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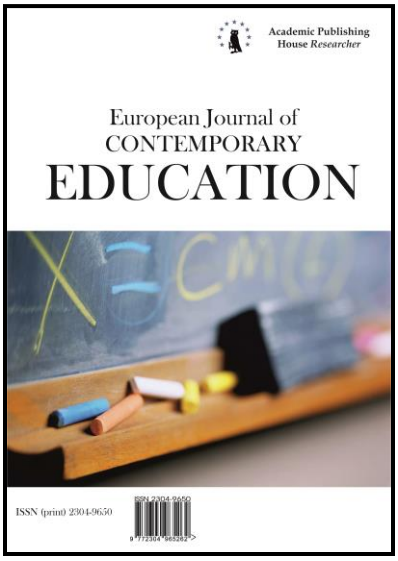

Abilities of 4–7 years old Children to Provide Independent Explanations and Generalisations of Causality

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Abstract

The understanding and generalisation of causality are important thinking abilities, as they form the basis for a person's activity. Researchers exploring these abilities do not have a unified opinion regarding the age of children when they develop causative understanding and its determinant factors (e.g. age, prior knowledge, the content of a task, etc.). The aim of the current research is to investigate the abilities of 4–7-year-old children to explain causative relations and independently generalise them. An original experiment using spatial figures of animals was chosen for the research. 66 pre-school children participated in the research, each group being represented by 22 children (4–5-year old, 5–6-year old, and 6–7-year old respectively). The research results revealed that pre-school children (4–7-year old) are able to distinguish and explain causative relations. Besides, no difference was determined between the children's abilities to explain and generalise causalities in relation to age (4–5, 5–6, and 6–7). It is assumed that the children of different age understand causal structures in the same way when the spatial figures of animals, which are close and familiar to children, are used as simulation material in the research. The obtained results of the experiment are discussed in the context of the works of other researchers.

Keywords: Pre-school children, abilities to explain and generalise, causal relations.

1. Introduction

Understanding of causality is the fundamental of human thinking and actions. According to Gopnik et al. (2004), this ability helps children to better perceive the results of the accomplished actions, which enables them to acquire a greater sense of the environment control. Some scholars (Legare, 2012; Schulz, Bonawitz, 2007) claim that while playing children are able to distinguish causal relations; however, there is no unanimous opinion at what age children develop causal

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understanding. A part of the scholars maintain that the older the child, the better he or she is able to employ causal relations (Piaget, 1929; Sobel, Buchanan, 2009; Göksuna et al., 2010). Other studies demonstrate that having an opportunity, younger children tend to employ more varied causal choices when solving tasks (e.g. Wellman, 2011; Bright, Feeney, 2014; Legare, Lombrozo, 2014). However, it remains unclear at what age children develop this ability and what factors it depends on (e.g. age, prior knowledge, contradictions in tasks, etc.). It is noteworthy that a child's ability to explain and generalise causal relations have not been explored in Lithuania. The analysed studies do not contain such an experiment which would reveal how a child explains and generalises causality. Hence, the aim of the current research is to explore the abilities of 4–7-year old children to explain causal relations and generalise them independently. The object of the research is the abilities to explain and generalise causal relations. An original experiment has been chosen as the research method.

