

## What Can We Learn From Children's Construction Play About Their Cognitive and Intellectual Development?

A review of



### **Knowledge Under Construction: The Importance of Play in Developing Children's Spatial and Geometric Thinking**

by Daniel Ness and Stephen J. Farenga

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Reviewed by

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My four-year-old son is a big fan of Thomas the Tank Engine. His favorite play activity is to navigate (using the toy train) through the meandering railway tracks on the train table, with a level of concentration rarely observed in a preschooler in other activities. He also seems to be particularly interested in making bridges. While riding in a car, he cannot contain his excitement whenever he is passing over a bridge or highway overpass. This explains why I was naturally drawn to this title, which promised to offer some important clues and answers to my perplexity: What is unique and special about preschoolers' spatial play and spatial thinking? Beyond personal curiosity, there is a deeper practical implication. If preschoolers' spatial play and thinking represent a significant form of cognitive and intellectual

development, how can formal schooling harness this emergent mental power to the advantage of developing children's scientific and practical knowledge?

Based on their systematic studies of preschool children's block and Lego construction during free play, Ness and Farenga attempt to elucidate its developmental and educational implications in their book *Knowledge Under Construction: The Importance of Play in Developing Children's Spatial and Geometric Thinking*. Although the book covers a wide range of topics and issues, this review focuses on the central claims of the book and its presentation of related evidence and underlying reasoning.

## Claims of the Book

Preschoolers' block and Lego construction reveals many underlying principles and concepts of space, geometry, and architecture.

The authors report a series of studies aiming at uncovering children's spatial thinking underlying their construction play. A distinct approach by the authors to children's spatial thinking or “emergent ideas” (p. 77) about space, geometry, and architecture-related principles is to situate their study in natural settings where children are engaged in block and Lego construction—what they dub “contextual observation” (Chapter 4, p. 95). This methodology has both advantages and disadvantages. One of the advantages is the authenticity of children's behavioral and cognitive tendencies expressed during their free play. A challenge of this method is how to develop an assessment system that is true to the nature of observations, which are likely diverse, mucky, and task specific, yet capable of providing theoretically informative, generalizable inferences about the representations and processes characteristic of preschoolers' spatial thinking. The authors developed a coding system, called SPAGAR, using both theory-driven (top-down) and data-driven (bottom-up) methods, yielding 13 codes pertaining to *spatial relations* (e.g., arranging objects in a symmetric manner) and *architectural principles* (e.g., building a foundation for a larger structure).

Although evidence presented in the book seems to indicate that children spontaneously engage in construction play and that quite a proportion of this activity involves figuring out spatial patterns and relations, it is less clear whether the coded categories of activity have correspondence with internal representations. In other words, what kind of inference is appropriate here, given that what is coded is observed behavior? The coded behavior is open to different interpretations.

For example, it is not clear whether the concepts and principles the authors claim that preschoolers have an intuitive grasp of are still embodied, relying on the relative position of the child (i.e., perceived symmetry is relative to the angle of the person) or visible cues (e.g.,

shaky blocks need some balancing), and to what extent they are disembodied (formal) concepts and abstracted principles or rules. It seems evident that preschoolers are capable of behavioral mastery of the tasks involving geometric and architectural principles, but whether preschoolers' construction play indicates “a powerful intellectual capacity” (p. 116) is subject to debate. We don't know whether preschoolers are indeed capable of cognitively representing the spatial objects and spatial relations in a principled way, unless a more stringent criterion is used (e.g., whether children engage in significant self-explanation and representational redescription; see Karmiloff-Smith, 1992).

In short, whereas the contextual observation the authors meticulously make about children's construction play provides interesting leads as to what preschoolers are capable of in terms of manipulating and representing spatial objects and relations, it is far less clear as to whether preschoolers truly possess related spatial and geometric knowledge, even at an unschooled, intuitive level.

Play serves important cognitive developmental functions.

“We see play as the primary mechanism by which emergent cognitive behaviors—protobehaviors—serve to support the development of both process skills and cognitive abilities” (p. xix). This is the main theoretical argument the authors advance in the book. The authors cite Vygotsky as the main inspiration: Play is children's work. How does construction play exactly mediate play behavior (blocks under construction) and development of knowledge and cognitive skills (knowledge under construction)? The main empirical basis for addressing this question comes from Chapters 6 and 7, which report several case studies of children building devices of varied complexity. Although case studies cannot be bias free, these cases are quite compelling in support of the authors' argument that the structure of construction play is similar to that of inquiry-based learning, involving goal-directed search, planning, trial and error, learning from setbacks, making adaptation to task constraints, and problem solving. However, when it comes to how spatial and geometric knowledge come about during construction play, these case studies do not yield much insight. The authors seem to focus more on illustrating how these children *use* their existing spatial and geometric knowledge in construction activities rather than how they *develop* this knowledge during play, which seems to be the original intent.

