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Elisabeth M. Weiss, Bianca C. Gschaidbauer, Andrea C. Samson,
Krista Steinbäcker, Andreas Fink and Ilona Papousek

From Ice Age to Madagascar: Appreciation of slapstick humor in children with Asperger's syndrome

Abstract: The aim of the present study was to examine whether children with Asperger's syndrome differ from typically developing children in the appreciation of and behavioral responses to simple slapstick type humor, in which cognitive requirements that are commonly impaired in autism spectrum disorders are reduced to a minimum. Short slapstick scenes and matched non-humorous control scenes were extracted from popular movies to produce an appropriate humor assessment material. Twenty-four boys with Asperger's syndrome (5 to 14 years) and 24 age-matched typically developed controls were tested. The results indicated that children with Asperger's syndrome enjoy humorous material as much as healthy children do, if the humor elements are simple and the incongruence can be perceived independently from theory of mind requirements, inferential demands, or language abilities. However, similar funniness ratings and behavioral expressions of mirth to the humorous scenes, but relatively higher values in response to the non-humorous scenes, suggested that the autistic children did not discriminate non-humorous from humorous stimuli as sensitively as the typically developing children did. Moreover, in autistic children, the outwards displays of emotion did not match their reports of subjective amusement. This dissociation may relate to the social interaction and communication difficulties in autism spectrum disorders.

Keywords: Autism Spectrum Disorder, Slapstick, Humor appreciation, Emotional coherence

Elisabeth M. Weiss: Department of Psychology, Biological Psychology Unit, Karl-Franzens University of Graz, Austria

Bianca C. Gschaidbauer: Libelle Centre for Autism, Graz, Austria

Andrea C. Samson: Department of Psychology, Stanford University, CA, USA

Krista Steinbäcker: Libelle Centre for Autism, Graz, Austria

Andreas Fink: Department of Psychology, Biological Psychology Unit, Karl-Franzens University of Graz, Austria

Ilona Papousek: Karl-Franzens University of Graz, Department of Psychology, Biological Psychology Unit, Univ.-Platz 2, A-8010 Graz, Austria. E-mail: ilona.papousek@uni-graz.at

1 Introduction

Humor is a ubiquitous human activity occurring in social interactions, which also serves important cognitive and emotional functions. Research has shown that individuals who have problems with social interactions, such as persons with autism spectrum disorders (ASD), are impaired in humor appreciation. Although there is some disagreement between study results, most studies suggested that individuals with ASD may enjoy basic forms of humor, like slapstick comedies and puns, but may show a poorer comprehension of more complex cartoons and jokes (James and Tager-Flusberg 1994; Lyons and Fitzgerald 2004; Ozonoff and Miller 1996; Reddy et al. 2002; Ricks and Wing 1975; Samson and Hegenloh 2010; see Samson, this issue). Until recently, existing studies in ASD have not formulated a clear picture of humor processing skills in this disorder, mainly because of methodological heterogeneities between the empirical investigations. In research literature a variety of humor assessment materials were published such as different cartoons, comic, jokes etc. Important issues in this context are differences between studies in stimulus characteristics, particularly the differences in the cognitive requirements that the stimulus pose on the perceiver (Samson and Hegenloh 2010).

It is assumed that in order to “get” a joke, one has to detect a conflict between two initially incongruent ideas, concepts, or situations that are brought together in a surprising or unexpected manner. This involves viewing what is originally perceived in one (often serious) sense from a different perspective. The sudden perception of incongruity between a concept (or expectation) and the observed object or situation results in a pleasurable experience accompanied by feelings of amusement and laughter (Suls 1972; see also Martin 2007; Ruch 2001). The sense of having understood the joke (having “gotten the point”) arises when the surprising incongruity can be resolved by consideration of information available elsewhere in the joke or cartoon (McGhee et al. 1990; Ruch 2001; Ruch and Hehl 2007). That is, there are cognitive requirements at both stages of humor processing. In order to enjoy humorous material, at least basic cognitive switching and conflict detection is required. Understanding (and being able to explain) the punch line requires additional cognitive functions resembling problem solving, which involve recognizing the cognitive rule (also called logical mechanism) that playfully reflect the relation between two scripts (Attardo and Raskin 1991). The types and the complexity of the cognitive processes required in humor processing strongly depend on the type of humor at hand. Often, additional social cognition skills (mentalizing, theory of mind) are required to appreciate the humor and understand the punch line (it has to be recognized that one character has a false mental state; Samson et al. 2008; Samson 2012). Additional processes may be involved, for instance, the anticipation of events that are only insinuated.

Thus, basic cognitive flexibility may be required to appreciate all humor. In all humor, some additional abilities such as the recognition of the logical mechanism are required to be able to explain the punch line. But only the perception of certain, more complex forms of humor require social cognition skills, the anticipation of events and other reasoning skills to appreciate and comprehend it.

Several cognitive and affective deficits, especially deficits in executive dysfunction (Ozonoff et al. 1991) and theory of mind (Baron-Cohen et al. 1985; Leslie 1994) have been advanced as cognitive explanations for impairments in social interactions and humor processing in ASD. Executive function is an umbrella term and includes specific cognitive skills such as planning, cognitive and behavioral flexibility, ability to inhibit a pre-potent response, set-shifting or mental flexibility, and working memory. However, while various executive functions have been shown to be impaired in individuals with ASD, no definitive neuropsychological pattern unique to individuals with ASD has been identified at this time (Kleinhans et al. 2005). Above all, less cognitive flexibility and a weak central coherence might explain the reduced ability of individuals with ASD to understand the global meaning of a joke (Emerich et al. 2003; Samson and Hegenloh 2010). In the theory of weak central coherence, a tendency to attend to details, rather than to understand the global meaning of a situation is hypothesized to lead to a failure to get the joke. Happé and Frith (1996) proposed that weak central coherence and theory of mind deficits combine to account for the social difficulties of those with ASD.

