

Fig. 1. *AlegreMENTE / Happy Brain* is designed for our youngest visitors – children from birth to age five, their companions, and caregivers. Children and adults play and learn together in the exhibition to build young brains.





Focusing on Adult Learning to Put the Youngest Learners First

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Few projects have the potential to transform a museum professional's understanding of their work in so delightful a way as an exhibition focused on early childhood. In August 2021, the Oregon Museum of Science and Industry (OMSI) opened a bilingual traveling exhibition that explores childhood brain development from birth to age five, titled *AlegreMENTE: Celebrando Conexiones Tempranas / Happy Brain: Celebrating Early Connections* (hereafter: *AlegreMENTE*) (fig. 1). Funded by a grant from the Science Education Partnership Award (SEPA) Program at the National Institutes of Health (NIH),¹ the project built on OMSI's long history of developing and touring exhibitions for North American audiences and of bicultural and bilingual (Spanish-English) exhibit development.²

AlegreMENTE also reflected OMSI's longstanding commitment to early childhood education. Since the 1980s, the museum has featured a dedicated space for early childhood learning, now called Science Playground, and has steadily expanded its offerings for preschool children, their families, and early childhood educators. The project's focus on Latino

Fig. 2. The “*Fuente de sabiduría* / Fount of Wisdom” shares information about early brain development and brain-building tips for caregivers. Push buttons below provide a sound-and-light activity to engage children while their caregivers are learning.

families serves a significant audience for OMSI and for our traveling exhibitions. In Oregon and nationally, Latinos are the fastest growing and the youngest demographic group, now comprising more than a quarter of the child population.³

Many museums apply the findings of brain research to design developmentally appropriate exhibits for young children. As a science and technology center, OMSI wanted to take this a step further and communicate the science of early brain development to adult learners. While our project team had a great amount of experience, creating an exhibition for young children that communicated to their adult caregivers about early childhood took us on an unfamiliar path. As we learned more about how adult-child interactions nurture healthy brain development, supporting these interactions became central to the exhibition design and visitor experience in ways our team had not conceived from the beginning. In result, we designed *AlegreMENTE* to communicate brain science messages to adult caregivers both visually and experientially. Ultimately, designing for adults was a means toward benefitting young children.

The Science Behind *AlegreMENTE*

Our exhibition’s messages for adult learners begin with an overview of the developing brain at the “*Fuente de sabiduría* / Fount of Wisdom” exhibit (fig. 2). This content grounds the exhibition in foundational brain science, which points to the long-term outcomes of early childhood experience.⁴ Early childhood from birth to age five is a time of remarkable and critical brain development. Babies are born with a nearly complete set of brain cells, or neurons – close to 100 billion. Brain building after birth

focuses on making connections between neurons. During these first years of life, up to one million connections grow per second. Each of a child’s experiences causes neural connections to grow and neurons in the brain to fire signals along pathways of connections. Repetition reinforces and strengthens these pathways. The more active connections and pathways grow stronger, while unused connections fade away. This is the “wiring” of our brains that lays the foundation of our individual brain architecture.

While making and reinforcing connections is the essential work of a young child’s brain, making and reinforcing strong, positive adult-child connections is the essential work of an adult caregiver. Decades of research indicate that playful, loving interactions and relationships with adults supports and enhances brain development in young children.⁵ Responsive back-and-forth interactions, known as “serve and return,” help build young brains in particular. Young children “serve” by giving a cue (such as smiling or reaching toward something) and their caregivers “return” by responding and encouraging continued interaction.⁶ For example, a child who hears people speaking from birth begins to learn the sounds, how to pay attention, and then to recognize the meaning of words and to vocalize. When caregivers respond positively to signs that the child is listening and to their baby babble, the child feels secure and knows they are communicating. The relationship between child and caregiver strengthens, reinforcing the child’s brain development and innate sense that caregivers are their source of learning.⁷ Our mission for *AlegreMENTE* was to share these powerful foundational ideas with parents and caregivers in ways that were relevant to their everyday lives and that supported and



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encouraged their brain-building practice in the exhibition and at home. The message of loving interaction and connection appears throughout the exhibition in words, images, illustrations, and experiences.

