Modeling Assumptions Clash with the Real World: Configuring Student Assignment Algorithms to Serve Community Needs

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MD4SG Workshop 2020

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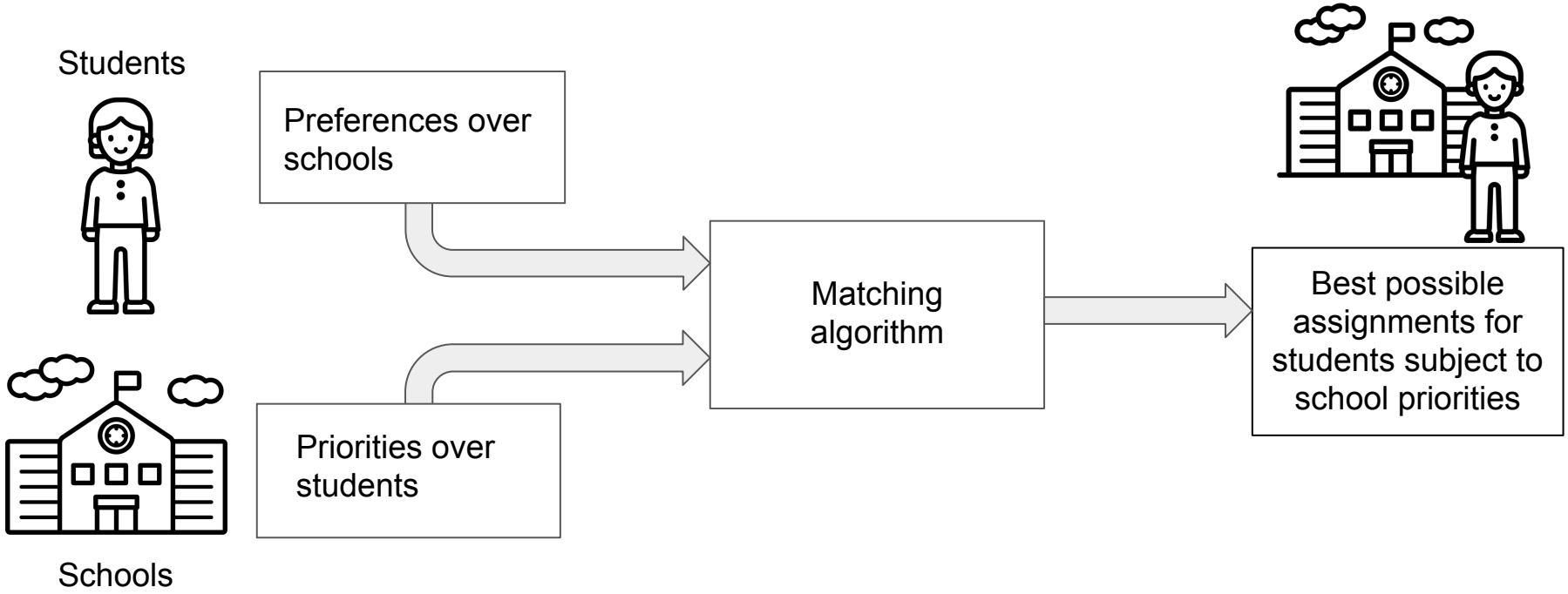
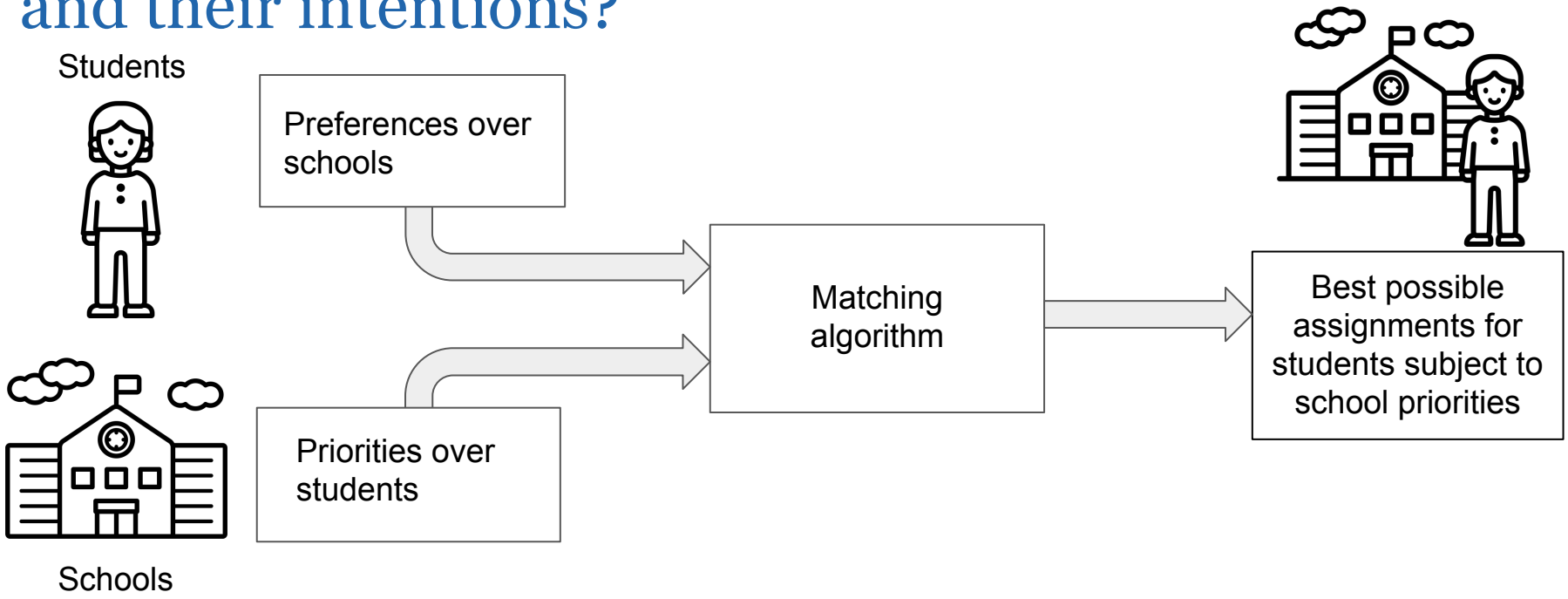
Student Assignment



