Assessing theories and mechanisms in sociology:
Insights from empirical studies on segregation, education, fertility, and class

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Science is messy, and the results of research
rarely conform fully to plan or expectation.

- Editorial in Nature Human Behaviour (2020)

Preface on the writing of this thesis

An editorial in Nature Human Behaviour (2020) provides some ideas that are worth sharing:

> *The current research culture is characterized by significant pressure to present research projects as conclusive narratives that leave no room for ambiguity or for conflicting or inconclusive results. The pressure to produce such clean narratives, however, represents a significant threat to validity and runs counter to the reality of what science looks like.*

When I first started working on this thesis, my project was entitled 'Unpacking social mobility. Using natural experiments to study the causes and mechanisms driving intergenerational mobility and persistence'. It was supposed to be a thesis using quasi-experimental methods to test central sociological theories on why people tend to resemble their parents in terms of socioeconomic outcomes, such as income, education, class, and occupation.

The result is somewhat different. The thesis does retain much of the focus on processes of intergenerational social mobility and persistence, clearly represented by two of the articles, but the scope is also broader. The thesis is about the empirical assessment of sociological theories and theoretical mechanisms in a wider range of fields, and how this can be done drawing on appropriate data and methods.

This thesis does not provide a clean narrative, or a coherent story based on a central theoretical framework. It also contains a lot of ambiguity, and many null findings and inconclusive results. What it does provide is five articles bound together by a common philosophical and analytic approach to social science, sociological theory and research methods. Each article is grounded in critical rationalism and the counterfactual approach to causality and causal inference, and each of them attempts to test or assess sociological theories and mechanisms by applying solid methods to high-quality data.

The writing of this thesis has been affected by two crises. The first crisis was global. During the pandemic, I struggled a with concentrating and maintaining progress. I also ran into data related issues as I realized I would have to do a lot more tedious data collection than I anticipated in order to properly exploit the college expansion reforms of the 1960s to 1990s. This, in combination with personal issues exacerbated by the pandemic, caused serious delays in my work. The result was that I had to abandon some of my ambitions but very labor-intensive plans with regards to social mobility studies and focus more on college expansion reforms. The second crisis was personal. My then-partner left me in January of 2023, after 13 years. With only four months left of my position, and five articles left to complete, the last few months have been an uphill struggle. But now it's done.

Summary

How can we assess theories and test theoretical mechanisms in sociology and the social sciences? This thesis presents five articles attempting to answer difficult sociological research questions using methods drawn from economics and behavior genetics, to assess theories and proposed mechanisms in the sociological research literature. These relate to the effects of segregated schools on native flight, the impact of local educational institutions on gender equality, social mobility and fertility patterns, and the role of genetic heritability in processes of class attainment. The articles represent a common approach to social science; critical rationalism, combined with the counterfactual approach to causality and causal inference, and a critical approach to theory.

All articles combine the use of high-quality population-wide administrative register data with other, new, or less common data sources, and they are written with the aim of making valuable, though incremental contributions to ongoing debates in sociology, by confronting sociological theories with new research questions, new data, and new methods.

Article 1 studies one of the potential causes of residential segregation and school segregation; native flight, and specifically addresses the question of whether out-mobility among native parents with young children, from neighborhoods with high concentrations of ethnic minority residents, may in part be driven by characteristics of schools.

Several theories attempt to explain patterns of ethnic or racial neighborhood segregation and school segregation. One of these is the theory of white or native flight. Essentially, this theory suggests that members of the ethnic or racial majority population respond to high or increasing proportions of minorities in schools and neighborhoods by moving out, thus exacerbating segregation patterns. Previous studies have documented such patterns of residential mobility in both the US and Europe. Some of these studies point to parents of young children as particularly prone to move out of neighborhoods with a high minority concentration, suggesting that school choice plays an important role.

To assess this mechanism, we employ a geographic regression discontinuity design to highly detailed geographic data on families' place of residence in relation to school catchment area boundaries. The individual-level data are drawn from administrative registers and linked to geocodes for place of residence. These geocodes provide fine-grained information on place of residence. We sample residents in the municipality of Oslo who have children aged 2-5, belong to the native majority population. We also use data on school catchment area boundaries obtained from the Municipality of Oslo.

Studying families who reside near school catchment area boundaries allows us to then study statistical neighbors who reside in similar neighborhoods, but on different sides of the school catchment area boundary of their local schools. With some assumptions, this allows us to estimate the effect of local schools with high minority concentrations on out-mobility among native families.

Along the borders of schools with the largest differences in the minority concentration (the top quartile), we find a 7-percentage point higher probability of moving out in a given year on the side of the border that has the highest minority concentration at the local school. Given a baseline out-mobility rate of 19 %, this effect is quite substantive. Our results suggest that local schools play an important role in producing patterns of native flight.

Articles 2-4 can be seen as one 'project' using the same research designs and data to investigate the impact of major educational expansion reforms that took place in Norway between 1969 and 1993. These reforms provided better educational opportunities for broad segments of the population and had a major impact on higher educational attainment. These and similar educational expansion reforms in other national contexts coincided with major societal changes in many different areas, such as increased gender equality, increased absolute educational mobility and the reduction in fertility levels following the post-war baby boom. They have therefore been central in many sociological theories explaining such trends.

These articles focus on the local impacts of these reforms, by studying the establishment and institutional upgrading of educational institutions. The main methodological issue associated with studying the impact of local educational institutions is that the localization of colleges is not random but may be systematically related to characteristics of the local population. Additionally, people may move selectively to attend college, which may bias results in naïve estimation strategies. To overcome these issues, and a set of quite technical and intricate issues related to comparisons with already-treated units in differences-in-differences designs with multiple treatment groups and time periods and potentially dynamic and heterogeneous treatment effects, we use a type of event study models that can produce unbiased estimates in research designs like ours. Essentially, we study whether the establishment or institutional upgrading of such institutions affected cohorts in the local population that reached college attendance age after a local educational institution was established, relative to older cohorts, and relative to regions where no such changes occurred.

In doing so, we use administrative register data covering the full birth cohorts 1950-1974. In addition, we have collected detailed data on the establishment, institutional upgrading, and growth of approximately 200 higher educational institutions in Norway. These allow us to identify with high accuracy who had access to post-secondary, non-tertiary, or tertiary educational institutions locally during the period we study, and when the establishment or upgrading of such institutions occurred. Linking these two data sources by municipality codes then allows us to study the impact of the establishment of educational institutions, and of the upgrading of such institutions to college status.

Article 2 uses these reforms to study the impact of local college institutions on educational attainment among young men and women, and to assess whether the opening of local colleges was an important factor contributing to the reversal of the gender gap in educational attainment. It also assesses whether local colleges offering educations in specific fields of study impacted gendered field of study choices and thus horizontal gender segregation in higher education.

The results suggest that the establishment and institutional upgrading of such institutions had little impact on educational attainment in the local population. Such effects were small and non-significant for women, and practically zero for men. Studying the impact of local field of study opportunities on field of study choices, we also find that local colleges did not shift individuals between fields of study, and thus that they also did not impact on gender segregation patterns in higher education. Overall, our findings point to the conclusion that although the aggregate student capacity was a prerequisite for increases in educational attainment in this period, the location of colleges mattered very little. We discuss the policy implications of these findings.

Article 3 uses these reforms to study the impact of local college institutions on intergenerational educational mobility. Despite large increases in educational attainment, and thus absolute educational mobility in this period, evidence on the impacts of such reforms on relative mobility is mixed. Researchers have found some increases in relative mobility in Scandinavian countries, but large inequalities in educational attainment persist.

Educational expansion reforms like those studied here have been central to sociological research and theorizing on intergenerational persistence in educational attainment and class positions, and several theoretical mechanisms have been proposed as explanations for why inequalities in educational attainment persist in spite of substantial improvements in educational opportunities.

Prior sociological studies have mostly focused on studying aggregate trends in educational expansions and mobility, and have not investigated the role of local educational institutions in these processes, nor used research designs suitable for causal inference. Additionally, effects of educational expansion reforms may be stronger at the local than national level.

The results suggest that the establishment and institutional upgrading of local post-secondary, non-tertiary and college institutions did not substantively impact the educational attainment of any social origins group, relative to regions where no such changes occurred, and thus that these institutions did not impact on

educational mobility locally. I further discuss potential explanations for persisting inequalities in educational attainment, including explanations drawn from sociology, economics, and behavioral genetics.

Article 4 studies the impact of the same higher educational expansion reforms on fertility and family formation patterns. Higher educational attainment among women has been seen as a key factor to explaining the drop in fertility levels following the post-war baby boom, together with changing gender norms, female emancipation, and increased female labor market participation. Both theory and empirical research in sociology, demography, and economics links higher education to postponement of childbearing and reductions in preferred family size among women.

This article assesses whether the establishment of local educational institutions may have affected fertility, measured by cohort fertility at age 40, and age at childbearing, effectively indicating both postponement and childlessness. We also assess whether the establishment of educational institutions impacted on age at marriage, as partnership formation is potentially an important mechanism linking educational institutions and fertility outcomes.

We find no evidence that these institutions affected completed fertility by age 40, age at birth, nor age at marriage. Although increasing educational attainment may have been an important factor in driving the fertility decline in this period, our results suggest that access to local educational institutions was not.

Article 5 investigates whether classical sociological theories are correct in asserting that social origins is an important factor important for class attainment, and that mechanisms linking family background to class attainment are primarily social.

The background for writing this article is that several different sociological theories explain class and occupational status outcomes in terms of social origins and social mechanisms of transmission. These theories differ with regard to which aspects of social background they see as important and which mechanisms are the most salient, but do not incorporate genetic heritability as a partial explanation of variation in class and occupational status outcomes.

Recent evidence from studies using various genetically informed research designs has generally found that much of the intergenerational associations in socioeconomic outcomes is due to selection effects, or that genetic heritability plays an important role in explaining variation in such outcomes. However, such studies have not used sociological class-based indicators of social positions, and few have engaged directly with classical sociological theories of class mobility and reproduction. We argue that results from genetically informed studies may also be directly relevant for theory and research based on class schemes.

To assess this, we estimate twin-based ACE models to examine how much of the variation in people's attained class position can be attributed to environmental factors shared by twins (C), unshared environmental factors (E), and additive genetics (A), using three different operationalizations of class and a scale measuring occupational prestige.

Our results suggest that about 50% of the variation in class positions can be ascribed to unshared environmental factors (E). Genetic factors (A) explain approximately 40% of the variation. The shared environment (C, which we argue captures the impact of social origins) explains around 10%. We discuss what implications our results, and results from similar studies, may have for sociological theory and research on social mobility and reproduction.

Good tests kill flawed theories;
we remain alive to guess again.

- Karl Popper[1]

1. Introduction: The topics of the thesis

What binds the articles in this thesis together is that they all represent the same underlying philosophical approach to social science; critical rationalism following non-dogmatically in the tradition initiated by Karl Popper (1934), combined with the counterfactual approach to causality and causal inference (see for instance Angrist & Pischke, 2009; Morgan & Winship, 2015). They represent attempts at making incremental steps towards a better understanding of social processes though solid empirical work and a critical approach to theory. They do this in different ways.

Article 1 is about native flight and school segregation, using data on school catchment area boundaries. Here, we use quasi-experimental methods to assess whether native parents respond to characteristics of schools by moving away from schools with high concentrations of ethnic minority students – a potentially important mechanisms in producing patterns of ethnic segregation in schools and neighborhoods.

Three of the articles can be seen as one 'project' using the same research design and data, investigating the impact of major educational expansion reforms on a variety of outcomes. **Article 2** studies gender equality and gender segregation in higher education, **Article 3** studies educational mobility, while **Article 4** studies fertility and family formation. Several different theories in sociology concern the impact of such reforms on these outcomes. One important way in which such reforms may have an impact, is by providing better educational opportunities locally. These articles assess the importance of this mechanism.

Article 5 is about genetic heritability and class attainment. This article attempts to assess sociological theories on class mobility by investigating the role of social environments and genetic heritability in processes of class attainment.

