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Are more humorous children more intelligent? A case from Turkish culture

https://doi.org/10.1515/humor-2021-0054
Received January 8, 2021; accepted July 22, 2021; published online August 18, 2021

Abstract: This study aimed to investigate the relationship between intelligence and humor ability in a Turkish sample. The sample included 217 middle-school students with a wide range of intelligence measured by a Turkish intelligence test (ASIS). Humor ability was measured using the Humor Ability Assessment Form. Students were instructed to write captions for 10 cartoons that were as funny and relevant as possible. Seven experts rated the funniness of the captions and their relevance to the cartoons, yielding a total of 30,380 ratings (217 students × 10 cartoons × two criteria × seven experts). The findings showed that both general intelligence and the second-level components (verbal ability, visual-spatial ability, and memory) had high correlations with humor ability. Intelligence explained 68% of the variance in humor ability. Among the third-level factors, verbal analogical reasoning was the primary predictor of humor ability ($\beta = 0.325$, $p < 0.001$). Humor ability scores significantly differed across intelligence clusters, implying that highly humorous children may be highly intelligent.

Keywords: children; correlation; humor ability; intelligence; regression

1 Introduction

Humor has been considered a sign of high intelligence throughout human history. For example, during competitions for women to mate within ancient times, men engaged in humor to demonstrate their cleverness and adaptability (Greengross 2008; Li et al. 2009). In scientific research, intelligence has been found to predict humor ability partly. People who quickly and easily produce witty ideas are

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considered highly intelligent (Bressler and Balshine 2006; Decker 1987; Earleywine 2010). Humor involves absurdities, and the comprehension of absurdities requires a high level of intelligence (Ziv and Gadish 1990). Feingold (1983) related humor ability to crystalized intelligence and humor comprehension to fluid intelligence. Christensen et al. (2018) found humor production to be related to memory in addition to intelligence. Two lines of research have emerged in terms of the correlation between intelligence and humor: The first line deals with the relationship between general intelligence and humor ability, whereas the second one compares the magnitude of the relationship of fluid intelligence and crystallized intelligence to humor ability.

Several studies were carried out to explore the relationship between intelligence and humor ability (Feingold and Mazzella 1991; Greengross and Miller 2011; Howrigan and McDonald 2008; Kellner and Benedek 2016). Most of these studies involved college students, yet with different measures of general intelligence and various tasks of humor ability. Because measures were diverse in these studies, correlations obtained between intelligence and humor were substantially different. For example, Feingold (1983) used the Wechsler Adult Intelligence Scale to measure general intelligence and sentence completion tasks to assess humor ability in college students. The study yielded a correlation coefficient of 0.58 between general intelligence and humor ability. Working with university students, Howrigan and McDonald (2008) used the Raven's Progressive Matrices, a figural test, and the production of comic stories and sarcastic responses to hypothetical questions. The researchers obtained a correlation of 0.29 between general intelligence and humor ability. Other studies carried out with university students found similar results, with correlations ranging around 0.30s between general intelligence and humor ability (e.g., Greengross et al. 2012; Kellner and Benedek 2016).