What modeling assumptions are made about people and their intentions?



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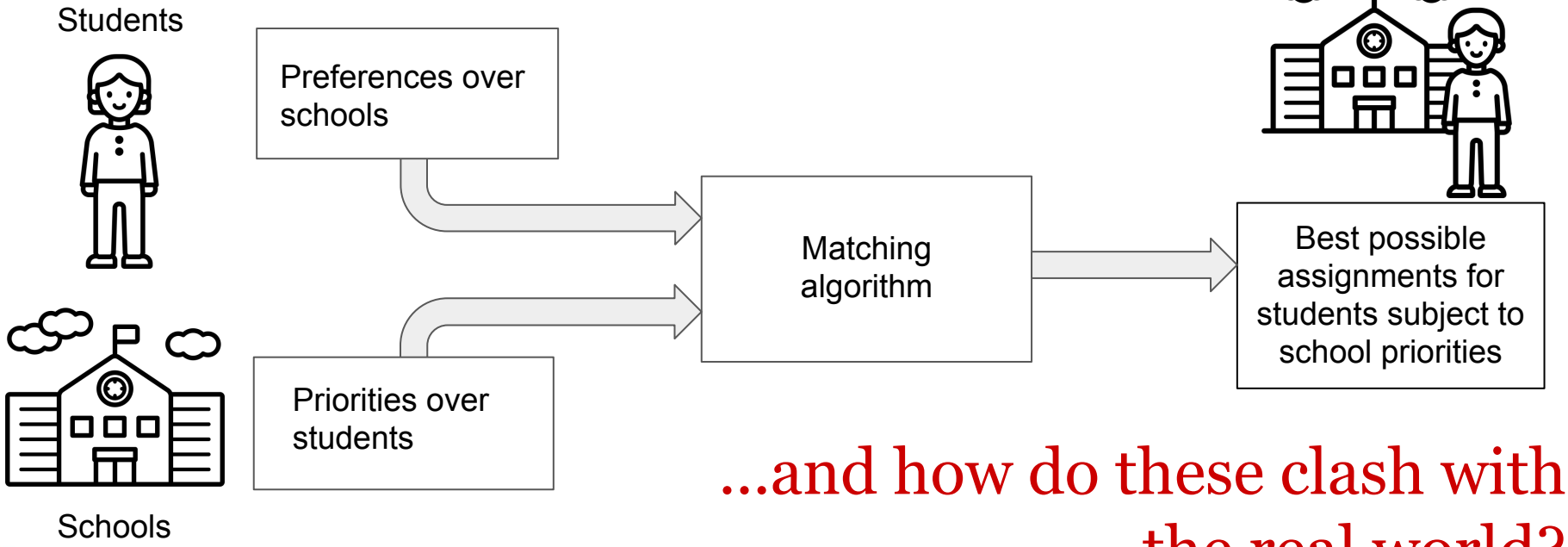
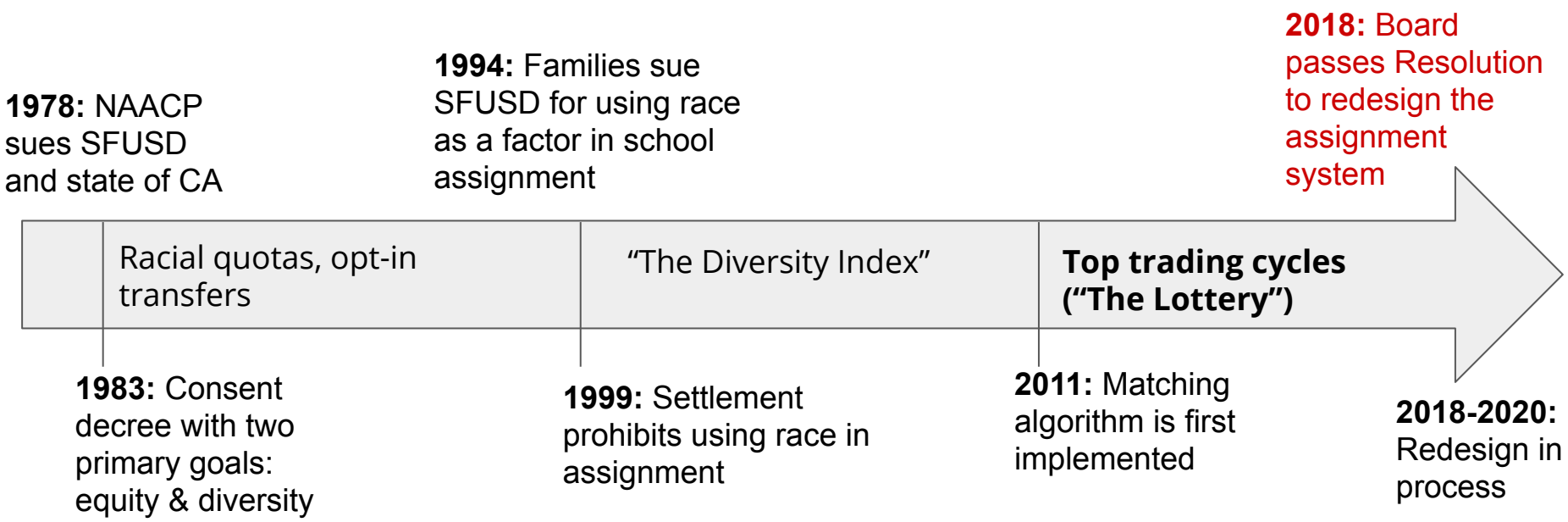


