Parent narratives and insights into pre-college experiences and engineering major choice

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Abstract

This full research paper investigates how parents contribute to their children's engineering major choice through narratives of pre-college pathways. Prior research has established that parents influence children's engineering interests, however, the mechanisms for this influence are not yet well-specified. This study addresses the research question: How do parents and guardians contribute to the academic decisions and educational pathways of first-year engineering students? We interviewed six parents of first-year engineering students enrolled at a public, research-intensive university in the Midwest. The semi-structured interview protocol focused on how parents described their children's pre-college journeys. We analyzed the data using reflexive thematic analysis, applying Main et al.'s (2021) model of student pathways into engineering as our conceptual framework. Our research design uniquely positions parents as key narrators of their children's engineering pathways, revealing how family narratives serve as interest-building infrastructure shaping major choice. Findings reveal two mechanisms through which parents influence engineering major choice. Parents actively construct pre-college engineering experiences through family stories and shared experiences, with strategies that vary by parental STEM exposure. Second, parents mediate their children's navigation of major choice by acknowledging their own expertise limits and affirming student autonomy in educational decisions. Together, our findings illustrate that engineering pathways are relationally produced through ongoing family dialogue, rather than through individual student discovery or student academic achievement alone. Our findings expand Main et al.'s conceptual model by revealing that connections between pre-college factors and engineering major choice can also be mediated by active parental support framing, and resource provision. Parent's own STEM exposure emerges as a key factor shaping both the strategies that parents employ and the forms of support that they provide. Understanding how students choose engineering, therefore, requires attention not just to individual student characteristics, but also to the family systems and narrative framings that make engineering student identities accessible, desirable, and achievable. Our study results suggest that increasing participation in engineering requires supporting families in the formative work that many already perform through leveraging the parents' roles in engineering major recruitment and retention, and by developing interventions that align with methods that parents currently use to support their engineering-intending children.

Keywords: pathways, academic support, pre-college preparation, enrollment, qualitative

1.0 Introduction

This full research paper investigates how parents contribute to their children's engineering major choice through narratives of pre-college pathways. Research on engineering major choice has emphasized individual student characteristics—academic preparation, self-efficacy, hands-on experiences—positioning major selection as individual achievement. However, recent scholarship increasingly recognizes that students do not navigate major choice in isolation; family conversations and relationships significantly shape whether students pursue an engineering degree [1], [2], [3]. Yet the mechanisms through which family influence

translates into engineering major choice remain underspecified, such as how parents actively construct pathways to make engineering major choice accessible and desirable. Understanding how students choose engineering requires attention to family relationships, resources, and narratives that position engineering as a viable trajectory. Parents are uniquely positioned to support their child's interest in engineering and at crucial stages throughout their child's educational path.

Our study uses qualitative methods to address this research gap by centering parent perspectives. We ask: *How do parents contribute to the academic decisions and educational pathways of first-year* engineering *students?* We first review relevant literature on engineering pathways and parental influence, establishing a research gap. We then describe Main et al.'s conceptual framework and our qualitative methodology. Through semi-structured interviews with six parents of first-year engineering students, we found that the decision to major in engineering is a relationally constructed process rather than an individual decision of either party. Our findings suggest that this occurs through ongoing family dialogue, in which parents frame their experiences in ways to connect their children to engineering pathways. We conclude this study by discussing theoretical contributions and practical implications for family engagement in engineering education. Our research demonstrates how higher education institutions can honor the varied strategies families employ to make engineering major choice possible.

2.0 Literature Review

Families constitute primary sources of social capital, providing students with connections to knowledge, institutions, and social networks [4], [5]. For engineering students specifically, family social capital can include access to STEM professionals, who model career possibilities, institutional knowledge about navigating university systems, course advice, encouragement to build their engineering identities, and guidance about balancing engineering study with other commitments [6], [7], [8], [9], [10], [11]. Parents can provide emotional support, encourage persistence through academic challenges, and connect students to resources and opportunities [12].

Parents' educational experiences influence the types of support they provide their students. Students whose parents hold engineering degrees or work in STEM fields report different pathway experiences than first-generation engineering students, with each group benefiting from distinct forms of family support that reflect parental educational experiences [13], [14], [15]. Parents with experience in engineering or STEM fields can provide navigational capital and engineering-specific information to help their children when selecting engineering as a major. Parents who do not have backgrounds in engineering can still provide support in the form of recognition of an engineering major choice and emotional support [9], [10], [16].