The articles differ in that they cover different topics, assess different theories, use different methods, and rely on different data sources linked to administrative register data. Despite this, they have some general themes in common that I will elaborate on below, but that I begin by briefly mentioning here:

- **Contributions to ongoing debates.** All articles aim at making a valuable, though incremental contribution to ongoing debates in sociology by confronting sociological theories with new research questions, new data, and/or new methods.
- **Solid data.** All articles use high-quality population-wide administrative register data. All of the articles also combine such data with other new or less common data sources (geocodes and catchment areas, historical data on educational institutions, and zygosity data).
- **Cross-disciplinary.** All articles combine data, methods and/or theories from different disciplines to generate new insights and shed new light on sociological theories and research questions.
- **Counterfactual approach to causality.** Articles 1-4 use methods and research designs that, conditional on their identifying assumptions, allow us to draw inferences about causality and test theoretical claims about causal effects. While article 5 takes a different approach to evaluating theories, it adheres to the same principles.
- **Popperian paradigm.** I believe that science, including the social sciences, gradually advances through trial and error, by coming up with new theories and hypotheses about the world, testing them, rejecting or revising those that do not hold up to empirical scrutiny, and tentatively keeping

[1] This quote is attributed to Karl Popper online (https://en.wikiquote.org/wiki/Karl_Popper) but I have not been able to confirm the original source. It doesn't matter. It's a good quote, no matter who formulated it. As the great man Karl Popper himself said, "[…] we must break with the habit of deference to great men" (Popper, 2020: preface to the first edition)

those that do. Or, at least, that this is the ideal that we should strive towards[2]. My goal is that that the articles in this thesis should reflect this attitude.

- **Critical approach to theories.** None of the articles are written with adherence to a specific theoretical framework or in support of a specific theory. Rather, they critically and empirically test or assess different theories and mechanisms on a wide variety of topics.

All articles relate to core topics in sociology – migration and ethnic segregation, gender equality, educational mobility, social demography and class and family background. They also have in common that they all concern how individuals respond to their circumstances, and how people make choices in various domains. Article 1 addresses how families respond to characteristics of local schools, and how these affect families' decisions to move or stay. Articles 2-4 address how individuals respond to changes in educational opportunities, and how such opportunities affect individuals' educational choices and their decisions regarding family formation and childbearing. Article 5 focuses more on what aspects of our family background shape us in ways that are important for understanding opportunities, traits and choices that impact socioeconomic outcomes.

Table 1 summarizes the articles in terms of the data and methods they use, what disciplines they draw theory and methods from, and whether the articles should be seen as hypothetico-deductive or explorative. A common theme is that they use methods drawn from other disciplines (economics and behavioral genetics) to confront sociological theories. Most of them specifically use quasi-experimental methods to assess causal mechanisms.

Figure 1 provides a more thematically oriented overview. Articles 1-4 all relate to education and educational institutions and use geographically informed data and quasi-experimental methods to draw inferences. Education is a central mechanism in Article 5 as well, but it is not directly included in the analyses. As mentioned, articles 2-4 are drawn from the same project, but study different outcomes. In articles 2 and 4, gender is a central topic. Articles 2, 3 and 5 relate to socioeconomic outcomes and inequalities, while articles 3 and 5 relate specifically to social or educational mobility and persistence (gender is important here, too, but plays a less central role).

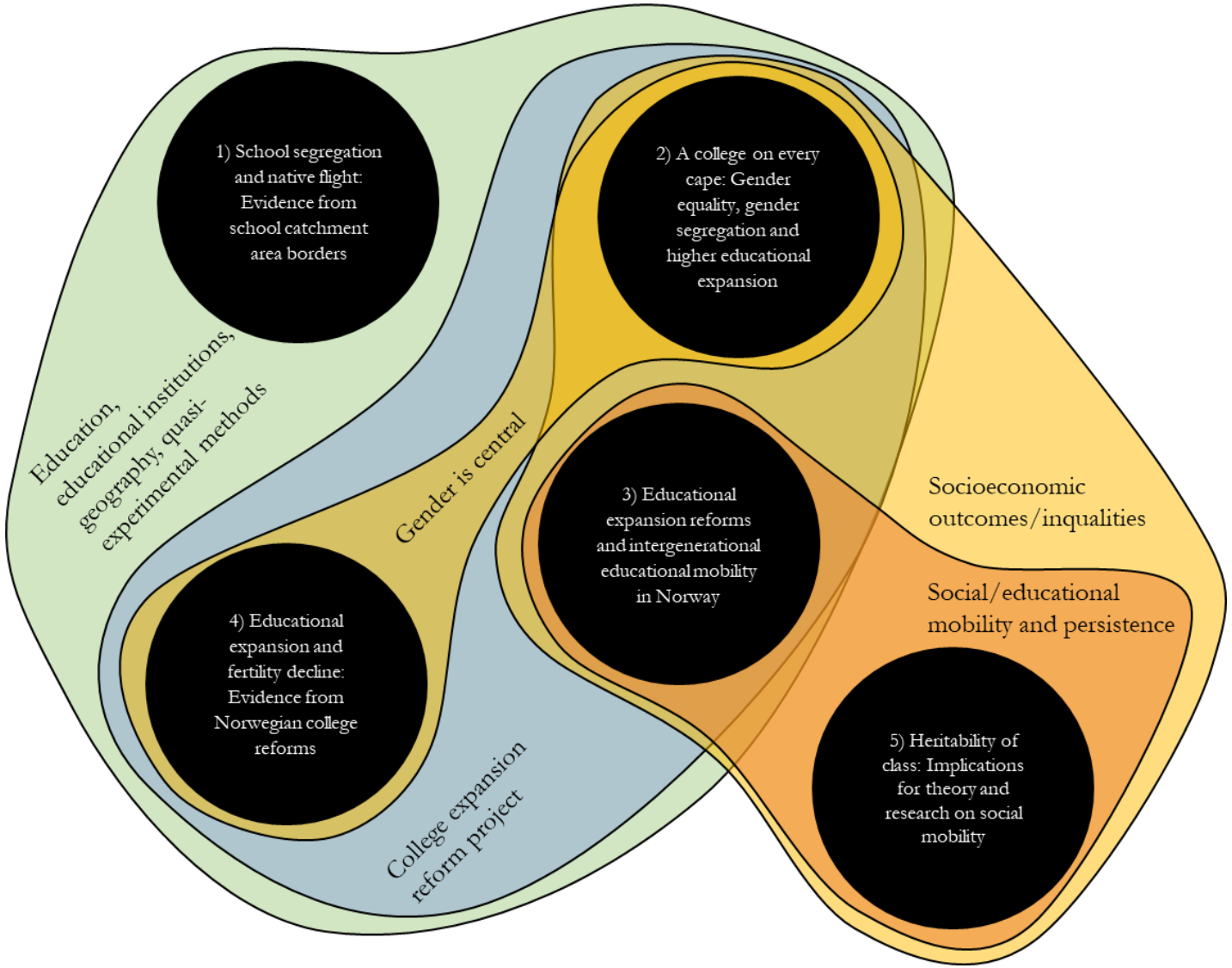
I use the remainder of this introduction to explain and discuss some of the principles and ideas relating to practical research and philosophy of social science that have been important to my work, and how they relate to the articles in this thesis. In doing so, I do not spend a lot of space elaborating on nuances, following Healy (2017), but rather try to be explicit about my position in a way that is relevant to understanding the overall framework of the thesis. The goal is to discuss what I see as some of the important shortcomings in sociological theory today, to discuss what I believe constitutes good theory, and discuss some principles on how explanatory theories in the social sciences can be evaluated and tested empirically. In doing so, I draw on examples from different fields, but primarily from theories on inequality, social mobility and segregation.

[2] I've always thought of the Popper/Kuhn debate as a false dichotomy. The debate resolves if we read Kuhn (2012 [1962]) as descriptive – he describes science as it usually, and unfortunately is, and read Popper as normative – he describes science as it ideally should be.

Table 1: Summary of articles

Article ***Authors***	**Data**	**Theory drawn from what discipline**	**Main method**	**Method drawn from what discipline**	**Explorative or deductive**
1) School segregation and native flight: Evidence from school catchment area borders *Adrian Farner Rogne, Solveig Topstad Borgen, Erlend Nordrum*	Registers, geocodes and catchment areas	Sociology	Geographical regression discontinuity (Quasi-experimental)	Geography and econometrics	Deductive
2) A college on every cape: Gender equality, gender segregation and higher educational expansion *Adrian Farner Rogne, Tora Kjærnes Knutsen, Jørgen Modalsli*	Registers and historical sources	Sociology	Difference-in-differences (Quasi-experimental)	Econometrics	Deductive
3) Educational expansion reforms and intergenerational educational mobility in Norway *Adrian Farner Rogne*	Registers and historical sources	Sociology, economics, behavioral genetics	Difference-in-differences (Quasi-experimental)	Econometrics	Deductive
4) Educational expansion and fertility decline: Evidence from Norwegian college reforms *Adrian Farner Rogne, Agnes Fauske, Rannveig Kaldager Hart*	Registers and historical sources	Sociology, demography, economics	Difference-in-differences (Quasi-experimental)	Econometrics	Deductive
5) Heritability of class: Implications for theory and research on social mobility *Arno Van Hootegem, Adrian Farner Rogne, Torkild Hovde Lyngstad*	Registers and twins/ zygosity	Sociology, behavioral genetics	Variance decomposition (Twin study)	Behavioral genetics	Explorative with deductive ambitions

Figure 1: Thematic and methodological overlap between articles



All theories are wrong,
but some are useful

- Paraphrasing of Box and Draper (1987: 424)

2. Theories

2.1 Evaluating theories

Let me first begin by elucidating what I mean by 'theory'.

There are different understandings of what is meant by the word 'theory' in sociology. For instance, to some sociologists, theories are perspectives on the social world. They are sets of glasses that you can put on to see and understand the social world from a different angle or in a different light. In this way, theories represent worldviews. To others, the word 'theory' may represent the writings of theoreticians, or hermeneutical interpretations. Abend (2008) identifies no less than seven different understandings of what the word 'theory' might mean or refer to in sociology. And there may be more. In some meanings of the word, theories are usually neither testable nor rejectable, and proponents of theories of this kind often do not claim that they are 'true' or 'accurate,' but might argue that they are 'interesting' or 'valuable'.

When I write about theories here, I use 'theory' in the meaning of 'explanation'. This corresponds with the definition by Swedberg (2014: 17) who sees theory as a "statement about the explanation of a phenomenon". They are theories about processes, mechanisms, and causality. Such theories are often, but not always, testable, or rejectable. If they are not, it is because testing them is difficult, impractical, or unethical, not because it is, in principle, impossible. In the words of John Goldthorpe (1996; 481-2);

> "A sociological theory is of value to the extent that it can provide an account of how established social regularities come to be as they are – and to the extent that, through the wider implications it carries, it remains open to further empirical test."

Such theories may range from simple statements to complex frameworks, and they may be stated at different levels of abstraction. As such they need not always be of the middle-range (Hedström & Udehn, 2011). Some may be very small. I'll use some examples related to articles in this thesis.

Assume, for instance, that researchers have observed a pattern where native families systematically move away from neighborhoods with high concentrations of ethnic minorities (they have). A simple theory could be a statement such as *'one reason why native families systematically move away from neighborhoods with high concentrations of ethnic minorities is that local schools have high concentrations of ethnic minority students'*. This explanation is simple, in the sense that it only deals with one cause and one outcome, and it does not attempt to explain all variation in the outcome – only a part of it. It is also fairly abstract; in that it does not go into the psychological mechanisms that are potentially at work – why would the concentrations of minority students affect native families' propensity to move? It could be due to prejudice, concerns over the learning environment, or other concerns that the student composition might be perceived as a proxy for. It also takes the terms and categorizations as a given.