…and how do these clash with the real world?

Case study: San Francisco Unified School District



Research Questions

- What are the goals of student assignment in SFUSD?
- Why *should* their assignment system meet those goals?
  - Theoretical properties of TTC
  - Modeling assumptions about families
- What went wrong?
  - How do those modeling assumptions *clash with the real world?*

Methods

- Qualitative content analysis
  - Semi-structured interviews with SF parents (n=7)
  - Online parent discussions on Reddit
  - SFUSD content (community feedback and official policies)
- Analysis of economics literature to understand theoretical promises
- Exploratory quantitative data analysis
  - 2017 Kindergarten preference and 3rd grade achievement data

What are the goals of student assignment in SFUSD?

- Transparency, Predictability, Simplicity
- Equity and diversity
- Quality schools
- Community & continuity

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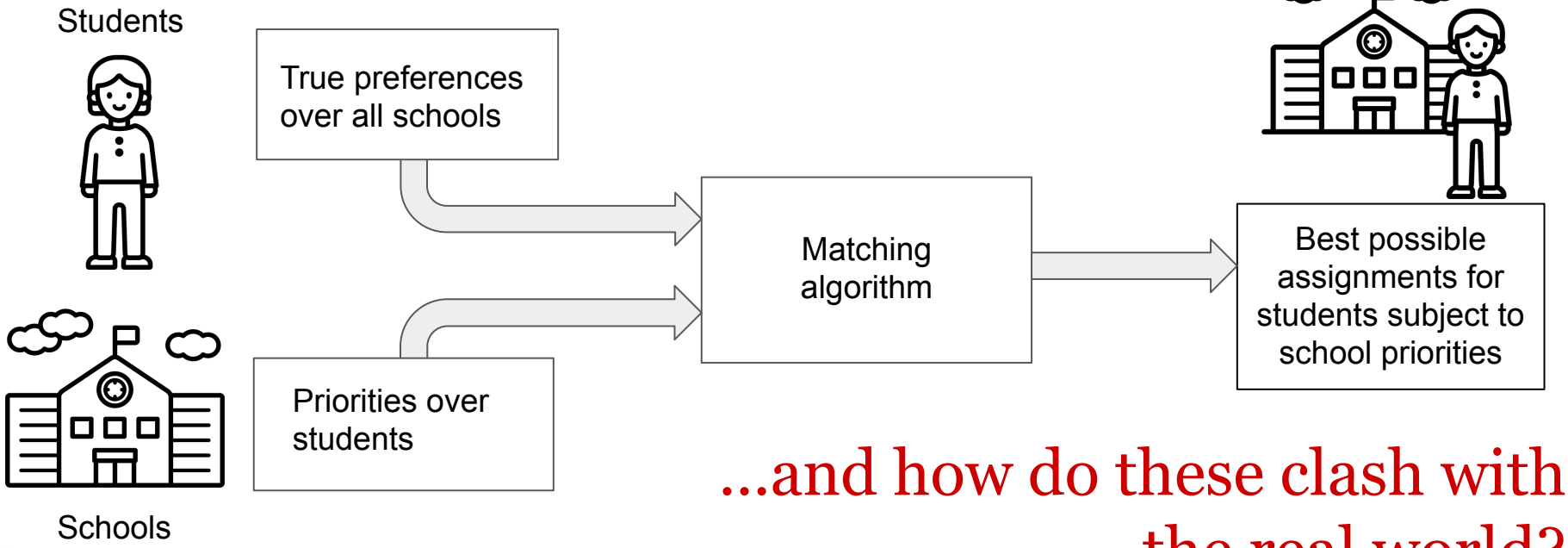


…and how do these clash with the real world?

VALUE: Transparency, predictability & simplicity	VALUE: Equity & Diversity	VALUE: Quality Schools	VALUE: Community & continuity

Students

Schools

Strategy-proof

True preferences over all schools

Priorities over students

Clearly defined, explicit procedure

Matching algorithm

Best possible assignments for students subject to school priorities

Optimizes for student preferences

VALUE: Transparency, predictability & simplicity

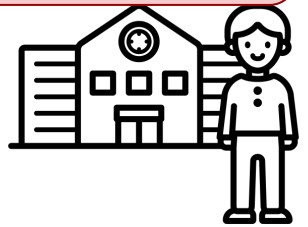
VALUE: Equity & Diversity

I do think that there is a certain group of people who have enough affluence to benefit from the system and get their kids into a better place. (P1)

Students

True preferences over all schools

Distrust → Strategy → perceived inequity



Matching algorithm