The significance of understanding causality. Persons think and act realising causal relations, i.e. why some events cause others. These events become understandable to us when we become aware of particular causal properties. For instance, a car key (perceived as a cause) unlocks the car door (result) as it causes the start of a particular mechanism (Sobel, Buchanan, 2009). Michotte (cited from Schlottmann et al., 2002) was the first to explore causative relations, where an event was assessed as caused by another event even without the involvement of physical objects. The author maintains that causality can be defined as an ability to understand events caused by other events. According to Gopnik et al. (2004), an ability to understand causes helps a child to successfully foresee future events and understand the results of an accomplished action. It is obvious that children themselves cannot always relate the cause to the result; yet, according to Field and Lawson (2008), if children are provided with causal explanations when explaining some information, the information is understood in a much easier way in comparison to situations when information is provided without any causative relation. Ahn et al. (2000) determined that the answers to the tasks performed by 7–9-year old children, which included some kind of categorisation, were largely influenced by a particular function that was caused by other functions (causality) rather than other features devoid of causality. It means that the understanding of causal relations is important for reasoning and better understanding of information. Moreover, the research, performed by Dunn and Brown (1993) several decades ago, revealed the influence of causal language on the recognition of a child's emotions. According to the authors, three-year old children (33 months old) that frequently used causal languages when talking to their mothers (about feelings, wishes, emotional states, and social activities) were better at recognising emotions. Thus, it is obvious that children's understanding of causality and ability to explain are significant aspects of cognitive development.

Understanding and explanation of causality provided by children of different age. As it has already been mentioned, children are able to distinguish causal relations by playing (Schulz, Bonawitz, 2007; Legare, 2012); however, researchers do not have a unanimous answer regarding the age when causal understanding and the ability to explain causality are formed. One of the approaches is that the older the child the better he/she is able to employ causality (Piaget, 1929; Das Gupta, Bryant, 1989; Frye et al., 1996; Sobel, Buchanan, 2009, Göksuna at al., 2010). According to Das Gupta and Bryant (1989), an ability to draw particular causal conclusions develops at the age of 3–4, since 3-year old children accomplished the tasks in a poorer way that 4-year old children. Frye et al. (1996) hold the same opinion and claim that causal explanations undergo some changes at the pre-school period. Sobel and Buchanan (2009) point out that 5-year old children tend to draw conclusions about the inner qualities of an object using causal explanations more often that 4-year old children. Meanwhile, Göksuna et al. (2010) confirms that 4-year old children provide more explanations in comparison to younger children when asked to describe a drawing.

Other researchers claim that young children employ causal choices when solving different tasks (Schlottmann et al., 2002; Kushnir, Gopnik, 2007; Sobel, Munro, 2009; Wellman, 2011; Bright, Feeney, 2014; Legare, Lombrozo, 2014). Sobel and Munro (2009) claim that children begin understanding specific aspects of particular areas at the age of three. Moreover, Kushnir and Gopnik (2007) state that small children can draw complicated causal conclusions. In their research, 3–4-year old children employed new evidence when drawing precise causal conclusions, even if they contracted children's beliefs. Legare and Lombrozo (2014) maintain that younger children can accomplish a task more easily when both cause and consequence exist; whereas older children are able to associate apparently unrelated things. According to the researchers, 3–4-year old children are not able to provide precise causal explanations, while 5-year old children are able to perform such a task. Other researchers, such as Bright, Feeney (2014) state that when solving a task 8-year old children make causal decisions more often than 12-year old children or adults. It means that children to do not demonstrate inductive selectivity up to the age of 12, and they can employ causal knowledge when drawing conclusions before this age. Wellman (2011) also claims that the application of causality can be easier for younger children, since decision-making demands a clearly understandable answer. Finally, according to Schlottmann et al. (2002), pre-school children can distinguish events that are determined by causal relations from the ones that are not influenced by causality. The authors maintain that older children's understanding of causality reflects their verbal skills rather than changes in understanding itself, since young children can also understand causality provided verbal requirements are reduced. Besides, Schlottmann et al. (2002) note that 3-year old children, when given an oral explanation by an adult, can understand causal structures and interrelate the necessary stimuli by separating physical and social causality.

