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What is This?
Original Article

Differences Between Humor Comprehension and Appreciation in Healthy Children and Children With Epilepsy

Kristi Suits, MSc1, Tiia Tulviste, PhD1, Ruth Ong, MSc1, Jaan Tulviste, MA1,2, and Anneli Kolk, MD, PhD3

Abstract
This study explored verbal, visual, motor, and tactile humor appreciation and comprehension among preschool children with epilepsy as compared with healthy children. Participants included 32 children with focal epilepsy, as well as 70 healthy controls. The results suggest that children with epilepsy assess humor dichotomously (as either not funny at all or as extremely funny) and generally as less amusing when compared with ratings given by controls (M = 6.08, and M = 7.44, P = .01, respectively). They also gave significantly lower ratings to verbal jokes than to visual jokes. Furthermore, children with epilepsy assessed the jokes they understood (ie, gave expected explanations to the content of jokes) as less funny. An important finding from our study was that children with epilepsy assess aggressive humor as not funny. The most frequent emotional reaction in both groups to jokes from all subtests was a smile, followed by a half-smile.

Keywords
humor, epilepsy, joke, emotion, smile

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Humor and laughter are considered important indicators of children's interpersonal, affective, and sociocognitive abilities as well as potential diagnostic measures for determining levels of cognitive development among both healthy children and children with atypical development.1 A sense of humor emerges in early childhood, develops with age, and facilitates social functioning and adjustment, mutual understanding, and communication.2 Humor helps to make new contacts with peers, overcome difficult situations, relieve tensions, and create trust.3 It also helps to maintain self-control in tense social situations, thereby providing support to others and facilitating a peaceful and calm resolution of conflicts.4

Humor develops cognitive functions, primarily memory. Funny statements and images are better remembered than those that are not funny, because active cognitive processing is required to adequately understand humorous material. The cognitive processing of funny, and therefore somewhat unusual, material in the brain is also related to emotional reactions (ie, surprise), which also increase attention and working memory functions.5,6

During early childhood, humor is related mainly to bodily sensations and motor-play such as hiding one’s face, tickling, chasing, and falling over. Later on, from the age of 5 to 7 years, humor acquires a more verbal quality, centering on word-play, rhyming, and riddles.7 Children who are interested in humor and use it skillfully tend to have more advanced verbal skills, be more talkative, possess a wider vocabulary, and be more articulate.3

Humor potentially involves expressive abilities involved in the generation of humorous stimuli as well as in the receptive abilities involved in humor comprehension. The majority of studies have been based on the most common humor theory, incongruity resolution,8 which proposes that humor comprehension is a 2-stage process. Incongruity, the first stage, involves the detection of an incongruous element (ie, an object or event) among 2 or more incompatible elements. In the second stage, the incongruent element is linked in a meaningful way to the body of the text, resolving the incongruity.9

Shultz differentiates between 2 phases in the development of humor evaluation: children up to 7 years old regard

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surprising stimuli, or simply unresolved incongruity, as funny.\textsuperscript{9} From that age on, humor is considered funny when the incongruity is resolved, that is, when humor is rationalized.

In addition to incongruency, preschool childrens’ humor assessment is also influenced by the content of the humor.\textsuperscript{10} Children who participated in Sinnott and Ross’s research preferred aggressive and incongruent situations to neutral ones. Helmers found that aggressive humor is considered funny primarily because the child is aware that the situation is make-believe and that the victim will be fine.\textsuperscript{11} If this does not appear to be the case, then the situation is perceived as frightening or confusing. Ueckermann and Daum indicate that slapstick humor (eg, slipping on a banana peel) is dependent only on the first stage, incongruity detection.\textsuperscript{6}

Studying preschool children (ages 5–7 years) is a critical part of the study design, because it is during this time period that the ability to understand linguistic statements and detect incongruencies develops,\textsuperscript{6} accompanied by the emerging ability to regulate and manage one’s emotions.\textsuperscript{3}