Best possible assignments for students subject to school priorities

Priorities over students

Difficult to explain & understand

Perceived randomness & unpredictability

Schools

I'm not really that confident in their actual lottery system. It could be bingo in the background for all I know. (P4)

VALUE: Transparency, predictability & simplicity	**VALUE: Equity & Diversity**	VALUE: Quality Schools	VALUE: Community & continuity

Equal access to all schools

Students

True preferences over all schools

All students can participate

Matching algorithm

Best possible assignments for students subject to school priorities

Schools

Priorities over students

Can prioritize underserved students

VALUE: Transparency, predictability & simplicity	**VALUE: Equity & Diversity**	VALUE: Quality Schools	VALUE: Community & continuity

Students

Barriers to accessing schools

True preferences over all schools

Barriers to participation

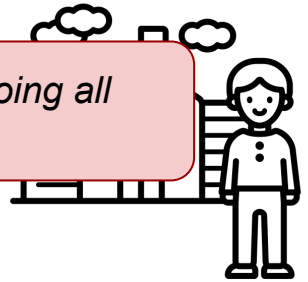
Schools

Priorities over students

Limited impact, Political tension, Can exacerbate stereotypes

Matching algorithm

Best possible assignments for students subject to school priorities



[I]t's like a full time job doing all the school tours. (P7)

So, you are telling me this school is [. . .] three blocks uphill and we're supposed to do that with a kindergartner and no car? (P1)

VALUE: Transparency, predictability & simplicity	VALUE: Equity & Diversity	**VALUE: Quality Schools**	VALUE: Community & continuity

Students

True preferences over all schools

Schools

Priorities over students

Matching algorithm

Best possible assignments for students subject to school priorities

Healthy competition between schools

VALUE: Transparency, predictability & simplicity	VALUE: Equity & Diversity	**VALUE: Quality Schools**	VALUE: Community & continuity