Children's ability to generalise causal relations. Generalisation is a mental operation when the general features or properties of a reality phenomenon are reflected by combining or grouping them on the basis of a certain feature. According to Piaget (cited in Kesselring, Müller, 2011), 3–8-year old children are characterised by egocentric thinking and syncretism, i.e. inability to generalise individual parts of a phenomenon. Klausmeier and Allen (1978) also explore generalisation. According to them, an ability to generalise through examples consistently develops depending on age (class). Crowley and Siegler (1999) confirm the statement by claiming that if children of different age are provided with the same instruction to accomplish a task, older children tend to provide wider generalisations (e.g. their research proves that 8-year old children are able to provide better generalisations than 7 or 6-year old children). According to the authors, it is assumed that older children provide better and more precise generalisations than younger children. However, the research conducted by Lucas et al. (2010) reveals that children made unusual generalisations on causative relations more often than adults, which proves that they have less partiality and prior presumptions, and are more focused on evidence that exists in the task. Moreover, the aforesaid research also determines that 4–5-year old children are able to recognise the forms of causality and apply them in making decisions in relation to new objects. Nevertheless, Booth (2014) states that children primarily learn to causally relate the features of things according to their purpose rather than causal properties of the things; hence, they tend to generalise properties that are based on perceived similarity.

2. Materials and Methods

The aim of the research is to explore the abilities of 4–7-year old children to explain and generalise causal relations independently. The objectives are as follows: (1) to analyse the abilities of 4–7-year old children to explain and generalise causal relations independently; (2) to compare the abilities of children aged 4–5, 5–6 and 6–7 to explain and general causality. The hypotheses are: (1) 6–7-year old children are better at giving independent and more precise explanations of causality than 5–6 and 4–5-year old children, whereas children aged 5–6 give better and more precise explanations of causality than 4–5-year old children; (2) 6–7-year old children are better at making generalisations than children aged 5–6 and 4–5, whereas children aged 5–6 are better at making generalisations than 4–5-year old children.

Seeking to explore children's abilities to give explanations of causality and make generalisations independently, an experiment was conducted. Its procedure was as follows: a test of colour recognition and naming → introducing a child with the research materials → a research on the abilities to explain causality → a research on the abilities to generalise causality. The research was conducted with every child individually in a separate room of the educational institution; children were given the same instructions and explanations. All the stages of the research will be presented consecutively.

The first stage of the research included the test of colour recognition and naming. Using a table of colours, a child was asked to recognise and name six colours. If the child was not able to define colours, he/she did not participate in further research. If a child was able to recognise and name colours, he/she was asked to explain causality and make independent generalisations.

Seeking to analyse the children's abilities to explain and generalise causality, stimulant materials were prepared. They consisted of eight figures: yellow hens with different spots on their wings (two figures with pink spots, two hens with purple spots, two figures with blue spots and two hens without spots on their wings). Different spots were provided as minor coloured stimuli that a child could relate to the egg. The child was expected to think and associate the spots with eggs; yet, the necessary thing would be discovered, since the wings of two hens were marked by the spots of the same colour, and only one of them contained an egg. Besides, it was noted that eggs were placed under four hens, and only two hens had the same wings. Hereby attempts were made to reveal the structure of the children's thinking, i.e. we wanted to know if the children would try to associate the colour of the wing spots, if they would discover some relation and try to explain the impossibility of causality. All the figures were of the same size (50 mm high and 60 mm wide). The legs of four hens were visible, and of the other four were hidden. White plastic eggs (30 mm) were placed under the hens that had hidden legs. Hence, an egg was placed under one of the hens that had the same colour spots on the wings or having no spots, and that had their legs hidden. The hens were placed on smooth green board (400x600 mm). Two of them sat in nests (130 mm in diameter): one of them with hidden legs and one with visible legs (the stimulant materials are presented in Fig. 1).

Fig. 1 Stimulant materials that was used in the research on a child's ability to explain and generalise causality independently

Introducing the children with the research materials. The researcher demonstrated the stimulant materials to the children and allowed looking at them from all sides: "This is a game – hens' farm. You can have a look at it but you cannot touch it." When a child explored the farm, the researcher explained the rules: "Some hens have laid eggs, but not all of them. The rules are the following: you have to understand and show which of the hens have laid eggs. You can take these two hens that sit in the nests (showed the child the hens in the nests). Look which of them has an egg (the child raised the hen and looked). Now you have to find the other hens that have laid eggs. There are three more such hens. You can try four times, but before searching, look closely at the hen that has laid the egg" (a child was allowed to examine the hen for 30 seconds).

