wealth, which drives a lot of other decisions that tend to uphold the status quo through no intentional actions of the parents involved.”

Analysis

I conducted a paired T-test on each of the survey questions with ordered responses. Five of the questions showed a significant shift in opinion and boxplots for these are shown below.

How would you prioritize race and class diversity? (p-value: 0.038)

How would you rank school segregation as a problem? (p-value: 0.012)

How likely are you to support a controlled-choice school assignment policy? (p-value: 0.0002)
Do you think your child would be negatively impacted in a school with many low-income/minority students? (p-value: 0.015)

Do you think your child would be negatively impacted in a racially isolated school? (p-value: 0.071)

For the yes or no question about the impact of parent choices, I compared responses using McNemar’s chi-squared test and got the following results.

Do you think individual parent choices can affect school segregation? (p-value = 0.4795)

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>10</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
</tr>
</tbody>
</table>

Although two respondents switched their answers from no to yes, the results were not significant. This may be due to the fact that 28% of the data was not captured correctly. The results from the T-test all showed changes in the expected direction except on the question about negative effects from exposure to minority or low-income students. Also, I was expecting to see more change in the question on low-income policy support to match the increased support for controlled-choice policy.

Summary

Overall these results show that the simulation was effective in influencing the attitudes of participants around the existence of school segregation, some of the factors contributing to it and the ways that individual behaviors have an impact.
Conclusion

The intention for this thesis was to explore how visualization could be used to challenge inequity in society. My goal was to shift public perception of seemingly individual decisions on school choice and towards an understanding of how school choice has an impact on the larger community and can contribute positively or negatively to school segregation. Additionally, I wanted to convey the way that policy choices can also restrict or open up options, guide decisions, and promote values. My underlying belief is that correction to inequality requires changes to policy as well as changes to individual behavior.

The method that I’ve used to influence individual behavior is interactive simulation in the Educate Your Child online experience. This simulation shows how different scenarios affect the viewer personally and the community collectively, contributing to the necessary work of shifting viewpoints and value assumptions. Results from testing show that this project does have the potential to shift attitudes thereby influencing behavior.
References