Students

Schools

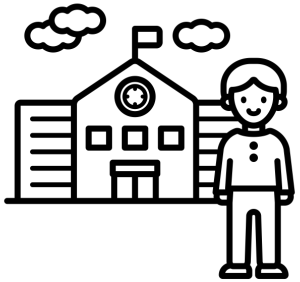
True preferences over all schools

Priorities over students

Matching algorithm

Best possible assignments for students subject to school priorities

Competition driven by social signalling & stereotypes



Difficult to direct resources to under-enrolled schools

[O]ur current choice system creates unhealthy competition between schools, and can have a negative impact on schools' ability to build robust and consistent enrollments. (SFUSD, 2019)

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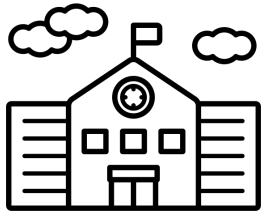
True preferences over all schools



Schools

Priorities over students

Matching algorithm

Best possible assignments for students subject to school priorities

Can prioritize neighborhood students, siblings

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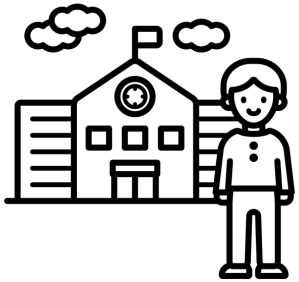
Students

Schools

True preferences over all schools

Priorities over students

Matching algorithm



Best possible assignments for students subject to school priorities

Capacity mismatch, conflict with diversity and equity goals

[The lottery is] great because people get more choices, but for people who just want their neighborhood schools [. . .] it's too stressful. (P4)

VALUE: Transparency, predictability & simplicity	VALUE: Equity & Diversity	VALUE: Quality Schools	VALUE: Community & continuity

Students

All students can participate

True preferences over all schools

Strategy-proof

Clearly defined, explicit procedure

Matching algorithm

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Schools

Priorities over students

Equitable access to all schools; prioritize underserved students

Healthy competition between schools

Can prioritize neighborhood students, siblings

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Barriers to participation

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Barriers to accessing schools

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Difficult to explain & understand

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Capacity mismatch; Political tension

Features of Successful Governance Institutions

- Provide congruent, necessary **information**
- Decentralize and **distribute power**
- Support and encourage **informed deliberation**
- Support low-cost **conflict resolution**
- **Monitor** and stay accountable to outcomes
- Encourage **adaptation** and change

(Dietz, Ostrom and Stern, 2003)

Recommendations

1. Provide **accessible, relevant information**
2. **Balance optimizing** for individual preferences and community-level goals
3. **Define community-level goals** in collaboration with stakeholders
4. Support **informed deliberation of trade-offs**

Thank you!
Questions?

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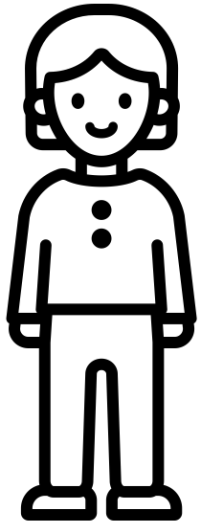
Extra slides



Summary: Results

School District Value	Algorithm's Theoretical Promises	Algorithm's Mental Model of the World	Real World Challenges
Transparency, predictability and simplicity	- Clearly defined and explainable procedure	- Families accept their assignment as fair and legitimate as long as the algorithm is explained - Information / explanation is available - Families truthfully report preferences	- Understanding the system and researching schools is time-consuming and hard - Some parents try to game the system - Lack of trust: perceptions of randomness and unfairness
Equity and diversity	- Any student can apply to any schools - Priority for underserved students	- All families participate - Everyone has identical opportunity to rank any school	- Time, language, economic barriers to participating - Transportation constraints
Quality schools	- Competition drives up overall quality	- Families accurately estimate school quality - Schools can respond to competitive pressures	- Competition driven by social signalling & stereotypes - Lack of resources to respond to pressure
Community and continuity	- Priority for siblings and neighborhood	- Schools have space for siblings and neighborhood students	- Frustrating for those who can't access local schools

Summary: Discussion

Recommendation for Student Assignment Mechanism	Current Assignment Challenges in SFUSD	Features of Successful Governance Institutions
Provide accessible, relevant information	- Difficult to find information about system or schools - Distrust and perceived randomness	- Make information accessible and congruent - Include sources of uncertainty
Balance optimizing for individual preferences and community-level goals	- Assignments satisfy individual preferences - Limited ability to optimize for community-level goals	- Decentralize and distribute authority - Monitor and stay accountable to outcomes
Define community-level goals in collaboration with stakeholders	- Diversity and equity goals contested but inflexible	- Involve stakeholders in informed deliberation - Monitor and stay accountable to outcomes - Encourage adaptation and change
Support informed deliberation of trade-offs	- Priority categories cannot resolve complex political tensions	- Involve stakeholders in informed deliberation - Support low-cost conflict resolution

Are We Governing the Educational Commons?

