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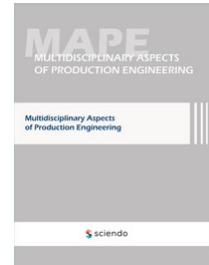
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## INTRODUCTION

„The child's definition of "happiness" is firmly associated with "I do what I want when I want", "I get what I want" or "something unexpected happens that is out of the ordinary" and is therefore considered a temporary state.” (Gummer et al., 2011, p. 16) It follows that in order for a child to experience feelings of happiness during play and for the toy to make him happy, he must allow him autonomy and freedom during play.

The game supports the development and growth of the brain, builds new nerve connections and develops intelligence. It helps to better understand the emotions of others (emotional intelligence) and adapt to ever-changing situations (Goldstein, 2012).

Toys should develop skills such as fine and gross motor skills, senses, mathematical skills, thinking, coordination (Titěra, 1963).

### Robotic and interactive toys

A closer look at the category of robotic or more commonly referred to interactive toys reveals that this category includes a wide range of products. The category also includes talking animals or dolls, interactive books, programmable vehicles, children's electronics and, last but not least, humanoid robots. Since there are a really large number of different robots, interactive or educational electronic toys, choosing the right one for a child may not always be an easy task. Especially when the selection requires, in addition to technical parameters, the psychomotor development of the child and the associated ergonomic principles, of which the average consumer may not be aware.

**A robotic toy** is anything that moves, can be put together, makes sounds or talks, all toys that interact with the child, respectively respond to its stimuli (touch, verbal command, gesturing, pressing a button on the remote control).

The purpose of every toy, whether robotic, plush or wooden, but also the game as such, is the child's development. The game improves his sensorimotor,

cognitive and sensory abilities, encourages his creativity, logical and abstract thinking (Best Interactive and Robotic Toys, 2021).

If we choose a crucial criterion for selecting a robotic toy, then the **child's age** is the most important. There is no lower age limit. The basis is that they are safe and have appropriate functions both to the child's age and to his or her mental and physical development (Best Interactive and Robotic Toys, 2021).

Interactive and robotic toys have made for children for several months. Depending on the type of interactive toy, it is possible to influence the child's development, so it is imperative to ensure that this effect is positive and beneficial to the child's development. For example, let's make a doll that answers in a foreign language. It is unnecessary and counterproductive for a year-old child as it does not respect his psychomotor development. A one-year-old child will appreciate and be enriched more by a toy that emits sound or light signals.

Robotic toys differ significantly in the way they controlled. From the point of view of ergonomics, this is an important parameter. The control varies mainly from the technical complexity of the toy and the already mentioned age of the child. The basic types of toy controllers are (Best Interactive and Robotic Toys, 2021):

- Buttons – directly on the toy – can handle even the youngest children;
- Remote control – from about 3 – 4 years of age;
- Verbal instructions, gestures – about 4 – 5-year-old children;
- Mobile application – older children.

Due to the focus of the article on the youngest children up to preschool age, we need to focus on manual controls and visual and audible announcers, which are directly part of the robotic toy. Robotic and interactive toys have many functions, such as movement in all directions, rotation, emitting sounds and melodies, light signals, limb movements or body bending. The main benefit of programmable toys is their positive impact on the development of abstract and logical thinking, the ability to remember information or improve the fine motor skills of the child (Best Interactive and Robotic Toys, 2021).

Types of Robotic and Interactive Toys (Best Interactive and Robotic Toys, 2021):

- **Talking and singing interactive animals** – their advantage is just talking, moving, or programming; on the contrary, they go backwards. Their goal is to improve communication skills, but above all, to expand vocabulary and possibly to teach foreign languages. They can respond or respond to other stimuli (button, controller, caress). They are generally suitable **for children from birth to old age**, depending on their specific functions.
  - *Robotic and interactive toys for children up to 2 years;*
  - *Interactive toys for the development of vocabulary and communication skills;*
  - *Interactive toys for learning foreign languages.*
- **Educational robotic toys** - various interactive books with recorded sounds and words or so-called sound memories, in which the child does not

remember the pictures but the sounds. As they are educational toys, their main goal is education. They are a very suitable choice **for children of all ages**, but the game should always take place in the company of an adult who can correct it.