Building Learning Goals into the Exhibition Design

Early observations and subsequent prototype testing in Science Playground for *AlegreMENTE* revealed significant challenges in communicating science content with adult learners. We installed test labels that offered activity suggestions for caregivers at a prototype dance area, a mirror for making faces and naming emotions, and a play area with construction toys and child-sized furniture. A large interpretive graphic about the brain hung between two of the interactives in close proximity (fig. 3). Rather than engaging with the brain science and parenting advice we had provided in graphics and bilingual text, though, we found that caregivers typically were busy keeping an eye on their children or catching their breath whenever the children were engaged. When they did engage with exhibits, it was usually to support their children's engagement. Not surprisingly, we learned that adults are

not primed to be learners in early childhood spaces; they show up on behalf of their children's learning rather than their own.

To address these challenges and convey our main messages in the final exhibition, the exhibit team adjusted the focus to an environment that supports the playful back-and-forth interactions that naturally occur between children and their caregivers – the same interactions that build neural pathways in the brain. Instead of relying on exhibit labels to interpret young brains and the importance of caregiver interactions, we decided to build messages and activities based on brain science into the exhibition design – through the illustrations, the inclusion of all ages, and the emphasis on serve-and-return experiences.

Illustrations Worth Thousands of Words

Whereas our early prototypes depended on text to convey messages, our final exhibits in *AlegreMENTE* feature prominent illustrations (along with words) to communicate with our audience. We worked with a local children's book illustrator, Johanna H. Kim, to create a playful forest and populate it with a diversity of human and animal families



Fig. 3.

Our first exhibit prototypes paired brain-building activities for families with text panels about early brain development for adult caregivers. This approach was not effective with adult learners.

(fig. 4). The fanciful illustrations set the everyday, relatable interactions modeled by the characters (e.g., passing a ball, or reading bedtime stories) into a magical storybook setting. Creating original illustrations meant we could convey particular behaviors, relationships, identities, and emotions relevant to our project goals. This is why, for example, we have illustrations of same-sex and multiracial parents, children crying, and adults napping – we sought to be inclusive in our representations of identity and experience.

Illustrated characters model intended adult and child interactions at each exhibit activity instead of instructional labels. In “*Uno encima de otro / Stack It Up*,” visitors can play with discs and cylinders that stack onto rocking bases. An adult holding a baby that reaches for a tabletop toy resembling the exhibit shows this in the accompanying illustration (fig. 5). Exhibit labels contain activity suggestions and describe how activities promote brain development – and we admit there is as much copy in the final exhibition as in the prototypes – but the labels do not play a prescriptive role. Instead, we chose to emphasize illustrations to show examples of what visitors may do at each exhibit.

Fig. 4. (top) The whimsical forest setting is home to diverse animal and human families that model adult-child interactions for brain building at each exhibit activity.

Fig. 5. (bottom) Simple illustrations encourage caregivers and children to play together at “*Uno encima de otro / Stack It Up*.”



Fig. 6. The “*Rinconcito de historias / Story Nook*” offers a cozy space for sharing a story or resting the senses.



Fig. 7. At “*Cuéntame un cuento / Tell Me a Tale*,” families arrange a series of pictures to make up a story.



Fig. 8. At “*Iluminando el cerebro / Lighting Up the Brain*,” adults help their children light up all the pathways and connection points in the game.

We chose activities that lend themselves to back-and-forth interactions and are as simple, open-ended, and as universal for North American audiences as possible.

This strategy also has the benefit of communicating well to speakers of any language, increasing the cultural and linguistic accessibility of the exhibition.