A more complex theory could be Golthorpe and colleagues' theories explaining observed patterns of intergenerational mobility and persistence (see for instance Breen & Goldthorpe, 1997; Bukodi & Goldthorpe, 2022; Goldthorpe, 1996; Jackson et al., 2007). This theoretical framework involves many different mechanisms explaining patterns of mobility between various educational levels and class positions. Mechanisms include rational action and relative positions, upper-class closure and opportunity hoarding, primary and secondary effects in education and much more. Complex theories are difficult to test as a whole, but researchers may test specific parts of them. In doing so, each mechanism may be seen as a more simple theory; *'individuals and families act rationally to avoid downward social mobility'*.

When evaluating explanatory theories, it is important to consider how *accurate* they are, how *relevant* they are, and how *clear* they are. Some theories may also be judged by how *predictive* they are (Friedman, 1953), but that is another story.

In this thesis, articles 1-4 provide tests of the accuracy of several causal explanations ('does x really cause y?', or 'how big is the effect of x on y?'). Article 5 provides a test of the relevance of a set of causal explanations ('how much of the variation in y can potentially be explained by the sum of x_1, x_2 and x_3?'). This thesis does not contain examples of assessing the clarity of a theory.

A central point made by Swedberg (2014), and others discussing how to develop theory is that we should put more effort into developing new theories; that theorizing and developing new theories should be central to sociological research. On this point, I disagree. It is not a big problem in sociology and the social sciences that we have too few theories and need more. Rather, I see it as a problem that we have too many, and that we, as a discipline, develop new theories at a faster pace than we are able to evaluate and test them.

Sociology and other social sciences have produced a large number of explanatory theories on all sorts of topics. Some of these are 'competitors' in the sense that they provide competing explanations for the same phenomenon, and their respective proponents may claim that one theory has explanatory priority over others. Other theories are far from mutually exclusive but offer complimentary explanations for the same phenomenon. Let me provide two examples.

Many theories aim at explaining patterns of residential segregation. The list of theories includes, but is not limited to, complex theories such as the spatial assimilation model (Massey & Denton, 1985), the place stratification model (Pais et al., 2012), the invasion-succession model (Lee, 2015), or the Schelling model (Schelling, 1971), and more simple or context specific explanations focusing on discrimination and racial steering (Pager & Shepherd, 2008; Pearce, 1979), the formation of ethnic enclaves (Wilson & Portes, 1980), neighborhood preferences (Clark, 2002; Emerson et al., 2001), White/native flight and avoidance (Crowder, 2000), market forces, zoning and regulation policies (Musterd, 2005; Myhre, 2017), and politically imposed segregation (Christopher, 2001). Many of these explanations can be complimentary in a given context. For instance, segregation patterns in a city can be affected by both the formation of ethnic enclaves, White/native flight and avoidance, and market forces at the same time, and some such explanations may be relevant for explaining the residential patterns of different subsets of the population.

Similarly, the field of social mobility research has produced a large number of theories attempting to explain intergenerational mobility, and, more importantly, intergenerational persistence. Important theoretical frameworks in this field include the status attainment tradition (Blau & Duncan, 1967; Treiman & Terrell, 1975), the neo-Weberian traditions (Breen & Goldthorpe, 1997; Bukodi & Goldthorpe, 2022; Goldthorpe, 1996; Scott, 2014), the neo-Marxist tradition (Western & Wright, 1994; Wright, 1994; Wright, 2000), the Bourdieusian tradition (Bourdieu, 1986; Bourdieu & Passeron, 1990; Flemmen et al., 2017; Friedman & Savage, 2017), and several others. Each theoretical framework points to different factors explaining why people tend to resemble their parents in terms of socioeconomic outcomes. These theories have considerable overlap in what mechanisms they invoke as salient in explaining intergenerational reproduction (Wright, 2015). All consider individual-level traits, acquired through some form of socialization process, and their impact on education and destinations. The neo-Weberian tradition additionally emphasizes rational action, relative positions, and closure, exclusion, and opportunity hoarding from the upper classes. The neo-Marxist tradition adds ownership and exploitation to the mix, while the Bourdieusian tradition additionally considers cultural domination, symbolic violence, forms of capital and cultural tastes and distinctions.

For each of these fields, and numerous others, we should, at least *in theory*, be able to evaluate the merits of these theories based on the criteria mentioned above. In doing so, it is difficult to treat the theories as a whole, but we can focus on specific aspects of them and consider the specific mechanisms they emphasize. I will illustrate this primarily by drawing on theories about intergenerational mobility.

No scientific claim,
irrespective of research method or theoretical tradition,
stands outside of the demand for falsifiability

- Tak Wing Chan (2019)

2.2 Accuracy

The most important criterion for evaluating an explanation is to assess whether it provides an accurate or valid account; is it true? An explanation usually builds on some assumptions and proposes one or more mechanisms that explain the phenomenon in question. Such mechanisms are often causal, but in my view, they don't have to be. The task is to assess whether the assumptions it builds on hold, or whether the mechanisms it proposes are actually the ones producing the phenomenon in question.

The neo-Weberian framework developed by Goldthorpe and his colleagues to explain patterns of intergenerational social mobility and persistence provides a good example. It asserts, among other things, that individuals and families will aspire to avoid downward mobility and, if possible, attain upward social mobility relative to their origins. It further asserts that individuals and families will act rationally to attain their goals, and that the choices they make and the opportunities they face are contingent on their relative position in the social hierarchy. An evaluation of this theory might start by asking whether this is an accurate description of individuals' and families' goals and ambitions, and of their perceptions and modes of action.

In doing so, we can start by considering how well it fits with the data. Based on the theory, we can draw predictions and assess whether these predictions are reasonably accurate. The theory does fit fairly well with observed patterns of intergenerational mobility and persistence (Bukodi & Goldthorpe, 2022). This should be expected, since the theory has been developed over several decades specifically to understand such patterns, and with a strict adherence to the notion that theories should be empirically informed and tested (Goldthorpe, 1996). But the fact that the theory fits with the observed patterns is not in itself evidence that the theory is accurate, only that it produces accurate predictions. Other theories could also fit with the observed patterns.

To more fully evaluate a theory, we must go beyond assessing whether it fits with the data and assess whether the assumptions it builds on hold. Applying this theory to explain observed patterns of intergenerational persistence requires that the researcher makes some (usually implicit) assumptions about individuals and their goals and beliefs about the world. Specifically, asserting that *individuals and families aspire to avoid downward mobility and, if possible, attain upward social mobility relative to their origins* relies on three key assumptions, that I deal with in turn.

First, the researcher must assume that *individuals and families perceive a social hierarchy and have a general understanding of their position within it*. This assumption is perhaps trivial. Surveys have documented that people do perceive the social world, and specifically occupations, as hierarchically ordered (Ganzeboom et al., 1992; Ganzeboom et al., 1991). These orders are also remarkably consistent across contexts.

The second point is more methodological. In order to apply the theory to their findings, the researcher must assume (usually implicitly) that *individuals' perceptions of such a hierarchy resembles the operationalization of that hierarchy* that the researcher has employed. Using relative position theory to explain patterns of mobility and persistence using the Goldthorpian operationalization of class (EGP; Erikson et al., 1979) does in part require that the individuals making decisions about avoiding downward mobility or aiming for upward mobility perceive the social hierarchy as structured in a way that resembles the EGP scheme; that what is perceived as 'up' or 'down' in the minds of individuals is approximately the same as 'up' or 'down' in the scheme. This assumption is less trivial. The EGP scheme is surely correlated with individuals' perceptions of the hierarchy of social positions or occupations, just as it is correlated with inductively constructed measures of such hierarchies, such as the Treiman (1977) scale. Likely because they, at the fundamental level, measure the same latent dimension; the social hierarchy. But the EGP scheme was not constructed to resemble individuals' perceived hierarchy as closely as possible, and there is not necessarily a close relationship between the operationalization of the hierarchy, and perceptions of the hierarchy. Rather, the scheme can be seen as a proxy for the underlying hierarchy, derived from theory, that only partially matches with individual perceptions. I have a hard time understanding why researchers applying this theory do not make it a priority to use an operationalization that as closely as possible matches that perceived hierarchy,

when perceptions of one's relative position within it is central to the theory. I suspect that not doing this impedes the accuracy of the theory in explaining observed patterns. In the end, assessing whether the operationalization of the social hierarchy matches perceptions of that hierarchy is an empirical task.

The third, and by far the most important point is that the researcher must assume that *people actually do aim to avoid downward mobility and, if possible, attain upward social mobility relative to their origins, and that they act rationally to this end.* And, for some of the mechanisms invoked by this theory, *parents must have this goal for their children, and they must actively seek to attain it.* A key to assessing whether this theory is accurate could be to assess whether this assumption holds. Certainly, many individuals and families have such ambitions. But does everyone, or at least most people? Rational action theorists working in this tradition have not been particularly eager to investigate whether their assumptions about people's goals for themselves or their children are accurate. People may have entirely different goals. Some may primarily want their children to be happy, to do what they want to do, to follow their dreams, or to pursue their own interests and talents. Some might not even have strong preferences for their children's outcomes. And individuals themselves might not always place a high value on whether they move up or down the social hierarchy. Intergenerational persistence may in part be driven by individuals simply wanting to do the same job as their parents, without regard to the hierarchical ordering of that job. Or they may aspire to follow their dream of becoming a mountaineering guide or police officer or dog hairdresser or medical doctor or yoga instructor without regard for whether this entails moving up or down the social hierarchy. A substantial amount of evidence has also documented that people tend to not behave purely rationally, even when faced with relatively simple choices (see Elster, 2015: 256-261).

The point with this example is to illustrate that a crucial point when evaluating a theory is to consider whether it provides an accurate explanation for a phenomenon by investigating the assumptions it makes and the mechanisms it invokes.

The key requirement of theory, as here understood,
is that it should have explanatory force.

- John Goldthorpe (1996)

2.3 Relevance

A theory can be accurate, but still have limited value if it only explains a small part of the phenomenon, or if it does not generalize beyond a particular case or subset of individuals.

An explanation may be more or less important and relevant. For instance, drawing again on theories on class reproduction, it could be that exclusion and opportunity hoarding maters a lot for maintaining intergenerational persistence in class positions, while cultural tastes and distinctions matter very little. An explanation can be unimportant without being wrong or inaccurate if the mechanism has an actual but very limited impact. Assume that average school grades, averaged over 15 subjects and exams, almost exclusively reflects demonstrated skill and ability in the subjects, except for in oral English exams, where a demonstrated cultural taste for classical literature can cause a 1 grade point difference in the exam grade (from C to B, for instance). In this case, the theory that cultural tastes matter for school grades is not wrong. The mechanism is just trivially unimportant to explaining differences in average school grades.

For most important sociological topics, there exists a plethora of theoretical explanations for the observed patterns. As I have discussed, social mobility research is no exception. All of these competing theories cannot be equally relevant or important. These theories emphasize different mechanisms that are, in many ways, competing explanations for the same phenomenon; patterns of intergenerational mobility and social reproduction. Some of the mechanisms postulated by these theories must be more important than others. In article 5 in this thesis, we suggest that they might all be not very important. I will use this article as an illustrative example. The reasoning is fairly straightforward, but it requires that we make two assumptions.

First, assume that the results we present in the article are approximately correct. Like all other research results, they may not be. But for the sake of the argument, let us assume that they are. I'll deal with the assumptions of the twin models and potential biases in the estimates later.

Second, assume that classical sociological mobility theories (that is, explanations for class outcomes) primarily explain such outcomes in terms of environmental influences that are shared by same-sex twins. That is to say that the mechanisms pointed to by sociological theories are mechanisms that according to these theories, would affect same-sex twins in the same way, and cause them to become more similar in terms of class outcomes than two random same-sex individuals. This is what Isungset (2021) terms the assumption of 'homogenous family background effects'. This is not to say that all things that might make such twins similar are covered by sociological mobility theories. Mechanisms such as peer influences in schools and neighborhoods, for instance, do not figure prominently in classical theories of mobility and persistence, but likely also have some role to play for class outcomes and twin similarity.