Especially in ASD research involving children and adolescents, some humor assessments such as cartoons are hampered by difficulties, since abstractions and simplifications in the drawing style as well as simple lines instead of detailed and realistic drawings are usually part of these materials. ASD individuals may focus on these visual details to a greater extent than normally developed individuals and therefore fail in getting the joke (Samson and Hegenloh 2010). The purpose of the present study was to examine whether children with Asperger's syndrome differ from typically developing children in the appreciation of simple humor material in which cognitive requirements that are commonly impaired in ASD are reduced to a minimum. To this end, a novel humor assessment material was developed, consisting of short video clips from popular movies. Humorous scenes that involved a simple, slapstick type of humor were extracted from these movies. Care was taken that it did not require theory of mind skills or inferences about past or future events to catch the humor elements. In addition, the extracted scenes were language-free, in order to exclude a potential confounding effect of language ability on humor processing.

Children with Asperger's syndrome (AS) were tested because AS is one of the milder forms of autism with average to above average intelligence, but primarily

impairments in social interaction, restricted patterns of interests and behavior, speech and language peculiarities, and non-verbal communication problems (Wing 1981). Executive dysfunction, especially in planning and abstract problem solving is also common in individuals with Asperger's syndrome (Hill and Bird 2006; Semrud-Clikeman et al. 2010).

Humor experience includes affective components (being genuinely amused or exhilarated) and cognitive components (the perception of the stimulus as humorous; Gardner et al. 1975; Goel and Dolan 2001; Ruch and Hehl 2007). Therefore, it was also examined if children with AS understand and can explain humor elements that involve little rational processing and do not involve social cognition (i.e., simple slapstick humor).

Moreover, children with ASD present deficits in displaying appropriate affect including affective displays that are limited in range or seemingly unrelated to the situational context (American Psychiatric Association 1994). This does not necessarily correlate with a diminished or inappropriate subjective experience of emotion. Neurological evidence indicated that the systems controlling subjective experience and outward expressions of emotion can operate independently (e.g., Ross and Mesulam 1979). Therefore, overt expressions of mirth (smiles and laughter) were observed in addition to ratings of funniness that the children delivered after watching each film clip.

Furthermore, the relation between self-reported and facially expressed emotion (response coherence) was examined. While several emotional response systems are usually in coherence in healthy individuals (e.g., Levenson 1992), a dissociation between self-reported and facial expression of emotion was found in psychopathological conditions involving executive dysfunction, such as schizophrenia (Berenbaum and Oltmanns 1992; Kring and Neale 1996), which is relevant because schizophrenia is associated with similar impairments in social cognition and social functioning as autism (Craig et al. 2004; Pinkham et al. 2008). Schizophrenia patients also showed dissociation between the ability to detect humor (the ability to discriminate between humorous and non-humorous stimuli) and the appreciation of humorous material (Tsoi et al. 2008). The coordinated engagement of the experiential and behavioral components of emotional responses is important for emotion-based social interactions (Keltner and Kring 1998). Therefore, a lack of coherence between the subjective emotional experience and overt affective behavior may exacerbate the social difficulties that are associated with ASD (Gena et al. 2005).

McGhee (2002) proposed a developmental model of children's humor with children progressing from being able to perceive incongruity (infancy) to producing incongruity nonverbally (toddlerhood), to producing incongruity verbally (early childhood) to finally preferring humor that presents not only an incongru-

ity but also a *resolution* to the incongruity (elementary school). Since several studies reported age-related improvements in executive functions from childhood to adolescence in autism (for a review see O'Hearn et al. 2008), the current study examined humor responses in two different age groups of children with Asperger's Syndrome and matched healthy controls (younger group aged 5–9 years and older group aged 10–14 years).

2 Methods

2.1 Participants

Twenty-four boys with AS were recruited from a consulting center for individuals with autism and AS in Graz, Austria. Subjects were divided into two age groups: 12 young boys with AS between the ages of 5 and 9 years ($M = 7.7$, $SD = 1.4$) and an older group between the ages of 10 and 14 years ($M = 12.2$, $SD = 1.4$; the two age groups correspond to primary and secondary school age). Only patients who met the criteria for autistic disorder on standardized diagnostic measurements (Autism Diagnostic Observation Schedule, ADOS; Lord et al. 1989; Bölte and Poustka 2004; and Autism Diagnostic Interview Revised, ADI-R; Lord et al. 1994; Poustka et al. 1996) and had a confirmation of the diagnosis ICD-10: F84.5 by a child-psychiatrist were included in the study. Four boys of the younger AS group and 6 boys of the older AS group had an additional diagnosis of ADHD and were treated with Ritalin, Atomoxetine, or atypical neuroleptics (Risperidone, Olanzapine).

Twenty-four typically developing boys (TD), matched for age, were recruited as a control group from two primary and secondary schools (age of the younger group: $M = 7.6$, $SD = 1.3$, age of the older group: $M = 12.3$, $SD = 1.5$). Before watching the film clips, an estimate of the current level of non-verbal overall intellectual function of all participants was made using the German standardization of the Culture Fair Intelligence Test (CFT). The CFT1 version was used for the younger groups and the CFT 20-R version was used for the older group (Weiss and Osterland 1997; Weiss 2006). IQ was determined based on age-related norms provided in the manuals.

