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Learning to Eat

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What, when, how and why

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Complementary feeding: What, when, how, and why

Hélio Rocha, MD, Msc

Serviço de Nutrologia Pediátrica do IPPMG-UFRJ, Brazil

helionutro@gmail.com

Key messages:

- **What?** Complementary foods are meals that complement breastfeeding and formula, providing infants with balanced, nutrient-dense options rich in iron and other nutrients to meet their high nutritional needs and prevent obesity.
- **When?** This process begins when a healthy suckling baby exhibits signs of readiness, typically between 4 and 6 months, thereby enhancing immune development opportunities.
- **How and Why?** Introduce age adapted foods considering the texture progression according to oral motor skills development, encouraging the baby to try feeding themselves small pieces (BLW or BLISS). These practices enhance food acceptance and foster independent eating habits.

Infant feeding is a multifaceted process that extends beyond simply offering food. Several aspects were carefully considered, such as:

- **Ideal timing to start:** Considering the baby's physical and neurological maturity, ensuring that they are ready for this new stage.
- **Perceptual complementary feeding:** Encouraging the baby's autonomy by creating a positive and welcoming environment. Sensory aspects such as texture, color, and flavor of foods are explored along with attention to the baby's hunger and satiety cues, allowing them to self-regulate their feeding.
- **Culture and family context:** Cultural factors and parents' or caregivers' perceptions of feeding are valued and integrated into the process, seeking constructive dialogue and a family environment conducive to feeding introduction.

It also involves the progression of textural changes to promote tongue, lip, and jaw movements, ensuring the proper development of organs involved in taste, chewing, swallowing, and babbling. Exposure to different food contents helps establish dietary preferences that persist in later life stages.¹

Cultural beliefs shape global breastfeeding practices and the introduction of regional foods for breastfeeding babies. Accurate nutritional information is vital to meet the nutritional needs of complementary feeding for optimal growth.²

Feeding introduction integrates nutrition, neuromotor development, and affection, creating a positive, respectful process tailored to the needs of each baby and family.

Solid foods, including fruits, vegetables, cereals, and proteins

(meats, eggs, and dairy products), from various regions of the world and influenced by local cultural and economic factors have been used to promote the growth and development of babies during breastfeeding and complementary feeding.

Complementary foods must be nutrient-dense and contain sufficient nutrients to achieve maximum development at each stage and at the end of growth. These should include essential amino acids, fats, micronutrients (minerals and vitamins), fiber, water, and energy derived from nutritional sources. Attention should be taken to specific nutrients, such as iron, considering infants in weaning phase have high demands of this micronutrient due to depleted iron stores and high iron needs for growth, adding the fact they are not able to consume big amounts of food. The addition of simple sugars, honey, and salt is not recommended until 12 months of age. Foods high in energy density and low nutrient content promote obesity and are not recommended during the complementary feeding period, which extends up to 24 months of age.^{1,3,4}

There are certain issues that arise concerning potentially allergenic foods in households where a history of atopic conditions exists. However, recent studies indicate that the introduction of these foods after four months may be more effective in preventing food allergies than avoidance. Rather than a