The piloting experiment of the abilities to explain causality. The researcher told a child: "Now you can start! Take one hen and show it to me. Let's look if it has laid an egg." (this attempt is not assessed). It is noteworthy that the children were encouraged to talk throughout the whole experiment by being asked various questions, such as "Why have you chosen this particular figure?", "Where did you know from/how did you guess that you'd find an egg here?", etc. The informants' replies were recorded on a dictaphone throughout the whole research.

Stage I of the research on the abilities to explain causality (assessed). The researcher told: "You have three attempts. Choose one hen which has laid an egg. Think and tell me why you have chosen this hen and we will look together if it has laid an egg." The researcher assessed the child's replies according to Table 1 – from 2 points (if the child was unable to explain causality) to 5 points (if the child could explain the connection between the visible legs of hens and the laid egg).

Stage II of the research on the abilities to explain causality (assessed). The researcher told: "You have two more tries. Choose a hen. Think and tell me why have you chosen this hen. Let's look under it if there is an egg." The child's replies were assessed from 1 to 4 points (see Table 1).

Stage III of the research on the abilities to explain causality (assessed). When choosing the last hen, a child was asked: "What do you think of the hens that have laid eggs – are they similar to or different from those that have not laid eggs? Think and tell me why have you chosen this particular egg." Bearing in mind that this was the last stage of the research, 0 points were assigned to a child if he/she could not understand and explain the causal relations between hens' legs and the laid egg. If the child could determine the causal relation, 3 points were assigned (see Table 1).

Table 1. Assessment of the children's independent replies concerning explaining causality

Children's explanations	Points assigned to children at different stages of the research		
	I	II	III
Unable to explain own choice The explanation does not comply with the reality or is unrelated to the task	2	1	0
Non-causal explanation (comparison to an unrelated object, identification of the position on the board or employing the strategy of guessing, personal motifs, employment of proximity)	3	2	1
Explanation of causality unrelated to legs, i.e. a child explains but does not generalise (this assessment was applied if a child explained the secondary stimulus, i.e. spoke about the spots on the wings of hens).	4	3	2
Causal explanation related to the legs of hens and the placed egg	5	4	3

When assessing the child's abilities of providing causal explanations, the total sum of the collected points can range from 3 (minimum) to 12 (maximum).

The stage of the research on the abilities of generalising causality. A child was told that all the stages of the experiment were finished and he/she was offered to lift the remaining hens. If needed, the child was allowed to think and asked to generalise: "What have you understood?" it is noteworthy that the current research aimed at complex generalisation, i.e. when objects were associated not according to one feature but according to several or more features. The child's abilities to generalise were assessed according to Table 2.

Table 2. Assessment of the children's independent generalisations

Children's abilities to generalise	Points assigned to children
Unable to generalise Generalisations unrelated to the task	0
Non-causal generalisation	1
Causal generalisation (this assessment was applied if a child was able to generalise using the secondary stimulus, i.e. the spots on the wings).	2
Causal generalisations relating the hidden legs of a hen and the existence of an egg under the hen	3

The participants of research. 66 children participated in the research. A convenience sampling was employed. Agreements from parents / caregivers were obtained. 6 children were not involved into the research (having obtained the parents' agreement, 4 children refused to participate in the experiment), one child did not want to continue, and 1 child did not recognise colours).

Table 3. Characteristics of research participants

Age groups of children	Age limits	Age average	Number of boys	Number of girls	General number of children in the research
4–5-year old	From 4 years 0 months to 5 years 0 months	4 years 8 months	9	13	22
5–6-year old	From 5 years 1 month to 6 years 0 months	5 years 6 months	11	11	22
6–7-year old	From 6 years 1 month to 7 years 0 months	6 years 5 months	13	9	22

3. Findings

When evaluating the abilities of pre-school children to make independent explanations and generalisations of causality, it is assumed that the analysis of both types of the research data (qualitative and quantitative), as it helps to envisage the thinking process of pre-school children.