All parents of the children in this study gave written informed consent and the study was in accordance with the 1964 Declaration of Helsinki. Demographic characteristics for both the experimental and control groups are shown in Table 1.

2.2 Stimuli

Initially, 26 scenes which contained nonverbal, slapstick style humor were extracted from the movies “Ice Age” and “Madagascar”. Both movies are very popular with children of all ages, and children with ASD are also familiar with these movies. The humorous scenes as well as non-humorous control scenes, which comprised the same characters and similar environments as the humorous scenes, were rated by two of the authors for stand-alone comprehensibility and funniness, absence of theory of mind requirements, and inferential demands. Eleven humorous scenes rated by both raters as funny without requiring theory of mind or inferential skills were selected and matched with 11 control scenes rated by both raters as non-humorous. If necessary, the film clips were prolonged by repeating short parts of the scene. The final film clips had a duration of 7 to 12 seconds each and were presented without sound in pseudorandom order.

2.3 Responses

2.3.1 Funniness ratings

After each film clip, the participants were asked to rate the funniness of the scene on a 5-point scale (1: not at all funny, 2: not really funny, 3: moderately funny, 4: funny, 5: very funny). They were instructed to point on the respective digit on a visual display of the scale. For some analyses, the ratings were dichotomized to obtain a score indicating the number of humorous and non-humorous film clips that were rated as (at least moderately) funny (i.e., scored 3 or higher).

2.3.2 Explanations of humor elements

If they had delivered a funniness rating of 3 or higher, the participants were asked to explain why they thought that the film clip is funny. The explanations were videotaped, and the participants’ responses to funny film clips were later evaluated. Answers were rated as correct explanations of the humor element, if they described the incongruent or surprising element in the scene. Imperfect verbal descriptions supported by gestures were also rated as correct. The rate of comprehensibly explained punch lines in the humorous film clips was used as a score indicating the degree of comprehension of the humor elements in the slapstick scenes.

2.3.4 Overt expression of mirth

During each film clip, the participants were observed for overt behavioral responses (smiles and laughter). Overtly visible upward movements of the lip corners were counted as smiles or, if accompanied by the characteristic sounds, laughter. The frequency of smiles or laughter as a response to the humorous and non-humorous film clips was used as a score indicating a child's overt expression of mirth.

2.4 Procedure

Participants were tested individually. They were told that they would watch some short films to which they should pay attention and that they would be asked after each film how funny they had found them. The rating scale was explained and the participants were instructed that they could watch a film a second time if they had difficulties understanding it. Seven participants of the AS group and two participants of the control group asked for a re-run of one or several film clips.

2.5 Statistical analysis

$2 \times 2 \times 2$ analyses of variance were performed, with diagnosis (AS vs. TD, between-subjects factor), age group (younger vs. older, between-subjects factor), and type of stimuli (humorous vs. non-humorous, within-subjects factor) as the independent variables; and the funniness ratings and the frequencies of overt expression of mirth as the dependent variables. Rates of comprehension of the humor elements in humorous film clips were analyzed using a 2 (diagnosis) $\times 2$ (age group) analysis of variance. To test whether AS and typically developing children may differ in the coherence between their subjective ratings of funniness and their overt behavioral responses to the humorous film clips, a hierarchical regression analysis was performed using the mean funniness ratings of the humorous clips as the dependent variable. The frequency of overt expression of mirth and diagnosis (first step) and the interaction between the two (second step) were entered as the predictors. A significant contribution of the interaction term to the explanation of the dependent variable indicates a moderating effect of AS on the relationship between the subjective ratings and the overt behavioral responses. Potential differences between the AS and the typically developing groups in age and IQ were examined using independent t-tests. Independent t-tests were also used to examine if AS children with and without an additional ADHD diagnosis

may differ in their responses to the film clips. All statistical tests were performed with $\alpha = .05$ (two-tailed).

3 Results

The AS and control groups were well matched for age and IQ (younger: age $t[22] = 0.03$, $p = .98$; IQ $t[22] = 0.40$, $p = .70$; older: age $t[22] = 0.18$, $p = .86$, IQ $t[22] = 0.11$, $p = .92$; Table 1) . All but three boys (all AS) were familiar with both movies from which the stimulus material had been extracted. Only one participant knew none of the two movies. AS children with an additional diagnosis of ADHD did not differ from those without ADHD in the funniness ratings of humorous and non-humorous cartoons ($t[22] = 0.23$, $p = .82$; $t[22] = .66$, $p = .52$), the rates of comprehension of humorous cartoons ($t[22] = -1.53$, $p = .14$), and the frequencies of overt expression of mirth during humorous and non-humorous cartoons ($t[22] = -0.13$, $p = .90$; $t[22] = 1.38$, $p = .18$).

Table 1: Demographic characteristics

	Younger AS	Younger TD	Older AS	Older TD
Age (years)	7.7 (1.4)	7.6 (1.3)	12.2 (1.4)	12.3 (1.5)
Estimated IQ	115.0 (8.9)	116.5 (9.7)	111.4 (11.3)	110.9 (12.0)

Note. Means (standard deviations). AS = Asperger's syndrome, TD = typically developing.

