

Interest Catalysts: The Unique Ways Families Connect with Program Experiences to Support Long-Term STEM Interest Pathways in Early Childhood

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Scott Pattison, TERC
Smirla Ramos Montañez, TERC
Alicia Santiago, Mt. Hood Community College (MHCC) Head Start
Gina Svarovsky, University of Notre Dame
Annie Douglass, Oregon Museum of Science and Industry (OMSI)
Verónica Núñez, OMSI
Julie Allen, MHCC Head Start
Catherine Wagner, University of Notre Dame

Interest is a critical motivating factor shaping how children engage with STEM inside and outside of school and across their lives (Harackiewicz et al., 2016; Renninger et al., 2015). Although definitions vary, interest is generally understood to include both the spark of emotion we feel when we are excited or compelled to engage with something in a particular moment, as well as the more enduring motivation to re-engage with an activity or topic that we may begin to associate with who we are as a person (Ainley, 2019; Renninger & Hidi, 2016). A growing body of research demonstrates the importance of interest development in early childhood and provides evidence that young children develop STEM-related interests through family-based experiences (Crowley et al., 2015; Dou et al., 2019), that these interests persist and have implications for early elementary school and beyond (Ozogul et al., 2017; Shaby et al., 2021), and that memories of these early interests resonate for STEM professionals and hobbyists years later (Cohen et al., 2021; Corin et al., 2018; Crowley et al., 2015).

Despite evidence of the importance of early STEM-related interests, there is still much that is not understood about *how and why* they develop or how they can be supported over time. As part of an ongoing effort to answer these questions, the research team conducted a longitudinal, multiple case study investigation with 10 low-income Spanish- and English-speaking families who had participated in a family-based engineering education program integrated within Head Start prior to their children entering kindergarten (ages 4 and 5). Both the program and study focused specifically on the experiences of low-income English- and Spanish-

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speaking families, who have traditionally been marginalized in STEM education (NASEM, 2021; NCSES, 2021). The study was guided by three research questions: (1) What structures and processes describe family interest development systems at this age, (2) How do family-level interest development systems evolve and change in preschool and kindergarten, and (3) What factors appear to influence interest development pattern across families?

Theoretical Framework

In order to fully capture the reciprocal, interconnected nature of learning in early childhood, we conceptualized interest as a family-level systems phenomenon (Pattison et al., 2016, 2018, 2020). Drawing from systems researchers (Bronfenbrenner, 1979; Cox & Paley, 1997; Hutchins, 2000; Zuiker et al., 2016) and family systems theory (Broderick, 1993; White et al., 2019), data collection and analysis were guided by three assumptions: (a) the family, including parents and children, is the appropriate unit of analysis for understanding interest development at this age; (b) components and phases of interest development are distributed or emergent across family members; and (c) families develop patterns and routines related to emerging interests that evolve in response to ongoing influences within and outside the family. Expanding on existing theories of interest (Bell et al., 2019; Hidi & Renninger, 2006), the *family interest development system* was defined as parents' and children's interrelated predispositions (stated and enacted) to reengage with a focus of interest over time, as well as the connected set of beliefs, values, knowledge, and skills that influence and are influenced by this reengagement and are distributed across family members.

Data Collection and Analysis

Families were recruited at the beginning of the child's last year of preschool as part of their enrollment in the Head Start on Engineering (HSE) informal engineering education program (Pattison et al., 2019, 2020). HSE is year-long family-centered program that engages low-income Spanish- and English-speaking families from Head Start in the engineering design process and explores the ways that families already engage with engineering at home in their everyday lives. The program is an ongoing research-practice partnership with Mt. Hood Community College Head Start with the goal of both studying the ways that these experiences shape long-term STEM-related interest development for families with young children and co-developing new approaches to supporting equitable engineering learning for Head Start families. During the 2020–21 school year, the program included four bilingual take-home family engineering activities, each with a children's book, activity guide, and materials for several engineering design challenges. The activities were supported by a variety of other program elements, including virtual parent meetings, activity videos, a project website with photos and reflections of families' experiences with the activities, classroom extensions, and regular communication with program and research staff.

A total of 24 families were enrolled in the program during the 2020–21 school year. Of these, 12 families were recruited to participate in the case study research described in this study,

and 10 of these completed the program and data collection activities. Four of these families primarily spoke Spanish and six primarily spoke English at home. All families were considered to have low-income based on their eligibility for Head Start. The primary parents or caregivers from these families self-identified their race and ethnicity in a variety of ways, including Hispanic (5), White or Caucasian (3), African American (1), and one family that chose not to share their racial or ethnic identity.

Data collection for the case study families spanned approximately 1 year and included in-depth qualitative interviews via phone or Zoom before, in the middle, and at the end of the program and during the fall of the child's kindergarten year. Data collection also included observations of all program events and tracking of program participation; recordings of family interactions with the four activity kits captured by families using their phones and an automated Zoom recording system; and documentation of other program artifacts, such as pictures, reflections, family communication, and meeting notes. Each case study family was assigned a research liaison that maintained contact with the family throughout the program and beyond and spoke either Spanish or English, based on family's preference.