Inclusive Accessibility

Our team designed experiences to be physically accessible and comfortable for both young children and adults. In *AlegreMENTE*, seating and exhibits scaled for adults invite them to be part of the experience rather than observers on the sideline. Likewise, step stools make exhibits accessible for younger and smaller children to interact with caregivers and each other. Seating allows for rest, comfort, flexibility, and for people of different sizes to have eye contact and to reach activities together. These design characteristics help draw adults into the fun and support the brain-building, serve-and-return interactions in the exhibit environment.

We paid particular attention to physical accessibility and universal design for the semi-enclosed “*Rinconcito de historias / Story Nook*” (fig. 6). This component provides a calmer space within the exhibition by reducing visual and auditory stimuli and increasing intimacy. One to three visitors (more if there are a few small children in the group) may read aloud and hear each other more easily, separate themselves from the stimulating environment, and feel like they have a cozy spot all to themselves. We consulted with one of our project advisors, a designer of accessible playgrounds, to think through the design. Some of our considerations included access for wheelchair users and older adults, rest from sensory overload, and the balance between feeling secluded and included. The

final component includes a padded armrest and repositionable cushions that enhance comfort and ease of ingress and egress. The space has an overhead interior structure that helps to reduce ambient light and sound. Additionally, the space is deep enough for a wheelchair or stroller user to come side by side with someone sitting on the bench, but not so deep as to completely separate occupants from the rest of the exhibition.

Serve and Return Embedded

Exhibit experiences in *AlegreMENTE* support serve and return – behaviors such as following each other’s leads, taking turns, engaging in dialogue, or exchanging questions and answers. For example, at the “*Cuéntame un cuento / Tell Me a Tale*” exhibit, adults and children can take turns selecting and arranging illustrated discs to make up a story (fig. 7). We chose activities that lend themselves to back-and-forth interactions and are as simple, open-ended, and as universal for North American audiences as possible. To encourage families to continue brain building after their visit, activities are familiar and easily repeated at home.

To prompt caregiver involvement, some exhibits assign a role for the adult in the activity. “*Iluminando el cerebro / Lighting Up the Brain*” invites adults and children to play together at a tippy table to move a ball around a network of pathways (fig. 8), which is intended to demonstrate how repeated back-and-forth interactions create connections and “light up” the brain. Pathways light up and cheerful bells ring when the ball rolls through intersections. Lighting up all the pathways, though, takes a team effort. To encourage adults to help

Fig. 9. The “*Piscina infantil* / Infant Pool” is a comfortable enclosed play space for babies, pre-walkers, and their caregivers. High-contrast graphics are at baby eye level, and interactive toys at floor level are easy to reach.

their children engage with the interactive, we made the tippy table oversized for young children who might not have the coordination and strength required to control the ball.

Meeting the Needs of Adults

Early in the exhibit development process, we used various methods to understand adults’ needs within an exhibit experience. We took careful consideration of how to address those needs by creating an environment conducive to the behaviors we wanted to encourage. We spent hours observing adults in Science Playground and conducted front-end evaluation with three focus groups. During this process, we observed the universal need of caregivers to take a break from the hard work of caring for young children, and how important it was to be able to rest and recharge. At the same time, caregivers needed to keep their children within sight at all times, even during rest breaks. These observations prompted us to provide ample seating and to create clear sight lines: our floor plan positions tall components with wall panels on the perimeter of the exhibition and short components in the center.

Our observations and formal evaluation were informed by the Adult Child Interaction Inventory, developed out of a study examining adult-child interaction during collaborative engagement at a children’s museum.⁸ The inventory lists 12 exhibit characteristics that support interactions between children and caregivers, and a wide range of roles that caregivers take on in their children’s learning.⁹ These considerations also informed our final designs. We learned from our research and early focus groups with parents and caregivers to avoid messages that convey pressure or judgement.¹⁰ This research

supported the benefits of an asset-based approach that affirms the value of caregivers’ existing knowledge, skills, experiences, and identities as resources for their learning. Caregivers’ simple interactions with their children and their everyday experiences are in fact the foundation of how they act as brain builders.