Our results suggest that approximately 50 % of the observed variation in class outcomes can be ascribed to environmental influences unshared by twins. This reflects much of the unexplained variance that is commonly found also in classical mobility studies and studies employing sibling fixed effects, as it captures all variance that is not attributable to the other model components. It consists of everything from measurement error and random chance to human agency.

Further, approximately 40 % of the observed variation in class outcomes can be ascribed to additive genetics. Essentially, monozygotic twins have more similar class outcomes than dizygotic twins. As I discuss below, there are good criticisms of assumptions behind the twin model, and particularly the assumption that the only reason why monozygotic twins are more similar is that they are more genetically similar.

That leaves us with about 10 % of the variance that can be attributed to the factors in the environment that twins share. What aspects of the environment does this component represent? We argue that, given the implicit assumption of homogenous family background effects, the C component captures more or less everything that classical sociological theories of intergenerational social reproduction emphasize as important to explaining the association between social origins and class destinations, and then some. It includes everything related to social origins, since twins reared together have the same social origins. But it also includes things that twins share that are not strongly related to social origins, such as major family

events (the unexpected death or illness of a parent, divorce etc., that might impact class outcomes), and things that are partly related to social origins, such as the local school context, the local environment, religious practices etc. According to Hermansen et al. (2020), around 2 % of the variation in adult socioeconomic outcomes are attributable to the school and neighborhood context. Taken at face value, that leaves a maximum of 8 % of the variation in class outcomes to be shared between other explanations found in classical sociological mobility theory. That is, explanations emphasizing the effect of socialization on all traits, including educational outcomes, relative positions and their impact on rational action, closure, exclusion, opportunity hoarding, ownership and exploitation, cultural domination, symbolic violence and cultural tastes and distinctions, and much more. On average, each such factor should account for much less than 1 % of the variation in class outcomes. Some may account for more, while some may account for less. That does not mean that these explanations are wrong. It just means that if our estimates are approximately correct, most of these explanations, or all of them, are not very important or not very relevant to explain variation in class outcomes.

The above example dealt with assessing the relevance of a theory in terms of its potential relative contribution to explaining the outcome. There is another, closely related kind of relevance that is also important – the relevance of a theory as applied to a general problem or a particular case. Some theories may be relevant and applicable to a wide array of cases, but too narrow and less relevant when applied to a wider problem. One example is theories of ethnic enclave formation (Wilson & Portes, 1980). Such theories may provide an important part of the explanation for the residential patterns of specific ethnic minority groups, making them highly valuable for explaining the residential patterns of that specific group. But if these groups are small, such theories may have limited relevance for the explanation of aggregate segregation patterns, where theories focusing on the residential behavior of large segments of the population may have more explanatory power. Other theories may be relatively wide and general, but be more relevant to some cases or contexts than others. For instance, a common critique of the theories of Pierre Bourdieu is that they do not necessarily generalize to other contexts, such as Norway (Skarpenes, 2007).

The relevance of a particular theory must often be assessed on a case-by-case basis. As such, it is a criterion that should be applied with specific regard to the research question at hand.

I think the authors would find themselves
with evidence which refutes the theory,
were it posed as a refutable theory

- Arlie Hochschild (1975: 560)

2.4 Clarity

Good theory always involves simplification. The social world is complex, and capturing all of its complexities in a single theory is not only impossible, but inadvisable. Healy (2017), criticizing the call for more nuance in theory, identifies three 'nuance traps'. Theories can fall into the trap if being too fine-grained, the trap of growing into too complex theoretical frameworks making them difficult or impossible to refute, and the trap of over-emphasizing the 'richness, texture, and flow of social reality' at the expense of the abstraction and simplification that makes a theory widely applicable. These traps may lead to theories that are too nuanced and complex to have much value. A central point is that parsimony in theorizing is a virtue that makes theories clearer, more understandable, and more useful.

Even more important than the substantive parsimony advocated by Healy, is the clarity of prose advocated by Elster (2015: 452-479). In his critique of unclearly formulated or unrealistic theories in the social sciences, he uses the term 'obscurantism' to describe the most extreme cases. Obscurantism is to make something less comprehensible in order to make it appear more deep, advanced and/or profound. He derides two forms of obscurantism.

Hard obscurantism, is the tendency to over-complicate things with an unnecessary reliance on math and formalized theoretical models. This type of obscurantism is, according to Elster, often perpetrated by economists, building elaborate and unrealistic models of (hyper)rational actors maximizing utility when making simple decisions. He also suggests that some regression analyses and agent-based models fall into this category. Soft obscurantism is the tendency to over-complicate things with the use of unnecessarily dense and opaque language. Many academics in the humanities and social sciences have been accused using this strategy by writing in long, incomprehensible sentences, using ambiguous metaphors and double meanings, poorly defined concepts and more, to express relatively simple ideas in a complicated way (Elster, 2015: 454; Sokal, 1996a). A lack of clarity makes the theory opaque, unnecessarily difficult to grasp, and thus unnecessarily difficult to test or criticize.

Regardless of labels and whether one would accuse specific authors of being intentionally obscure, the principle remains; theories should be clearly formulated. The reason is that if they are not clear, it becomes more difficult to agree on what they state and what their implications are, and thus more difficult to criticize or test them, making them less valuable. I believe that deliberate obscurantism is relatively rare in present-day sociology, but there are ample examples of unclearly formulated theories.

A convenient example of this can be found in frequent debates about Bourdieu's theories on class and culture, where debates, in my view, sometimes stall because researchers can't agree on what Bourdieu *really* meant (see Lareau & Weininger, 2003). One such debate ran in Volume 70, issue 3 of the British Journal of Sociology in 2019, where some of the disagreement had its roots in different interpretations of Bourdieu's writings. It would probably have been easier to discuss these issues if there was a consensus on how to interpret these theories. Such a consensus could probably have been easier to reach if the original texts had been more clearly formulated. John Goldthorpe and Erik Olin Wright provide good examples of clearly formulated theories in the same field.

The main task of the social sciences
is to explain social phenomena

- Jon Elster (2015: 3)

3. Non-causal explanation and theorizing

3.1 Non-causal explanation

When theorizing about an observed association, it is tempting to assume that the association reflects a causal relationship, and to build a theory that explains it in causal terms. For many topics in sociology, we have several competing theories invoking different causal mechanisms to explain the same specific phenomenon, and much work is put into discussing which theory is most accurate and what mechanisms are most salient.

Elster (2015: 1) has argued that all (good) explanation is causal. This is true in the sense that all phenomena are caused by something, but I disagree with regards to theories explaining empirical relationships. I would argue that, when theorizing, we should be equally eager to provide non-causal explanations for observed relationships, and that sociological theories too often invoke causal explanations when studying relationships that may primarily be the result of selection processes, confounding, compositional differences, or reverse causality.

My master's thesis was about the effect of retirement on health and mortality. In this field, a consistent empirical finding was well-established in numerous studies in different contexts. The field had a clear explanandum; a stylized fact; a statistical regularity in need of explanation: *people who retire earlier on average tend to die younger*. Sociologists, economists, and gerontologists had made attempts to explain this relationship. In doing so, they had come up with several different, partly overlapping theories. The *activity theory of aging* (Havighurst, 2009 [1963]), *continuity theory* (Atchley, 1989), *disengagement theory* (Cumming & Henry, 1961), *retirement as a stressful life event* theory (Daatland & Solem, 2011; Minkler, 1981), and the *process perspective* (Atchley, 1976) all in various ways predict that retirement is detrimental to health and longevity. The Grossman (1972) theory of *health capital investments* can also be used to make such predictions. Working on my thesis, I only came across one theoretical contribution, by Ekerdt (1987), that objected to the notion that retirement was somehow harmful.

The conclusion from my master's thesis, in its final article form (Rogne & Syse, 2018), was that there was no causal relationship. Using a pension reform as a natural experiment, we found no effects of earlier retirement on mortality. In summarizing the research literature, we found that studies using research designs that could plausibly identify causal effects had mostly produced small effect estimates or reached similar conclusions as we did. A lot of theorizing work and empirical studies over several decades may have gone into producing and discussing causal explanations for what is likely mostly a process of negative health selection into early retirement.

Many similar examples can be mentioned from the sociological research literature, where relationships are theorized as causal processes, but where some recent studies suggests that causal effects may be smaller than previously assumed, and that selection processes, confounding, compositional differences between groups or reverse causality likely play an important role[3]:

- Neighborhood effects on adult economic outcomes (Ludwig et al., 2013)
- The effects of marriage and employment on criminal offending (Lyngstad & Skardhamar, 2013; Skardhamar & Savolainen, 2014)
- The effects of books in the home on educational outcomes (Engzell, 2021)
- Fertility contagion in social networks (Hart & Cools, 2019)
- Higher occupational gender segregation in more egalitarian contexts (Barth et al., 2014; Barth et al., 2023)

[3] This is not to say that these studies all provide conclusive evidence that there are no causal effects, but that causal effects may be modest.

- The effects of parents' education on children's education (Björklund & Salvanes, 2011; Black et al., 2005)
- Peer effects on many educational outcomes (Borgen, 2021; Brunello & De Paola, 2017; Van Ewijk & Sleegers, 2010)
- Gender discrimination in hiring (Birkelund et al., 2022)
- Social origins and socioeconomic outcomes (Erola et al., 2022; Van Hootegem et al., 2023)

The list goes on. There are honorable exceptions, of course. The theory of immigrant selectivity provides a selection-based explanation for observed patterns of health and longevity advantages among immigrants, and possibly a partial explanation for high upwards social mobility among children of immigrants. See Feliciano (2020) for a summary and Borgen and Hermansen (2023) for a test.

3.2 Establishing causality as the explanandum

Merton (1987) emphasized the seemingly self-evident point that before attempting to explain a phenomenon, we should establish that phenomenon. To this, I would add that before proposing a causal explanation, we should empirically establish a causal relationship. Or at least also consider non-causal explanations.

Causal explanations should not be given any explanatory priority, and we should not jump to causal explanations more easily than other types of explanations. When attempting to theoretically explain a relationship, we should come up with plausible explanations that involve all sorts of mechanisms and paths. Explanations invoking causation, selection, confounding, reverse causation, compositional group differences, even endogenous conditioning[4], should be part of the explanatory toolbox of sociologists. These are not simply methodological problems to be solved, but reasonable explanations for observed relationships.

An illustrative example came up at a recent department seminar, where two colleagues presented a very interesting paper on wealth-related inequalities in mortality. I found the most interesting slide to be a graph showing Kaplan-Meier curves for survival by gender and wealth quantile. There were vast inequalities in survival by wealth quantile among men, but the differences were very small among women. The presenters discussed their findings but did not enter into an attempt at explaining the gender differences. This led to a whispered discussion between a colleague I was sitting next to and myself regarding whether the presenters should have theorized their findings more and attempted to explain the observed gender differences in the association between wealth and mortality. My view was that it was too early to theorize the findings – or at least too early to theorize about causal mechanisms.

At this stage, the explanandum – the established fact in need of an explanation – was that *wealth inequalities in longevity are smaller among women than among men*.

I suspect that many sociologists eager to theorize would start exploring different types of causal explanations first. One could propose, for instance, that wealth has a stronger effect on male longevity than on female longevity because *wealth more strongly affects health behavior among men*, or because *current gender roles mean that wealth is more associated with status and prestige among males, so that that the health penalties of relative deprivation is more acutely felt among males*.

Surely, many such theories about causal mechanisms can be devised without much difficulty. But invoking such a particular causal explanans requires that we assume that the explanandum is that *wealth has a stronger effect on male longevity than on female longevity*. That is not the case. By doing so, we would be theorizing about why there is a causal relationship before we had established that there is one. We would in a sense be

[4] Endogenous conditioning came up frequently as an explanation when I was teaching SOS4020 – quantitative methods. Many students were doing analyses on the associations between working conditions and life satisfaction, subjective health, or other related outcomes among elderly employees. Poor working conditions probably have a negative impact on various subjective life outcomes, but if working conditions are sufficiently poor to substantively affect such outcomes, people are likely to stop working and retire early, meaning that the group of elderly employees is likely endogenously conditioned on having decent working conditions and its causal descendants (Elwert & Winship, 2014). This is essentially a process of survivorship.

proposing different causal mechanisms as explanans before we had established causality as the explanandum.