- Hardin (1968) - The Tragedy of The Commons
  - Resource users are trapped in a commons dilemma
- Ostrom (1990) (and others)
  - Many social groups have managed resources & prevented degradation through self-governance
- Limited resource: Educational Opportunity
  - Everyone wants access; demand > capacity
  - Current arrangement allows certain groups privileged access to the resource
  - Unclear/unpredictable distribution rule → tension, dissatisfaction
  - Distribution requires:
    - Decision making under uncertainty
    - Trade-offs between conflicting human values/interests

General Principles for Robust Governance of Resources

- Provide congruent, necessary **information**
- Support and encourage **analytic deliberation** to deal with conflict
- **Monitor** usage and devise accountability mechanisms
- **Nested**, varied institutional **authority**
- Induce compliance/cooperation
  - **Trust & buy-in**
  - **Social capital & communication**

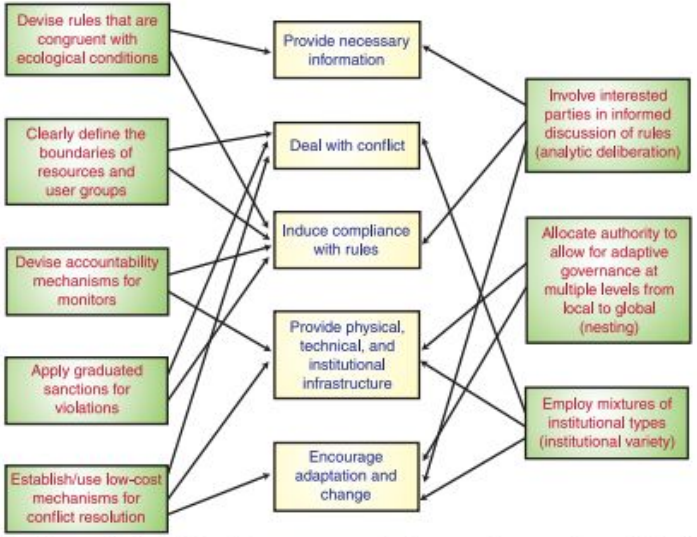


Fig. 3. General principles for robust governance of environmental resources (green, left and right columns) and the governance requirements they help meet (yellow, center column) (*13*, *158*). Each principle is relevant for meeting several requirements. Arrows indicate some of the most likely connections between principles and requirements. Principles in the right column may be particularly relevant for global and regional problems.

(Dietz, Ostrom & Stern, 2003)

Framing the Challenges in SFUSD

Governance Principle	Assignment Challenge
Information	Information acquisition very expensive
Monitoring	Unclear definitions of success
Analytic Deliberation	Tie-breakers are an imperfect and ineffectual compromise Uneven civic engagement
Nested Authority	Significant emphasis on student preferences Tie-breakers have limited impact/control
Communication & social capital	Social learning → Stereotyping/Choice patterns
Trust & Buy-in	Distrust, perceived inequity, strategizing, stress