3.1 Appreciation of humorous material

The funniness ratings of the humorous (Cronbach's $\alpha = .82$), as well as the non-humorous film clips ($\alpha = .86$), showed satisfactory reliability (consistency across film clips). Overall, the humorous film excerpts were rated clearly more funny ($M = 4.2$, $SD = .6$) than the non-humorous control clips ($M = 1.5$, $SD = .6$; $F[1,44] = 620.2$, $p < .001$, $\eta_p^2 = .93$). Across all presented film clips, funniness ratings were higher in AS boys ($M = 3.0$, $SD = .5$) than in TD boys ($M = 2.7$, $SD = .4$; main effect diagnosis $F[1,44] = 7.4$, $p < .01$, $\eta_p^2 = .14$). In addition, younger boys ($M = 3.0$, $SD = .4$) delivered generally higher funniness ratings than older ones ($M = 2.6$, $SD = .4$; main effect age $F[1,44] = 13.5$, $p = .001$, $\eta_p^2 = .23$). None of the interactions were significant.

In the analysis of the number of clips that were rated funny at all (i.e., scored 3 or higher), the same main effects were significant as above (type $F[1,44] = 847.5$,

$p < .001$, $\eta_p^2 = .95$; diagnosis $F[1,44] = 8.5$, $p = .005$, $\eta_p^2 = .16$; age $F[1,44] = 8.5$, $p = .005$, $\eta_p^2 = .16$). Beyond that, the interaction diagnosis $\times$ type proved to be significant ($F[1,44] = 6.2$, $p < .05$, $\eta_p^2 = .12$); indicating that on average, AS boys rated as many humorous film clips funny as the typically developing boys ($M = 10.2$, $SD = 1.0$; $M = 10.1$, $SD = 1.6$), but rated non-humorous control clips funny more often than their healthy counterparts ($M = 2.0$, $SD = 2.5$; $M = .33$, $SD = .6$). The marginally significant three-way interaction diagnosis $\times$ age $\times$ type indicated that this predominantly held for younger children ($F[1,44] = 3.8$, $p = .056$, $\eta_p^2 = .08$). Means and standard deviations are shown in Table 2. No other effects were significant.

Table 2: Number of humorous and non-humorous film clips rated as funny

	Humorous film clips		Non-humorous film clips	
	AS	TD	AS	TD
Younger	10.3 (1.0)	10.5 (.9)	3.1 (2.6)	.5 (.8)
Older	10.1 (1.1)	9.7 (2.0)	.9 (1.8)	.2 (.4)

Note. Means (standard deviations). AS = Asperger’s syndrome, TD = typically developing.

3.2 Comprehension of the humor elements

Most children could in most cases comprehensibly explain why a particular humorous film clip was funny ($M = 97.1$, $SD = 8.2$), with no differences between AS vs. TD ($F[1,44] = 0.7$, ns.) or between younger and older participants ($F[1,44] = 0.9$, ns., interaction diagnosis $\times$ age $F[1,44] = 0.4$, ns.).

3.3 Overt expression of mirth

Overall, the humorous film clips clearly elicited smiles or laughter more often ($M = 9.8$, $SD = 1.9$) than the non-humorous stimuli ($M = .9$, $SD = 1.5$; $F[1,44] = 863.3$, $p < .001$, $\eta_p^2 = .95$). The detailed analysis of the behavioral data mirrored the analysis of the funniness ratings. AS boys ($M = 1.4$, $SD = 1.9$) smiled or laughed more often in response to the non-humorous film clips than their typically developing counterparts ($M = .4$, $SD = .7$), whereas no difference was observed after the humorous clips ($M = 9.6$, $SD = 2.3$; $M = 10.0$, $SD = 1.4$; interaction diagnosis $\times$ type $F[1,44] = 5.4$, $p < .05$, $\eta_p^2 = .11$). The three-way interaction diagnosis $\times$ age $\times$ type failed to reach statistical significance ($F[1,44] = 3.2$, $p = .08$, $\eta_p^2 = .07$), but also

suggested a similar pattern as the analysis of the funniness ratings; that is, greater responsiveness to the non-humorous stimuli mainly in the younger AS group (see Table 3). No other effects were significant.

Table 3: Number of overt expressions of mirth after humorous and non-humorous film clips

	Humorous film clips		Non-humorous film clips	
	AS	TD	AS	TD
Younger	9.4 (2.9)	10.5 (.7)	2.0 (2.1)	.6 (.8)
Older	9.8 (1.7)	9.6 (1.8)	.8 (1.5)	.3 (.5)

Note. Means (standard deviations). AS = Asperger’s syndrome, TD = typically developing.

3.4 Coherence between overt behavioral responses and ratings of funniness

Step one of the regression analysis proved significant ($R^2_{adj} = .13$, $F[2,45] = 4.5$, $p < .05$), with a significant main effect of overt expression of mirth ($\beta = .39$, $p < .01$). This indicates that across the whole sample, ratings of funniness and overt expressions of mirth were positively correlated ($sr = .39$). Adding the two-way interaction diagnosis $\times$ overt expression to the model in Step 2 significantly increased the predictive power of the model ($F_{change}[1,44] = 10.3$, $p < .005$; interaction $\beta = -.236$, $p < .005$). A graphical representation of the moderating effect of diagnosis is given in Figure 1. It shows a clear positive relationship between ratings of funniness and overt behavioral responses in TD children, which is absent in AS children. Zero order correlations were $r = .75$ ($p < .001$) in controls and $r = .18$ (ns.) in the AS group.