Data were analyzed in the original language of the family following a multiple case study approach (Stake, 2006; Yin, 2018). To begin, each research liaison synthesized data across all sources into an interest development narrative, using a case study narrative template developed by the research team. These narratives were then updated after careful review and critique by other members of the research team. Next, the narratives were reviewed individually and collectively to identify themes and patterns within and across the case studies. These emergent patterns were then used to develop a focused coding scheme that was applied to the narrative using NVivo qualitative coding software and Grounded Theory coding techniques (Charmaz, 2006). Results of this coding process were interpreted to develop a final set of analysis themes. During the final parent interview in the fall of the child's kindergarten year, a one-page summary of the interest development narrative was shared and discussed with the parent as a member check and a prompt for ongoing reflections.

Research Findings

All 10 families showed strong evidence of long-term interest development related to their program experience, such as ongoing engagement with program activities and materials, new beliefs about engineering, and seeking out other engineering-related activities. In this paper, we focus particularly on the concept of *interest catalyst* that emerged from data analysis as critical to the process through which each family developed unique engineering-related interest pathways. As defined by the team, an interest catalyst is an instance or moment in which an element of the program (or other learning resource or experience) connects with the prior interests, knowledge, experiences, or values of the family in order to catalyze new, reinforced, or transformed interests or interest-related behaviors. The concept emphasizes that interest development is not a property of only the family or the experience but a unique combination and outcome of the two. Although similar to triggered situational interest as described in Hidi and Renninger's Four-Phase Model

of interest development (Hidi & Renninger, 2006; Renninger & Hidi, 2011), the idea of *interest catalyst* focuses attention on not only the ways that interest is sparked for individuals in a particular moment but how prior interests, goals, and values shape when and how these interests are sparked and how the process reinforces or transforms existing interests in unique ways for each family.

In-depth analysis of the longitudinal case studies highlighted unique interest catalysts that appeared to shape the long-term interest patterns of each family. For some families, the intersection of prior family values and elements of the program motivated them to continue to engage in the program activities and seek out similar experiences and resources. For example, Lau (family 1), a first-time mom participating in the program, described how as a parent she values finding ways to have fun as a family without spending money. Early in the program, she shared a story about how she and her husband built a playhouse from a large cardboard box they saved and how this was an enjoyable activity for her son. During one of the program take-home activities in which families design and build forts of different sizes and purposes using furniture and materials from around the house, she was reminded of how simple, inexpensive materials can be used to create fun and educational experiences. This reminder, connected with her prior values, motivated her to find more opportunities for activities like this that use everyday materials, support her children's development, and allow the family to spend time together. At the end of the program, Lau seemed excited to think about other activities she could create for her son.

For other families, interest catalysts reinforced and transformed interests that were already present. For example, Tiffy (family 27) talked about how her children's grandfather had always wanted to build a tree house for the family but that in the past her children had not shown much interest. However, after they used the fort building activity, the children became more excited about the idea. During a subsequent visit over the summer, the grandfather worked with the children to build a tree fort in the backyard—an experience which both built on the grandfather's prior interests and extended the family's growing engagement with engineering-related activities. The family also began talking more about how engineering relates to other aspects of their lives, such as cooking or building structures for their toys.

Similarly, Cali (family 3) described how her son had always been interested in engaging in adult activities and working with adult tools (more than toys, as she said). During the program, Cali noticed that the engineering activities gave him a chance to do this, highlighting for her the power of supporting her children's learning with everyday household items. After they moved to her parents' farm in the country, she continued to seek out opportunities to support her son's learning and creativity through everyday experiences with household materials—including opportunities for her son to engage in engineering-related activities, such as helping his grandfather design and build a milking stool. As with the other two examples, Cali's story highlights the ways that prior family interests, goals, and values appeared to shape families' experiences with the program and their subsequent interest development pathways.

Significance and Contributions

Understanding the processes through which families with young children develop long-term interests related to STEM is critical for creating effective, equitable programs that support ongoing STEM learning. This study provides a unique look at interest development and learning in early childhood, which is a growing focus of STEM education research. Using a family systems perspective to better account for the ways that learning in early childhood is distributed across the family, the study describes a new theoretical concept, *interest catalysts*, for understanding how the unique combination of family and program characteristics motivates long-term patterns of interest and engagement. This emergent, family-centered perspective can inform programs that are tailored to the interests and values of families—and especially those whose perspectives have often been absent from STEM education research.

From a theoretical perspective, the study also expands our conceptualizations of interest for studying and supporting family STEM learning, including emphasizing interest as a family-level systems phenomenon rather than an individual construct (Pattison et al., 2020) and highlighting the diverse interest pathways shared by families that may or may not directly connect to traditional notions of STEM concepts and practices (Azevedo, 2011; Pattison & Ramos Montañez, 2022). Perhaps most importantly, findings support the growing movement away from deficit-based narratives of families that ignore family interests, goals, and values and instead towards a focus on the ways that existing family interests connect with program elements in unique ways to help motivate ongoing learning and engagement (Azevedo, 2018; Pattison et al., 2022; Ramos Montañez & Pattison, 2021).

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