Rather, theorizing these findings should start with proposing both causal and non-causal explanations. This could include, for instance:

- a causal explanation: *wealth has a stronger effect on male longevity than on female longevity*
- a distributional explanation: *the distribution of both wealth and longevity is more compressed among women than among men, so that the scope for wealth-related differences in life expectancy is smaller among women*
- a confounding-based explanation: *social origins has a stronger impact on both health and wealth accumulation among males*
- a reverse causality-explanation[5]: *health problems have a stronger impact on wealth accumulation among males than among females*.

Each of these (and many more) are perfectly plausible explanations (though they are all a bit shallow). And all of them are, at least in theory, testable. But they are just guesses. We have no good reason to assume that one is more accurate or relevant than the others.

I think my colleagues presenting their work at the seminar did the right thing in presenting an empirical puzzle, without also spending time on coming up with an explanation to go along with it in their presentation. Had they also suggested an explanation, hey might have convinced someone in the audience that it was the right one, leaving us with a false sense of confidence in a particular theory.

My argument is that exploring different types of causal explanations (or mechanisms) is fine at a later stage, when we have established that the relationship is indeed causal. But it is potentially a waste of time that could lead research astray until we have established a causal relationship as the explanandum. It is not yet an explanandum, just one of several potential explanans(es).

The methods required to adjudicate between different causal and non-causal explanations differ based on the problem at hand and the explanation under investigation. The majority of articles in this thesis attempt to assess the importance of causal mechanisms, and I discuss such methods below. Likewise, decomposition methods such as a Kitagawa (1955)/Oaxaca-Blinder decomposition, may provide information on the impact of compositional differences between groups[6]. Careful application of control variables may tell us something useful about confounding, while detailed studies of panel data may provide clarity on the plausible direction of causality.

I am not saying that we should not theorize our findings, but that that when we do make new theories, we should not automatically assume that the process we are theorizing is a causal one but be at least equally willing to theorize it as a selection process or similar. And we should, when possible, assess whether relationships are causal before spending a lot of time theorizing or discussing causal mechanisms.

In his book about theorizing, Swedberg (2014: 8) states that "an idea or a hypothesis has little value until it has been carefully tested against data according to the rules of science". An untested theory has no intrinsic value. It is, at best, a tentative explanation – a good guess. However, Swedberg also stresses that coming up with new theories is important and difficult. I disagree. In general, it's my view that we should spend less time and energy on making new theories and spend more time and energy on testing old ones. Theorizing, in the sense of making up a plausible explanation for a phenomenon, is relatively easy. Any sociologist worth their salt should be able to come up with at least three different explanations for any given social phenomenon (Stinchcombe, 1987: 13). The hard part is to figure out which of those three theories are accurate and relevant, and which are not.

[5] I believe that there are effects of wealth on mortality, but I would argue that the reverse relationship is likely also strong; poor health likely impedes the accumulation of wealth to a substantial degree.
[6] Explanations emphasizing compositional differences are quite common in demography

I don't like assumptions

- Andreas Kotsadam[7]

4. Assumptions

Stronger assumptions make for weaker theory and evidence. That goes for both theoretical assumptions, and modelling assumptions (which are often just formalized versions of the former). As social scientists, we should make our assumptions explicitly articulated, make as few of them as we can, make small ones rather than big ones, and test them rigorously, if possible[8].

All methods employed in this thesis rely on assumptions. For instance, the geographic regression discontinuity design employed in Article 1 assumes that characteristics that affect the out-mobility of native families with pre-school children do not differ discontinuously along school catchment area borders, and that families either do not have, or do not act on information on where the school catchment area borders go when deciding where to live initially, so that who lives on each side of the border is conditionally as good as random. The difference-in-differences/event study method employed in articles 2, 3 and 4 assumes that the establishment of college institutions is exogenous, and that trends in the observed outcomes would be parallel across regions in the absence of college establishments. These assumptions are not directly testable with the data at hand, though we attempt to assess whether they are plausible, and discuss the implications it would have if they are violated. Another assumption is clearly violated in these articles, namely the Stable Unit Treatment Value Assumption (SUTVA). Since people can and do move to attend college, and since people older than 20 may attend college, untreated cohorts and regions in my research design are, in fact, partially treated. This is discussed clearly inn all three articles as a potentially important source of downward bias in the estimates. We could possibly have made the argument that this should not be considered a bias if, instead of interpreting the estimates as effects of access to college vs no access to college, we interpreted them as estimates of effects of access to colleges in the home region at age 20 vs access to college in more distant regions and at other ages. We did not make such an argument.

The twin model methodology presented in Article 5 has been criticized for relying on strong and unrealistic assumptions (Burt & Simons, 2014; Richardson & Norgate, 2005). For some of these assumptions, violations would imply that we overestimate the degree of genetic heritability. Most importantly, violations of the equal environments assumption (EEA), would have this implication. Meanwhile, violations of the of 'no assortative mating' assumption (NAM) would entail that we underestimate the heritability of class. We are pretty sure that this latter assumption is violated due to class-related homogamy (Toft & Jarness, 2021; Torvik et al., 2022).

There are essentially three potential weaknesses in the EEA.

The first is that monozygotic, or identical (MZ) twins may be treated more similarly by their environment than dizygotic, or fraternal (DZ) twins are, on the basis of being MZ twins. Intuitively, this makes sense. It is easy to imagine MZ twins in identical clothing being treated very similarly by their environment, sometimes to the extent of being mistaken for one another because they are identical. We can think of this as 'imposed' similarity (Morris-Yates et al., 1990). Note that to be relevant as a criticism, differences in the similarity of environments must be of a kind and magnitude that is relevant to cause differences in similarities for the outcome in question. Differences within families in the way siblings are dressed, addressed and treated within families is not often brought up as a major contributor to within-family differences in educational or class attainment in sociological theory, as these often implicitly assume that family background effects are homogenous (Isungset, 2021), but such effects cannot be ruled out.

The second is related to evocative childrearing. If MZ twins are, on average, more similar, both in terms of appearance, interests, skills, personality etc. than DZ twins, they may be treated more similarly by evoking more similar responses from their environments, thus environmentally exacerbating their genetic similarity. We can think of this as 'evoked' similarity (Bouchard Jr et al., 1990). The extent to which the family environment adapts to children's appearance, interests, skills, personality etc. does not figure prominently in sociological theories either, though it may be important. If parents respond to twins' traits in ways that

[7] Said during a lecture in the course 'SOS9019 – Research Designs for Causal Inference'. Later confirmed by e-mail.
[8] I see the irony in that I made two assumptions in the previous chapter.

reinforce such patterns in relevant ways, this may be an issue for the EEA, though such differences in evocative childrearing in response to heritable traits may also in some sense be seen as a product of those traits.

The third, and potentially most relevant issue for socioeconomic outcomes, is that MZ twins may be more strongly connected to each other and want to be more similar than DZ twins (Morris-Yates et al., 1990). Growing up with, essentially, a genetically identical clone of oneself may lead to a particularly strong bond. A desire to be similar or stay connected may lead MZ twins to make more similar educational and labor market choices, making their socioeconomic outcomes more similar, while DZ twins may want to distinguish themselves from one another, thus inflating heritability estimates (Erikson & Goldthorpe, 2002).

With strong assumptions come great responsibility. The EEA assumption is a strong assumption that may bias twin study estimates if it is violated. Many have attempted to test it, and findings suggest that 1) the EEA assumption generally holds reasonably well, 2) violations of the EEA do not produce large biases, and 3) violations of the EEA and NAM tend to cancel each other out (Barnes et al., 2014; Conley et al., 2013; Derks et al., 2006; Felson, 2014; Kendler et al., 1993; Mönkediek, 2021). Though several studies have identified relevant violations of this assumption or criticized tests of it (examples include Fosse et al., 2015; Pam et al., 1996; Richardson & Norgate, 2005).

The problems associated with the EEA are less relevant in studies of twins reared apart, however, which have generally produced results that are compatible with those from regular twin studies (Bouchard Jr et al., 1990; Keller et al., 1992; Lichtenstein et al., 1992), casting some doubt on the relevance of the criticisms of the EEA, though they should not be ignored.

Some reassurance about the validity of the findings can also be found in the results from studies using different genetically informed research designs, that rely on different sets of assumptions and are thus not sensitive to the EEA and NAM assumptions. Studies of educational achievements and attainment, using twin studies, multiple children of twins-studies, adoption studies, and quasi-experimental variation mostly reach compatible conclusions (see for instance Amin et al., 2015; Baier, Eilertsen, et al., 2022; Baier, Lang, et al., 2022; Björklund & Salvanes, 2011; Black et al., 2005; Branigan et al., 2013; Carneiro et al., 2013; Currie & Moretti, 2003; Engzell & Tropf, 2019; Herd et al., 2019; Holmlund et al., 2011; Lichtenstein et al., 1992; Lindahl, 2011; Suhonen & Karhunen, 2019). Though there is some variation, they all point to the conclusion that causal effects of parents' education and family background are relatively small, at least in Scandinavian contexts, and that selection or genetics account for a large share of the intergenerational persistence in educational achievement and attainment, or a large share of the variation in such outcomes. These do not deal with the same socioeconomic outcome variable as we use – class. But education and class are closely related, and my hunch is that if it were possible to apply different research design to class-based measures in a similar fashion, this would produce similar and mostly compatible results.

Regardless of these arguments, the results may still be biased, and should be interpreted with caution. This is why we are careful to point to the assumptions and limitations of this study, and other studies in this thesis, and not to draw overly strong conclusions[9]. But it is also pertinent to make the following point.

We are explicit about our assumptions and state them clearly, though we could have discussed them even more thoroughly. Being explicit about these assumptions leaves this study, and similar studies, open to criticism and dismissal, due to the assumptions they openly rely on. The same cannot always be said for classical sociological studies of social mobility. These studies typically make a much stronger assumption, namely that genetics do not play a role in patterns of intergenerational social reproduction, and that similarities between parents and children are not partly genetic in origin. We can call this assumption the 'no genetic confounding' assumption (NGC). This assumption is not only unlikely to hold, but is almost assuredly wrong (Freese, 2008; Turkheimer, 2000). Violations of the NGC assumption may lead to severe

[9] In an op-ed based on article 5, we did use too strong language and drew overly strong conclusions based on our study (Rogne et al., 2023). In the subsequent debate, we received strong criticism for this (Flemmen, 2023; Ljunggren & Heggebø, 2023). We agreed with our critics in that we used too strong language and drew too strong conclusions based on the article (Lyngstad et al., 2023), and I learned a lot about research communication the hard way. However, it is important to note that although this was not sufficiently clearly stated initially, our main argument was not based on our study alone, but on a larger research literature (Lyngstad & Rogne, 2023).

biases, but it is seldom tested in studies of intergenerational mobility, and it is usually made implicitly without even being mentioned. A similar critique may be raised towards other subfields studying parent-child similarities in areas such as fertility, substance use and much more.

Strong theoretical assumptions can lead research astray, and worse; lead to policy recommendations that have little impact. Such assumptions can be about the causal nature of the relationship under study, or about the mechanisms that produce it. An example of the former could be to assume that because cultural tastes correlate with class positions, cultural tastes must also affect class attainment. An example of the latter would be to assume that neighborhood-level differences in socioeconomic outcomes among adults, such as employment, reflect neighborhood effects. Interpreting research results in light of theories making such assumptions may lead us to the wrong conclusions – that inequalities in class attainment can in part be explained by teachers or employers discriminating based on signals of cultural tastes, or that observed neighborhood differences in socioeconomic outcomes are due to neighborhoods exerting a strong influence on people. Policies aimed at reducing inequalities or increasing social mobility based on such interpretations might prove ineffective if signals of cultural tastes are not important determinants of class attainment, or if neighborhood differences are primarily due to selection processes.

Without data, you're just
another person with an opinion.