4 Discussion

Ever since Kanner’s (1943) initial description of autism, there has been considerable debate about deficits in emotion perception and expression in children with ASD. Related to that, it has been traditionally proposed that individuals with ASD show deficits in humor responses, that is, that they do not understand and enjoy humor (Asperger 1944; Wing 1996). However, several observational studies have

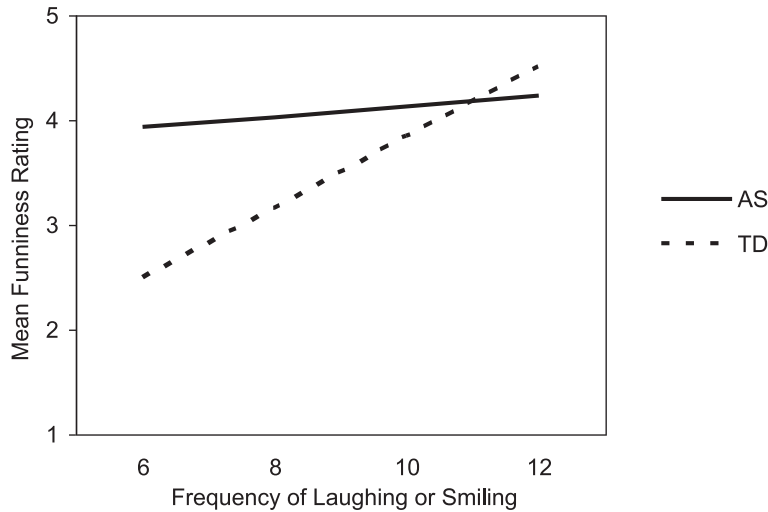


Fig. 1: Correlations between overt expressions of mirth and ratings of funniness.
Note. AS = Asperger's syndrome, TD = typically developing.

suggested that individuals with ASD may appreciate more basic types of humor (Reddy et al. 2002; Ricks and Wing 1975). The current study clearly indicated that children with AS enjoy humorous material as much as healthy children do, if the humor elements are simple and the incongruence can be perceived independently from theory of mind requirements, inferential demands, or language abilities, as was the case in the slapstick scenes of the present study. This is in accordance with previous experimental evidence, indicating that adult individuals with AS showed reduced affective responsiveness to cartoons comprising humor elements that were semantic or theory of mind dependent in nature, but rated visual puns as funny as healthy controls did (Samson and Hegenloh 2010). Other experimental studies focusing on humor production or using jokes requiring a variety of cognitive functions to be able to recognize the humor are not directly comparable with the present experiment (Emerich et al. 2003; James and Tager-Flusberg 1994; Ozonoff and Miller 1996).

In contrast to the study in which cartoons (line drawings) were presented to adults with AS (Samson and Hegenloh 2010), the groups in the present study did not differ in how well they could explain the punch lines of the slapstick scenes. This can be attributed to the fundamental differences in the stimulus characteristics between the studies. The line drawings in the cartoons may have tempted the participants to focus on visual details to a greater extent than the much more

realistically drawn movie scenes. However, as the rate of comprehensible explanations was very high it cannot be excluded that ceiling effects may have played a role in this finding.

Similar funniness ratings and behavioral expressions of mirth to the humorous film clips but relatively higher values in response to the non-humorous clips suggested that AS children did not discriminate non-humorous from humorous stimuli as sensitively as typically developing children did. However, this was only observed in the younger (5 to 9 years) group. Similarly, Reddy et al. (2002) found that children with autism were significantly more likely to produce unshared laughter than healthy control children. Parents of children with autism reported that their children's laughter was common in strange or inexplicable situations but relatively rare in response to events such as funny faces when it would have been expected. No differences in the discrimination ability between AS and healthy controls were found in a study in which various types of cartoons were used as stimuli (Samson and Hegenloh 2010). Nonetheless, the study tested participants aged 19 to 50 years were tested, which may explain this discrepancy. Impaired ability to discriminate between humorous and non-humorous stimuli was also observed in schizophrenia patients, in whom the degree of discrimination difficulties seemed to be related to the extent of executive dysfunction (Tsoi et al. 2008). The degree of executive dysfunction was also negatively correlated with comprehension of humor (performance in humor tests such as the Joke Completion Test) in a sample of otherwise healthy elderly people (Shammi and Stuss 2003). Hence, the finding of slightly impaired discrimination in the younger AS group may only relate to delayed developmental progression of certain executive functions in ASD (Luna et al. 2007).

Previous studies of emotion expression in children with AS showed that they were less likely to display facial expressions of positive affect during social encounters relative to comparison participants (Dawson et al. 1990; Snow et al. 1987; Yirmiya et al. 1989). Other studies reported a similar absolute quantity of laughter over time in AS, as compared to healthy children (James and Tager-Flusberg 1994; Reddy et al. 2002). How much the displays of positive emotions differ between autistic and typically developing individuals may depend on their context, with the most salient differences occurring during social interaction (Jaedicke et al. 1994). In the current study, young AS children appreciated the humorous material and showed behavioral expressions of amusement and joy, but the outward displays of emotion in the individual trials did not match their reports of amusement in the ratings. This finding might be due to fundamental differences in the emotion-expressive behavior of AS and typically developing children. Hudenko et al. (2009) investigated the variability of laughter in children with AS. They found that autistic children laughed just as often as the non-autistic

kids. But the autistic children largely produced a uniform (voiced) kind of laughter, whereas non-autistic children produced a greater variety of laughter including unvoiced types. The laughter of children with autism seemed to be less modulated by contextual circumstances and social demands than that of TD children. The findings of the present study suggest that this pattern may generalize to humor-eliciting events, leading to less differentiated emotion-expressive behavior (also reflected in more displays of amusement during non-humorous clips) and thus, to a reduced coherence between the subjective experience of amusement and the outward expression of emotion.