The distinction between use of knowledge and development of knowledge brings to the forefront the theoretical debate between constructivists and neonativists regarding sources and genesis of knowledge (spatial and geometric knowledge, in this case). Although not explicitly siding either way, the authors' sympathies seem to be with constructivism, as they emphasize the role of experience (through play) and learning. However, the way they describe children's spatial and geometric knowledge as present and functional, without explaining how it comes about, seems at variance with a constructivist view of knowledge

and more in keeping with nativism. In other words, preschoolers' spatial knowledge tends to be described in these cases as static, not dynamic (i.e., truly under construction).

It is my opinion that the principles of ecological psychology in terms of affordances and effectivities can be used here to explain how experience produces knowledge and how the logic eventually gets extracted from the contingent, to use Forman's words, quoted by the authors (Chapter 3, p. 74). As the professor of architecture mentioned in the book comments, children's representations may depend on the materials they are given. The question is, then, can the given material itself (with its affordances) provide clues into structural features of the envisioned object to be constructed (engendered effectivities)? Kant's answer is no: Sensory experiences of an object are not enough to provide rules for their organization. Constructivists' answer is yes: Construction play can bootstrap knowledge of the object in question. Children's construction play, studied as carefully as the authors did, should potentially provide important insights regarding these competing propositions. However, this can be done only when play, as the mechanism for knowledge building, is truly explicated rather than implied.

Preschoolers' emergent capacity for spatial representation and manipulation can be an important determinant of later cognitive and intellectual development and functioning, and should be cultivated in preschool and harnessed in formal education, particularly in math and science teaching.

This is a corollary of the previous argument that spatial and geometric knowledge through construction play constitutes a significant form of knowledge and holds “intrinsic value” (p. xvii). In view of the fact that school puts way more emphasis on verbal and number skills and neglects spatial thinking as fundamental for knowledge construction, the call seems reasonable, even timely. However, despite retrospective evidence pointing to the significant role of spatial thinking and imagination in scientific discovery (e.g., Miller, 1996), there is a dearth of predictive studies showing long-term benefits of construction play in early childhood for later cognitive and intellectual development.

Nevertheless, the authors make useful practical suggestions regarding how mathematics education can benefit from our understandings of preschool children's emergent capacity for manipulating and representing spatial objects and relations. One suggestion is an integrated mathematics and science curriculum that capitalizes on young children's emergent spatial knowledge and capability (p. 117). Particularly interesting from a pedagogical perspective is how social interaction in the preschool classroom might facilitate children's spatial and geometric knowledge construction at their respective zones of proximal development.

As the authors suggest, the unschooled, informal knowledge through construction play can be cultivated and built on in school settings to develop schooled concepts and knowledge that are more formal, articulated, and principled. Exactly how such

developmental change can be facilitated remains to be explored. A more general lesson we can draw from the book is the role of play in formal education. The final chapter of the book gives an overview of this issue. In essence, children's construction play can be a springboard for building a rich repertoire of what the authors call "protoscientific and protomathematic behaviors" (p. 213), such as manipulating objects, identifying patterns, and recognizing attributes, which can be further developed into more formal skills such as classifying based on attributes and criteria and defining and identifying and manipulating variables. Above all, play is the best experiential learning, through which children's minds are actively engaged in developing new understandings through intellectual inquiry and practical problem solving.

## Summary

For preschool educators as well as interested developmental researchers, *Knowledge Under Construction* offers a succinct, useful introduction to the topic, delineating various aspects of spatial, geometric, and architectural thinking and related theoretical perspectives that can be brought to bear on children's construction play. The book also contains helpful pedagogical features such as a set of topics and questions at the end of each chapter for discussion. Major contributions of the book are in situating this important developmental topic in natural settings (young children's spontaneous construction play) and in pointing to some promising directions regarding how this knowledge can shed light on preschool and elementary education, particularly in science and mathematics.

A future challenge is to develop a process account of how emergent ideas about space, geometry, and architecture develop during play activities, not assuming their presence by mere behavioral observation. Furthermore, this line of inquiry needs to be pursued in light of the larger corpus of the developmental literature so that the process and significance of children's construction play can be further understood as integral parts of children's cognitive and intellectual development. This book is successful in striking this point home, and I will be more mindful the next time I see my son building bridges or Lego houses.

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## References

- Karmiloff-Smith, A. (1992). *Beyond modularity: A developmental perspective on cognitive science*. Cambridge, MA: MIT Press.
- Miller, A. I. (1996). *Insights of genius: Imagery and creativity in science and art*. New York: Springer-Verlag.

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