Another line of research compared the relationship of fluid intelligence and crystallized intelligence to humor ability. For example, Greengross and Miller (2011) used the Raven's Progressive Matrices to measure fluid intelligence and the Multidimensional Aptitude Battery to measure crystallized intelligence in university students. Humor production tasks included generations of dialogs to cartoons. Results showed that humor production had a correlation coefficient of 0.31 with crystallized intelligence, whereas the correlation between fluid intelligence and humor production was 0.24. Christensen et al. (2018) investigated the relationship between humor, intelligence, and memory in university students. They used the Cattell Culture Fair Intelligence Test, the Advanced Vocabulary Test, the Extended Range Vocabulary Test, and a battery of memory tasks. They used caption writing for cartoons, generating jokes, and writing comic definitions using three words to assess humor ability. Humor ability had a correlation coefficient of 0.49 with crystalized intelligence, 0.22 with fluid intelligence, and 0.38 with memory. The researchers also used bifactor modeling and found that when general intelligence was modeled, memory and crystallized intelligence still correlated with humor production at a level of 0.20 and 0.47, respectively, while fluid intelligence did not significantly correlate with humor. Similarly, Kellner and Benedek (2016) used the Cattell Culture Fair Intelligence Test to measure fluid intelligence and the Wilde Intelligence Test to measure crystallized intelligence in university students. Humor production tasks included completing empty cartoons. The regression models showed that crystallized intelligence explained more variance in humor production than did fluid intelligence. In short, studies carried out with adolescents and adults yielded incomparable results because measures of humor production ability in these studies were of a different kind. However, all the studies showed positive small to medium correlations between the two constructs.

Research on the relationship between intelligence and humor ability carried out with children is somewhat limited. A few studies have been done. For instance, Masten (1986) studied the relationship between the two constructs in children. The researcher used the Wechsler Scales and humor comprehension and humor production tasks. The study yielded a correlation coefficient of 0.50 between general intelligence and humor ability. Hauck and Thomas (1972) measured fourth-, fifth- and sixth-grade students' humor ability using sociometry methodology. Their intelligence was assessed by the Lorge Thorndike Intelligence Test. Students nominated three students with the highest humor ability in their classes. The researchers found a 0.91 correlation coefficient between students' general intelligence and humor ability. Shade (1991) compared the humor ability of gifted students and their normal peers in fourth, sixth, and eighth grades. In the study, gifted students outperformed their normal peers in verbal humor comprehension and humor production tasks. In short, based on the limited amount of research evidence, it could be hypothesized that the magnitude of the correlation between intelligence and humor ability seems to differ across age groups, with higher correlations in children than adults.

The magnitude of correlations between intelligence and humor ability may differ across cultures, as well, because both intelligence (Sternberg 2000) and humor (Yue 2010) are cultural constructions. Even though humor is a universally practiced behavior, the ways it is used and appreciated by people are greatly influenced by their cultural norms, beliefs, and values (Martin 2007). A particular behavior perceived as intelligently humorous in a culture may not be so intellectually humorous in another culture. For example, Kuiper et al. (2010) maintain that Western culture values humor that develops oneself, whereas eastern cultures do not appreciate this type of humor. Chen and Martin (2005) point out Western culture's individualism and the collectivism of eastern culture as the source of this difference. Humor is perceived as a creative behavior (Sternberg 1985) and self-actualization (Maslow 1968; Mintz 1983) in Western culture while it is not considered to be creative behavior, for example, in Chinese culture (Jiang et al. 2011; Yue 2011). While humor is accepted as a way to cope with problems in western cultures, it is not deemed so in eastern cultures, such as Japan (Abe 2006), China (Chen and Martin 2005), and Singapore (Nevo et al. 2001). That is, humor reflects cultural norms even though it is a universal phenomenon. Because humor appreciation is shaped by cultures (Kaufman et al. 2008), humor ability may differentially correlate with intelligence in different cultures. Therefore, exploring the relationship between intelligence and humor ability in different cultural contexts might provide new evidence on their relationship.

1.1 The present study

The purpose of the current study was to investigate the relationship between intelligence and humor ability in children. This study differs from prior studies in terms of its sampling and methodology. First, most prior studies were carried out in the western countries, mostly in the United States (Christensen et al. 2018; Greengross and Miller 2011; Howrigan and McDonald 2008; Kellner and Benedek 2016), whereas a few studies involved participants in eastern cultures (Alinia et al. 2009; Huang and Lee 2019; Sun et al. 2017; Wang et al. 2019). This study was conducted in Turkish culture, which is a synthesis of the eastern and western cultures. Turkish culture is unique in treating humor and rationality together in that it has created legendary characters in folk stories who use humor with rational reasoning as a problem-solving tool. One exemplary character is the legendary Nasrettin Hoca, a quick-minded problem solver in most narratives, representing the voice of reason in a witty manner (Sak 2007). Because humor in Turkish culture requires rationality or unorthodox reasoning and funniness together, we expected a high correlation between children's humor ability and their intelligence in a Turkish sample. In the current study, the intelligence test (ASIS) used to measure intelligence and the cartoons to measure humor ability were developed in Turkish culture.