Jarvie-Eggart et al. [17] surveyed 158 first-year engineering students and found that a majority (63%) had at least one family member in engineering. This included 73 survey responses indicating a father and 22 indicating a mother in engineering or STEM. This result shows the impact of parents on the choice of engineering as a major by providing a source of engineering-specific information. Main et al. [1] found that parents' perceptions of engineering influence engineering career choice. When interviewing students, Mein et al. [18] found that in

the absence of a parental engineering figure, teachers and mentors filled the gap. What is missing from this analysis is how the parents influenced the educational decision. Using the High School Longitudinal Study of 2009 (HSLS:09) as a data source, Main et al. [13] suggested that more research was needed to find potential differences by field rather than just STEM in aggregate.

While this research establishes that parents influence engineering pathways, we know less about the specific mechanisms through which parents contribute to the children's pre-college experiences. Existing studies rely primarily on student retrospective reports of parental influence, which cannot fully capture the work parents perform. Thus, this gap is both conceptual and methodological. Understanding engineering major choice therefore requires direct examination of how parents describe their children's major choice decision and frame engineering as a viable future. This study addresses the conceptual and methodological gap by centering parent voices to examine not whether parents influence major choice[19], [20], but *how* they guide their children towards engineering as a viable undergraduate major.

3.0 Conceptual Framing

This research study is guided by the conceptual model of student pathways into engineering created by Main et al. [1], and identifies connections between the different life experiences that accumulate along individual engineering pathways. As an application of the life course perspective [21], the student pathways into engineering approach aligns with this study's examination of pre-high school and high school experiences that make engineering major choice accessible and desirable, and the development of career interests. This model also accounts for the role of parental support within pre-college engineering activities, emerging interests, emotional support, and academic achievement. Furthermore, the model informs our analysis of parent narratives as indicators of social influences on engineering pathway decisions at multiple times during students' pre-college life. However, the model does not specify how parents interpret children's experiences, connect disparate interest to engineering opportunities, or position engineering as desirable and achievable.

We operationalize this framework in three distinct ways. First, we use the pathway components as concepts that guide out interview protocol development. Our questions asked parents to narrate how their children's engineering major decision emerge from pre-college activities, STEM exposure, academic preparation, and emotional support. Second, we analyze parent narratives to reveal how parents actively connect and leverage these pathway components across their child's major decision process. Third, we investigate how these parental strategies vary by parental background to reveal that parental support is not uniform or evidenced by a singular result

4.0 Method

We conducted semi-structured interviews with the parents of first-year engineering students from one public university in the Midwest. Students were first invited to complete a survey. From the survey responses, we identified and solicited student interviews through stratified sampling across engineering course sections, social identities, and demographic characteristics. Student interview participants were provided with an email that they could

voluntarily forward to their parent or guardian. From the responses we received, we then recruited six parents (from each respective student interviewee) for this analysis. All participants in this study were biological parents (four mothers and two fathers) whose children successfully enrolled in an undergraduate engineering program.

4.1 Positionality Statement

Our collaborative research team includes five scholars at different career stages from diverse backgrounds, each bringing distinct perspectives to understanding how parents construct pre-engineering pathways through family narratives. We are comprised of faculty members at research universities, community college faculty, and graduate students. The composition of our team reflects varied pathways to engineering education research: some of us hold engineering degrees and worked as practicing engineers before entering academia; others come from education, social sciences, or interdisciplinary programs. To manage potential bias, we discussed how our positionalities as parents, as children, and as educators shaped what we recognized as significant in parent narratives. We were particularly attentive to avoiding deficit interpretations of parents without STEM backgrounds, instead seeking to understand the diverse strategies families employ. Our choice to center parent narratives as primary data reflects our epistemological stance that parents' own sense-making work reveals major choice processes that student-reported parental influence cannot fully capture. We acknowledge that our positionalities as researchers shaped our interpretations of parent accounts and our framing of family support as central to engineering pathway construction.