- William Edwards Deming[10]

5. Data

The administrative register data I use in this thesis is of exceptionally high quality. They cover the entire resident population of Norway and thus do not suffer from sampling errors, selective non-response or attrition, except from naturally occurring attritions due to death and migration, and listwise deletion due to missing values (mostly relevant for education indicators among immigrants and people who have studied abroad, which is not a major issue in these articles).

Sample sizes are potentially very large – as large as the actual population – though for specific purposes they may be reduced to focus on specific sub-groups. As such, the register data samples are always representative for the population they are drawn from, as long as the researcher does not make use of sample restrictions that reduce their representativity. We do this in all of the five articles, for reasons explained below.

Sample representativity is important. It is most important in descriptive studies. If we wish to describe the population, drawing a representative sample is key for making an accurate description. This is because for descriptive purposes, external validity (generalizability) is the main goal.

The same is not the case when we wish to say something about causal relationships or test explanations. When this is the purpose of the study, the hierarchy of evidence is different. Internal validity is then more important than generalizability.

This is because to assess causal claims, the data-generating process is the most important factor. Data generated by selection processes or heavily affected by confounding or reverse causation cannot tell us much about the causal process we are interested in, because it was not generated by this causal process.

Let me use an example from articles 2-4. If we want to know if establishing local colleges impacted the educational attainment of the local population, we usually cannot answer this question using a representative sample. If our parameter of interest is this causal effect, we are in most cases forced to make concessions for external validity in favor of internal validity.

Imagine that we are unwilling to make this concession, but rather insist on using a representative sample of the target population in our identification of the causal effect. Then we might decide to naïvely compare individuals residing near colleges to individuals who do not. If so, we will likely be comparing individuals who self-selected into their treatment status by moving or not moving to such areas. We will also likely compare individuals who differ in other ways, such as by their social origins, since this is highly correlated with the location of colleges. In other words, our estimates are likely to be biased by selection and confounding. Even though we have a representative sample, generalizing the finding to the population will not be advisable, because there is no internal validity. The parameter estimate might have internal validity as an estimate of the association between local colleges and educational attainment, but not as an estimate of the effect of local colleges on educational attainment. When studying causation, external validity is secondary to internal validity (Imbens, 2010).

Therefore, if, we are primarily interested in identifying a causal effect, we should be willing to sacrifice external validity for the sake of internal validity, and accept that it is better produce an unbiased estimate for a non-representative subset of the population than to get a biased result for the entire population. In articles 2, 3 and 4 in this thesis, my co-authors and I make several sample restrictions that reduce the representativity of the sample, but increase the internal validity, by ensuring that for the sample we are studying, potential biases are as small and unlikely as possible. This leaves us studying the effects of the opening and institutional upgrading of local colleges for individuals residing near a handful of colleges in

[10] This quote is attributed to William Edwards Deming online (https://en.wikiquote.org/wiki/W._Edwards_Deming) but I have not been able to confirm the original source. Again, it's a good quote, no matter who formulated it.

regions that did not previously have a college institution. These samples are not representative. For instance, all individuals residing in major cities are excluded. In Article 1 of this thesis, we similarly limit the data to residents in Oslo, residing near a school catchment area border, who meet a series of demographic sample restrictions. Again, this sample is not representative of the Norwegian population. It is not even representative of the population in Oslo. But doing so allows us to argue that the effect we estimate represents a causal effect of local schools with a high concentration of minority students.

Making such sample restrictions leaves us with less variation to study, but because we attempt to exclude variation that is due to selection, confounding or reverse causality, we are able to focus in on a small amount of variation that is plausibly a result of the causal process we are interested in, and thus more informative about this process. The data is less representative of the population, but the variation is of higher quality for our purposes.

For these studies, we could not rely on register data alone, but had to supplement with data from other sources. This was a painstaking and tedious process. For Article 1, other members of the Segregation project at my department had acquired the lists of addresses we used to identify catchment area boundaries, and my co-author, Erlend Ingridsønn Nordrum, did the enormous job of turning these into grid-based geocodes that we could link to register data. For Article 2, 3 and 4, Siri Frisli did a fantastic job as a research assistant trawling though old budget documents in search of data on educational institutions and documenting the ins and outs of these data. I did parts of it too but could never have finished it without her efforts. These data are central to our analyses, because they allow us to exploit variation that is plausibly not due to selection, confounding or reverse causality.

Only after producing a credible estimate of the effect may we consider whether and under what circumstances our estimate may be generalizable to other populations and contexts. This can be done both theoretically, and by assessing the evidence from multiple studies on different samples. A research literature based on a wide variety of studies with high internal validity done on several different samples in different contexts provide a better basis for assessing causal effects than a research literature with representative samples but biased estimates.

Let method be the servant,
not the master

- Glenn Firebaugh (2008)

6. Methods

In this section, I briefly discus the methods used in this thesis. To motivate my methodological choices and put them into a broader framework, I first offer some reflections on quantitative methods in sociology and the social sciences.

6.1 Transgressing the boundaries: towards an interdisciplinary methodology[11]

Throughout my studies and work, I have often come across statements, criticisms or questions about whether something is sufficiently sociological. This happens mostly verbally and informally, so I don't have any sources to cite. But I still think it is worth discussing, because I believe that such concerns are an obstacle to progress in the social sciences, and because this thesis explicitly attempts to transgress such symbolic disciplinary boundaries by combining methods and theories from different fields.

There are no sociological methods. More or less all subfields of sociology draw on methods and theories inspired or borrowed from other disciplines. Examples include discourse analysis (literary studies, popularized by Foucault, a historian and philosopher), ethnography and participant observation (anthropology) and OLS regression (Legendre, mathematics; Gauss, mathematics and physics; Galton; biology and, regrettably, eugenics). More or less every field of sociology also overlaps thematically with other fields, ranging from literature, philosophy and history to statistics, medicine and biology. Given the considerable methodological, theoretical and thematic overlap with other disciplines, particularly in the social sciences, I believe it makes little sense to distinguish something as purely sociological, or to treat such disciplinary purity as a virtue. We should always be open to drawing on theories and methods from other disciplines.

As discussed above, many sociological theories revolve around causal explanations. To test such explanations, we need to use methods that in a credible way allow us to draw causal inferences. This thesis builds on the counterfactual approach to causality in the social sciences (see for instance Angrist & Pischke, 2009; Morgan & Winship, 2015). In layman's terms, this means that to identify causal effects, we in practice need to compare the outcome in a group that has experienced the event or 'treatment' in question to the outcome in a group that has not, but where we can plausibly assume that differences between the two groups are due to the treatment and not some other factors. This latter point is the key. It means that to say something about causality, we need to use methods and research designs that plausibly rule out the possibility that group differences are due to selection processes, confounding, reverse causality etc. The gold standard for such research designs is the Randomized Controlled Trial (RCT), as randomization of the treatment, if done properly, effectively rules out systematic biases (and allows us to quantify unsystematic biases). RCT studies have become increasingly popular in the social sciences, including in sociology (Jackson & Cox, 2013), and they have a wide variety of applications, ranging from studies of labor market discrimination (Quillian & Midtbøen, 2021) to fertility intentions (Lappegård et al., 2022). However, randomization is not always feasible or ethical. In such instances, natural experiments, of the sort studied in Articles 1-4 may in some cases still provide credible answers to the research questions, but they usually also rely on stronger and more tenuous assumptions. Most methods for studying natural experiments have been developed by economists.

The term 'Economics Imperialism' is often used to denote or deride the tendency for economists to apply their theories and methods to topics that thematically sort under other disciplines (see for instance Fine, 2002; Mäki, 2009), often without citing central works from those disciplines. This tendency has been felt strongly by many sociologists. Although there are several earlier examples, the 'new home economics' literature, developed or inspired by Gary Becker is perhaps one of the most influential early examples of economists delving into a field traditionally studied by sociologists. This literature uses formalized rational

[11] This is a subtle nod to Sokal (1996b)

action theory to mathematically model and explain a variety of family, home and work-related behaviors. Some would say that it does so with mixed success.

More recently, the development of quasi-experimental methods and the strong focus on identifying causal effects in economics (or the 'credibility revolution' as some economists call it; Angrist and Pischke (2010)), has also led economist to reach into a wide array of fields, using methods that often produce results that align poorly with established sociological theory and empirical evidence. With the use of experimental and quasi-experimental methods, economists and others have frequently found established and well-theorized empirical relationships to partly reflect selection processes or confounding, casting doubts over the established truths of many sociological theories (examples have been provided in earlier sections). As researchers, we should welcome such developments and the potentials such methods provide. We should choose our methods based on how well they answer our research questions without regard to what discipline they originate from.

Quasi-experimental methods have become increasingly popular in sociology, and they are especially applicable to studying the impacts of policy reforms, such as the introduction of electronic monitoring as an alternative to incarceration (Andersen & Telle, 2022), welfare retrenchments (Larsen, 2018), or various family policies (Bergsvik et al., 2021). The attractiveness of using natural experiments to draw causal inferences, compared to observational studies, stems from the assumption that if events are 'exogenous', meaning that they are caused by some external force outside of the relationship under study, they are also conditionally independent of the characteristics of the individuals that experience them. In other words, in a proper natural experiment, people cannot self-select into their treatment status, and the design ensures that treatment status is as-good-as-random, so that systematic differences in the outcome between the group that experienced the treatment and the group that did not can plausibly be inferred as an effect of the treatment.

This thesis draws on methods developed in economics and behavioral genetics because they are relevant to answering sociological research questions.

If we don't know whether we are doing any good,
we are not any better than the medieval doctors and their leeches

- Esther Duflo (2010)

6.2 The methods of this thesis

This thesis uses many different methods for descriptive purposes. In all articles, we present descriptive statistics in the form of means, percentages and descriptive graphs. Additionally, some articles present naïve estimates to serve as a baseline for comparison. In article 1, we present a scatter plot with lowess smoothers to describe the association between the proportion of students from non-western minority backgrounds in schools and native out-mobility. In article 2, we use a relatively complex two-way fixed effects estimator to illustrate, among other things, how results turn out if we do not use methods that correct for some technical biases related to comparisons with previously treated units. In article 3, I present some simple logistic regression models to show aggregate mobility trends. I will not go into details on those methods here.

All articles also use methods specifically aimed at providing credible answers to the research questions at hand. To test the accuracy of causal explanations, we need methods that are suitable for causal inference. Four of the articles in this thesis use such methods. These are geographic regression discontinuity models (Article 1) and event study (difference-in-differences) models with adjustments for heterogeneous and dynamic treatment effects (Article 2, 3 and 4). The fifth article takes a different approach and uses structural equation models for ACE variance decomposition to assess the relevance of a set of explanations. Each method is described in detail in the articles, and I do not provide a full description here, but discuss the motivation for using them.

For article 1, the question is whether schools with high concentrations of minority students cause native families with pre-school children to move. The key methodological problem addressed in this article is neighborhood-level confounding. Essentially, to say anything meaningful about the causal effect of schools, we have to account for the effects of neighborhoods, and selection into neighborhoods. We do this by comparing individuals who reside in the same neighborhood, but that due to school catchment area boundaries sort into different schools. In other words, relating to the previous chapter, we seek to isolate the variation that is due to schools, by assuming that neighborhood-level characteristics are a continuous function of distance to the school catchment area boundary. We do this using a geographic regression discontinuity design. As discussed above, this design relies on some very specific assumptions, that we explicitly address and attempt to test as thoroughly as possible. We also address the possibility that our estimates may be sensitive to our methodological choices by estimating models using a large number of possible alternative specifications.