Table 4 presents the primary quantitative (the number of the children's provided answers) and qualitative (examples of the answers) expression of the research data collected during the process of the children's explanations how they chose one or another hen.

Table 4. Explanations provided by children of different age

A child's explanation	Explanations		
	Number and examples of explanations provided by 4-5-year old children	Number and examples of explanations provided by 5-6-year old children	Number and examples of explanations provided by 6-7-year old children
Unable to explain own choice	25 answers [does not speak] "I don't know", "so so", "because I knew it", "because I thought so", "I was hidden and I found it"	24 answers [does not speak], "I don't know", "I guessed", "because it is usually so", "I tried", "I only looked and that's it", "because I want so"	21 answers [does not speak], "I don't know", "I thought that it was in that", "I guess I think so", "I can guess, I had this in my mind", "I somehow knew that it was there – my brain is a computer"
The explanation does not comply with the reality or is not related to the task	8 answers "because I heard the sound", "it is simple, I can know everything because I think a lot", "I know it because my aunt has some hens"	5 answers "The eye are surprised, they are wide", "because I have holly blood, I know it", "I play such a game at home, my mum taught me this game when you have to look	5 answers "I don't know, because it was looking at me", it looks funny", because there is an egg, I can read", "because there is an egg, I saw a mountain", "because I looked and thought so"

A child's explanation	Explanations		
	Number and examples of explanations provided by 4-5-year old children	Number and examples of explanations provided by 5-6-year old children	Number and examples of explanations provided by 6-7-year old children
		where something is", "when their mother leaves, the child breaks the egg"	
A non-causal explanation	3 answers "It looks like the sun or a flower", "I went through the colours", "I noticed this hen"	4 answers "without legs", "because I like this colour", "because it is this", "I go in turn"	12 answers "They are different! They have legs, and these ones don't!", "because they were standing at the front", "because it has blue (spots), and it is my favourite colour", "as it is more beautiful"
Explanation of causality unrelated to legs, i.e. a child explains but does not generalise	3 answers "I thought it was here, because it could be here, as I thought it was here", "it is because of spots – it is always because of spots", "because it is with the "spots"	2 answers "the sports here are the same as there", "there are blue spots [it is an egg]"	3 answers "Those with eggs have blue spots, and they are all yellow", "I thought there will be no, but I guessed by these hens [with spots]", "I only looked at the spots, but not all of them have spots"
Causal explanation relating the legs of the hens with the laid egg	4 answers "because I understood that legs are here and here, where there are legs, there are eggs", "as I saw that sometimes where there are legs, there are eggs"	4 answers "because of legs", "there is an egg here. I find it different – one is with the legs and it has an egg, the one which has no legs has no egg"	6 answers "all of them had legs and this one also had legs, so I took this one", "I know it because there are legs – I recognised by legs (…) these hens are more real, otherwise how will they walk?"

As it is seen the number of answers varies in different age groups of children with the exception of the explanations that do not comply with the reality, are unrelated to the task or do not explain causality (i.e. parallels are drawn with an unrelated object, the position of the hen on the board or application of the strategy of guessing, personal motifs, employing proximity).

Having analysed the research data from the qualitative perspective, it is obvious that the explanations provided by children of different age groups do not differ considerably. The children of the two younger groups (aged 4–5 and 5–6) that are not sure of the answer use simple and hardly descriptive statements "I don't know", "because it is usually so", and only the children from the senior group (aged 6–7) provide more elaborate answers, e.g. "I somehow knew that it was there – my brain is a computer". The answers in which children try to provide different explanations (both related and unrelated to the cause) are also similar in all the age groups, yet it is noteworthy that they are more numerous, e.g. "I can know everything because I think a lot" (the answer of a 4–5-year old child).

The data provided in Table 5 demonstrate that the children of all age groups are able to make independent generalisations.