- **Children's** electronics develop many skills – fine motor skills, concentration, learning, memorization, abstract and logical thinking, communication, etc. they belong here:
  - *Drones for children* – are suitable for older children from the age of about 7 years;
  - *Children's cameras and camcorders* – they make video and audio;
  - *Children's laptops* – **for children from a few months**. Models for older children should have simple computer games, write and read, button and mouse control, and other features such as changing the screen's background or playing music. Foreign language teaching is also quite common.
- **Electronic musical instruments** – all of which have built-in melodies and various sounds can also be described as interactive and robotic toys. Any musical instruments of this type are suitable for tiny as well as older children.
- **Folding robotic animals and kits** – combine the training of fine motor skills and logical thinking and arouse the child's interest in technology.

Does robotics have the potential to engage every child? Isn't it more the prerogative of technically oriented boys? Why does the number of them in robotic competitions exceed the number of girls several times every year? For example, the American Lifelong Kindergarten, a group of researchers in the field of "children and technology", organizes successful robotic activities for the general public (Rusk et al., 2008) to promote interest in robotics in children regardless of gender.

Harvard research from the 1970s identified two predominant ways children play: patterns like discovering mechanical properties, objects, playing with cubes and puzzles, looking for structure or model. Playwrights like to play with dolls or animal toys and play various situations and dialogues with them.

Robotic tasks usually attract children who prefer an engineering approach to the game. However, a well-designed activity can also attract theatregoers; for example, we can base the theme of the movement on a well-known story, a fairy tale (Rusk et al., 2008).

## RESEARCH METHODOLOGY

In preparing the article, we based on material whose subject is the study of psychomotor development of children. We focused on research findings that focus on the specifics of psychomotor development of the child from birth (newborn period and from 1 month – infant), the period of younger preschool age (in the period of 1 year to 3 years of age) and older preschool age (from 3

to 6 years). In short, development is a process of a series of progressive changes in nature, not random but legitimate, and are the result of the interaction of internal and external conditions. It has an irreversible character (Mlynárová and Grmanová, 2014). We investigated which parameters of gross and fine motor skills develop in children of the monitored age groups and the specifics of somatic development of the given age groups. We also rely on research that shows that the use of computer technology in preschool-age leads to a more excellent "perception of competencies" and independence in the use of computers in the future (Kasík, 2019).

In addition to these findings, we also considered the results of consumer tests of toys (Best Interactive and Robotic Toys, 2021), which discuss the strengths and weaknesses of selected types of robotic and interactive toys focusing on the age category chosen. We also examined the offer of automatic and interactive toy manufacturers on the market. The results of research by foreign authors were also an essential source for evaluation.

## RESULTS

The robotic or interactive toy primarily intended to motivate the child to play and help him develop. The offer of products on the market in this area is extensive, depending on the age, preferences of the child, gender, motor skills and, last but not least, the price of the selected toy.

When choosing any robotic toy for any age category, the shape of the controls is essential so that the child can be gripped and held well. Another essential factor to consider is the weight of the toy itself, the rounding of the edges, which could cause injury to the child; as in the case of the youngest children, fine motor skills are not yet sufficiently developed. In this age group, these are primarily sound and light signals, so we must also monitor the noise level and whether it is possible to regulate it. The quality of the materials used should be a matter of course. All toys must be certified according to EU toy legislation (EU Directive 2009/48/EC of the European Parliament and the Council, 2009), which states the parameters that the toy must meet concerning its safety, health and environmental protection..

In a survey aimed at finding out what kind of senses and competencies help to develop interactive toys depending on the selected age categories, we found the facts listed in the Table 1.

In addition to the child's age, toys intended for pre-school age must already take into account gender. This angle of view of interactive and robotic toys reflected in the Table 2.

**Table 1 Types of interactive toys by age and their function (own processing)**

Age category	Development	Toy type	Acquired competencies
Newborn – Infant up to 1 year	hearing, touch; eyesight;	soft, rustling, ringing, colorful, shimmering, sound effects	They stimulate to discover; Motivation in physical activity (climbing); They motivate to move naturally; They support sensorimotor development; They soothe or put to sleep;
Toddler (1-3 years)	senses; motor skills; memory;	shapes, colors; animal sounds; simple numbers;	Children discover the cause and effect. "What happens when I press this button? It will happen again next time?"
Preschooler (3-6 years)	a more sophisticated form of entertainment, the ability to solve more complex problems;  development of fine motor skills;  Differentiation of a toy for a girl or a boy.	play on something - items of daily consumption;  interactive animals;  solving reasonably complex logical tasks;	Role playing (for mom, for cops); Care e.g., about an animal; Logical thinking training adjusting the volume intensity; Motion sequence programming; Walking mode changes; They arouse interest in technology, science, mathematics and engineering