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Information

Optimization

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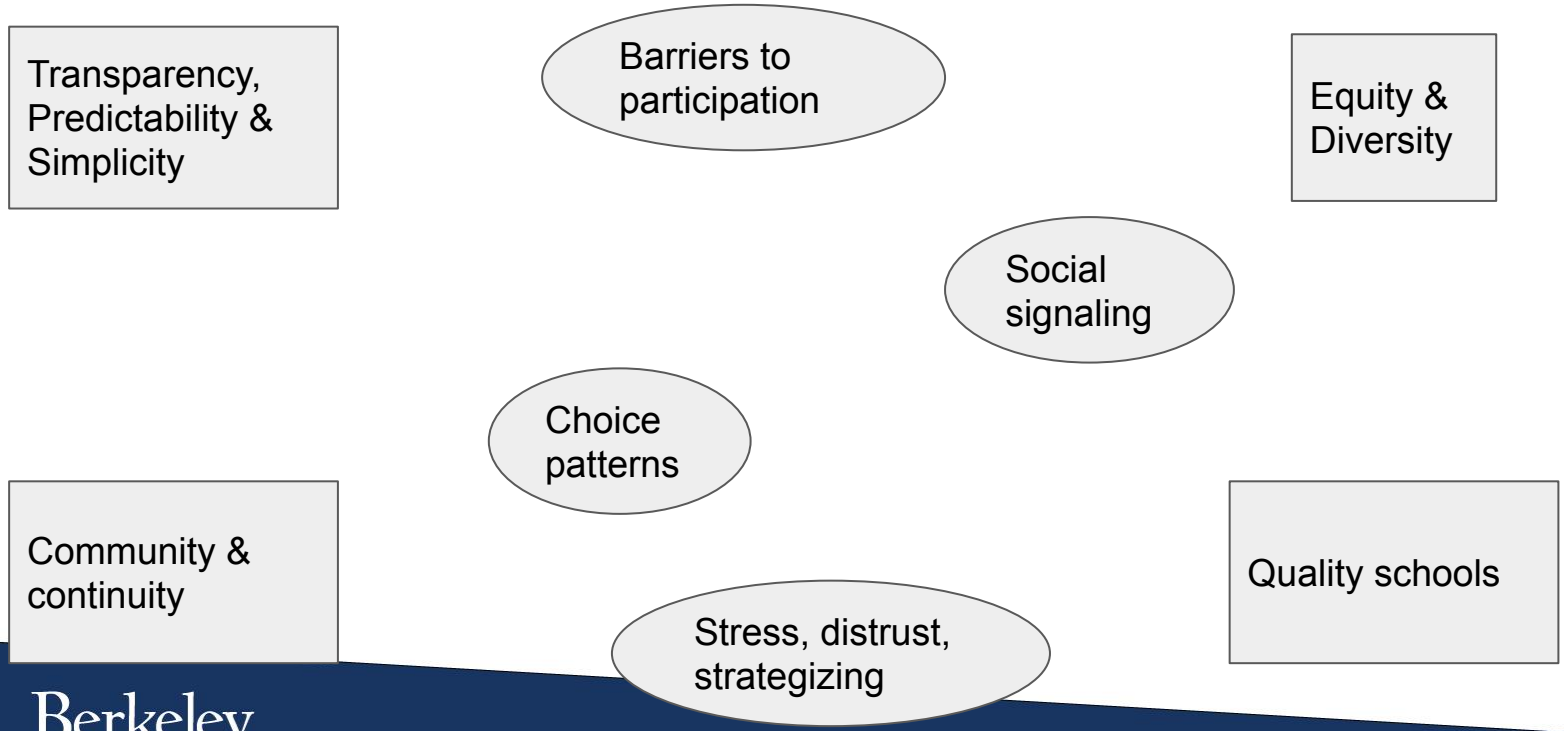
Acknowledgements

I am very grateful for many helpful discussions with staff at Berkeley GSE, SFUSD, OUSD, and OaklandEnrolls.

- Norma Ming
- Henry O'Connell
- Susan Hsieh
- Moonhawk Kim
- Sonali Murarka
- Luis Rodriguez
- Julia Judge
- Lisa Gibesdegac

Results: Unaddressed needs



Mechanism Design Will Fix Everything!

Goal	Why is this difficult or important?	How is mechanism design going to help?
Transparency, predictability, simplicity	Disparities in access to information on schools and enrollment processes	Clearly defined procedure Strategy-proof
Equity & Diversity	Residential segregation Disparities in school quality	Everyone has access to all schools Schools can specify priorities or quotas
Quality schools	Limited funding & resources	Competition should put pressure on underperforming schools to improve Demand data can help district to choose when to open/close schools
Community & Continuity	Mismatch between capacity, neighborhood size, and demand Residential segregation	Schools can specify priorities Transparent reasoning Stability

...or not...

How is mechanism design going to help?	Why didn't this work?
Clearly defined procedure	Everyone is confused about how it works. This is exacerbated by frequent changes to specifics and disparities in information access. The district lacks clear definitions of success and cannot link their goals directly to their mechanism.
Strategy-proof	Distrust in the system leads to strategizing, particularly among the more well-off who have the capacity to do this and tend to be vying for spots at more popular schools. This exacerbates distrust and perceived inequity.
Everyone has access to all schools	There are barriers to participation of all kinds: informational and transportation/financial are the biggies. Language may also be significant. For minority students, particularly Latinx and African American, they may face discrimination or isolation at majority White and/or Asian schools.