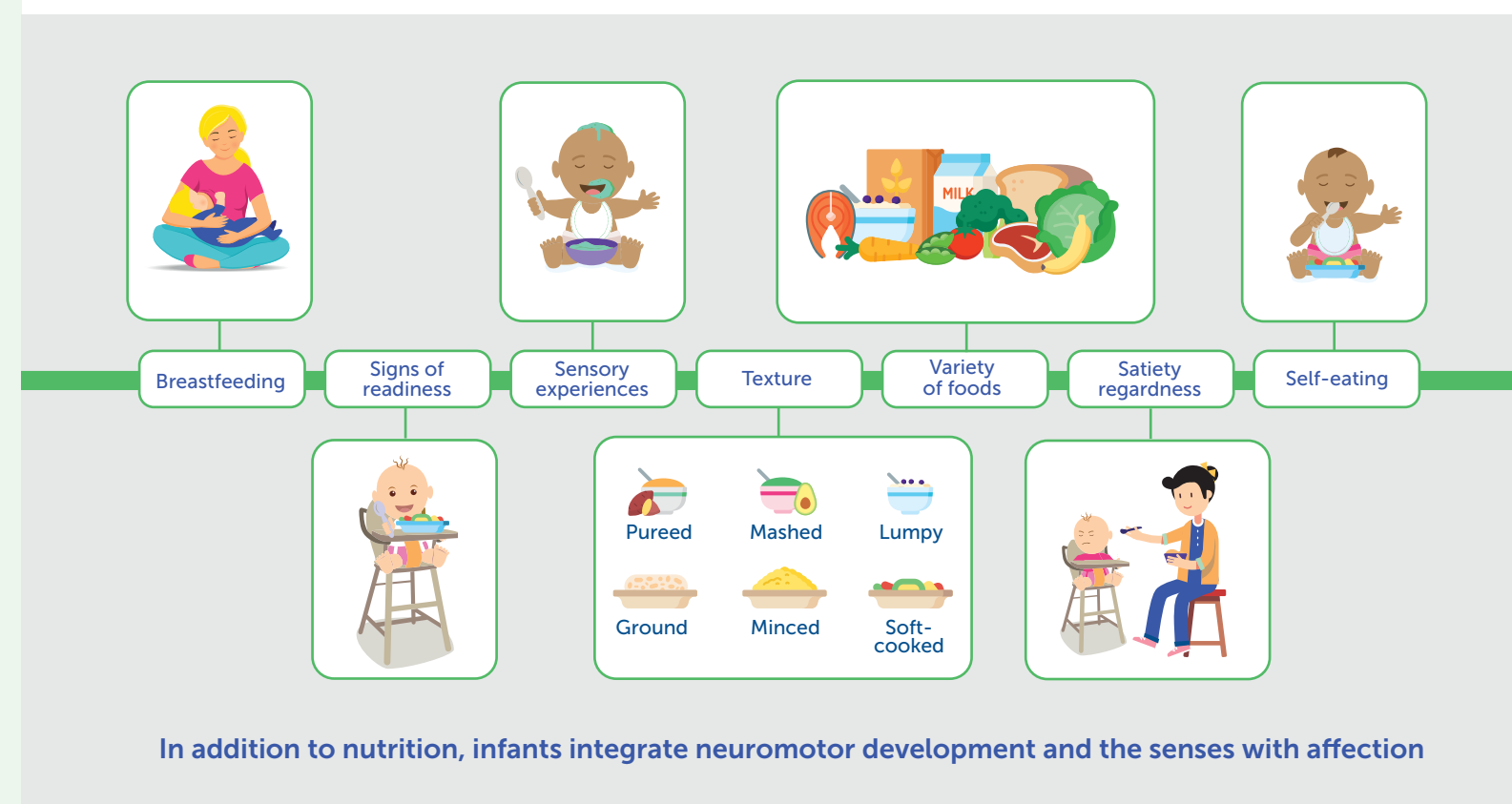
specific age, developmental cues can be the best indicator of "readiness" to accept complementary foods. At six months, as recommended by governments and international health authority, babies are generally ready to incorporate pureed and semi-solid foods into their diet.⁵ By eight months of age, most babies demonstrate the ability to handle solid foods, which are modified in preparation and format to allow infants to eat them independently.⁶ This is the time required to introduce a variety of food densities and textures to promote self-feeding. Methods such as Baby Led Weaning (BLW) and the Baby-Led Approach to Eating Solids (BLISS) are deemed safe under the guidance of healthcare professionals. The combined approach of those feeding methods, together with traditional spoon feeding, helps to prevent the development of selective eating habits and ensures nutritional adequacy.