4.2 Participants and Data Collection

We conducted semi-structured interviews with parents of first-year engineering students. We developed an interview protocol based on the conceptual model of student pathways into engineering by Main et al. [1]. We focused our inquiry how parents storied the pre-college journey of their children. Specifically, we asked parents about their occupation, education, parenting practices, child's education, knowledge of engineering, child's engineering interest, community, and their aspirations for their child (refer to Table A1for the interview questions relevant to this study). We adopted pseudonyms for each participant, and any quotes shared in our findings will be attributed to participant pseudonyms (refer to Table A2 for summary of study participants). The majority of the participants had STEM educational or professional backgrounds, with careers in medicine, information technology, pharmaceuticals, financial auditing, retail sales, and K-12 education.

4.3 Data analysis

To determine findings in response to our study's research questions, we conducted reflexive thematic analysis [22] using inductive open coding [23], and episode profiling [24] of participant transcripts. Episode profiles provide an added benefit of summarizing each interview and enhancing research design credibility [25]. The research team met weekly to interpret data, to discuss findings, and to co-construct meaning from revised analytic themes. Any discrepancies were discussed until a consensus was reached. Additionally, we sought feedback during the data analysis process and the writing of this study from engineering education researchers external to their team to ensure credibility and demonstrate process reliability [26].

5.0 Findings

5.1 Theme 1: Family narratives connect children to engineering pathways

Parents in this study connected their children with engineering pathways through stories of family history, childhood interests, school experiences, academic strengths, relationships, and personal characteristics. These family narratives provided emotional support while strategically positioning engineering as a desirable and achievable undergraduate major. Parents with STEM backgrounds demonstrated particular facility in translating their children's diverse interests into the language of engineering possibilities, while parents without STEM backgrounds employed alternative strategies to make engineering major choice accessible.

STEM familiar parents actively constructed connections between their children's varied experiences and engineering major choice. Jenna, a mother whose husband works in computing and whose sister-in-law is an engineer, illustrates how parents describe seemingly unrelated childhood interests into engineering pathways. She described how her son's engineering major choice emerged gradually through family experiences:

> We … went to the Grand Canyon, and you know we saw that, but I think he started getting a little bit more interested in in the engineering field, probably in Junior High. And I think that was related to the sort of math that … And then, of course … my sister-in-law is an engineer.

This narrative demonstrates several critical parental strategies through which parents construct engineering major choice as viable. First, she exposed her child to a diverse set of opportunities as part of their family activities. She did not initially describe these activities as focused on engineering. Secondly, she connects these family experiences to engineering concepts, through her son's middle school mathematics competency. Third, she positions these connections as compatible with the exposure to engineering careers her son received through other family members. In Jenna's framing, family connections are central, and her son's authentic childhood interests are woven throughout. Her narrative emphasizes the role of parents and families in helping their child build relationships with engineering as an academic discipline through accumulated family experiences that ultimately shape major selection.

Similarly, Lorie drew on her post-graduate scientific training to help her daughter translate a research-based internship into an interest in engineering. This internship occurred while her daughter was applying to undergraduate programs and actively considering major options. After she completed a study of PCR assay development, Lorie helped her daughter to identify what part of the experience most resonated with her educational aspirations:

… And there she worked on a reagent setting, trying to develop a PCR assay on an instrument. Then she realized, okay, the things that she's working on [with] those instruments were different [companies]. Then she started [to think…] - Oh, there are different companies. And this is how [they are different]… what is better? … and [she] started looking at the micro fluidics and other parts that also play an important role in the different things. And that's how she decided, okay, I want to do biomedical engineering.

While Lorie's own scientific background may have logically swayed her daughter's interest towards a scientific research career, Lorie instead supported her daughter's emerging interest in the instrumentation, design, and technological systems—the engineering dimensions of scientific research. This story represents sophisticated career guidance that requires understanding the engineering-science interface and a careful elucidation of what experiences most captivated her daughter's curiosity. Lorie's approach demonstrates how parents facilitate major choice by helping their children articulate interests they encounter but have not yet named, supporting identity development that may initially appear tangential to more obvious career paths.