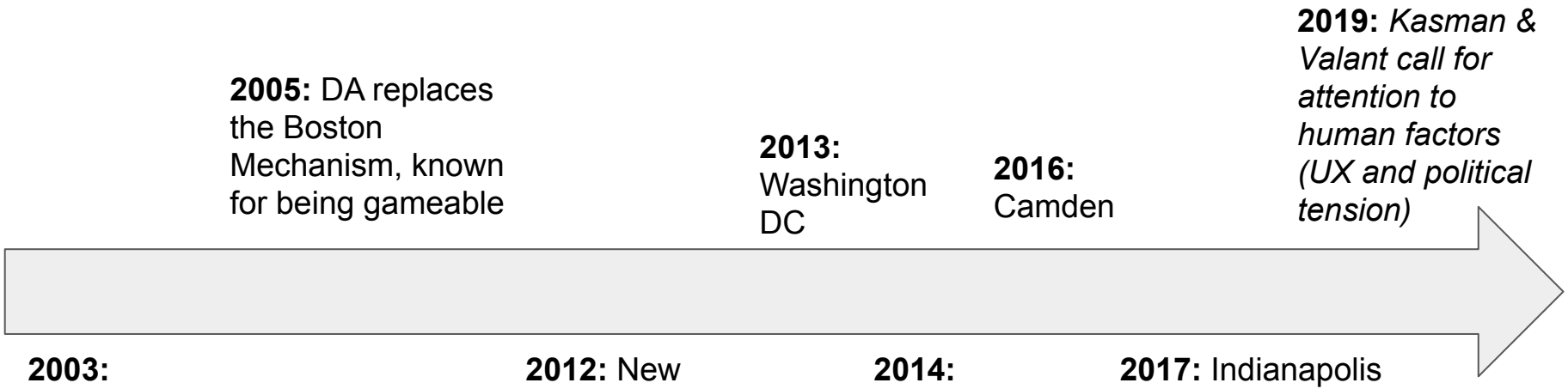
...or not...

How is mechanism design going to help?	Why didn't this work?
Schools can specify priorities or quotas	Quotas are legally difficult. Priorities are limited in their ability to achieve distributional goals (sibling priority makes sense, but CTIP1 priority is limited if CTIP1 parents only list schools close to home, for example).
Competition should improve school quality and help target resources	Competition is often driven by social signaling and stereotyping rather than actual value-added. It can instead exacerbate stereotypes and harm underperforming schools. The district is concerned about helping under-enrolled schools, not closing them. Under-enrollment is correlated with racial demographics, so simply closing these schools is not an option.
Stable outcomes	Unclear whether this is perceived as fair or not, or even perceived at all.

Glossary

- **SFUSD, the district** = San Francisco Unified School District
- **The lottery** = The process by which students or parents submit preferences and are assigned to schools. May refer to the whole process or the algorithm itself
- **Tie-breaker** = a priority category at a school (e.g. sibling, AA, CTIP1)
- **AA** = attendance area
- **CTIP1** = the areas of the city with schools in the lowest quintile of academic achievement, used as a proxy to give low income students priority

A Brief History of Mechanism Design for School Choice



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What are the current challenges?

Families:

- Barriers to participation
  - information, time, language
- Demand > Capacity
- Stress & unpredictability → distrust, strategizing

The District:

- Segregated choice patterns
- Limited resources
  - esp at under-enrolled schools
- Neighborhood size > Capacity
- What does success look like?

Information | Monitoring | Analytic Deliberation | Nested authority | Communication and social capital | Trust and buy-in

Barriers to participation

Students

Distrust → Strategy → perceived inequity

True preferences over all schools

Segregated choice patterns

Difficult to explain & understand

Matching algorithm

Capacity mismatch, conflict with D&E goals

Priorities over students

Political, limited impact, can exacerbate stereotypes

Schools

Perceived randomness & unpredictability

Best possible assignments for students subject to school priorities

Competition driven by social signalling & stereotypes

Difficult to direct resources to under-enrolled schools

VALUES

Transparency, predictability & simplicity

Equity & Diversity

Quality Schools

Community & continuity

CHALLENGES

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GOVERNANCE PRINCIPLES

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Monitoring

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Communication and social capital

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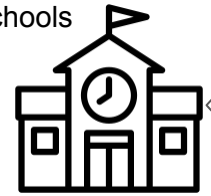

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Open Questions

What information? How?

Informational Needs

- Accessible information about school choices
- Outreach & recruitment
- Focus on relevant algorithmic details: e.g. predictability/uncertainty

Optimization Needs

- Explicitly optimize district goals
- Clearly defined and flexible metrics of success
- Active deliberation of trade-offs (e.g. neighborhood vs. diversity; diversity vs equity) at low involvement cost

Community Needs

- Develop trust in District
- Combat harmful stereotypes of underserved students & schools

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What details are relevant? How to explain?

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How to design for low cost engagement?

How to engage stakeholders in algorithm design?

Community Needs

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- Combat harmful stereotypes of underserved students & schools