For article 2, 3 and 4, the questions all concern the impact of local higher educational opportunities on various educational and demographic outcomes. In these articles, the key methodological problem is that to identify the effects of local colleges, we have to account for the possibility that the localization of colleges is not random, but may be related to a range of factors that might affect the outcomes in the local population. We do this by essentially studying changes in the availability of educational institutions over time, compared to areas where no such changes occurred (or where they occurred later), while accounting for characteristics of regions that are stable over time, and temporal trends that are parallel across regions. This is done in a difference-in-differences design using event study models. This choice of modelling strategy was made at a late stage in the process. When I started working on these articles, two-way fixed effects models were still the conventional way to estimate difference-in-differences. It wasn't until August of 2021 that I became aware that such methods could produce biased estimates in analytical designs like mine (Goodman-Bacon, 2021), and that we needed another estimator that could handle multiple treatment groups and time periods, variation in treatment timing and potentially heterogeneous and dynamic treatment effects. At this point, I had to rework the analytical strategy more or less from scratch, and sift though the fast-growing econometric research literature in search of an estimator that was up to the task. Luckily, my supervisor Rannveig and I found the did_multiplegt estimator in June 2022 (De Chaisemartin & D'Haultfoeuille, 2022; de Chaisemartin et al., 2019; De Chaisemartin et al., 2022).

Neither of the methods used in articles 1-4 are perfect. They all rely on assumptions, as discussed above. They also place below true experiments in the hierarchy of evidence. But given the difficulty, excessive cost

and ethical issues related to running true experiments in these fields, they represent my best attempt at answering these questions with the methods and data available.

For article 5, we do not attempt to identify causal effects, or to test causal claims directly. Here, we rather attempt to assess how much scope there is for sociological theories as explanations of class attainment. An important problem that we address is that associations between social origins and class outcomes may be confounded by genetics. While we do not make causal claims and cannot address confounding directly, we assess how much of the variation in class and occupational status outcomes can be attributed to various model components and argue that one of these model components (C) captures social origins and other factors shared by twins, and that another component (A) captures additive genetics. I have discussed the model assumptions above. Here, it is pertinent to discuss whether a basic twin model is the best choice of method for answering this question. The answer is that it is probably not. We could possibly have produced results that are less sensitive to model assumptions by using an adoption design or a multiple children of twins design. For this article, which is the first to assess the heritability of sociological class categories, we wanted to produce basic, descriptive results using relatively simple and transparent models, to serve as a baseline for future research. We have already planned a study combining an adoption design and a multiple children of twins design, that will hopefully provide even better, more robust estimates.

Primum non nocere

- Thomas Sydenham[12]

7. Ethics

7.1 Data and approvals

There are important ethical issues related to research on administrative register data. The most important concern is that individuals cannot give informed consent. Necessary recommendations and approvals for the use of administrative register data and of the project that Articles 1-4 in this thesis are associated with (SEGREGATION) were obtained from the National Research Ethical Committee, the Norwegian Data Protection Agency, and the Data Protection Official of the University of Oslo. Approvals of the use of administrative register data, twin data and of the project that Article 5 is associated with (OPENFLUX) were obtained from the Norwegian Data Protection Authority and the Norwegian Center for Research Data. The University of Oslo's Data Protection Official approved the data protection impact assessments for the projects. For both cases, permissions to use data without informed consent were based on the assessment that the issues related to lack of informed consent were outweighed by the societal relevance of the research. Informed consent is a prerequisite for inclusion in the twin register.

All sensitive data have been de-identified by Statistics Norway and stored on secure servers maintained by the Services for sensitive data at the University of Oslo. Researchers with access to these data have signed non-disclosure agreements pledging, among other things, not to attempt to identify individuals in the data. Some of the data used is particularly sensitive. This especially pertains to the geocodes used in Article 1. Access to these data have been restricted to a limited number of project members. When working with these data, we have been particularly careful not to publish information that may be identifiable from geographic information.

7.2 Vulnerable groups and controversial topics

The national guidelines for research ethics in the social sciences and the humanities (NESH, 2022) explicitly state that researchers "have a special responsibility to protect the integrity and interests of disadvantaged and vulnerable groups." Article 1 does not primarily study particularly vulnerable groups, as the main research subjects are native parents. However, research on native flight and school segregation may contribute to stigmatization of vulnerable groups of children from immigrant origins, or of particular schools or neighborhoods. The guidelines further state that "researchers must avoid using classifications or terms that invite unreasonable generalisations [sic], are defamatory and/or could lead to group stigmatization." In writing Article 1, we were careful not to use classifications and terms that may be perceived as stigmatizing, and to clearly explain how individuals were grouped. We also believe that research on ethnic segregation is important, that understanding the mechanisms producing segregation is a prerequisite to reducing it, and that the potential benefits of such an understanding outweigh the potential risks of stigmatization in this particular case. Articles 2, 3 and 4 do not study particularly vulnerable groups. Regarding Article 5, one might argue that estimating the heritability of class positions legitimizes and 'naturalizes' social inequalities. In such a view, the results presented in this article may stigmatize individuals in disadvantaged social positions, while legitimizing the social advantages of middle- and upper-class individuals based on a perception of these individuals as 'inferior' or 'superior' based on genetically heritable traits. We are very clear in the article, and also in disseminating the results, that we reject such an interpretation of our findings. In fact, we make the opposite argument, in saying that chance related to genetics is no more fair than chance related to social origins. The guidelines further state that researchers should "point out and correct misleading representations and misuse of research in the public debate" – a practice I engaged heavily in when misleading and politicized interpretations of our study were discussed on Twitter following the publication of our working paper. The risk that our research may be used in public debates to legitimize social inequalities or stigmatize disadvantaged groups is a potential concern regardless of the strength with which we as researchers reject such arguments. However, concerns that others may interpret or use research results in ways that the researchers disagree with is always present when studying

[12] 'Above All, Do No Harm' (Smith, 2005)

controversial topics (Andersson, 2018), and it is a concern that should not in itself preclude studying such topics. As researchers, we should be held responsible for how we present our findings, but we cannot be held responsible for how others interpret them or use them in political contexts. Rather, as researchers we have an ethos of organized skepticism (Merton, 1979), which includes the critical assessment of theories and previous research. It is my view that the risk of stigma or politicized misinterpretations of the findings presented in Article 5 are outweighed by the importance of a better understanding of the processes that produce variation in class attainment, and that, with the clear stance we have taken on the interpretation of the findings, this article is well within the bounds of research ethics.

If we are uncritical we shall always find what we want:
we shall look for, and find, confirmations,
and we shall look away from, and not see,
whatever might be dangerous to our pet theories.

- Karl Popper (2017: 18)

8. Summaries of the articles

Article 1 – School segregation and native flight: Evidence from school catchment area borders[13]

This article studies one of the potential causes of residential segregation and school segregation; native flight, and specifically addresses the question of whether native out-mobility among parents with young children, from neighborhoods with high concentrations of ethnic minority residents, may in part be driven by characteristics of schools.

Several theories attempt to explain patterns of ethnic or racial neighborhood segregation and school segregation. One of these is the theory of white or native flight. Essentially, this theory (in its many forms) suggests that members of the ethnic or racial majority population respond to high or increasing proportions of minorities in schools and neighborhoods by moving out, thus exacerbating segregation patterns.

Previous studies have documented such patterns of residential mobility in both the US and Europe. Some of these studies point to parents of young children as particularly prone to move out of neighborhoods with a high minority concentration, suggesting that school choice plays an important role.

To assess this mechanism, we have to circumvent the problem that characteristics of schools and neighborhoods correlate, meaning that any association between school characteristics and native out-mobility may be driven by neighborhood-level confounding, or affected by selection into neighborhoods. We do this by employing a geographic regression discontinuity design.

Our highly detailed individual-level data are drawn from administrative registers and linked to geocodes for place of residence. These geocodes provide fine-grained information on place of residence down to 100x100 meters, and they are crucial to our identification strategy. We sample residents in the municipality of Oslo who have children aged 2-5, belong to the native majority population. We also use data on school catchment area boundaries obtained from the Municipality of Oslo. These are recoded to correspond to our geocodes for place of residence, and we link them to our individual-level data to obtain individual-level measures of distances to school catchment area boundaries and characteristics of local schools.

Studying families who reside near school catchment area boundaries allows us to then study statistical neighbors who reside in similar neighborhoods, but on different sides of the school catchment area boundary of their local schools. With some assumptions, which we discuss thoroughly and attempt to test as well as we can, this allows us to estimate the effect of local schools with high minority concentrations on out-mobility among native families.

Along the borders of schools with the largest differences in the minority concentration (the top quartile), we find a 7-percentage point higher probability of moving out in a given year on the side of the border that has the highest minority concentration at the local school. Given a baseline out-mobility rate of 19 %, this effect is quite substantive.

Our results suggest that local schools play an important role in producing patterns of native flight, but the results should be interpreted with some caution, as sensitivity analyses reveal that they are sensitive to certain aspects of our model specifications.

[13] One of my motivations for writing this article was that I had previously done studies of native out-mobility using observational data and methods. One of these studies (Stonawski et al., 2022) has been published, while the other unfortunately remains in my file drawer. Since I was sympathetic to the theory of native flight as a partial explanation for neighborhood and school segregation patterns, I was also personally motivated to put it to a strict test.

Article 2 – A college on every cape: Gender equality, gender segregation and higher educational expansion

This is the first of three articles on the effects of the major educational expansion reforms that took place in Norway between 1969 and 1993. These reforms provided better educational opportunities for broad segments of the population and had a major impact on higher educational attainment.

These and similar educational expansion reforms coincided with major societal changes in many different areas, such as increased gender equality, increased absolute educational mobility and the reduction in fertility levels following the post-war baby boom. They have therefore been central in many sociological theories explaining such trends.

This article uses these reforms to study the impact of local college institutions on educational attainment among young men and women, and to assess whether the opening of local colleges was an important factor contributing to the reversal of the gender gap in educational attainment. It also assesses whether local colleges offering educations in specific fields of study impacted gendered field of study choices and thus horizontal gender segregation in higher education.

The main methodological issue associated with studying the impact of local educational institutions is that the localization of colleges is not random but may be systematically related to characteristics of the local population. Additionally, people may move selectively to attend college, which may bias results in naïve estimation strategies.

To overcome these issues, and a set of quite technical and intricate issues related to comparisons with already-treated units in differences-in-differences designs with multiple treatment groups and time periods and potentially dynamic and heterogeneous treatment effects, we use a type of event study models that can produce unbiased estimates in research designs like ours. Essentially, we study whether the establishment or institutional upgrading of such institutions affected the educational attainment of the local population, relative to regions where no such changes occurred.

In doing so, we use administrative register data covering the full birth cohorts 1950-1974. In addition, we have collected detailed data on the establishment, institutional upgrading, and growth of approximately 200 higher educational institutions in Norway. These allow us to identify with high accuracy who had access to post-secondary, non-tertiary, or tertiary educational institutions locally during the period we study, and when the establishment or upgrading of such institutions occurred. Linking these two data sources by municipality codes then allows us to study the impact of the establishment of educational institutions, and of the upgrading of such institutions to college status, on the educational attainment of the local population.

The results suggest that the establishment and institutional upgrading of such institutions had little impact on educational attainment in the local population. Such effects were small for women, and practically zero for men. Studying the impact of local field of study opportunities on field of study choices, we also find that local colleges did not shift individuals between fields of study, and thus that they also did not impact on gender segregation patterns in higher education.

Our approach rests on some identifying assumptions that we discuss thoroughly and attempt to test. The findings appear to be fairly robust to various model specifications and analytical choices, but they may be biased downwards due to violations of the Stable Unit Treatment Value Assumption.

Overall, our findings point to the conclusion that although the aggregate student capacity was a prerequisite for increases in educational attainment in this period, the location of colleges mattered very little. We discuss the policy implications of these findings.

Article 3 – Educational expansion reforms and intergenerational educational mobility in Norway

This is the second article assessing the impacts of the abovementioned educational expansion reforms, and it focuses on their effects on intergenerational educational mobility.

Despite large increases in educational attainment, and thus absolute educational mobility in this period, evidence on the impacts of such reforms on relative mobility is mixed. Researchers have found some increases in relative mobility in Scandinavian countries, but large inequalities in educational attainment persist.

Educational expansion reforms like those studied here have been central to sociological research and theorizing on intergenerational persistence in educational attainment and class positions, and several theoretical mechanisms have been proposed as explanations for why inequalities in educational attainment persist in spite of substantial improvements in educational opportunities.