We also benefited from direct collaboration with Vroom®, a program of the Bezos Family Foundation that provides extensive educational resources for parents, caregivers, and professionals based on brain science, free of cost, in Spanish and English.¹¹ Vroom strongly aligns with our project goals and grounds its work in extensive brain research and audience testing. The activity suggestions in our initial exhibit labels echoed many of the ideas found in Vroom Tips™. As a result, we worked together to incorporate actual Vroom Tips into the exhibition content, reframing them as “Brain Boosters.”

Collaboration with Vroom also provided a proven framework for our messages to caregivers, known as the Vroom Brain Building Basics®: *Mira* / Look, *Síguelo* / Follow, *Conversa* / Chat, *Túrnense* / Take Turns, and *Extiende* / Stretch. We related one or two of the Brain Building Basics to the exhibits as part of each Brain Booster. Our relationship with Vroom led to funding from the foundation for an additional exhibit kiosk with bilingual (Spanish-English) Vroom video content, free print materials, and QR codes for online caregiver resources.¹² A central message stressed by Vroom – that adults have everything they need to be brain builders, anytime, anywhere – likewise became central to *AlegreMENTE*.



The Link Between Designing for Infants and Designing for Adults

We developed *AlegreMENTE* to be engaging and accessible for children from birth to five years. However, creating activities that were developmentally appropriate for children younger than two years turned out to be challenging. Our formative evaluation showed that our prototypes lacked engagement for the youngest children. This is the very age range when the most brain connections grow and establish the foundation for all future neurodevelopment. Because of the importance of this stage of life, we strove to make the entire experience as inclusive as possible for the youngest children, providing brain-building opportunities for them and their caregivers.

Infants are not able to engage in most exhibits independently, and it is difficult

to accommodate their physical and motor abilities in most exhibits and environments. Thus, designing for the inclusion of infants naturally entails the needs of adults because infants rely on caregivers to participate in exhibits and other museum experiences. A secondary benefit of design for the inclusion of infants is that doing so opens up opportunities for infants and caregivers to interact with other family members. The exhibition becomes more inclusive for the whole family group.

We designed a dedicated area for infants, “*Piscina infantil / Infant Pool*,” to prioritize safety needs and developmentally appropriate experiences for infants and children just learning to walk (fig. 9). Adults can access the space by going through the gate or sitting on the cushioned perimeter bench. In this space, we emphasize the development of a strong personal bond

Fig. 10.

“Fiesta alegre / Happy Dance” invites families to dance and interact together with animated characters and moving objects on the screen.



between caregivers and children, because this secure attachment encourages infants to become curious and interact with the world. Illustrations in the Infant Pool show caregivers and babies sharing loving moments. The Brain Boosters here promote eye contact and following a baby's gaze. Throughout *AlegreMENTE*, illustrations show caregivers interacting with babies, and high chairs and booster seats provided for infants allow all ages to sit and play together at exhibits.

Conclusion

We do not have results from our summative evaluation at OMSI yet, but remedial evaluation results and anecdotal accounts have offered some insights. Predictably, visitors have not always responded as we expected. Our visitors immediately transformed a writing area intended for caregiver reflection into a drawing area for all ages – so we revised the labels to focus on drawing and the conversation that adults and children can have when they compare their drawings. We also added more prompts for adults and more activities in some of the exhibits to increase adult-child interaction. For example, at “Fiesta alegre / Happy Dance” (fig. 10), we added interactive elements to the animation (falling leaves, blooming

flowers) and gave the animated characters word bubbles with prompts for each dance to increase engagement. We will continue to collect summative data from visitors during the spring 2022 venue at the Children’s Discovery Museum of San Jose in California and produce a full summative report by the end of the grant in July 2022.