Table 5. Generalisations provided by the children of different age groups

A child's ability to generalise	Generalisations		
	4–5-year old	5–6-year old	6–7-year old
Unable to generalise	6 answers [does not speak], "I don't know what to tell you", "Hens. A nest. A board".	6 answers [does not speak], "I don't know", "I learnt myself"	7 answers [does not speak], "I don't know", "I understood everything well", "I don't know how to say… I am here for the first time"
Generalisations unrelated to the task	4 answers "When hens have eggs, they had an egg – either this or this (…). When I take this egg, my dad takes an egg and we cook the egg, and I eat the egg", "We have such a game at home and we play with my mom and dad, we have such eggs and nests, and you have to guess. We play such a game"	3 answers "You have to be clever and guess. Know", "I created this game, and my mum said that we will have to make these till night, and I know (…) but my mom didn't tell me anything"	1 answer "They will soon hatch the eggs"
Non-causal generalisation	4 answers "You see, these differ – one has laid an egg, and this one – no, when you take, you understand", "From this game I understand that you have to find eggs"	6 answers "not all hens had eggs, but some them differ – some have no legs, others have legs with spots, the spots differ", "some hens had eggs, others – no"	8 answers "Some hens have eggs, four hens", "you had to guess which hens had eggs", "you have to find eggs"
Causal generalisations	2 answers "You have to look for eggs (…), I looked by the spots", "you have to guess where the spots are (…), I thought that the ones with spots had eggs"	2 answers "There are hens (…) that have eggs, those with spots, here are no spots, and these are purple", "we have found three eggs, they differ, the wings don't have… you know what? Here, the spots"	1 answer "There are spots here, and here there are no spots"
Generalisations of causality relating the hidden legs of the hens with the existence of an egg	6 answers "Where there are legs, there is an egg, where there are no legs, there is no egg", "You have to find which hen has eggs, this, this, this and this have eggs, because they have legs, and these don't – this is the	5 answers "Where there are legs, there are eggs", "They have purple spots, and blue; the one that have legs have them [eggs], others don't"	5 answers "It is easy – where there are two legs, there is an egg. It's easy", "I understood from the very beginning, you didn't tell me but I understood at once that these hens had eggs (…)

A child's ability to generalise	Generalisations		
	4–5-year old	5–6-year old	6–7-year old
	difference"		because they had legs"

The quantitative data demonstrate that nearly the same number of children of different age groups could not provide generalisations; the differences in other groups of generalisations are not significant, either. A consistent statistical analysis of these data is provided below.

Assessing the children's abilities to generalise from the qualitative perspective, it is noteworthy that only the children that could not generalise provided very short and simple answers, such as "I don't know", "Hens. A nest. A board". The children of all age groups that made attempts to provide or provided generalisations spoke in longer monologues ("You see, these differ – one has laid an egg, and this one – no, when you take, you understand", a child aged 4–5), their language was more elaborate with some extra thoughts. It is possible to state that the children had a kind of a conversation with the researcher (e.g. "We have found three eggs, they differ, the wings don't have... you know what? Here, the spots").

Tables 4 and 5 present quantitative research data. They were assessed by attributing a certain sum of points (according to the points ascribed in accordance with Tables 1 and 2); their statistical analysis was performed. The criteria of Kolmogorov-Smirnov and Shapiro-Wilk tests were employed to verify the hypothesis on the normal distribution of variables. Table 6 presents the results of the normality test. The results of both Kolmogorov-Smirnov and Shapiro-Wilk tests are used, as well as the Sig level of significance is considered. As it is seen, the independent explanation and choice of variables differs from the normal distribution, since Kolmogorov-Smirnov and Shapiro-Wilk criteria were $p<\alpha$, when the significance level was $\alpha=0,05$. Hence, the data did not have normal distribution.