Second, prior studies were carried out mainly with adults and university students (e.g., Christensen et al. 2018; Feingold 1983; Feingold and Mazzella 1991; Greengross et al. 2012). We hypothesized that the magnitude of the relationship between intelligence and humor ability might be different in children because characteristics of humor differ across developmental stages (Greengross 2013; Martin et al. 2003; Thorson and Powell 1996); therefore, we recruited younger children (10–12 years of age) than participants involved in prior studies.

Furthermore, we had a purposeful sampling, with children having a wide range of intelligence from lower bounds to upper bounds of the normal curve.

Third, most prior studies used the funniness aspect of humor production (e.g., funny caption writings) to assess humor ability (Christensen et al. 2018; Greengross et al. 2012; Greengross and Miller 2011; Kellner and Benedek 2016). We used both funniness and comprehension to measure humor ability because both humor comprehension and humor production are important components of humor ability (Attardo 1994; Feingold 1983; Kozbelt and Nishioka 2010). Humor comprehension involves incongruity detections and incongruity resolutions (e.g., scope and degree of resolution) (Ritchie 2009; Suls 1972). In the current study, humor comprehension is operationally conceptualized as the degree of relevance of students' dialogs as responses to stimulus cartoons. The relevance of captions presents evidence as to whether students comprehend the context of cartoons by detecting and resolving incongruities in these cartoons. For example, students may produce funny captions, but these captions may not fit cartoons and thus sound nonsensical.

2 Method

2.1 Participants

Participants included 217 students (Mean age = 10.8; SD = 0.78; female = 105; male = 112), of whom 23 were sixth-grader and 194 were seventh-grader in a large city in the mid-western part of Turkey. They came from seven different schools. Of the participants, 51 were officially identified as gifted by a research center for high-ability education at Anadolu University. The center used a mathematical and scientific aptitude test to identify these students. They were receiving special education from this center. The rest of the participants had no formal identification. Participants' intelligence was measured by the Anadolu Sak Intelligence Scale as follows: 18 students (%8.3) were below the normal range (IQ 74–84), 129 students (%59.4) were within the normal range (85–115), 32 students (%14.7) were above average (116–129), and 38 students (%17.5) were highly intelligent (130 and above). Participants' intelligence ranged from 74 IQ to 155 IQ, with a mean of 109 and a standard deviation of 19.61. Participation in the study was voluntary.

2.2 Instruments

2.2.1 Humor ability assessment form (HAAF)

The HAAF was composed of 10 stimulus cartoons selected (by permission) from a cartoonist's 700 cartoons. Five of the cartoons did not have any captions. The original dialogs written by the cartoonist were deleted from these cartoons. Students were required both to start and to carry on comic dialogs relevant to the cartoons. The remaining five cartoons had one caption and one or more empty boxes (Appendix). Students were instructed to carry on a caption by writing comic dialogs relevant to the first caption and the cartoon.

Two criteria were used in rating dialogs produced by students: relevance as an indicator of comprehension and funniness (Feingold and Mazzella 1991; Greengross and Miller 2011). The scoring was based on a 5-point Likert-type scale, from 1 to 5. Each cartoon received two scores: One for funniness and one for relevance. The maximum score for a cartoon was 10, and the minimum was 2. The maximum score obtained for each aspect was 50, and the minimum was 10. Thus, the total score obtained from the 10 cartoons was 100.