It is crucial to offer age-appropriate foods and supervise mealtimes to prevent choking hazards and ensure the safety of infants.^{1,7}

Complementary foods must adhere to rigorous quality and hygiene standards. Safeguarding their safety is imperative to prevent foodborne illnesses and support the health of infants and young children. Proper handling, storage, preparation, and serving techniques are essential to minimize the risk of contamination by harmful pathogens. Parents and caregivers should follow the recommended food safety practices, including thorough handwashing, using clean utensils and surfaces, and preventing choking hazards. Adhering to these guidelines ensures that complementary feeding positively impacts growth and development, and reduces the incidence of non-communicable inflammatory diseases over the future decades of life.^{3,5}

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In addition to nutrition, infants integrate neuromotor development and the senses with affection

FIG. 1. Complementary feeding

Early food sensory experiences and the development of eating behaviours

Marlou Lasschuijt and Ciarán Forde

Sensory Science and Eating Behaviour group, Division of Human Nutrition and Health, Wageningen University and Research, Wageningen, The Netherlands

marlou.lasschuijt@wur.nl, ciaran.forde@wur.nl

Key messages:

- Complementary feeding is a critical period during which the frequency, variety and quality of food texture exposure supports a reciprocal relationship between the development of oral anatomy and the oral processing skill that ultimately shape the child's food preferences and dietary patterns.
- By offering infants a broad experience of different age-appropriate food textures, children learn how to eat (orally processing skill) foods with different textures and through this learn to 'like' a wider variety of foods.
- Eating behaviour is learned, and can affect the child's habitual texture preferences, eating rate and energy intake which in turn can influence their longer-term dietary patterns, weight-gain and health. Obesogenic eating behaviours such as selecting softly-textured energy dense foods that are consumed at a faster eating rate, place children at a higher risk of diet related chronic disease and ill health in later childhood.

The development of food preferences starts in utero and continues through early-life experiences with food, which ultimately shapes our dietary habits and preferences. The complementary feeding period typically starts around 6 months of age and is a critical period in shaping early life eating behaviours and dietary preferences.¹

Starting to eat

At the start of complementary feeding, the infant moves from being reliant solely on breastmilk or bottle-feeding to transition to table foods to support the energy requirements of their growth and development. This transition to more energy rich food sources is accompanied by a change to more textured foods such as semi-solid and solid products, that tend to be lower in water content and therefore are higher in energy density. A prerequisite for infants to transition from liquids to more complex food textures is the ability to independently sit in an up-right position and control their head to reduce the risk of choking on food particles. To support food familiarization and the development of oro-motor skills necessary to safely chew and swallow more textured foods, it is important that an infant is exposed to a variety of different food texture challenges during complementary feeding.

The value of experience-texture learning

Oral processing is a skill which has to be acquired through experiential learning. There is a reciprocal relationship between food texture exposure, the development of oral anatomy and the evolution of oral processing skills, which helps to shape early-life food preferences and the development of healthy eating behaviours. Learning to eat is a complex process that involves the coordination of 26 oro-facial muscles via 5 cranial nerves. Each specific food texture, or texture combination, requires a different approach of biting, chewing, tongue movements and swallowing, all of which must be learned through experience. Through experience with increasingly complex textures, the infant has an opportunity to learn to apply the appropriate bite-force to break down and fragment food during chewing, to soften and lubricate fragments into a bolus, and to move this bolus with their tongue to enable safe swallowing. During the complementary feeding period the anatomy of the oral cavity changes dramatically, where fat deposits in the cheeks decrease and palate length doubles to create the space for the first deciduous teeth to emerge. Chewing helps to increase the palate space and creates more room for lateral and

