

The Pink Paradox: Tensions in How STEM Toys are Marketed Toward Girls

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Abstract

The purpose of this narrative literature review is to describe the current state of knowledge about the tensions present in how science, technology, engineering, and mathematics (STEM) toys are marketed to young children. Effective toy marketing is essential for engaging kids in the types of play that support spatial skill development and engineering thinking skills. The continued underrepresentation of women earning engineering degrees and persisting into the engineering workforce suggests that continued efforts to improve women's participation in engineering are still very much needed. A critical component of this effort is focusing on ways children develop a sense of engineering identity that supports early interests in engineering-related subjects, and ensuring that girls are included in these activities and experiences, not just physically, but culturally. Children's engineering identity may develop throughout pre-adolescence, and play is one avenue through which this development occurs. Hence, our interest in *why* girls do or don't engage in play with certain kinds of building toys.

Throughout this paper, the terms *girl* and *boy* are generally used to either represent biological sex assigned at birth, or two extremes of a gender-based lens we applied to a collection of toys to assess who was or was not included in its target audience. Specifically, this paper is focused on a review of influential toy companies that have employed strategies to market building-related toys specifically to girls. While we have used categorical labels of *girl*, *boy*, and *neutral* as a schema to interpret how cultural messaging may be perceived, our intention is not to imply that children themselves, or the ways they experience and express gender, will neatly fall the same categories.

It is widely believed that girls are drawn to toys that involve some form of narrative or storytelling. Two popular STEM toys of interest that market to girls using narrative storylines include LEGO® Friends and GoldieBlox®, both of which contain character-driven stories that appear across multiple forms of media beyond the toy itself, including books and videos. While these toys were designed to capture girls' interest in construction play and engineering, they have been criticized for using traditionally feminine themes, hobbies, and color palettes in their marketing approach. This tension that is negotiated in STEM toy marketing and design is what the authors call "the pink paradox," and serves as the focal point of this literature review.

The "pink paradox" refers to the tension that toymakers face when marketing STEM toys in a way that appeals to girls without sending harmful messages that may reinforce gendered stereotypes or exclude certain children from playing with these toys. This literature review provides an overview of gendered toy marketing in the United States and highlights the critiques that toys like LEGO® Friends and GoldieBlox® have received for using traditional gendered stereotypes to appeal specifically to girls. For example, this review found that both of these toys use pink and purple and employ themes traditionally associated with femininity in their pieces and branding. These toys also use traditionally feminine appearances to attract girls (e.g., the white, blonde-haired, blue-eyed "princess") and reinforce what an ideal consumer of such a toy might look like, thereby excluding children who don't identify with these archetypes, with girls of color and non-binary children perhaps being the most affected by this exclusion. STEM toys were also found to present narratives drawn from traditionally feminine hobbies and interests,

such as caring for animals, planning parties, and focusing on friendships, which assume a specific set of life experiences and interests. Using stereotypes in marketing these toys may be harmful to young children, especially those who are already less likely to see themselves in represented in engineering, and are also developing their engineering identity, sense of self, and future career aspirations.

This review concludes by describing areas of future research, namely, the need to understand the relationship between toy narrative, engineering identity, and children's interest in and access to STEM toys. Understanding the relationships between these constructs can help girls develop spatial skills and interest in engineering through play, which may ultimately encourage them to pursue engineering pathways in the future.

Introduction

There are many research reports and studies that highlight the gender gap between men and women in engineering fields [1]. In 2018, 22.2% of bachelor's degrees in engineering were earned by women [2]. Additionally, in 2019, among those with science and engineering (S&E) degrees, 15.98% of women worked in S&E occupations (compared to 35.38% of men) [2]. The gap between the number of women and men earning engineering degrees as well as the number of women pursuing science and engineering careers suggests the need to improve and support women's participation in engineering fields.