**Table 2 Gender distribution of interactive toys**

Boys	Girls	Unisex
means of transport; baby walkie-talkies; electronic robots fighting spiders and beetles;	talking doll; sound-responsive bird; interactive animals;	Soft toys (talking plush); toys bring new knowledge (reading pencils, talking books); everything similar to adult electronics (children's cameras, computers, sleeping lamps);

Although robotic and interactive toys made for the youngest children, it can state that a higher degree of interactivity is with toys intended for the age category of 3 years and more elevated. Quality robotic toys for a given age category cannot harm a child, but supervision needed when playing with them, especially for children under five years of age. This is also important because we find small and large interactive toys, from handheld digital games to giant teddy bears and life-size electronic robots. Size also affects the suitability of toys for specific age groups of children, as toys with too small pieces are not suitable for the youngest children, who explore the world by mouth, tend to push objects into their mouths, and swallow a small part.

When choosing a folding robotic toy, it is necessary to consider the appropriate number of components of which it consists. As the table of psychomotor development of a child in the monitored age categories also indicates, the youngest children develop mainly gross motor skills, playing with any toy requires the cooperation of a parent or other person; therefore, the role of an interactive toy for the youngest children is to motivate about getting to know the

child's surroundings. The rapid development of gross and fine motor skills in the child occurs during the infant's period; therefore, the individual components must be reasonably large, as the child's fine motor skills in this period (approximately three years) are not yet sufficiently developed. When choosing a robotic toy for a younger child, it is necessary to pay attention to the sufficient size of the components and the smaller number of pieces in which it is composed. Only from the preschooler's age (approx. 5 years) it is appropriate to choose more demanding models with a more significant number of smaller parts. An overview of the child's psychomotor development summarized in the Table 3.

**Table 3 Overview of psychomotor development of a child with respect to age category**

Age category	Gross motor skills	Fine motor skills	Cognitive competencies
Newborn – Infant up to 1 year	Rolling, laying	Grasping objects	
Toddler (1-3 years)	gradual control of all muscle groups, especially skeletal muscles and animals - this is related to the ability to control excretion; walking, running, jumping, roller, tricycle	develops through various activities of the child, but especially in the game when grasping and manipulating various objects (e.g., stringing corals, cubes, kits) ball handling, hygienic habits, gluing, cutting,	preconceptual (symbolic) thinking; the attention is volatile; inability to divide an object into parts and combine them into a whole; short and individual play;
Preschooler (3-6 years)	good motor skills; movement coordination is improving and "greening"; running, jumping, climbing, boiler without assistance; short stand on 1 leg; cycling, scooters, swimming, kating,	independence in self-service activities (dressing, eating cutlery); tying laces; play with sand, plasticine; drawing, cutting, gluing; ball game (head, legs, 1 hand),	illustrative, intuitive thinking (Piaget, 1970); perception of time and space (Vágnerová, 2012); group game finding differences and similarities in pictures; filling in missing parts;

Source: According to (Mlynárová and Grmanová, 2014)

In toys, it is also necessary to consider the child's physical dispositions, for which they intended, whether he can grasp or carry him due to his size and abilities. This is because toys are in many cases produced in actual sizes (for example, a table); others are miniatures (furniture for a doll's house) (Kasík, 2019).

The basis of a child's psychomotor development is the coordination of the hand and eye. Movement coordination, speed, the accuracy of movements are evolving. First, gross motor skills develop then fine motor skills (Duchovičová and Lazíkova, 2008). At the age of four, fine motor skills, gross motor skills are improving. The child begins to be more independent, more prompt.

## DISCUSSION

Research (Juhaňák et al., 2019) shows that using computer technologies in preschool-age leads to a more significant "perception of competence" and independence in the use of computers in children. This is also the reason why the market offers a considerable number of different robotic and interactive toys. The manufacturers convinced that even a child in preschool-age would gain the ability to program, logical thinking, creativity, orientation in space and many other benefits thanks to a robotic toy.

But is it so? Is it not necessary to think about the negatives in addition to the positive impact? As there is a significant psychosomatic development in preschool children. It is essential to think about the physical health of children (e.g., damage to the wrist bones) when designing toys (Vrábeľová-Roháľová, L., 2010).

This is exactly what we can ensure by respecting ergonomics in the construction and selection of the robotic toy itself. The mechanical toy should always be appropriate for the child's age. For children from the lowest age categories, the active participation of a parent is often necessary when playing. When choosing a robotic toy, it is essential to consider that the toy limits the child to the fulfilment of the assigned tasks and provides space for the child's creativity.