The Krippendorff Alpha coefficient (Viera and Garret 2005) was calculated to examine the inter-rater reliability of the scores. The items included funniness and relevance scores produced by seven experts ($7 \times 2 = 14$). The coefficient was found to be 0.42 for seven raters. An analysis showed that one rater had radically inconsistent ratings; therefore, this rater was excluded from further analyses. The new analysis yielded an inter-rater reliability coefficient of 0.84. The inter-rater reliability for the funniness and the relevance were 0.79 and 0.64, respectively. Cronbach Alpha for internal consistency was found to be 0.93. Furthermore, we examined correlations between the funniness index and the relevance index by rater and total score. Correlations between the two indices by rater were 0.45, 0.49, 0.55, 0.62, 0.73, 0.77, respectively, and 0.82 by the total score.

2.2.1.1 Construction of the HAAF

Two groups of experts worked in the construction of the HAAF. The first group, consisting of two experts who taught humor education to children, selected 14 cartoons from a list of 700 cartoons according to their appropriateness to students' age (1) and interest (2) and their clarity (3) and understandability (4) for students. The second group, consisting of five cartoonists, examined the content validity of the cartoons (Fitzpatrick 1983) as to whether the cartoons were appropriate for measuring humor production ability. All the cartoonists had master's or doctoral degrees in animations and arts and published cartoons in journals. They advised excluding one cartoon and provided revisions for the 13 cartoons. After revisions were made, the 13 cartoons were administered to 10 seventh-grade students to check if students understood the cartoons. Three of the cartoons were eliminated based on qualitative feedback taken from the students.

2.2.1.2 Procedures

A group consisting of seven experts (five cartoonists and two humor educators) used the Consensual Assessment Technique (CAT) to assess 217 students' captions for 10 cartoons based on the funniness and relevance of captions. Experts use the CAT to assess the quality of products (Amabile 1982; Baer and McKool 2009). Each expert rated 4,340 qualities (217 students × 10 cartoons × two criteria). In total, seven experts conducted 30,380 ratings (217 × 10 × 2 × 7) using the CAT procedures. They were provided with the following instruction for rating the captions: using the 5-point scale provided below, rate the first captions of all students, then the second captions, and then the third, and continue ratings in this order until all of the captions are rated. Separately rate the funniness and relevance of captions. Relevance refers to the degree to which a caption fits a cartoon's content and the first caption. Funniness refers to how comic a caption is relative to other captions produced to respond to stimuli. Aligned with this instruction, experts first rated the funniness and the relevance of the first captions written for the first cartoon on the HAAF. By carrying out cartoon-by-cartoon evaluations, experts were able to compare the funniness of each caption produced by a student to other captions produced by other students for the same stimuli. Then, experts rated the second cartoon and the third, fourth, and so on. Experts were informed that middle-school students wrote captions. They were provided with no further information about the participants.

Students' scores for each caption's funniness and relevance were derived from the mean scores of expert ratings. The sum of the funniness and the relevance scores provided the total humor ability score.

2.2.2 Anadolu Sak Intelligence Scale (ASIS)

The ASIS is an individually administered intelligence test in verbal and visual domains (Sak et al. 2016). It is appropriate for 4 to 12-year-old children. It provides three componential and seven subtest-level scores besides a general factor score. The componential scores include verbal ability, visual-spatial reasoning, and short-term memory. While verbal ability is an indicator of crystallized intelligence, visual-spatial reasoning measures fluid intelligence (Carroll 2005; Schneider and McGrew 2012). The subtests consist of verbal analogical reasoning, visual analogical reasoning, vocabulary, perceptual reasoning, visual ordered memory, visual memory for patterns, and verbal short-term memory.