Epilepsy is a chronic disorder that has an impact on all areas of life of children, including cognitive and academic skills and social functioning.\textsuperscript{12} In children with epilepsy, deficits in attention, language, visuoperceptual, and memory functions as well as indications of mental rigidity and excessive focus on details have been described. Furthermore, the antiepileptic treatment itself can affect humor perception. The neural processing and appreciation of humor requires integration of multisensory information, as well as mental manipulation and organization of information in the anterior medial prefrontal cortex, bilateral superior frontal gyri, and temporoparietal junctions, which might be disturbed by epilepsy. It may also be related to an inappropriate focus on irrelevant details, difficulties at integration, tendencies toward concreteness, and egocentricity.\textsuperscript{13}

One of the few studies involving adults with epilepsy, which evaluated the social-cognitive functions of patients with frontal lobe epilepsy, showed no differences between people suffering from epilepsy and the control group in the Theory of Mind Test, but the perception of humor from funny images (humor appreciation) and recognition of facial emotions was severely impaired.\textsuperscript{14} So far, research has been done regarding humor perception in children with developmental deficit (intellectual and learning disabilities),\textsuperscript{15,16} Down syndrome, and autistic spectrum disorders,\textsuperscript{17,18} but studies involving children with epilepsy have not been conducted.

Research has shown that children with learning disabilities have difficulties comprehending humor,\textsuperscript{16} and children with autism do not tell jokes and show less humor appreciation with visual incongruity.\textsuperscript{17} Children with Down syndrome have been found to enjoy humor more than do those with other types of mental retardation.\textsuperscript{17,18}

Studying children with epilepsy may help not only to understand differences between normal and atypical development of sense of humor and the mechanisms of humor development in general, but also to develop more appropriate and effective interventions.

Goals of the Study and Hypotheses
The goal of the present study was to investigate similarities and differences in perception and understanding of different types of humor (verbal, visual, motor, and tactile humor, as well as picture drawing) in preschool children with epilepsy as compared with healthy children. Based on previous research, we hypothesized that:

1. Children with epilepsy are less able to perceive humor, and they experience humor as less funny than healthy children. They have less positive reactions to humor and have more difficulties in explaining the reasons why joke is funny.
2. Humor perception and understanding depends—for both groups—on the type of humor. Children perceive verbal humor as less funny than visual humor, because understanding verbal humor is cognitively more demanding and difficult.

Methods
Participants
Participants were 102 Estonian preschool children ranging in age between 5 and 7 years (mean = 5.78 years, standard deviation [SD] = 0.75 years). The study group consisted of 32 children with focal active epilepsy, of whom 11 were boys and 21 were girls. Mean age of the study group children was 5.77 years (SD = 0.81). The inclusion criteria were: children with diagnosis of focal epilepsy, absence of mental retardation and physical abnormalities, age between 5 and 7 years (preschool children), parental consent for participating in the study.

The International League Against Epilepsy 2006 classification of epileptic seizures was used for definitions and principles for diagnosis.\textsuperscript{19} A seizure was classified as focal when there was evidence of a clinical partial onset and characteristic focal electroencephalogram (EEG) findings. The epileptic focus of the children was determined using awake and/or sleep EEG recorded in every case during the interictal state. The mean age at onset of epilepsy was 4 years, 3 months. Children with epilepsy were on anticonvulsant medication; all children were undergoing monotherapy, including carbamazepine, oxcarbazepine, or valproate with good seizure control.

The study group was tested during their outpatient visit at the Children’s Clinic in Tartu University Hospital to minimize side effects. The control group consisted of 70 healthy children, of whom 32 were boys and 38 were girls. The mean age of the control group children was 5.62 years (SD = 0.61). They were tested in 3 kindergartens in Tartu, Estonia. The study was approved by the Medical Ethics Committee of the University Hospital in Tartu.

Study Material
The Special Humor Test, created by the authors, was used in this study. The Special Humor Test is based on research and theories regarding the comprehension and appreciation of humor among preschool children. A pilot study was conducted in order to create study material for measuring preschoolers’ humor comprehension and appreciation covering different types (ie, verbal, visual, motor, and tactile) of jokes that would be funny for 5- to 7-year-old children. With this aim, 51 jokes and funny materials were presented to 20 kindergarten children.
aged between 5 and 7 years. Children were asked to rate the funniness of the presented jokes. Some of these jokes were from previous studies conducted by Klein. Most of the verbal jokes were from Estonian children’s magazines and popular books. Eight jokes the children considered as not funny were omitted from the created study material.