One factor that may impact someone's choice in pursuing engineering is their engineering identity [3]. Engineering identity generally refers to how someone views themselves as an engineering student or how they perceive their capabilities in engineering [4]. Engineering identity can be represented across different dimensions such as academic identity (beliefs about oneself as a student) or engineering career identity (what one knows about an engineering career or their aspirations for an engineering career) [3]. Some research has suggested that children may begin developing engineering identities as early as pre-adolescence and these identities may impact their interests and aspirations for future careers in engineering [3]. Children receive messaging through media, games, and their social environments about what engineering is, what engineers look like, and who gets to be an engineer. These messages could impact their perceptions of engineering and the formation of their engineering identity.

Research has suggested that children may also develop a sense of engineering identity through their play activities [5]. Play is an important way that children interpret their lived experiences and externalize them. According to Vygotsky [6], play is important in a child's development as it allows them to engage in imaginative thinking, exercise self-control, and learn to follow rules. Research has shown that play is important for children's development as independent learners and for building their creativity and problem-solving skills [7]. Developmental psychology research has shown that play impacts language development and children's self-regulation abilities [6], both of which are significant predictors of academic achievement and emotional wellbeing [8]. Play is also an important way that children negotiate their identity, interests, and how they construct ideas about their future selves and their future career [9], [10]. Play may therefore be a valuable avenue for supporting children in developing engineering identities. Investigating the nature of children's play may be useful for designing educational activities and

interventions to help young girls develop an interest in and identity with engineering fields, potentially encouraging them to participate in engineering careers in the future.

A growing number of toy manufacturers have created toys designed to engage girls in STEM, particularly through building and construction play. Notable examples include the LEGO® Friends product line and GoldieBlox®, both of which use narrative, character-driven storylines to engage girls in building and engineering activities. These two toy lines have been met with criticisms about using traditional feminine stereotypes (e.g., color palettes, themes, and marketing imagery) in order to make building/engineering appealing to young girls. By continuing to target girls with building toys that reinforce social stereotypes about traditionally feminine interests, hobbies, and activities, girls may be dissuaded from exploring other potential areas of interest, including science and engineering. This may contribute to girls feeling a lack of identity with engineering at a young age, thereby dismissing engineering as “not for them.” In turn, less women may choose to pursue and participate in engineering fields compared to men.

The tension between needing to engage girls’ interest in STEM and/or building toys while simultaneously using traditional, gendered stereotypes of femininity in order to do so is what we have termed *the pink paradox*. To more fully understand the current nature of gendered toy marketing and the pink paradox, we performed a literature review. In this narrative review, we present an overview of the current state of gendered toy marketing in the United States. We describe how many toys play upon traditional feminine and masculine stereotypes to target certain groups of children and how this leads to the tension in the overall effort to encourage girls to engage with toys traditionally not marketed toward them (i.e., *the pink paradox*). We conclude with suggestions for areas of potential future research, particularly for impacts within engineering education.

History of the Gendered Toy Aisle

Toy stores have organized toy aisles by gender for many years, developing in the 1980s as a marketing strategy to appeal to young children [11]. In many toy stores in the United States, shoppers see toy aisles “for girls” and “for boys,” each containing toys with different themes, colors, and storylines. Toys marketed for girls often incorporate hobbies and activities drawn from traditional feminine stereotypes, such as dolls, cosmetics, and toys for jewelry making, cooking, and cleaning [12], [13]. They also use color palettes that are often associated with femininity, such as pink and purple [12]. In contrast, toys marketed for boys often include themes relating to vehicles, action figures, weapons, adventure, and building/constructing [12], [13]. Typical colors used in the marketing of masculine toys include red, black, gray, and brown [12].