The dissociation between the experiential and the behavioral responses may be related to the social interaction and communication difficulties in ASD. The coherent engagement of the various components of the emotional response (including experience, behavior, and physiology) is important for the coordination of interpersonal interactions (Keltner and Kring 1998). If the overt emotional behavior is dissociated from the subjective experience of emotions, the social-communicative function of emotions is disrupted (Buck 1994; Keltner and Kring 1998). Previous studies have indicated a lack of coherence between displays of positive affect and other communicative behaviors such as direction of gaze in autistic children, which are usually linked in typically developing individuals (Dawson et al. 1990; Kasari et al. 1990). Other empirical findings lend support to the hypothesis of a link between reduced emotion coherence and impaired social functioning in ASD. Response coherence has shown to be correlated with social connectedness (Mauss et al. 2011). A study by Freudenthaler et al. (2012) showed that the coherence between different emotional response systems co-varied positively with trait emotional self-efficacy, which is a powerful predictor of social functioning (e.g., Mavroveli et al. 2009). In addition, individuals with ASD were found to score lower on trait emotional self-efficacy than controls (Petrides et al. 2011).

A limitation of the study is that the ratings of overt expressions of mirth were only based on simple behavioral observations. Therefore, a replication of the findings with more refined methods, such as the Facial Action Coding System (Ekman and Friesen 1978), would be desirable, in which facial emotion expressions can be more reliably assessed and can be differentiated between genuine and non-genuine smiles and between different intensities of emotional displays. A further limitation may be that only male AS children were included in the sample.

Taken together, the present study shows that children with Asperger's syndrome clearly appreciate slapstick humor in which cognitive requirements that are commonly impaired in ASD are reduced to a minimum, but show subtle differences in their humor responses, as compared to typically developing children.

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References

- American Psychiatric Association. 1994. *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Asperger, Hans. 1944. Die "Autistischen Psychopathen" im Kindesalter ["Autistic psychopaths" in childhood]. *Archiv für Psychiatrie und Nervenkrankheiten* 117. 76–136.
- Attardo, Salvatore & Victor Raskin. 1991. Script theory revis(it)ed: Joke similarity and joke representation model. *Humor: International Journal of Humor Research* 4(3–4). 293–347.
- Baron-Cohen, Simon, Alan M. Leslie & Uta Frith. 1985. Does the autistic child have a "theory of mind"? *Cognition* 21. 37–46.
- Berenbaum, Howard & Thomas F. Oltmanns. 1992. Emotional experience and expression in schizophrenia and depression. *Journal of Abnormal Psychology* 101. 37–44.
- Bölte, Sven, & Fritz Poustka, F. 2004. The German form of the autism diagnostic observation schedule (ADOS): First results on reliability and validity. *Zeitschrift für Kinder- und Jugendpsychiatrie und Psychotherapie* 32. 45–50.
- Buck, Ross. 1994. Social and emotional functions in facial expression and communication: The readout hypothesis. *Biological Psychology* 38. 95–115.
- Craig, Jaime S., Christopher Hatton, Fiona B. Craig & Richard P. Bentall. 2004. Persecutory beliefs, attributions and theory of mind: Comparison of patients with paranoid delusions, Asperger's syndrome and healthy controls. *Schizophrenia Research* 69. 29–33.
- Dawson, Geraldine, Deborah Hill, Art Spencer, Larry Galpert & Linda Watson. 1990. Affective exchanges between young autistic children and their mothers. *Journal of Abnormal Child Psychology* 18. 335–345.
- Ekman, Paul & Wallace V. Friesen. 1978. *FACS*. Palo Alto: Consulting Psychologists Press.
- Emerich, David M., Nancy A. Creaghead, Sandra M. Grether, Donna Murray & Carol Grasha. 2003. The comprehension of humorous materials by adolescents with high-functioning autism and Asperger's syndrome. *Journal of Autism and Developmental Disorders* 33. 253–257.
- Freudenthaler, H. Harald, Helmut K. Lackner, Karin Nauschnegg, Günter Schultze & Ilona Papousek. 2012. Trait emotional self-efficacy and coherence of subjective and cardiovascular responses during anticipation of real-life academic stress. *Manuscript submitted for publication*.
- Gardner, Howard, Paul K. Ling, Laurie Flamm & Jen Silverman. 1975. Comprehension and appreciation of humorous material following brain damage. *Brain* 98. 399–412.
- Gena, Angeliki, Sophia Couloura & Effie Kymissis. 2005. Modifying the affective behavior of preschoolers with autism using in-vivo or video modeling and reinforcement contingencies. *Journal of Autism and Developmental Disorders* 35. 545–556.
- Goel, Vinod & Raymond J. Dolan. 2001. The functional anatomy of humor: Segregating cognitive and affective components. *Nature Neuroscience* 4. 237–238.
- Happé, Francesca & Uta Frith. 1996. The neuropsychology of autism. *Brain* 119. 1377–1400.