The final test material consisted of 43 jokes and funny activities in 5 categories: verbal humor (9 funny stories, 2 riddles, 2 poems, and 2 songs); visual humor (16 pictures, 3 of them with aggressive content); 4 motor activities; 4 tactile activities; and 4 drawings.

(a) **Verbal subtest.** Jokes were presented to the children one by one and then the children were asked to assess and explain what they perceived as funny. The verbal jokes and riddles are from a well-known Estonian children’s magazine Täheke, the poems from a book of poems called Kiltul oli vilu by Eno Raud, and the elephant story from a study by Klein about humor perception of kindergarten children (see Examples 1-3 in the Appendix).

(b) **Visual subtest.** Funny pictures were presented to the test subjects one by one (see Examples 4-5 in Appendix), and the children were then asked to assess how funny they were and explain what was funny about them. Pictures were downloaded from the Corel Clipart Web page (royalty-free images, http://www.clipart.com/en).

(c) **Motor activity subtest.** The motor activity test involved imitating animals and birds after following the experimenters’ example and assessing how funny it was perceived to be. Test subjects were asked (according to the experimenter’s instructions) to imitate a frog, a duck, a rooster, a bear, and finally an animal or a bird of their own choice that they thought was funny. They were then asked to rate jokes on funniness and to explain what it is that is funny about it.

(d) **Tactile activity subtest.** The tactile activity test consisted of games involving manual activity. Four games “Clapping hands” (see Example 6 in the Appendix), “Finger counting” (see Example 7 in the Appendix), “Catching hands,” and “Guess what’s in your palm,” were played with the experimenter.

Children were asked to assess how funny these activities were and what was funny about them.

(e) **Drawing subtest.** The experimenter drew 4 pictures, “Hobbit Kroli” (see Example 8 in the Appendix), “The rabbit with a carrot nose” (see Example 9 in the Appendix), “Funny house,” and “Turtle on wheels,” with mismatching parts one at a time, describing her intentions simultaneously. The child’s task was to assess how funny these activities were and what was funny about them.

The reliability of the subtests was high: Cronbach $\alpha$ was 0.91 (for the verbal and visual humor subtests $\alpha = 0.83$, and for the tactile and motor humor subtests $\alpha = 0.99$).

**Procedure**

The children were tested individually by 2 researchers, and the order of presentation of subtests was random. The test took approximately 1.5 hours (including pauses) to complete. The aim of the test was to determine how funny the child perceived the presented material to be and what he/she perceived as funny.

The children were observed in a quiet room of at least 15 m$^2$. The study group was observed in the children’s hospital during their outpatient visit, and the control group was in their kindergarten environment while other people were not in the same room, by the same 2 researchers.

**Humor ratings.** First, the child was asked to rate each joke or activity on funniness using a colored scale. It was similar to pain scales used to measure patients’ pain intensity. On one side, the scale had different intensities of color: the darker shade corresponded to a higher value. On the other side, there was a numerical scale from 0-10. The participants were asked to show how funny the joke was on the colored side of the scale, and the researcher used the numerical side to give numbers to the child’s ratings.

**Children’s emotional reactions.** While presenting the test components, 2 researchers simultaneously measured the child’s emotional reactions according to Pien and Rothbart’s 4-point scale: serious/not laughing (0), faint-smile (1), smile (2), laughter (3). Children’s emotional reactions were judged by 2 researchers with more than 94% cases in agreement for all protocols. Disagreements were resolved through discussion.

**Humor explanations.** Children were asked to explain why they thought the joke or activity was funny or to explain the punch line (what made it funny). Humor explanations were coded into 5 types (scores 4-0). For instance, explanations given to a verbal joke presented in Example 1 (in the Appendix) were classified into the following types:

- **Expected explanations (score 4).** These included full and explicit explanations that were expected by the experimenters to be given. Here the child gave the logical outcome or punch line, identifying the critical element in a joke that made it funny. For instance, “He wants to put his hands in his pocket. Hands have to be washed, not put in the pocket.”