Prior sociological studies have mostly focused on studying aggregate trends in educational expansions and mobility, and have not investigated the role of local educational institutions in these processes, nor used research designs suitable for causal inference. Additionally, effects of educational expansion reforms may be stronger at the local level. Such local effects may even be masked at the aggregate level if educational expansions primarily benefited individuals from higher social origins since institutions were primarily located in cities and regional centers.

This article draws on the same data and methodological approach as Article 2, but investigates whether the establishment and institutional upgrading of local educational institutions impacted educational mobility locally. It does so by a simple stratification by social origins, indicated by parents' educational attainment, and assesses if local colleges had a stronger impact on the higher educational attainment of some social origins groups than others. In other words, it assesses whether expanding local educational opportunities had heterogeneous treatment effects.

The results suggest that the establishment and institutional upgrading of local post-secondary, non-tertiary and college institutions did not substantively impact the educational attainment of any social origins group, relative to regions where no such changes occurred, and thus that these institutions did not impact on educational mobility locally. I further discuss potential explanations for persisting inequalities in educational attainment, including explanations drawn from sociology, economics, and behavioral genetics.

Article 4 – Educational expansion and fertility decline: Evidence from Norwegian college reforms

This article also studies the impact of the same higher educational expansion reforms, but investigates their impact on fertility and family formation patterns.

In 1968, the last year before the educational expansion reforms started, the total fertility rate (TFR) in Norway was 2.75. By 1977, it had fallen to 1.75, and it continued to decline in the following years, reaching 1.66 in 1983. Although the TFR bounced back somewhat during the late 1980s, it has remained at sub-replacement levels since.

Higher educational attainment among women has been seen as a key factor to explaining the drop in fertility levels following the post-war baby boom, together with changing gender norms, female emancipation, and increased female labor market participation. Both theory and empirical research in sociology, demography, and economics links higher education to postponement of childbearing and reductions in preferred family size among women.

This article assesses whether the establishment of local educational institutions may have affected fertility, measured by cohort fertility at age 40, and age at childbearing, effectively indicating both postponement and childlessness. Local educational institutions may affect these outcomes through several mechanisms. One is through higher educational attainment, which may lead to postponement of childbearing during the period of studies, but may also affect values and preferences for number of children and raise the opportunity cost to childrearing. The second is through affecting the local partner market, since the establishment of local institutions may increase the number of eligible partners locally but may also increase competition in the local partner market. The last is through contextual effects at the local level since the presence of educational institutions may shape norms and values in the local community, and impact other factors, such as the local labor market etc.

The article uses the same data and methods as the previous two.

In the article, we can only assess the first two of these mechanisms more or less directly, while we may only discuss the importance of the third. The first mechanism may be relevant if the institutions affected educational attainment. The second mechanism may be relevant if they affected age at partnering, proxied by age at marriage (cohabitation data is limited for this period). If institutions affected fertility levels but had no impact on educational attainment nor age at partnering, the third mechanism, local normative changes, may still also be relevant.

In the analysis, we find no evidence that these institutions affected neither completed fertility by age 40, nor age at birth. While these findings make arguments about mechanisms somewhat moot, we still assess these, since this was in accordance with the plans we made before we started doing the analyses. We rule out the first mechanism, educational attainment, since the opening of local institutions had no appreciable impact on educational attainment, relative to regions where no such institutions were opened. We find no impacts on age at marriage. Our results suggest that although increasing educational attainment may have been an important factor in driving the fertility decline in this period, access to local educational institutions was not important.

Note on Articles 2, 3 and 4: A critical reader may ask why we/I wrote Articles 3 and 4 when Article 2 showed no substantive effects of local colleges on educational attainment. The answer is that I had already made the decision to write about all of these topics and started working on them in parallel when we got the results on the effects of local colleges on educational attainment. Abandoning the last two articles and keeping them in the file drawer based on expecting to find null results would have contributed to publication bias-related problems (Franco et al., 2014). A critical reader may also ask if these articles represent a case of salami slicing. I originally intended to cover all these topics in a single article, but was advised against this approach, as the substantive topics are too dissimilar, and since such an article would be far too long.

Article 5 – Heritability of class: Implications for theory and research on social mobility[14]

In this study, we to investigate whether classical sociological theories are correct in asserting that social origins is important for class attainment, and that mechanisms producing intergenerational persistence are primarily social. We do this by examining how much of the variation in people's attained class position can be attributed to environmental factors shared by twins (C), unshared environmental factors (E), and additive genetics (A).

The background for writing this article is that there are several different sociological theories that explain class and occupational status outcomes in terms of social origins and social mechanisms of transmission. These theories, associated primarily with the work of authors such as Goldthorpe, Bourdieu, Wright and Treiman, differ with regard to which aspects of social background they see as important and which mechanisms are the most salient. None of these central theories incorporate genetic heritability as a partial explanation of variation in class and occupational status outcomes.

Recent evidence from studies using various genetically informed research designs has generally found that much of the intergenerational associations in socioeconomic outcomes is due to selection effects, or that genetic heritability plays an important role in explaining variation in such outcomes. However, none of these studies have used sociological class-based indicators of social positions, and few have engaged directly with classical sociological theories of class mobility and reproduction. We argue that although such previous research has used different socioeconomic outcome variables, results from genetically informed studies may

[14] An edited Norwegian-language version of parts of this article summary has also been used in an op-ed published online (Rogne et al., 2023). I hope this does not qualify as self-plagiarism.

also be directly relevant for theory and research based on class schemes. To assess this, we use three different operationalizations of class[15]:

- The Erikson-Goldthorpe-Portocarero scheme (EGP), which is based on neo-Weberian theory (Erikson et al., 1979)
- The Oslo Register Data Class scheme (ORDC), which is based on Bourdieu's theories (Hansen et al., 2009)
- Daniel Oesch's class scheme, which is an attempt to update and modernize the operationalization of the concept of class (Oesch, 2006)

To provide a continuous occupation-based measure that can be used in a classical twin model, we also use the Standard International Occupational Prestige scale (SIOPS), developed by Donald Treiman (1977).

We use data on zygosity from the Norwegian Twin Register, linked to administrative register data. We then run twin-based ACE models on all of these operationalizations. We use three different sets of models. For the SIOPS scale, we use a classical twin study model for continuous variables. For the class schemes, we use a model for ordinal variables, where we merge classes and reduce the complexity of the schemes to four ordinal categories. This is not ideal, as the schemes are intended to be used as full versions with many categories. Therefore, we also calculate models for each class in the full scheme, and calculate the average A, C and E in each of them.

Apart from the analyzes where we simplify the schemes to just 4 classes, we consistently find roughly the same result, regardless of how we define class. About 50% of the variation in class positions can be ascribed to unshared environmental factors (E). Genetic factors (A) explain approximately 40% of the variation. The shared environment (C, which we argue includes social origins) explains around 10%. Our results suggest that classical sociological theories of class reproduction can at most explain approximately 10% of the variation in class attainment.

We also discuss what implications our results, and results from similar studies, may have for sociological theory and research on social mobility and reproduction.

[15] Let me point out here that I do not believe that class schemes are the best available indicator of social hierarchies. The use of class schemes was a deliberate choice to methodologically and conceptually engage with a sociological literature that had not previously engaged much with this topic.

Prioritizing conclusive over transparent research narratives
incentivizes a host of questionable research practices

- Editorial in Nature Human Behaviour (2020)

9. Conclusions

My aim with each of the articles in this thesis has been to make a solid but incremental contribution to sociological research on their respective topic. As such, the findings from each individual article do not sum up to provide insights or clear conclusions on a broader subject. The substantive conclusions that we can draw are that:

- Many native parents of pre-school children seem to respond to local schools with high concentrations of ethnic minority students by moving away from such schools
- Local colleges and post-secondary, non-tertiary educational institutions have small to no impacts on educational attainment, gendered field of study choices, educational mobility, fertility, and family formation patterns
- Genetic heritability plays an important role for class attainment, while social origins, to the extent that it is captured by environmental factors shared by twins, play a more modest role

Although in each article, we explicitly attempt to reduce potential sources of bias and clearly discuss the limitations of the methods we use, all of these findings rely on a set of modelling assumptions that would bias the results if they are violated, and all should be interpreted with an appropriate amount of caution.

Looking beyond the conclusions of each individual article, the question is then; what can we learn from this thesis?

First and foremost, I hope this thesis conveys that critically assessing theories and mechanisms in sociology and the social sciences is important and possible, although difficult. Doing so may require the use of new data, and drawing on methods and insights from other disciplines. No test of a specific theory or mechanism is conclusive, and results may vary by context, based on the methods used, and various other factors. However, by critically testing and evaluating our theories and the mechanisms they propose, we can gradually move closer to an understanding of how societies work, and how they don't.

Further, this thesis illustrates that all methods come with assumptions, and the credibility of research results will always rest on the credibility of these assumptions. In many cases it is possible to discuss, or even estimate, what directions biases would go and how big they would be if various assumptions are violated, but in other cases this is not so easy. Although the assumptions in this thesis are strong, I would argue that the assumptions that would be required to draw similar conclusions using more conventional methods would be stronger. For instance, naïvely comparing out-mobility rates between school catchment areas to assess the impact of schools, comparing regions with and without colleges to assess the impact of local institutions, or estimating intergenerational or sibling correlations to assess the impact of social origins on class attainment would require assuming that there is no unobserved neighborhood-level, geographic, or genetic confounding, respectively.

More substantively, Articles 1-4 illustrate that individuals do not always respond to policies in ways that we would expect. Abstractly, these papers relate to preferences and how people respond to opportunities. These studies show that people do not respond blindly to the local opportunities they face, but may choose differently. They can move out of catchment areas or move to study elsewhere. Indirectly, these studies illustrate that people's preferences for educational institutions and fields of study play an important role in educational decisions. In the words of Diego Gambetta (1987: 168-169):

> Educational decisions are the joint result of three main processes: of what one can do, of what one wants to do and, indirectly, of the conditions that shape one's preferences and intentions. They are the result partly of causality and partly of intentionality.

These papers do not investigate how such preferences are formed, but they do discuss this issue extensively, especially when discussing parents' preferences for schools, or how gender norms may influence choices of field or childbearing decisions. Article 5 may shed some more light on preference formation, though this light is very indirect. To the extent that individual-level preferences influence educational choices and other

socioeconomic outcomes, the results of Article 5 are consistent with a view that such preferences are partly genetic in origin (Freese, 2011), possibly through influences on personalities, likes and dislikes, though this point is possibly most relevant to higher educational choices.

Finally, this thesis hopefully illustrates the importance of null findings, and surprising or confusing findings. Reporting such findings is crucial in science, and contributes to the incremental accumulation of knowledge.

If I give you my data, isn't there a chance that you will find out that I'm wrong and tell everyone? Yes.

- Gary King (1995: 451)

10. Where to go from here? The ideal of open science

The open science movement is one of the most important recent developments in science, and in social science in particular. Ensuring transparency and reproducibility of results is our most effective tool to combat the problems of p-hacking, post-hoc hypothesizing, selective reporting, publication bias and benign human errors, that are likely all too common in the social sciences, especially in non-experimental studies.

For the articles in this thesis, we have made the college dataset we assembled and used in Articles 2, 3 and 4 available online (Frisli & Rogne, 2023a, 2023b). The code for article 5 is available online, and I intend to also make code for articles 2, 3 and 4 available after submitting the thesis. Making data available is more difficult, since the register data used are highly sensitive and Norwegian privacy regulations limit my ability to share them. I have tried to be conscious not to engage in p-hacking, post-hoc hypothesizing, selective reporting etc. in this thesis. I have also tried not to make errors. However, assessing the quality of the analyses would have been easier with open data and code. If I could start over again from scratch, the most important thing is that I would do differently would be to preregister my studies and make better attempts at making data and code available for reproducibility purposes. This is, in my view, the most important shortcoming of this thesis. Going forward in my research career, I aim to make this a priority.

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