If the toy teaches programming, it is necessary to choose those that are not single-purpose because they limit creativity. A frequent problem with robotic toys intended for children of the selected age category is the so-called "second-hour problem" when such a toy cannot keep the child's attention during a more extended play.

Another disadvantage is if the child does not have the opportunity to see the programmed sequence. Thus, if the robot does not do what the child expects, it must start again, and it is difficult to find mistakes at the age of selected age groups. However, this is a crucial programming ability (Kasík, 2019).

It is necessary to consider the purpose for which the robotic toy for the child purchased. Expecting that even a small child can learn to program a program is misguided. As already mentioned in the article, it is necessary to involve an adult in the game for a given age category. The robotic toy designed for the youngest children to preschool children rather fulfils the function of an aid through which it is possible to demonstrate how the basics of programming work. It is the task of the parent or adult to find a way to engage the robotic toy and incorporate it into the child's cognition. If the child left with only the mechanical pressing of buttons, it is impossible to develop his creativity and logical thinking. They will only learn to repeat repeatedly, which is not the goal we would like to achieve by using a robotic toy.

When processing the material for the article, we found that adults usually do the testing of robotic toys, so the feedback from the target group for which the toy intended is not objective. Instead, it is about giving parents an overview of what to expect from each type of toy. This is logical because it would be difficult for us to get feedback from infants and toddlers. Therefore, it is necessary to appeal

to parents of children to consider their ergonomic parameters, which will support the child's development without negatively impacting the child's motor development, when choosing robotic and interactive toys.

From the point of view of ergonomics for any toy and robotic, the shape of the controls is an essential factor that we must respect when choosing. The toy handling must be simple so that the unacceptable condition of the authorities does not cause various painful deformity syndromes when gripping and holding it. The weight of the toy itself is directly related to this, as the youngest children develop their muscles as part of psychomotor development, so the child cannot be overwhelmed by manipulating toys that are heavy and can cause injury to the child if he cannot keep them for a long time. It is necessary to consider whether there are sharp edges on the toy that could injure the child if handled carelessly. The size of the individual parts of the toy must also be taken into account so that the child cannot swallow or inhale too small amounts. As these are age categories of children who may tend to put their fingers in their mouths or the toys themselves and do not yet have sufficiently developed hygiene habits, it is necessary to consider the material from which the toy made to keep it hygienically clean. For robotic toys that emit sound or light signals, it is essential to ensure that they can regulate the noise level. It can affect the child's hearing and mental well-being because especially the youngest children often fight too noisy robotic toys and can therefore refuse play. With this type of toy, which is contrary to the goal that we want to achieve by using a mechanical toy in a child, namely to motivate him and encourage him to get to know the world.

## **CONCLUSION**

For children, especially those of age, the game is one of the primary forms of learning and discovering the world. With this in mind, parents often overly try to satisfy this need by buying lots of toys. Psychological research shows that too many toys are not beneficial for the child's stimulation and development. They hamper the child's creativity, create chaos, and, as a result, the child does not play and is bored in the flood of toys. Parents often succumb to the advertising of toy manufacturers to confiscate the child without delay and even use the toy to educate the child. Robotic and interactive toys are currently in great demand. They focus on intellectual (primarily mathematical – logical) abilities. They preferred manipulative toys, which represent a group of motor and social games. Since the article deals with robotic toys intended for ages from infants, toddlers to preschool children, they cannot expect to learn programming or that the child will be able to play with them without the help of an adult so that the game enriches them. For a given target group, this type of toy is more an opportunity to get acquainted with programming basics and arouse the youngest children's curiosity and desire to discover and research on what principle they work.



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**Abstract:** At present, there are a large number of manufacturers operating on the market, which are engaged in the production and distribution of mechatronic and robotic toys. These toys range from the cheapest and simplest to sophisticated costly models for play education. Looking at the market offer, it can be stated that mechatronic toys are being produced, which are intended for children of several months. When developing children's and educational robotics, it is, therefore, necessary to take into account the psychomotor development of the child. Respecting or not respecting it has a major impact on the success of the toy for the consumer and the fulfillment of the educational goal for which it is intended. Last but not least, in connection with the child's development, the question arises as to what ergonomic principles, when designing toys intended for children depending on age, need to be respected and implemented into solutions to eliminate problems related to the development of children's and educational robotics. The subject of interest in the article is the age groups of children from birth to preschool age. The aim of the article is to identify which factors in the construction of children's robotic toys for the youngest children up to the period of preschool age are key from the point of view of ergonomics.

**Keywords:** children, ergonomics, toys, psychomotor development of the child, children's robotics