- **Unexpected explanations (score 3).** These included irrelevant or incorrect explanations where for the child some uncritical element of the joke seemed to be funny, for instance, “It isn’t difficult to wash the face.”

- **Unconventional explanation (score 2).** These included explanations when the child added details that were not given in the joke. For instance, “That the face has to be wiped, (washed).”
The control group highly rated all kinds of jokes, while the study group gave the highest funniness ratings to the visual jokes in the control group children. As shown in Table 1, there were no statistically significant differences between verbal and lower ratings to verbal jokes compared with visual jokes. There was also found with visual jokes (study group mean 7.76, SD 6.27, control group mean 7.30, SD 5.68, t = 0.50, P = .01). In all subtests, the study group children found it difficult to explain what was funny and tended not to give explanations more frequently than the control group children, but not in the drawing test, for which the control group found it difficult to explain what was funny and tended not to give any explanation. In the motor and tactile subtests, the control group retold or described the joke more frequently than did the study group.

To get a better picture regarding joke appreciation, the children’s ratings for funniness of jokes were divided into 4 categories (assessments 0; 1-5; 6-9; 10). The distribution of ratings for all jokes is presented in Figure 1. The study group tended to use either the bottom of the rating scale, score 0 (21% perceived the verbal and visual subtests, and 31% the motor subtest to be not funny), or the top of the rating scale, score 10 (42% rated the verbal and visual subtests, and 39% the motor and tactile subtests to be extremely funny). In contrast, the control group tended to use the upper side of the rating scale. Only 6.5% of control group children said that the jokes were not funny at all; the majority (76%) of them tended to assess jokes to be funny or extremely funny.

Thus, as expected, the study group rated jokes as less funny than the control group did. The biggest differences in the 2 groups’ assessments were in the verbal subtests in the riddle “How do you catch a rabbit?” (Example 3; control group mean = 7.41, SD = 2.76; study group mean = 4.35, SD = 3.99, P = .05, d = 0.99) and in the visual subtest in the picture, “Man stepping on a rake” (Example 5; control group mean = 6.83, SD = 3.45, study group mean = 4.83, SD = 4.55, P = .05, d = 0.50). The biggest group differences between assessments’ were in the tactile subtest: “Clapping hands” (Example 6; control group mean = 6.69, SD = 3.43, study group mean = 4.44, SD = 4.41, P = .05, d = 0.60), and in the drawing “Hobbit Kröll” (Example 8; control group mean = 8.29, SD = 2.61, study group mean = 5.91, SD = 4.18, P = .05, d = 0.68).

Humor Explanations

The distribution of children’s explanations as to why jokes are funny is presented in Table 2. The results show that children from both groups found it difficult to explain the punch line of the jokes. Control group children demonstrated better humor comprehension than study group children only in the verbal subtest (P = .05). In all subtests, the study group children tended not to give explanations more frequently than the control group children, but not in the drawing test, for which the control group found it difficult to explain what was funny and tended not to give any explanation. In the motor and tactile subtests, the control group retold or described the joke more frequently than did the study group.

Relationship Between Children’s Explanations and Assessments of the Jokes

The t test was used to compare the relationship between the children’s explanations and assessments of the jokes in the control and study groups. Significantly more verbal jokes were understood (ie, the child gave expected explanations) and assessed to be funny by the control group (mean = 7.27, SD = 2.47, P = .05) compared with the study group (mean = 4.13, SD = 2.63, d = 1.23). A similar tendency was also found with visual jokes (study group mean = 4.09,

Table 1. Funniness Ratings of the Jokes by Control Group and Study Group

<table>
<thead>
<tr>
<th>Groups (N = 102)</th>
<th>CG (n = 70)</th>
<th>SG (n = 32)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal subtest</td>
<td>7.34</td>
<td>5.78</td>
<td>.01</td>
</tr>
<tr>
<td>Visual subtest</td>
<td>7.76</td>
<td>7.03</td>
<td>ns</td>
</tr>
<tr>
<td>Motor subtest</td>
<td>6.27</td>
<td>5.88</td>
<td>ns</td>
</tr>
<tr>
<td>Tactile subtest</td>
<td>7.73</td>
<td>5.53</td>
<td>.01</td>
</tr>
<tr>
<td>Drawing</td>
<td>8.09</td>
<td>6.16</td>
<td>.01</td>
</tr>
<tr>
<td>Total</td>
<td>7.44</td>
<td>6.08</td>
<td>.01</td>
</tr>
</tbody>
</table>

Abbreviations: CG, control group; SG, study group; ns, statistically not significant.