One genre of toys that has had a clear market separation between girls and boys are building toys. Players use building toys to imagine, construct, and assemble different types of objects, structures, or vehicles. Building toy sets have historically been marketed primarily toward boys, encouraging construction, invention, and engineering structures and devices [11]. Common building toys include LEGO, model kits, erector sets, blocks, Lincoln Logs, and action figures that require assembling. The ways in which toy companies have marketed building toys to children has evolved over time. During the 1970s, many building toys were marketed for girls

and boys or as gender-neutral [11], with LEGO being one brand that adopted this strategy. Throughout the 1970s, LEGO affirmed that LEGO was “for boys and girls,” running advertisements featuring girls and boys playing with the sets together. By the end of the 20th century, however, building toy sets were primarily marketed to boys and those marketed toward girls used feminine stereotypes to do so, including using pastel colors and princess themes [11]. As a response to a decline in profits in the early 2000s, the LEGO brand began focusing more development on toys targeted toward boys [14] and product lines targeted toward girls (e.g., LEGO® Scala), were discontinued. These choices contradicted the brand’s original statement in the 1970s about being for both girls and boys, and were made in part because the brand assumed girls would not be interested in playing with traditional building toys that did not have stereotypical feminine themes [14].

In 2012, LEGO’s market research showed that girls were the primary player of LEGOs in only 9% of households [15]. In response to this statistic, the brand conducted a large-scale market research endeavor to understand what would make LEGO toys more interesting for girls. This four-year global study with 3,500 girls and their mothers explored what types of toys girls liked to play with and perspectives on what would encourage girls to play with LEGO [15]. The outcome of this market research was the introduction of the LEGO® Friends product line, a series of building toys that take place in the fictional Heartlake City, where builders can construct and play with animals and vehicles in schools, shops, and outdoor environments. The toys feature bright, new colors for the building components; a more realistic minifigure termed the ‘minidoll;’ and narrative storylines, aspects of the toys that the research study indicated were desired by girls and their mothers [15]. The LEGO® Friends line was successful financially; in 2014, LEGO’s sales reached \$900 million, up from \$300 million in 2011 [16].

Another toy developed to engage girls in construction play is GoldieBlox®. Founded by mechanical engineer Debbie Sterling, the GoldieBlox® toy franchise taught girls about fundamental engineering concepts through the use of character-driven narrative stories [17], [18]. On their website, GoldieBlox® stated that their goal was to “disrupt the pink aisle and inspire the future generation of female engineers” [19]. By combining stories with building tasks, such as designing a belt loop drive, GoldieBlox® toys aimed to promote young girls' spatial skill development and knowledge about engineering topics such as friction and forces. In her TEDx talk in 2013, Sterling highlighted her own experience as an engineer as inspiration for GoldieBlox®, describing how she and many other women were at a disadvantage in engineering because of underdeveloped spatial skills [17]. She noted that the types of toys that build children’s spatial skills (e.g., LEGO) are commonly regarded as being “boys’ toys” (9:35), and that young girls are encouraged to play with “dolls and makeup kits” (9:48). Sterling claimed that adding a narrative element to a construction toy, including a book containing stories and characters, would draw girls to playing with building toys and learning STEM content [17], [20]. In 2012, Sterling launched a Kickstarter campaign for GoldieBlox®, raising more than \$285,000, and as of 2013, the GoldieBlox and the Spinning Machine toy had sold over \$1 million worth of product [18].

The popularity of both LEGO® Friends and GoldieBlox demonstrate how using gendered toy marketing to market toys specifically to girls can be successful. Girls are seemingly enticed by toys with narrative storylines that follow characters they can identify with. Toy companies have

therefore leveraged girls' interest in stories and books in order to attract girls to playing with building toys that may in turn develop their spatial skills and engineering identity.

New Initiatives: Change in Attitude

Over the years, attitudes towards the gendering of toys have undergone a more inclusive shift. In 2021, LEGO partnered with the Geena Davis Institute on Gender in Media to conduct a study on whether and how the concept of creativity was gendered [21]. Through online surveys distributed to parents and children ages 6-14 years old, this study revealed that girls are “more open towards different types of creative play compared to what their parents and society typically encourage” [22, p. 1]. As a result, LEGO pledged that their products and marketing would be “free of gender bias and harmful stereotypes” [22, p. 3]. At the time of publication, LEGO's website is void of an option to search or filter toys by gender [23]. The categories under the “Shop” tab offered on the website include sets by theme, interests, age, price range, and other criteria, but they do not include gender as a classification. In addition, the pages across the website showcase a diverse representation of children and parents engaging with a wide range of toys. The option to filter for toys by gender is also unavailable among other major online toy retailers, including Amazon, Disney, and Walmart [24]–[26].