- Hill, Elisabeth, L. & Chris M. Bird. 2006. Executive processes in Asperger syndrome: Patterns of performance in a multiple case series. *Neuropsychologia* 44. 2822–2835.
- Hudenko, William J., Wendy Stone & Jo-Anne Bachorowski. 2009. Laughter differs in children with autism: An acoustic analysis of laughs produced by children with and without the disorder. *Journal of Autism and Developmental Disorders* 39. 1392–1400.
- Jaedicke, Susan, Sharon Storoschuk & Catherine Lord. 1994. Subjective experience and causes of affect in high-functioning children and adolescents with autism. *Development and Psychopathology* 6. 273–284.
- James, Paula J. St. & Helen Tager-Flusberg. 1994. An observational study of humor in children with autism and Down syndrome. *Journal of Autism and Developmental Disorders* 24. 603–617.
- Kanner, Leo. 1943. Autistic disturbances of affective contact. *Nervous Child* 2. 217–250.
- Kasari, Connie, Marian Sigman, Peter Mundy & Nurit Yirmiya. 1990. Affective sharing in the context of joint attention interactions. *Journal of Autism and Developmental Disorders* 20. 87–100.
- Keltner, Dacher & Ann M. Kring. 1998. Emotion, social function, and psychopathology. *Review of General Psychology* 2. 320–342.
- Kleinhaus, Natalia, Natacha Akshoomoff & Dean C. Delis. 2005. Executive functions in autism and Asperger's disorder: Flexibility, fluency, and inhibition. *Developmental Neuropsychology* 27. 379–401.
- Kring, Ann M. & John M. Neale. 1996. Do schizophrenic patients show a disjunctive relationship among expressive, experiential, and psychophysiological components of emotion. *Journal of Abnormal Psychology* 105. 249–257.
- Leslie, Alan M. 1994. Pretending and believing: Issues in the theory of ToMM. *Cognition* 50. 211–238.
- Levenson, Robert W. 1992. Autonomic nervous system differences among emotions. *Psychological Science* 3. 23–27.
- Lord, Catherine, Michael Rutter & Ann Couteur. 1994. Autism diagnostic interview-revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders* 24. 659–685.
- Lord, Catherine, Michael Rutter, Susan Goode, Jacquelyn Heemsbergen, Heather Jordan, Lynn Mawhood & Eric Schopler. 1989. Autism diagnostic observation schedule: A standardized observation of communicative and social behavior. *Journal of Autism and Developmental Disorders* 19. 185–212.
- Luna, Beatriz, Sara K. Doll, Stephen J. Hegedus, Nancy J. Minshew & John A. Sweeney. 2007. Maturation of executive function in autism. *Biological Psychiatry* 61. 474–481.
- Lyons, Viktoria & Michael Fitzgerald. 2004. Humor in autism and Asperger syndrome. *Journal of Autism and Developmental Disorders* 34. 521–531.
- Martin, Rod A. 2007. Approaches to the sense of humor: A historical review. In Willibald Ruch (ed.), *The sense of humor: Explorations of a personality characteristic*, 15–60. Berlin: Mouton de Gruyter.
- Mauss, Iris B., Amanda J. Shallcross, Allison S. Troy, Oliver P. John, Emilio Ferrer, Frank H. Wilhelm & James J. Gross. 2011. Don't hide your happiness. Positive emotion dissociation, social connectedness, and psychological functioning. *Journal of Personality and Social Psychology* 100. 738–748.
- Mavroveli, Stella, K. V. Petrides, Yolanda Sangareau & Adrian Furnham (2009). Exploring the relationships between trait emotional intelligence and objective socio-emotional outcomes in childhood. *British Journal of Educational Psychology* 79. 259–272.