Description or retelling the joke by the child (score 1). For instance, “Mother washes Paul’s face and wants to wash the hands, too, but Paul wants to put them in his pocket instead.”

No explanation (score 0). “Don’t know” answers.

Statistical Analysis

Analyses were conducted with STATISTICA (data analysis software system) version 7.0 (StatSoft Inc., 2004, Tulsa, Oklahoma). The mean values of the assessments, emotional reactions, and explanations given to the jokes by the control group and test group were compared using the t test. The value of the effect size (Cohen d) was calculated using the means and standard deviations of the study group and the control group. Cohen considered a small effect size to be 0.20, a medium effect size to be 0.50, and a large effect size to be as 0.80. The distributions of children’s assessments were presented as percentages in frequency tables.

Results

In a preliminary analysis, no significant age or sex differences were observed between control and study group regarding assessments of the jokes and children’s explanations and emotional reactions. Therefore, age and sex were not included as variables in further analyses.

Humor Ratings

Children in the study group rated the jokes in a verbal subtest, in a tactile subtest, and in a drawing subtest as significantly less funny than the control group did, as shown in Table 1. In the visual subtest, significant differences between the study and control groups were found only when the pictures had aggressive content (in the study group, mean = 5.37, SD = 4.34; in the control group, mean = 7.30, SD = 3.38, P = .01, d = 0.50), and the control group rated aggressive pictures to be less funny.

As expected, the study group children assigned significantly lower ratings to verbal jokes compared with visual jokes. There were no statistically significant differences between verbal and visual jokes in the control group children. AS shown in Table 1, the study group gave the highest funniness ratings to the visual subtest. The control group highly rated all kinds of jokes, except the motor subtest.
SD = 2.98, control group mean = 6.94, SD = 2.95, P = .05, d = .96). Thus there are significantly more verbal and visual jokes in the control group, compared with the study group, that were understood and assessed as very funny.

Regarding the verbal subtest, more jokes were understood but assessed as not funny by the study group (mean = 0.39, SD = 0.65) compared with the control group (mean = 0.14, SD = 0.39, P = .05, d = 0.47). No statistically significant differences were found in other joke subtests.

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### Children’s Emotional Reactions

Children’s emotional reactions to different types of jokes are presented in Table 3. As shown, the most frequent emotional reaction in both groups for all subtests was a smile. To verbal and visual humor and funny motor activities, children also frequently reacted by a half-smile. The least common reaction in the verbal and visual subtests in the control group was no reaction and in the study group, laughter. Laughter was the least common reaction to motor activities in both the control and the study groups. In the study group, no reaction was also very seldom observable in the motor subtest.

### Relationship Between Children’s Explanations and Emotional Reactions

Children’s reactions were analyzed in relation to the given explanations, which showed that when explaining the punch line of verbal humor, the control group expressed a positive reaction (half-smile, smile, or laughter) significantly more often than the study group (the mean number of tasks in control group, mean = 7.26, SD = 2.47 and study group mean = 4.12, SD = 2.63, P = .05, d = 1.23). This tendency also emerged in the visual subtest (control group mean = 6.94, SD = 2.95 and study group mean = 4.09, SD = 2.98, P = .05, d = 0.96). No statistically significant differences between the control and study groups in this relationship were found in other subtests.
study group mean
picture-drawing subtest (control group mean
SD
more jokes as funny and reacted positively (mean
the tactile subtest control group, children assessed significantly
differences between the control group and the study group. In