Major brick and mortar retailers have also responded to this evolving perspective. In 2015, Target announced its commitment to phase out gender-based signage in sections such as toys and bedding [27]. The company also stated that they would eliminate references to gender on their shelves, such as the use of pink or blue paper on the back walls of their displays that implied a gender association with certain toys [27]. As a result of this initiative, current toy aisles in Target typically use white shelves and have a range of toys displayed among them [28]. Notably, display signs do not mention gender and aisles are categorized based on brand and theme of toys. However, some aisles may still appear to have certain gendered color schemes due to the appearance of the products' packaging.

At a legislative level, California enacted a bill in 2021 requiring large stores to adopt gender-neutral display practices for toys and childcare items [29]. While the law does not prohibit gendered sections in shops, it mandates the establishment of a separate, gender-neutral section to accommodate a broader and more inclusive range of choices for consumers. The bill aims to eliminate the implication that certain products are only to be used by a specific gender [30]. At the time of publication, California is the only state with gendered toy aisle legislation.

Overall, these collective efforts mark a considerable shift toward rejecting the use of traditional gender stereotypes in the toy industry. Despite these changes, implicit biases may persist among consumers and retailers regarding color schemes and their association with gender. Those same biases drive marketing. In the following section, we will examine how these biases manifest in the marketing of toys for girls and their potential implications on perpetuating gender stereotypes.

Criticisms of Gendered Toys: Use of Stereotypes in Building Toys

Marketing toys specifically toward girls often involves using traditional gender stereotypes in order to capture girls' interest. Sweet [11] found that toy marketing has fluctuated throughout the 20th century in terms of using gender stereotypes to sell products to children. At certain points, stereotypes were prominently used in advertisements and marketing materials to drive sales and influence consumer behavior. Sweet notes that these actions "added to -- and helped to perpetuate -- evolving cultural narratives about gender" (p. 221). Feminine toys highlighted domesticity, the adoption of nurturing qualities, and emphasis on attractiveness, while masculine toys encouraged building, aggression, and action. Through continued play with gendered toys that reflect societal stereotypes, girls may internalize that their worth is based on their attractiveness or ability to be nurturing in a domestic environment. In addition, boys receive messaging that they should be interested in violence, aggression, and adventure, and that these are desirable masculine characteristics [11], [13].

LEGO® Friends, while promoted with the intention of encouraging more girls to play with LEGO, has been met with criticisms about the toys' narrative reinforcing gender stereotypes. The toy sets include storylines about planning parties, caring for animals, and preparing food, perpetuating feminine stereotypes of being nurturing, caretaking, and engaging in playful recreation [9], [16]. In contrast, LEGO® City, a narrative-driven series targeted toward boys, promotes themes of heroism, adventure, and leadership. LEGO® City sets encourage players to perform stunts, engage in action, and provide aid throughout the city [16]. The narratives embedded in these two LEGO sets reinforce traditionally feminine and masculine roles in society, and do not encourage girls to develop social identities beyond the traditionally feminine, such as being a leader or a hero [9].