Our problem solving focused first on the specific design challenges of *AlegreMENTE*. As our design solutions took shape, we realized that these ideas were applicable to any exhibit experiences that caregivers and young children might explore. At OMSI, this includes all of our exhibits. Visitors come in family groups with all ages of children, including babies, toddlers, and preschoolers on foot, in strollers, and being carried. How could we apply these ideas throughout the museum to engage adults and young children in shared play and exploration? Could we integrate some serve-and-return activities for families and some brain-building tips for caregivers elsewhere at OMSI? Could other museums apply these strategies?

Brain science makes clear the lifelong benefits of early learning. Designing for early learners supports our informal learning mission and broadens our audience. More importantly, it enriches the exhibit

experiences of both caregivers and our youngest visitors and, ideally, inspires further adult-child play, enhanced brain building, and potential lifelong benefits beyond their visit. We set ourselves the challenge of creating an exhibition for young children that directed content at an audience of adult learners. In the process, we identified strategies that expanded our practice of exhibit development and design. ■

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1 The SEPA Program funds innovative pre-kindergarten to grade 12 formal and informal science, technology, engineering and mathematics (STEM) educational projects that focus on any area of NIH-funded research.

2 These other exhibitions received support from various funding sources including NIH.

3 “Racial and Ethnic Composition of the Child Population,” Child Trends, 2018, <https://www.childtrends.org/indicators/racial-and-ethnic-composition-of-the-child-population>.

4 National Scientific Council on the Developing Child, *The Timing and Quality of Early Experiences Combine to Shape Brain Architecture: Working Paper #5* (Center on the Developing Child at Harvard University, 2004), <http://www.developingchild.harvard.edu>.

5 National Research Council and Institute of Medicine, *From Neurons to Neighborhoods: The Science of Early Childhood Development*, Committee on Integrating the Science of Early Childhood Development, Jack P. Shonkoff and Deborah A. Phillips, eds., Board on Children, Youth, and Families, Commission on Behavioral and Social Sciences and Education (Washington, DC: National Academies Press, 2000).

6 National Scientific Council on the Developing Child, *Young Children Develop in an Environment of Relationships: Working Paper No. 1* (Center on the Developing Child at Harvard University, 2004): 1, www.developingchild.harvard.edu.

7 While children with hearing impairments may not follow the same trajectory of language development based on sounds, serve and return applies to any sort of interaction between children and caregivers, including those that contribute to language learning in children with hearing impairments. The exhibition only addresses what is considered typical neurodevelopment. Due to the highly varied nature of diverse neurodevelopment, our team and project advisors decided that addressing atypical development was more than a 1,500-square-foot exhibition could address adequately.

8 Lorrie Beaumont, *Developing the Adult Child Interaction Inventory: A Methodological Study* (unpublished technical paper, Boston, Massachusetts: Boston Children’s Museum, 2010), https://static1.squarespace.com/static/50f6e23ae4b08fc5612b49a0/t/522de39ae4b04c838fb0b127/1378739098107/Preschoolers_Parents_and_Educators-Developing_the_Adult_Child_Interaction_Inventory.pdf.

9 Beaumont, *Developing the Adult Child Interaction Inventory*, 48–53. The 12 exhibit characteristics are: wide variety of materials available; easy for adult to figure out; easy for child to figure out; open space with clear sight lines; controlled exits; plenty of materials available; seating; acoustic treatment to reduce ambient noise; labels use pictures or photos; includes tables and chairs designed to accommodate adults; and other (“other” allows for evolution of the inventory). The caregiver roles are: player, facilitator, interpreter, supervisor, student of the child, and co-learner.

10 Carla Herran and Scott Randol, *Interactive Family Play Front-End Evaluation* (unpublished technical paper, Portland, Oregon: Oregon Museum of Science and Industry, 2018), 6–10, https://omsi.edu/sites/default/files/Front-end%20Evaluation_%20FINAL%2010_04_2018%20-%20proofed%20%28Scott%20Randol%29.pdf.

11 “Resources,” Vroom, accessed January 26, 2022, www.vroom.org/tools-and-resources; “Print Materials,” Vroom, accessed January 26, 2022.

12 Many Vroom materials are available in 15 additional languages.