While Jenna and Lorie helped their children to discover engineering major choice through interpreting diverse experiences, other parents socialized children into engineering as an expected family tradition. Brenda's family narrative represents a distinct pathway strategy in which engineering major choice reflects multi-generational family tradition. Brenda is the mother of four children who attended the same engineering-focused high school academy and enrolled in the same undergraduate engineering program. When speaking about her twins, her two youngest children who are both enrolled in a first-year engineering program, she emphasized the family's role in their common pursuit of an engineering degree:

> [We] kind of prepared them because we know how hard engineering is gonna be … my husband's side [of the family]… we have 3 generations and every single one are engineers from [the same university]. So, they know what it's gonna be like. And my husband is in electrical engineering too.

The pursuit of electrical engineering has been instilled with a sense legacy, tradition, and predetermination for Brenda's children. The phrase "we know how hard engineering is gonna be" positions academic discipline difficulty as family knowledge, rather than an individual challenge. Her family functions as an institutionalized engineering pathway, with parental support extending beyond academic preparation to include emotional scaffolding, sibling peer support, and multi-generational institutional knowledge of their specific university.

Across the families in this study, parents construct distinct and complementary narratives of their children's engineering pathways. Jenna and Lorie serve as interpretive guides, helping their children recognize engineering competencies within experiences that might otherwise seem unrelated. Brenda stories the role of family legacy and inheritance within her children's pathway. In each case, parents described their children's pathway to engineering from their parental relationship—discussion, childhood stories, and connections to family members. Engineering was not discovered independently, or all of the sudden. Secondly, parental STEM exposure shaped their strategies. Those with STEM backgrounds emphasize engineering's compatibility with varied interests, while multi-generational engineering families structure major choice as family expertise. Third, these narratives highlight the way that engineering major choice is storied over time through conversation, and connections within families. Parents actively produce the conditions for engineering to become a desirable and achievable degree for their children.

5.2 Theme 2: Facilitating interest for aspiring engineers

As students approached college enrollment and major selection decisions, parents described the ways they mediated their children's engagement with engineering as an academic discipline and professional career. Simultaneously, parents acknowledged their own (sometimes limited) exposure to engineering, affirmed their child's educational autonomy, and cultivated engineering study within lifelong learning. Through this mediating work, children accumulate the emotional and psychological support that transforms engineering major choice into an accessible process.

Even parents with extensive engineering experience encounter knowledge limits when children pursue engineering subdisciplines outside parent expertise. Jack, a computer engineer with prior technical knowledge from multiple firms, illustrates this dynamic. Despite his engineering background—and a close family member with an engineering PhD—Jack recognized his limits when his son pursues a Civil and Construction engineering major:

> ... he's like, I wanna build bridges… I'm thinking … But there's not a huge demand for it, you know, at least as far as my thinking was compared to computer engineering, or even the traditional mechanical and chemical engineering fields where there's … bigger demand. But I, I'm getting educated more on that.

Jack's statement reveals several critical parental moves in supporting his son's major choice. He initially evaluated his son's engineering interest through his own disciplinary lens, assessing market demand in industries familiar to him. However, the pivotal shift from "there's not a huge demand" to "I'm getting more educated on that" demonstrates Jack's recognition that his initial assessment reflects a disciplinary bias rather than comprehensive knowledge. Rather than insisting his son reconsider based on Jack's expertise, he models the intellectual humility and curiosity that it will take for his son to decide appropriately. By withholding his parental dismissal, Jack supports his son's major choice and acknowledges that their understanding of engineering may diverge. The emotional subtext is critical: Jack supports his son's decision, even though he doesn't fully understand it, because a decision of this scale requires autonomy, modesty, and discomfort. Jack's narrative reveals that parent support for engineering major choice depends less on expertise or education than on willingness to seek help, admit ignorance, and learn alongside children.

A common strategy amongst parents is to broker access to mentors with engineering discipline knowledge. Carmen, who draws on her professional experience in retail and athletics, illustrate how parents in other professions facilitate engineering major choice. Her daughter's interest in engineering emerged from a community aeronautics program and a career-ending soccer injury. Despite limited STEM infrastructure in her community, Carmen actively pursued available opportunities for her daughter:

> She needed a push, and she couldn't get it from me. I could only provide information, support, and getting her to people that were strong. But they had to help her and give her that confidence that she could succeed.

Carmen's parental approach is honest about her limits and capacity. At the same time, she strategically provided "information" for finding relationships that would get "her to the people" who could support her daughter's engineering major interest. Critically, Carmen recognized that her daughter's success depended on access to engineering discipline mentors. This brokering work was particularly challenging when the field of study was mutually unfamiliar, community resources were limited, and gender bias in STEM programs was prevalent. Similar to Jack, Carmen models expert-seeking and advocacy for opportunities not readily available—skills her daughter will need to navigate within her own major choice experience.