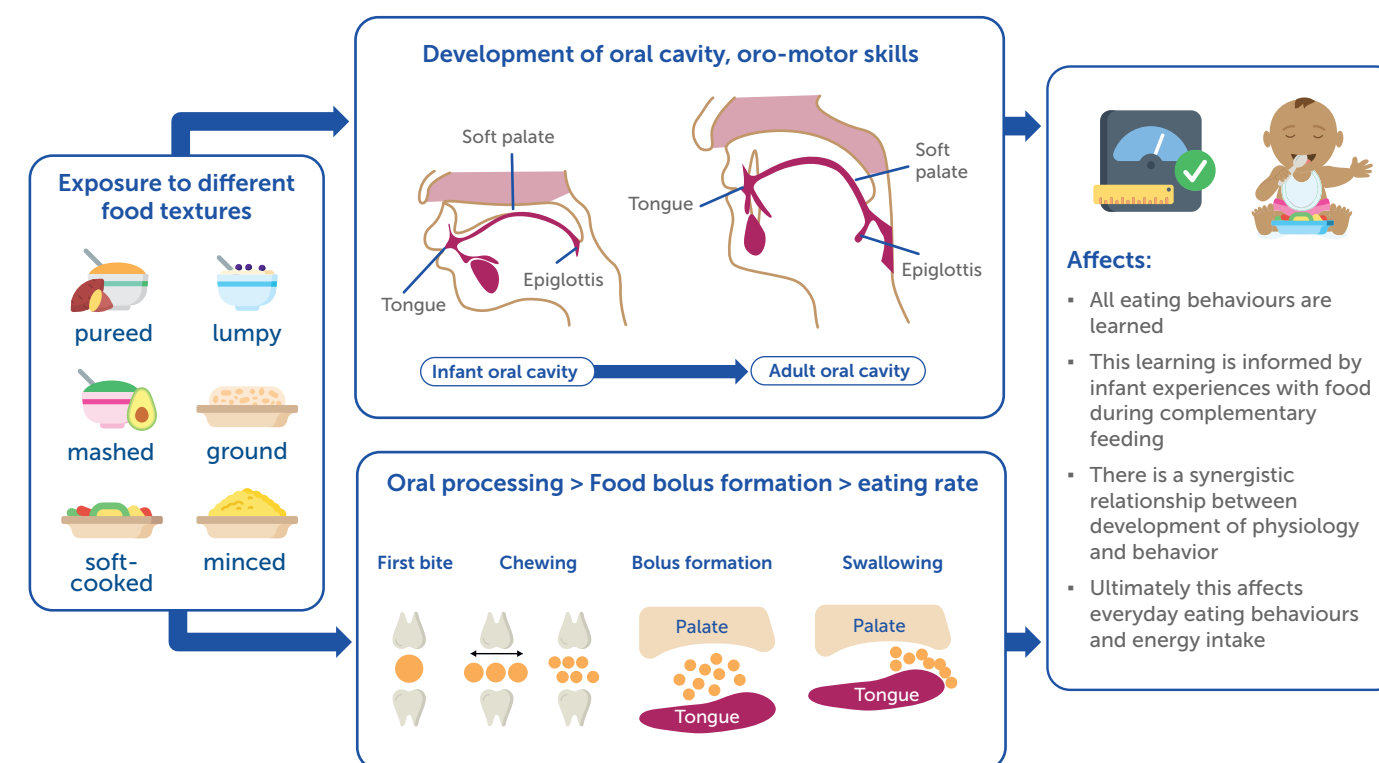


FIG. 1. The role of early food sensory experiences in the development of healthy eating behaviour

circular tongue movements which are needed to direct the food bolus between the posterior teeth for efficiently crushing and chewing of food.

Eating behaviour and dietary habits

Infants exposed to a wider variety of food textures during the critical complementary feeding phase of development are better prepared to adapt their oral processing skills to a more diverse range of food textures, which in turn is linked to broader food acceptance.² A broad experience with age-appropriate food textures affords children an opportunity to hone their eating skills and familiarize themselves with a world of textures, tastes and smells to allow the child to like what they know and eat what they like.³

Acquiring the necessary oral processing skills thus affects food preferences but can also help shape a toddler's eating behaviours. Eating behaviour stabilises early in life and persists into later childhood. Observed differences in pre-school children's eating behaviours have been linked to habitual meal size and energy intakes.⁴ Certain eating styles have been termed 'obesogenic' because they can promote larger meal size, and support positive energy balance over-time. Children that select food textures that can be consumed quickly, and also learn to eat at a faster rate, routinely consume more energy within and across meals compared to children that prefer 'slower' food textures and eat slower.⁵ Longer term, sustained energy overconsumption leads to adiposity in early life, and can support weight gains that persist into

adolescence and adulthood, which increases the risk of diet-related chronic diseases. Eating faster is therefore a risk factor for developing overweight and obesity, underscoring the importance of early life texture exposure, and eating behavior development in long-term health outcomes.⁶

The complementary feeding period is a critical period to acquire oral processing skills and in shaping food preferences needed to develop a healthy dietary pattern. The frequency, quality and variety of early-life food texture experiences that an infant receives during complementary feeding helps to equip them with the skills needed to orally process the complexity of their food environment and supports the development of the eating patterns needed for healthy growth.