Table 6. The results on the variables according to Kolmogorov-Smirnov and Shapiro-Wilk tests

Age		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Independent explanation and generalisation	4–5	,324	22	,000	,679	22	,000
	5–6	,345	22	,000	,618	22	,000
	6–7	,241	22	,002	,733	22	,000

Table 7 shows that the variable of all generalisations was $p<\alpha$, when the selected significance level was $\alpha=0,05$. Hence, these variables did not have normal distribution, either. This being the reason, Mann-Whitney-Wilcoxon test was employed for independent samples, and Wilcoxon rank-sum test was used for dependent samples.

Table 7. The results on the ability to generalise according to Kolmogorov-Smirnov test

Generalisation	Age	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Made independently	4–5	,299	22	,000	,768	22	,000
	5–6	,236	22	,003	,794	22	,000
	6–7	,274	22	,000	,789	22	,000

The results presented in Table 8 demonstrate that 4–5-year old children were able to provide independent and precise explanations of causality better than 5–6-year old children; yet this difference was not statistically significant ($p=0,688$; $p>0,05$). Moreover, 6–7-year old children were able to provide better explanations of causality than 4–5-year old children (p=0,276) and 5–6 (p=0,099), yet the differences between these two age groups were not statistically significant, either (p>0,05). Hence, a statistically significant difference was not established between the aforesaid age groups concerning independent explanations of causality.

Table 8. Comparison of the ranks of the abilities to provide independent explanations of causality in all age groups of children

Children's independent explanation of causality							
Age	N	Mean of ranks	Total sum of ranks	Mann-Whitney U	Wilcoxon W	Z	Significance
4–5	22	23,18	510,00	227,000	480,000	-,402	p=0,688
5–6	22	21,82	480,00				
4–5	22	20,50	451,00	198,000	451,000	-1,090	p=0,276
6–7	22	24,50	539,00				
5–6	22	19,50	429,00	176,000	429,000	-1,650	p=0,099
6–7	22	25,50	561,00				

The results presented in Table 9 demonstrate that 5-6-year old children provided more precise generalisations than 4–5-year old children at all stages of the research, yet the difference was not statistically significant (p=0,822; p>0,05). It is also obvious that 6–7-year old children provided more precise generalisations than children aged 4-5 (p=0,336) and aged 4–5 (p=0,275), yet the difference was not statistically significant, either (p>0,05). Consequently, the abilities of children aged 4–5, 5–6, and 6–7 to generalise did not differ statistically significantly.

Table 9. Comparison of the ranks of the abilities to generalise in all age groups of children

Children's abilities to generalise							
Age	N	Mean of ranks	Total sum of ranks	Mann-Whitney U	Wilcoxon W	Z	Significance
4–5	22	22,07	485,50	232,500	485,500	-,225	p=0,822
5–6	22	22,93	504,50				
4–5	22	20,66	454,50	201,500	454,500	-,962	p=0,336
6–7	22	24,34	535,50				
5–6	22	20,41	449,00	196,000	449,000	-1,092	p=0,275
6–7	22	24,59	541,00				

4. Discussion

The opinion of numerous researchers (Legare, 2012; Schulz, Bonawitz, 2007) that children can distinguish and explain causality by playing has been confirmed. In the current research, it has been determined that children aged 4-7 can explain causal relations, yet no statistically significant difference has been determined between all the age groups. The research confirms the propositions of Kushnir and Gopnik (2007) that 4-year old children can draw causal conclusions and the findings of Schlottmann et al. (2002) that young children understand causality provided linguistic requirements are limited. It is noteworthy that no high standards were set for children concerning oral answers. Nevertheless, we agree with Legare and Lombrozo (2014), who claim that older children experience less difficulty in searching for oral explanations, yet the quality of explanations themselves shall not necessarily be different.