In the visual jokes subtest, pictures with joyful activities and
happiness, as well as pictures with aggressive content like mis-
fortune or accidents were used, which Bariaud describes as
funny thematic for preschoolers.24 An interesting finding from
our study was the support for the hypothesis that epileptic chil-
dren assess the pictures with aggressive content as considerably
less funny, whereas the control group assessed all pictures,
including aggressive ones, to be funny. Helmers has found that
aggressive humor is considered funny primarily because the
child is aware that the situation is make-believe and the victim
will be fine.11 In our study, children with epilepsy frequently
stated that being hurt or hurting someone was not funny. One
explanation for this finding could be that the understanding
of aggressive jokes requires the child to have developed abil-
ities of abstract thought, cognitive flexibility (placing the funny
stimulus in a new and coherent context), perception of ambigu-
ity, and fantasy.10 Therefore we infer that relatively inflexible,
concrete thinking, a detailed perception, and impaired ability of
abstract thought, which are a result of epilepsy, prevent the
child from analyzing the joke as a whole and cause him or her
to perceive the aggressive content of the picture as not funny.
One more explanation of the different perception of aggressive
pictures by children with epilepsy would also be their experi-
ence of being hospitalized and suffering from chronic illness,
which has influenced their emotional reactions to seeing some-
body getting hurt, despite the fact that that it is merely a joke.
Future studies are needed to explore further why children with
epilepsy assess humor with aggressive content differently.

The first hypothesis was confirmed: children with epilepsy
assess humor differently and as less funny than healthy chil-
dren. It was found that the study group children assess humor
dichotomously, as not funny at all or extremely funny. It might
be that their shorter attention span or memory impairment
made epileptic children give their funniness assessments
immediately after the presentation of the jokes, and before
they are able to fully analyze and understand them. The dichot-
omous assessments may also be caused by the mental rigidity
and an excessive focus on details among children with
epilepsy.13

Furthermore, the study group children gave lower assess-
ments of verbal jokes than to visual jokes. Humor development
theories emphasize that appreciation of verbal humor requires
more cognitive resources than appreciation of visual humor.25
This might be a reason for the difficulties of our study group
children in understanding verbal humor.

The verbal jokes, which got statistically significantly lower
scores in the study group compared with the control group,
were based primarily on simple incongruity and repeated words
or rhymes. Differences in the assessments of phonological
jokes were probably because of the effects of the study group
children’s epileptic activity on the temporal and frontal lobes
region as well as the integrated functioning of different brain
association areas, which affected the perception and assess-
ment of phonological jokes. Therefore, the lower assessment
scores of verbal humor are due to semantic complexity, but also
result from phonological and grammatical aspects, which are

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**Table 3. Distribution of Children's Emotional Reactions**

<table>
<thead>
<tr>
<th>Explanation Types</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal subtest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CG</td>
<td>4</td>
<td>44</td>
<td>46</td>
<td>6</td>
</tr>
<tr>
<td>SG</td>
<td>15</td>
<td>40</td>
<td>40</td>
<td>5</td>
</tr>
<tr>
<td>Visual subtest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CG</td>
<td>4</td>
<td>41</td>
<td>48</td>
<td>7</td>
</tr>
<tr>
<td>SG</td>
<td>9</td>
<td>43</td>
<td>46</td>
<td>2</td>
</tr>
<tr>
<td>Motor subtest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CG</td>
<td>19</td>
<td>35</td>
<td>41</td>
<td>5</td>
</tr>
<tr>
<td>SG</td>
<td>11</td>
<td>30</td>
<td>48</td>
<td>11</td>
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<tr>
<td>Tactile subtest</td>
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<tr>
<td>CG</td>
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</tr>
<tr>
<td>SG</td>
<td>17</td>
<td>29</td>
<td>41</td>
<td>13</td>
</tr>
</tbody>
</table>

Note: Emotional reactions: 0, not smiling; 1, half-smile; 2, smile; 3, laughter.
Abbreviations: CG, control group (n = 70); SG, study group (n = 32).

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**Discussion**

The goal of the present study was to examine differences and
similarities in appreciation and understanding of humor in
preschool-age children with epilepsy and in healthy children.
To our knowledge, this is the first study to explore the perception
and the understanding of humor among children with epilepsy.

An important finding from our study was that children with
epilepsy did not have a global humor perception or understand-
ing deficit, but that the differences depended upon the type of
joke as well as upon specific joke content. Children with
epilepsy are likely not to rate verbal jokes, tactile jokes, and
picture drawing as highly as control group children.