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The development of the 5 senses within children and the impact of complementary feeding

Sarah Smith-Simpson, PhD

Nestlé Product & Technology Center (NPTC) Nutrition, USA

Sarah.Smith-Simpson@rd.nestle.com

Key messages:

- The development of all 5 senses begins before birth. Child’s senses gradually mature, and are a child’s connection to the world around them.
- The senses of taste and touch are emerging at birth and develop quickly within the first 2 years, whereas vision matures around 3 years. Senses of hearing and smell continue maturing until at least 8 years of life.
- During mealtime, each of the 5 senses are activated, offering opportunities to challenge sensory development and ultimately achieve acceptance of a wide range of tastes, textures, smells, sounds, and sights.

The development of the five senses in infants is an intricate process that begins before birth and continues throughout early childhood. From the moment of conception, the sensory systems of a baby start to form and gradually mature, allowing them to perceive and interact with the world around them. This journey of sensory development involves complex interactions between genetic factors, neural pathways, and environmental stimuli.

Vision

At birth, babies have limited visual acuity and are primarily attracted to high-contrast patterns and faces. As their visual system matures, they gradually develop the ability to focus, track moving objects, and perceive depth and distance.¹ This development is influenced by both genetic factors

and environmental experiences, such as exposure to visual stimuli and interactions with caregivers. The formation of neural connections and the refinement of visual pathways play a crucial role in shaping the development of visual perception in infants.

Hearing

At birth, babies already have a well-developed sense of hearing and can react to sounds by startling, becoming quiet, or changing facial expressions. They can recognize familiar voices, including their parents and show attentiveness to speech. However, it takes time for babies to fully perceive and understand a wide range of sounds.² Early auditory experiences and interactions with caregivers play a crucial role in shaping the development of their auditory perception.

Touch

The sense of touch is one of the most vital senses to develop in babies.³ It begins to develop as early as 7 weeks of pregnancy and continues to mature throughout infancy. Touch plays a crucial role in bonding between parents and infants, as well as in their overall development. Skin-to-skin contact and gentle touch provide comfort, security, and a sense of connection for babies.⁴ The development of the sense of touch is essential for sensory integration, motor skills, and emotional well-being. Additionally, the sense of touch is particularly sensitive to mealtime occasions as children transition from breast or bottle to eating solid foods of advancing textures.

Taste

The development of the sense of taste in babies begins in utero and continues to evolve through early childhood. At approximately 13-15 weeks of gestation, taste buds start to form on the tongue, and by the time a baby is born, they have approximately 10,000 taste buds, which is more than adults.⁵ Initially, babies are primarily responsive to sweet tastes, which are innately pleasurable and help promote the acceptance of breast milk or formula.⁶ As they grow, their taste preferences expand, and they become more receptive to a wider range of flavors, including sour, salty, and bitter tastes. This development is influenced by genetic factors, exposure to different foods, and cultural influences.

	 Vision	 Hearing	 Touch	 Taste	 Smell
 Pre-birth	Senses begin developing in the womb				
 Breast/bottle feeding	Consistent across feedings (once adjusted to feeding)	Consistent (once adjusted to feeding)	Textures change throughout feeding with breastfeeding	Flavors change throughout feeding with breastfeeding	Aromas change throughout feeding with breastfeeding
 Start complementary foods	Changes with every bite	Consistent	Minimal tracking	Changes in flavors	Changes in aroma
 Transition to all family foods	Changes in colour, shape, size	Quiet/soft, loud/crunchy	Tracking pieces in mouth; firmness	Wider variety, exposure to many flavors	Wide variety, exposure to many aromas

FIG.1. All senses are functioning within each feeding

Smell

The sense of smell, or olfaction, begins to develop in babies even before birth. By the time they are born, infants already have a functional sense of smell and have been reported to be able to identify the scent of their mother’s breastmilk.⁷ As time passes, babies become more adept at distinguishing different smells and developing preferences for certain scents. This development is influenced by genetic factors, exposure to different odors in the environment, and early experiences with breastfeeding and bonding with caregivers.