In addition, the figures introduced in the LEGO® Friends line are not compatible with pieces in the traditional LEGO sets because of their shape and design. The LEGO® Friends line introduced the minidoll, a character figure that is given a more feminine appearance with realistic looking and hair and clothes compared to the traditional block-shaped minifigures. In one study conducted with girls aged six to eleven, some girls preferred the look of the minidolls because of the different clothing options that they have, while others projected body image ideals onto the minidolls, claiming that they "could never be that skinny" [14, p. 258]. The latter comment raises concerns about the target audience of the LEGO® Friends minidolls. If girls are not able to identify with the minidolls, they may feel excluded from playing with these toy sets. In addition, LEGO's choice of introducing minidolls for the LEGO® Friends sets instead of using the traditional, block-shaped minifigures may suggest to girls that their LEGO toys are inherently different and the original LEGO product lines aren't "meant for them." This could contribute to young girls feeling further excluded from playing with building toys, and in turn, discouraging them from developing interests in engineering.

GoldieBlox has received similar critiques about the use of feminine stereotypes to engage girls. In an analysis of the GoldieBlox toy narratives and corporate decisions, Hudak [31] discussed the tensions that critics have raised around whether the toys truly "disrupt the pink aisle." First, GoldieBlox uses the color pink throughout their branding and in the toy sets themselves. Pink has been used in marketing toys to girls since the mid-1990s [11], and a review of the Disney

Store website in 2010 revealed that 86% of pink toys were marketed specifically for girls [12]. GoldieBlox toys have thus been criticized for using pink while simultaneously attempting to challenge stereotypes about the types of toys girls should play with [31].

GoldieBlox toy sets also promote the idea of girls being “more than just a princess” [20]. This marketing strategy has been critiqued because it suggests that the default state of being for girls is to be a princess, rather than not a princess at all [32]. In a similar vein, GoldieBlox uses a traditional “princess” appearance in the product design of their main character Goldie, who is white and blonde-haired. Her look has been compared to that of Disney princesses, who often are portrayed with blonde hair, big eyes, and a “cute” appearance [31, p. 166]. Similar imagery portraying white, middle-class girls has also been found in marketing materials for other initiatives designed to encourage girls to engage in STEM (e.g., images on websites, appearances of dolls, and brand logos) [32]. These images presented by GoldieBlox and other toy franchises and media may send implicit messaging about the types of girls that get to play with STEM toys, i.e., those who are white, affluent, and have traditionally feminine interests (e.g., princess toys). This messaging can be harmful as it may suggest that engineering is a space for only a certain demographic, excluding girls that do not identify with the imagery present in these advertisements and marketing materials.

Gendered Toy Marketing Impacts Career Interests and Aspirations

Upholding traditional gendered stereotypes in children’s toys and separating toys based on gender may impact children’s perceptions and interest in future career opportunities and whether they choose to pursue them [10]–[12], [33]. Labeling toys as being “for girls” or “for boys” sends a message to children about their traditional role in society and can shape their identity and interests [11]. In one study, Bigler and Liben [33] suggested that children’s gender-typed interests informed their perceptions about certain careers and their beliefs about their own personal occupational goals. For example, girls in the study that noted that they wanted to be a teacher often referenced their interest in helping people as their reason for aspiring to this career. Boys in the study that indicated they wanted to be a police officer said it was because of their interest in catching bank robbers and driving police cars [33]. In the case of LEGO® Friends, traditional conceptions about what young girls may be interested in, such as helping or taking care of people, are leveraged in the sets’ narratives. There are no opportunities in the LEGO® Friends narrative for them to explore being a police officer in Heartlake City as there are in LEGO sets marketed toward boys. In their critique of the LEGO® Friends narrative offerings, Black et al. [9] argued that “Heartlake City needs its own suite of municipal service sets to offer young female players the opportunity to explore a broader range of social roles” (p. 75). Critiques of the LEGO® Friends product line such as this further show how the Friends sets represent a narrow spectrum of interests and potential career options to girls who play with them. As a result, girls may not develop career interests beyond those that they encounter in sets that are marketed “for girls” and would believe that occupations such as being a police officer are “for boys.”