Visual jokes (mean = 3.05, SD = 1.92, P = .05, d = 4.23).
When comparing the study group and control group, a statisti-
cally significant difference in verbal and visual humor could be
seen, since both types of humor produced more positive reac-
tions in the control group when assessing the stimulus as funny
(verbatim humor, control group mean = 13.08, SD = 1.46, study
group mean = 9.87, SD = 2.88, P = .05, d = 1.85; visual
humor, control group mean = 3.31, SD = 1.94, study group
mean = 2.31, SD = 1.66, P = .05, d = 0.55).

In the motor subtest, there were no statistically significant
differences between the control group and the study group. In
the tactile subtest control group, children assessed significantly
more jokes as funny and reacted positively (mean = 2.97,
SD = 1.14) than the study group (mean = 2.06, SD = 1.56,
P = .01 d = 0.67). This tendency also emerged in the
picture-drawing subtest (control group mean = 3.27, SD = 1.05,
study group mean = 2.28, SD = 1.61, P = .01, d = 0.72).
Control group children frequently perceived something funny in the stimulus that was not intended to be funny. It was mentioned also by Shultz and Horibe that a child who does not fully understand the joke invents his or her own meaning and considers it funny. Healthy children seem to be more creative than children with epilepsy.

Explanation of a joke requires not only understanding it but also remembering and reproducing the content of the joke (short-term memory function) after giving an assessment. In other words, it requires the effective collaboration of various brain regions.

A noteworthy result that emerged from this research was that children with epilepsy were more likely than were control group children to understand the joke (ie, they gave expected explanations), but they assessed the joke as not funny. This finding may indicate that children with epilepsy can understand and describe the content of the joke, but that they have difficulty integrating it with the funny components of the joke or punch line. This tendency cannot be explained by study group children’s intellectual abilities or impairment of single neurocognitive function (their overall cognitive abilities are at a normal level), but with epileptic activity, which has affected their associative network and abstract thinking abilities.

A limitation of this study was that the observers were not blind to the diagnosis of epilepsy in the study group, but the study was designed for examination the impact of epileptic activity for humor perception in children. Moreover, although both groups of children were assessed in a separate room in which only 2 observers and the child were present, the study group children’s study room was in the hospital (in the outpatient department), and those of the control group in their kindergartens. It is likely that this situation might have had an impact on the findings.

In summary, the present study is one of the first to study differences in appreciation and understanding of different types of jokes between children with epilepsy and healthy children. The findings from this study may help us move toward a better understanding of brain dysfunctions caused by epilepsy. The study showed that at preschool age, children with epilepsy appreciated some type of humor and some specific jokes less than control group children. It was difficult for all children from this age group to relate what makes jokes funny. Future longitudinal research is needed to answer the question, Are these peculiarities of humor appreciation typical only of preschool children with epilepsy, or are they also characteristic of humor perception among older children and adults with epilepsy? Future studies should explore humor assessment among children with other acquired brain lesions as well. The results from such studies could be used in informing rehabilitation programs and practices in order to help improve neurocognitive outcomes for children with various types of disorders.

Appendix

Example 1:
Mother washes little Paul’s face with great difficulty.
“Now the hands, too,” she says to the boy. Paul replies: “No, I will put them in my pocket.”

Example 2:
A cow is sitting in a tree and a rabbit hops by, very surprised:
“Hey cow, what are you doing THERE?”
“I’m eating apples” replies the cow, calmly.
“But cow! That’s not even an apple tree?”
“Whatever. I have my own apples with me!”

Example 3:
“How to catch a rabbit.”
“One must go behind a tree and make the carrot’s voice!”

Example 4: “Bucket upside down on dog’s head”

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Author Contributions
KS and RO constructed the Special Humor Test, collected and organized the data. KS, RO, and TT analyzed the data. KS wrote the first manuscript (including the first draft). TT and AK conceptualized the study and reviewed the results. TT, AK, and JT revised the manuscript.

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Ethical Approval
All control and study group children had parental consent for participating in the study. The study was approved by the Medical Ethics Committee of the University Hospital in Tartu.
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