Mealtime

All 5 senses are engaged during mealtime regardless of a baby’s developmental stage. During breast or bottle feeding, once babies adjust to the mealtime situation little change is detected by each of the senses. When babies start complementary feeding, regardless of the method, each sense is challenged with every spoon or bite requiring constant adaptation and acceptance. Exposure of babies to experiences that offer sensory variety is key to developing a healthy independent eater.

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Influences and interactions in the weaning process

Erin Sundseth Ross, Ph.D., CCC-SLP, CLC

Feeding FUNDamentals, LLC, USA

eross@feedingfundamentals.com

Key messages:

- Mealtime influences are bi-directional.
- Caregivers not only decide what and when to feed their child, but also influence with guidance and responsive behaviors.
- Infants need to be repeatedly offered a variety of foods, in a positive and interactive environment.

In a recent survey, 85% of parents reported knowing enough to make appropriate decisions about their child's diet; however, 42% wished they could improve their child's willingness to try new foods.¹ The foundation for food preferences develops early and is highly influenced by caregivers.²

There have been many different approaches for introducing complementary (solid) foods. Traditional weaning involves spoon-feeding pureed foods, with a progression to more solid foods as the child develops oral skills. Purees provide the infant with an introduction to a variety of tastes but limited exposure to textures; they also offer a fairly safe way to eat iron-rich foods that are necessary after 6 months of age.³ Advocates of "baby-led weaning" suggest spoon feeding overrides the emerging autonomy of the infant and may lead to over-feeding. Baby-led weaning approaches focus on offering family foods, often as soft cubes, with an emphasis on infant autonomy.

This approach promotes increased exposure and a more relaxed feeding atmosphere, but the challenge then becomes how to offer iron-rich foods

which are harder-to-chew.³ "Responsive feeding" advocates have focused primarily on responding to the cues of the infant, with an emphasis on behaviors of hunger and satiety. Responsive feeding has been linked to healthy eating behaviors; however, it may not be sufficient to promote healthy food preferences.⁴

A recent summary of existing guidelines has emphasized providing a positive feeding environment, while responding to hunger/satiety cues as well as the interests of the infant and their emerging capabilities when introducing solids.⁵ The role of the family in exposing their child to a wide variety of foods, and repeatedly offering these foods in a pleasant, interactive environment is also highlighted. Food consistency and texture should be tailored to the developmental skills of the child, which change as the child gets older.

The bi-directional influence during mealtimes of both the caregiver and the child is now leading to a concept of "Sensitive feeding".⁶ This takes the ideas of traditional, baby-led, and responsive feeding approaches and broadens the role of the caregiver.

Sensitive feeding responds to all aspects of the child during mealtimes (e.g., hunger/satiety, likes/dislikes) and brings the family from a responsive role to a more active role. Parental sensitivity, affect, and the ability to allow the infant to explore without intruding all appear to influence infant intake and liking.⁶

Parents and other caregivers are the primary role models for children under two years of age, and as such have the most influence on both what the infant is offered during mealtimes as well as mealtime environments and structure. Caregivers decide what and when to feed their infant and are often looking for information on how to help their child choose foods and develop preferences for a diverse, nutritious diet.

Repeated exposure alone is not enough to teach children how to eat a wide variety of age-appropriate foods. Illustrating the evolving roles of parents and children, Figure 1 integrates these evidence-based, core principles of weaning across approaches. During successful mealtimes the infant is guiding and responding to their caregiver, and caregivers are leading as well as following. Practical suggestions such as focusing on happy, calm environments where families actively engage and encourage infants to explore different tastes and textures without pressure may help promote a lifelong enjoyment of energy-rich foods. The best of traditional, baby-led, responsive and sensitive feeding practices combined.