While observing how the children of all age groups provided independent explanations of causality in our research, it became obvious that older children had less difficulty in providing oral explanations. Considering the research results quantitatively, it appears that 6–7-year old children provided more answers than the children aged 4–5 and 5–6, i.e. they kept silent more rarely, the answer "I don't know" was less frequent, and their replies more often complied with the reality and the task. Following Legare and Lombrozo's (2014) findings, although children experience less difficulty in finding words for explanations of causality, this fact does not affect the precision of the explanation itself. Therefore, it seemed that older children were able to find words for causal explanations more easily, no statistically significant differences were determined between all the age groups.

In the current research, we compared how the children of different age groups generalised causality. It was determined that the generalisation abilities of children aged 4–5, 5–6, and 6–7 did not differ significantly. The data of the research performed by Klausmeier and Allen (1978), and Crowley and Siegler (1999) demonstrate that school children's ability to generalise improves depending on their age, yet this fact was not confirmed by our research. Two reasons can be distinguished: first, the research was conducted with pre-school children and not with school children; second, no statistically significant difference was determined when analysing causal explanations in the explored age groups (aged 4–5, 5–6, and 6–7), bearing in mind that generalisation can depend on the ability of explanation.

Limitations of the research and further research. During the research attempts were made to create equal conditions for all children: the experiment was conducted individually with every child in a separate room, as well as the same instructions and explanations were provided to all children. However, the children's explanations might have been affected by external factors, such as the institutional environment, time of the day, poor motivation for speaking, and others. Hence, carrying out further research, it is important to equalise formal aspects as well (e.g. the research environment). It is noteworthy that causality is understood differently by different researchers. Seeking to clear out how children understand causal relations, particular simulant mechanisms are employed (Frye et al., 1996; Kushnir, Gopnik, 2007; Schulz, Bonawitz, 2007; Schulz et al., 2007a; Sobel, Buchanan, 2009, Sobel, Sommerville, 2009; Waismeyer et al., 2015). For instance, in their experiment, Schulz and Bonawitz (2007) provided children with two boxes equipped with two levers that dropped (or not) dolls. Sobel and Buchanan (2009) used a box with a switch that activated (or not) a melody, whereas Kushnir and Gopnik (2007) employed light switch, etc. In the current research, electronic devices were replaced by spatial bird figures, whereas children should relate certain details of the figures with the object to be found. The children had to understand that the hidden or visible legs of hens were related to the placed egg under a hen rather than understand a particular mechanism, as in the aforesaid researches. Moreover, photographs and pictures were used as simulant materials in other researches. For instance, in the studies conducted by Ahn et al. (2000), Bright and Feeney (2014), Gottfrieda and Gelman (2005), children were shown certain cards of animals, plants and mechanisms. In the latter research, attempts were made to combine similar simulant materials employing spatial visual materials reflecting causality. It is assumed that the choice of simulant materials could have an effect on children's replies and their explanation of the task. It is important to note that children perceived the provided information as compliant with the reality. For example, in the research conducted by Schulz et al. (2007b), some fairy tales were read to children, and they had to define causality. It is obvious that some simulant materials were associated with life situations than others, whereas some mechanisms might not be familiar to children. It is assumed that the results of different aforesaid researches can differ and depend on children's age. In our research, we provided the children with simulant materials, which did not aim at imitating real life situations. However, the children's replies showed that they were not contradicting real life situations, either (e.g. "I know it because there are legs – I recognised by legs (…) these hens are more real, otherwise how will they walk?"). Hence, the diversity of the provided simulation materials and the results obtained on the basis of this research lead to the assumption that the children's explanations of causality can depend on simulant materials. Therefore, when conducting further research on children's understanding and explanation of causality, it is recommended to consider and develop a research using different simulation materials, such certain mechanisms, pictures and life situations. Such being the case, future studies would expand our knowledge on how children of different age groups understand different structures of causality.

5. Conclusions

During the research, it has been determined that pre-school children (aged 4–7) are able to distinguish and explain causality. Besides, the research results demonstrate that the children's abilities to explain and generalise causality do not depend on their age (4–5, 5–6, and 6–7). It is assumed that children of different age groups understand structures of causality in a similar way if simulant materials, such as spatial animal figures, are close and understandable to children.

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