Girls having a lack identity with certain career interests from a young age is particularly important when attempting to engage girls in engineering [34]. Many building toys that encourage construction play and engagement with engineering concepts are marketed toward

boys. As a result, girls may not develop interests in these types of toys and feel that construction and building play is “not for them,” potentially dismissing engineering-related careers for themselves in the future. Debbie Sterling aimed to challenge this idea when designing and promoting GoldieBlox; by creating a building toy specifically marketed to girls with a narrative centered around a female engineer, she hoped that more young girls would identify with and be inspired to pursue engineering in the future [19].

Summary of Reviewed Literature

Overall, this literature review highlighted several concepts related to importance of play in childhood and the pink paradox. This review discussed the importance of play in supporting the development of children’s motor skills, spatial thinking, creativity, and self-concept, and also outlined how gendered stereotypes are used in toy marketing, the associated messages that are conveyed through marketing strategies, and the potential impacts that this has on girls’ developing identity. When toy manufacturers use stereotypes to attract girls to play with building toys (e.g., pink and purple color palettes, themes surrounded friendship and leisure, and traditionally feminine appearances and clothing), this reinforces narrow messaging about what building and engineering look like and who gets to participate in these activities. Some girls may therefore be excluded from identifying with engineering, leading them to feel left out and that engineering is not for them. As a result, girls may not develop interests in engineering and may internalize beliefs about their roles in society and the types of activities that they “should” be interested in, and in turn, may not pursue engineering career pathways in the future. The types of toys that children play with can have an important role in impacting their developing associations of gender, engineering identity, and career aspirations while also supporting spatial skill development, creativity, and problem-solving ability. Overall, the pink paradox leads to a cycle in which girls are marketed to in ways that are appealing to them but may use harmful stereotypes in order to do so, therefore perpetuating the same stereotypes that they are intending to break down.

Unraveling the Pink Paradox

The current body of research highlights the importance that building toys have for developing children’s spatial skills, which are correlated with success in engineering disciplines [35]. Many of these building toys are primarily marketed toward boys, and those marketed toward girls often use potentially harmful stereotypes to do so. While these gender-typed toys have been met with popularity and financial success, they have been criticized for using traditional feminine stereotypes in order to reach the interest of girls and their parents. These toys also may also be excluding certain populations of girls due to the way they are marketed and advertised. As a result, some girls may not have the opportunity to develop a sense of engineering identity through play with these building toys. Research also suggests that the formation of an engineering identity is important for developing interest and persistence in engineering [3], [4].

However, there has been little work done to establish relationships between cultural identities, spatial cognition, and gendered narratives embedded in toys, and how they impact one another in the formation of engineering interest and identity in children. The primary aim of this body of work is to focus on the relationships between which groups of children are drawn to different

toys, what role embedded narratives play in the strength of their interest, and how strong or weak interest changes the nature of their play. These constructs all support our mission to understand and unravel the pink paradox with the goal of encouraging more girls to participate in engineering through play with building toys. In addition, our review uncovered very little that specifically brought intersectional experiences of girls of color or disabled girls, or the experiences of nonbinary children into the conversation of narrative-based toys, who is being represented, and the impact of that representation as it relates to participation in engineering. With that said, in light of the recent changes and developments highlighted in this review, we are reaffirmed that including “children” as opposed to exclusively girls in our study will be a significant strength to potentially capture the impacts these recent changes are having, both for the kids who play with these toys, and also for the adults who buy them.

Conclusion

This narrative review provides an overview of the current state of knowledge on *the pink paradox*, a construct that we use to refer to the tension between the need for toy marketing to appeal to girls while also rejecting stereotypes about girls’ interests, career aspirations, and social identity. Exposing all children to a variety of play experiences and contexts would allow them to explore new interests and develop skills in areas that may not be traditionally targeted to them. Girls could develop their spatial skills through more opportunities to build, construct, and invent during their play. They may then have an increased interest in fields such as engineering and would be more prepared to enter engineering in the future by having better-developed spatial skills. Understanding the relationship between spatial skills, engineering identity, and gendered toy narratives can provide important insights into how children play and the effects that play experiences have on their aspirations for their future.

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