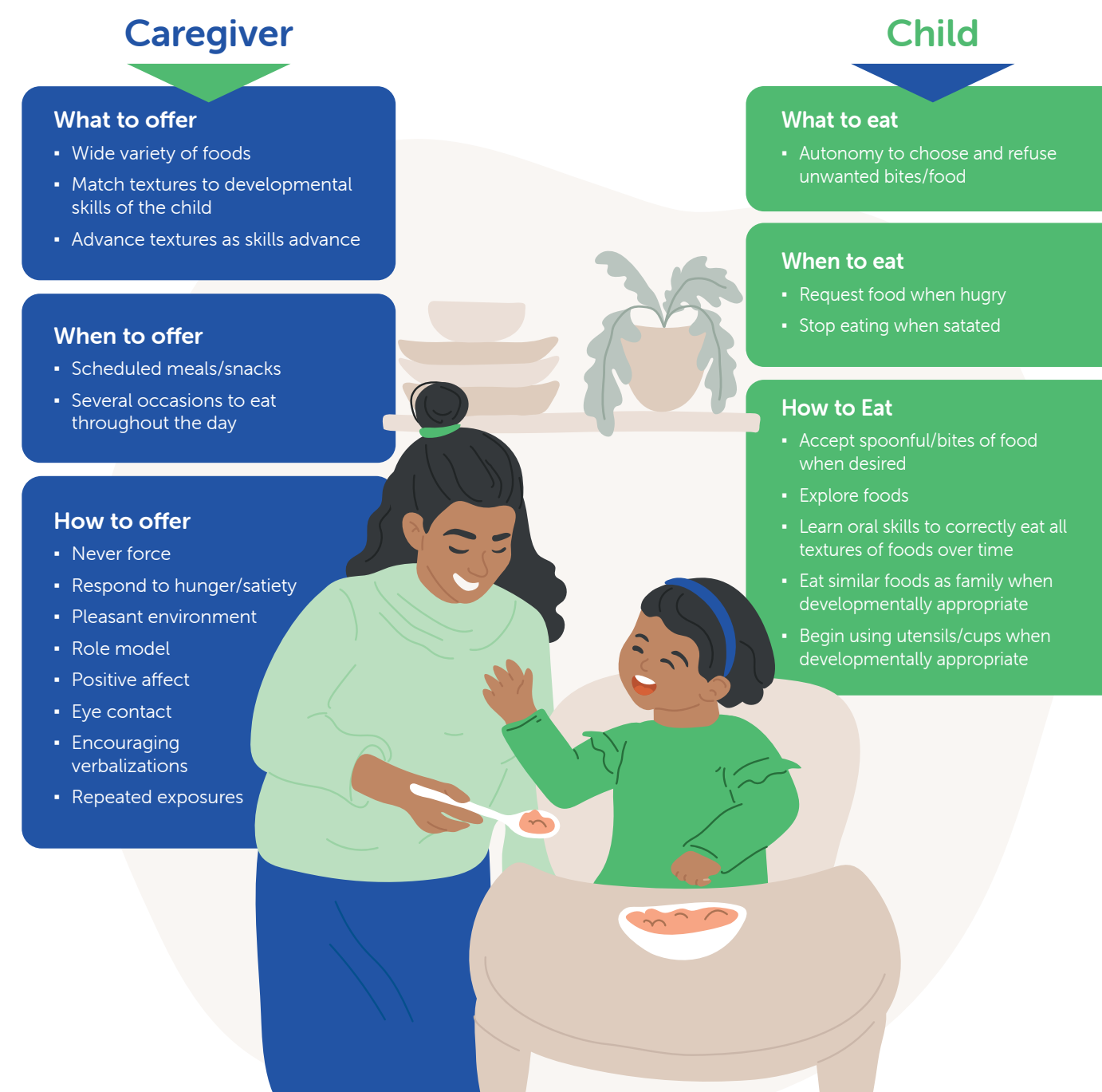


FIG. 1. Roles in mealtimes

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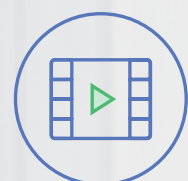
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