Beyond acknowledging expertise limits and brokering mentor access, parental support affirms the child's capacity to make educational decisions about their own academic paths; even when those decisions diverge from parental expertise. Richard's narrative illustrates parental affirmation of student-driven educational changes that lead to engineering major choice. Even prior to high school, his son's initiated institutional change:

> He wanted something more challenging for himself … We just supported him … he said, I want to change. I said, Okay, fine. You change you. He identified the school. He changed the school, he changed the curriculum, and we just supported him. So, it was purely his decision to change and

Richard's parental support affirmed his son's capacity to recognize education needs and act on them independently. Rather than managing the transition himself, Richard validated his son's autonomous decision a preparation for his future education path. His approach mirrors Carmen's mentor-brokering and Jack's support: they acknowledged that supporting engineering interests requires empowering their children to navigate necessary changes.

Across these narratives, parents acknowledge that engineering major choice is complex, and will require their child's growth and self-awareness. Rather than simply encouraging their children to "work hard towards their passions", they create emotional support infrastructure around their child's serious commitments. Jack models learning across subdisciplines; Carmen demonstrates persistent resource-seeking and mentor-brokering; Richard affirms student autonomy in education navigation. Each approach recognizes that engineering major choice is not straightforward individual decision. Rather, it emerges through accumulated support enabling children to navigate unfamiliar territory. Through this mediating work, parents construct engineering major choice as both achievable and supported—even when they themselves lack comprehensive knowledge of what their children are choosing.

6.0 Discussion

By demonstrating that engineering interests are not individually discovered but relationally constructed, this study demonstrates that engineering major choice is a fundamentally relational accomplishment. While prior research has established that parents influence children's engineering interests [7], [9], [12], [14], [27], our findings elaborate the specific mechanisms through which this influence operates: parents actively story their children's disparate experiences into coherent engineering narratives, and mediate their navigation of disciplinary complexity and major selection. Understanding how students come to engineering

therefore requires attention not just to individual characteristics but to the family systems and narrative framings that make engineering identities accessible, desirable and achievable. Our research design uniquely highlights parents as the key narrators of their children's engineering pathways, revealing how family narratives themselves serve as interest-building infrastructure. Unlike studies that ask students to report parental influence retrospectively, our approach captures parents' sense-making work. This methodological choice illuminates parent agency and parenting strategies in ways that student-centered research cannot fully capture.

6.1 Theoretical contributions

Our findings elaborate Main et al.'s (2022) conceptual model of engineering major choice to explain the ways that pre-college factors translate into engineering major choice. Main et al. identify key factors supporting engineering choice—family members in engineering, hands-on activities, student clubs, math/science interest, career awareness—and our first theme demonstrates how parents narratively construct connections between these factors and engineering career possibilities for their children. Significantly, our analysis confirms that these connections are not always self-evident, and require active parental interpretation, framing, and family resources.

Parental STEM exposure emerges as a key factor shaping both the strategies parents employ and the forms of support they provide. Theme 1 shows that parents with STEM backgrounds can reframe diverse interests as engineering-compatible and multi-generational engineering families transmit institutional knowledge and family expertise to their children. This variation by family STEM exposure represents a significant elaboration of the model, describing critically how family background contextualizes familial mechanisms of influence. Theme 2 clarifies the crucial ways that parents provide discipline specific support—not just informational resources, but psychological authorization to navigate complex systems, acknowledge multiple identities, and advocate for their educational needs. This complements existing research on the role of parental support in student major choice decisions [2], [28], [29]

6.2 Limitations and future directions

While this study provides valuable insights into parental roles in engineering pathways, several limitations suggest directions for future research. First, our sample includes only parents whose children successfully enrolled in engineering programs, represents a segment of parental perspectives, and may limit the transferability of our findings. We did not speak to families whose children were interested in engineering but did not enroll, or who enrolled but left engineering. Comparative research including these families would illuminate which forms of parental support are most associated with persistence versus attrition. Second, our study captures parental narratives at a single time point (during their child's first year of college). Longitudinal research following families throughout undergraduate engineering experiences would reveal how parent-child dialogues evolve and which parental strategies sustain as students approach graduation and career entry. Third, while our sample includes parents from diverse racial/ethnic, socioeconomic, and educational backgrounds, we did not explicitly analyze how these social positions intersect with the strategies parents employ. Future research should investigate how race, class, and gender contribute to the specific strategies they deploy. Finally, our study focuses on parents as a primary source of family influence. Future research should examine

theories of siblings, extended family, and family friends in constructing engineering pathways; recognizing that "family" extends beyond parent-child dyads and that engineering interest may be constructed through broader kinship networks.