- McGhee, Paul E., Willibald Ruch & Franz-Josef Hehl. 1990. A personality-based model of humor development during adulthood. *Humor: International Journal of Humor Research* 3(2). 119–146.
- McGhee, Paul E. 2002. *Understanding and promoting the development of children's humor*. Dubuque, IA: Kendall Hunt.
- O'Hearn, Kirsten, Miya Asato, Sarah Ordaz & Beatriz Luna. 2008. Neurodevelopment and executive function in autism. *Development and Psychopathology* 20. 1103–1132.
- Ozonoff, Sally & Judith N. Miller. 1996. An exploration of right-hemisphere contributions to the pragmatic impairments of autism. *Brain and Language* 52. 411–434.
- Ozonoff, Sally, Bruce F. Pennington & Sally J. Rogers. 1991. Executive function deficits in high-functioning autistic individuals: Relationship to theory of mind. *Journal of Child Psychology and Psychiatry and Allied Disciplines* 32. 1081–1105.
- Petrides, K. V., Kristelle Hudry, Georgia Michalaria, Viren Swami & Nick Sevdalis. 2011. A comparison of the trait emotional intelligence profiles of individuals with and without Asperger syndrome. *Autism* 15(6). 671–682.
- Pinkham, Amy E., Joseph B. Hopfinger, Kevin A. Pelphrey, Joseph Piven & David L. Penn. 2008. Neural bases for impaired social cognition in schizophrenia and autism spectrum disorders. *Schizophrenia Research* 99. 164–175.
- Poustka, Fritz, Sonja Lisch, Dorothea Rühl, A. Sacher, Gabriele Schmötzer & K. Werner. 1996. The standardized diagnosis of autism: Autism diagnostic interview-revised: Interrater reliability of the German form of the interview. *Psychopathology* 29. 145–153.
- Reddy, Vasudevi, Emma Williams & Amy Vaughan. 2002. Sharing humour and laughter in autism and Down's syndrome. *British Journal of Psychology* 93. 219–242.
- Ricks, Derek M. & Lorna Wing. 1975. Language, communication and the use of symbols in normal and autistic children. *Journal of Autism and Childhood Schizophrenia* 5. 191–221.
- Ross, Elliott D. & Marek-Marsel Mesulam. 1979. Dominant language functions of the right hemisphere. Prosody and emotional gesturing. *Archives of Neurology* 36. 144–148.
- Ruch, Willibald. 2001. The perception of humor. In Alfred W. Kaszniak (ed.), *Emotion, qualia, and consciousness*, 410–425. Tokyo: Word Scientific Publisher.
- Ruch, Willibald & Franz-Josef Hehl. 2007. A two-mode model of humor appreciation: Its relation to aesthetic appreciation and simplicity-complexity of personality. In Willibald Ruch (ed.), *The sense of humor: Explorations of a personality characteristic*, 109–142. Berlin: Mouton de Gruyter.
- Samson, Andrea C. 2012. The influence of empathizing and systemizing on humor processing: Theory of mind and humor. *Humor: International Journal of Humor Research* 25(1). 75–98.
- Samson, Andrea C. 2013. Humor(lessness) elucidated – Sense of humor in individuals with Autism Spectrum Disorders: Review and introduction. *Humor: International Journal of Humor Research* 26(3). 393–409.
- Samson, Andrea C. & Michael Hegenloh. 2010. Stimulus characteristics affect humor processing in individuals with Asperger Syndrome. *Journal of Autism and Developmental Disorders* 40. 438–447.
- Samson, Andrea C., Stefan Zysset & Oswald Huber. 2008. Cognitive humor processing: Different logical mechanisms in non-verbal cartoons: An fMRI study. *Social Neuroscience* 3. 125–140.
- Semrud-Clikeman, Margaret, Jenifer Walkowiak, Alison Wilkinson & Brianne Butcher. 2010. Executive functioning in children with Asperger syndrome, ADHD-combined type,

- ADHD-predominately inattentive type, and controls. *Journal of Autism and Developmental Disorders* 40. 1017–1027.
- Shammi, Prathiba & Donald T. Stuss. 2003. The effects of normal aging on humor appreciation. *Journal of the International Neuropsychological Society* 9. 855–863.
- Snow, Margaret E., Margaret E. Hertzog & Theodore Shapiro. 1987. Expression of emotion in young autistic children. *Journal of the American Academy of Child and Adolescent Psychiatry* 26. 836–838.
- Suls, Jerry M. 1972. A two-stage model for the appreciation of jokes and cartoons: An information processing analysis. In J. H. Goldstein & P. E. McGhee (eds.), *The psychology of humor*, 81–100. New York: Academic Press.
- Tsoi, Daniel T., Kwang-Hyuk Lee, Kate A. Gee, Kritina L. Holden, Randolph W. Parks & Peter W. R. Woodruff. 2008. Humour experience in schizophrenia: Relations with executive dysfunction and psychosocial impairment. *Psychological Medicine* 38. 801–810.
- Weiss, Rudolf H. & Jürgen Osterland. 1997. *Grundintelligenztest Skala 1 (CFT1)* [General Intelligence Test Scale 1]. Göttingen: Hogrefe.
- Weiss, Rudolf H. 2006. *Grundintelligenztest Skala 2 - Revidierte Fassung (CFT 20-R)* [General Intelligence Test Scale 2 - Revised]. Göttingen: Hogrefe.
- Wing, Lorna. 1996. *The autistic spectrum: A guide for parents and professionals*. London: Constable.
- Wing, Lorna. 1981. Asperger's syndrome: A clinical account. *Psychological Medicine* 11. 115–129.
- Yirmiya, Nurit, Connie Kasari, Marian Sigman & Peter Mundy. 1989. Facial expressions of affect in autistic, mentally retarded and normal children. *Journal of Child Psychology and Psychiatry and Allied Disciplines* 3. 725–735.

Bionotes

Elisabeth M. Weiss is a licensed psychiatrist and psychologist. She is the head of the Biological Psychology Department at the Karl-Franzens University of Graz, Austria. Her research interests include cognition in psychiatric and neurological disorders, neuroimaging and neurogenetics.

Bianca Gschaidbauer completed her MSc in Psychology at the Karl-Franzens-University of Graz, Austria. Her Master's thesis dealt with executive functions in autism. Currently she is working with autistic people at the Verein Libelle (Autism Center Styria).

Andrea Samson completed her PhD in Psychology (University of Fribourg, Switzerland) on cognitive humor processing, Theory of Mind and its neuronal correlates. She is currently a postdoctoral researcher at the Department of Psychology, Stanford University. Her research interests focus on neural correlates of humor, emotion regulation, Autism, and mixed emotions.

Krista Steinbäcker is a licensed psychologist working with autistic people at the Verein Libelle (Autism Center Styria). She completed her MSc in Psychology (Karl-Franzens-University of Graz, Austria) on the link between brain development and autism.

Andreas Fink is a professor at the Department of Psychology, Biological Psychology Unit, Karl-Franzens University of Graz, Austria. His research is concerned with cognitive and neuronal mechanisms underlying different facets of personality and cognition, with a special focus on creativity.

Ilona Papousek is a professor at the Biological Psychology Unit of the Department of Psychology, Karl-Franzens University of Graz, Austria. Her main research interests are in the field of affective neuroscience. Her specialisms include humor related issues and affective flexibility.