7.0 Implications

Current K-12 engineering education often focuses on student-centered activities (design challenges, robotics competitions, STEM clubs) that implicitly position engineering interest as individually cultivated through direct hands-on, technical experiences. Our findings suggest that K-12 engineering education should explicitly engage families in recognizing how engineering connects to their existing knowledge, experiences, and values. Rather than treating engineering as a specialized domain separate from everyday life, teachers can design activities that create opportunities for students to have engineering conversations with family members; and make engineering more legible to families from various educational backgrounds by connecting it to e knowledge that families already possess about problem-solving and design thinking.

Post-secondary engineering recruitment, outreach, and student counseling typically target students directly, with parents positioned as a peripheral audience for financial aid information. Our findings suggest that student support services should recognize parents as active co-constructors of engineering pathways, and should educate families about engineering's breadth, while honoring parents' support work. Engineering programs should recognize that parents possess differing levels of institutional knowledge along with crucial understanding of their children's interests, capabilities, and constraints. Rather than excluding parents due to their unfamiliarity with specific engineering disciplines, programs should position parents as experts on their children, while providing them with institutional and disciplinary knowledge they can integrate into their support work. Additionally, post-secondary programs should foster ongoing family engagement throughout the undergraduate experience to bolster the emotional support and frameworks for success that parents provide. Finally, further research can be done to examine the influence of family on the major choice of engineering students.

8.0 Conclusion

This study demonstrates that engineering major choice is a fundamentally relational accomplishment, constructed through ongoing family dialogue in which parents actively story children's experiences, and mediate disciplinary navigation. By applying a conceptual model of student pathways into engineering, we reveal how parental STEM exposure shapes the strategies parents employ. Our findings challenge individualistic framings of engineering interest and major choice, revealing instead that what appears as individual interest is actually the culmination of years of family dialogue and narrative construction. Understanding engineering pathways, therefore, requires attending not just to students' individual characteristics but to the family systems that make engineering accessible and desirable. Ultimately, this research suggests that broadening participation in engineering requires not just recruiting diverse students or re-imagining technical instruction, but supporting diverse families and the narratives about engineering that they construct and perform.

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10.0 Appendix A

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Table A1: Participant interview protocol overview

Interview questions:
1) Did you talk to your child about engineering as a possible career? (If so, describe that conversation) a) When did they decide to study engineering? (Please describe that experience) b) In what ways did you come to a decision together? 2) What are some of the resources or activities that have impacted your child's decision to pursue an engineering degree? a) How do these resources or experiences differ from each other (time of introduction, range, variety, composition)? b) Was there a particular person who provided a resource or was part of an experience that helped your child meaningfully? 3) How has your child responded previously to unsupportive or hostile environments in their education? a) Was there a person other than you who helped your child through this particular challenge? b) Describe the types of challenges you anticipate that your child may encounter on their path to an engineering degree. 4) In what ways have you discussed community, national, and world events with your child? a) How can engineering allow your child to address societal inequality? b) How do your child's values and identities align with the opportunities that engineering may provide? 5) Describe your career and educational hopes for your child. 6) Is there anything else you would like to tell us about your child's educational pathway in engineering?

Table A2: A demographic overview of the study participants.

Pseudonyms	Relationship	Race / Ethnicity	Parental Occupation	Child's High School Geography
Brenda	Mother	Asian/Asian American	Medicine	Midwest
Carmen	Mother	Asian/Asian American	Sales	Pacific Coast
Jack	Father	White	Information Technology	South
Jenna	Mother	White	K-12 education	South
Lorie	Mother	Asian/Asian American	Pharmaceuticals	Midwest
Richard	Father	Asian	Financial Auditing	International