The validity and reliability of the ASIS were investigated in several studies (e.g., Cırık et al. 2020; Sak et al. 2016; Sözel et al. 2018; Tamul et al. 2020). The theoretical validity of the ASIS was investigated and confirmed using exploratory and confirmatory factor analyses (Sak et al. 2016). A study on criterion validity shows satisfactory results. ASIS scores significantly correlate with grades in math (from 0.69 to 0.82), science (0.57–0.77), social studies (0.59–0.81), and language arts (from 0.63 to 0.83) (Sak et al. 2019). Correlations between ASIS scores and the UNIT and the RIAS intelligence tests range from 0.50 to 0.82 (Dülger 2018). In another study, the social validity of the ASIS was evaluated to be very high by test users (Tamul et al. 2020). The ASIS was also used with clinical groups diagnosed with intellectual disability, autism spectrum disorder, attention deficit hyperactivity disorder, learning disability, and giftedness (Cirik et al. 2020; Sözel et al. 2018). The classification of their intelligence measured by the ASIS was consistent with their formal diagnoses, which supports the discrimination validity of the ASIS. Reliability studies show that the internal consistency of the subtests and the component scores range from 0.81 to 0.94 in the norm sample. The minimum intercoder reliability is 0.96 (Sak et al. 2016). Test-retest reliability for factor scores ranges from 0.91 to 0.95, whereas it is between 0.66 and 0.85 for the subtests (Tamul 2017).

2.3 Data collection

Gifted students took both the ASIS and the HAAF in the gifted education center. Those participants who had no identification were administered both assessments in their schools. The ASIS was administered individually by eight testers to gifted students in a testing room in the center. Similarly, other students were tested by the eight testers in the counseling rooms in their schools. The testing rooms in schools and in the center were small and quiet and designed for individual counseling and testing purposes. The individual administration of the ASIS took 30–50 min. The HAAF was administered in a paper-and-pencil format in group settings. Four researchers administered it in students' classrooms at the schools and the gifted education center. Students were delivered a ten-page cartoon, with one cartoon on each page. The instruction was as follows: write as funny dialogs as you can in the empty boxes on each cartoon. Your dialogs should fit the picture and the first dialog, if any, on the cartoon. You can add more boxes or write outside the boxes if needed. The administration of the HAAF lasted 40 min.

2.4 Data analysis

First, students were clustered by their IQ scores in five groups, lower boundary (70–84), average −1 SD (85–100), average + 1 SD (101–115), upper boundary (116–129), and highly intelligent (130 and above) to find out if a one-standard-deviation difference in intelligence made a significant difference in humor ability. Then, students' humor ability scores were compared by their intelligence classification. Next, differences in humor ability by intelligence level were tested using the one-way ANOVA. Preliminary analyses showed that the homogeneity of variances was not equal; however, the groups had normal distributions. Therefore, we used Tamhane's T2 as a post hoc test for multiple comparisons because it does not assume equal variances (Huck 2008). Next, Pearson's correlational analysis was conducted to explore the relationship between ASIS scores and humor scores. Finally, standard multiple regression analysis was used to determine the unique contribution of each subtest-level score to humor ability.

3 Findings

3.1 Humor ability scores by intelligence level

Humor production scores by intelligence level are presented in Table 1. The descriptive findings showed apparent differences among all the groups. The higher the intelligence mean was, the higher the mean of humor ability was. The highly intelligent group outperformed all the other groups. The one-way ANOVA showed a statistically significant difference ($F_{(4,\ 212)} = 112.829$, $p<0.001$; $\eta^2 = 0.68$). The effect size was large. Further analyses using Tamhane's T2 showed that the differences between all the groups were significant ($p<0.01$). According to the post hoc tests, all the differences between the groups had large effect sizes (Table 2).

The standard deviations of humor ability were much higher in the lower-ability groups (9.82 and 9.85 for the two low groups) than the higher-ability groups (6.10 and 3.29 for the two high groups). Thus, humor ability was more homogeneous in the highly intelligent group while it was more heterogeneous in the average and below-average group. Although the standard deviation of humor ability was smaller in the highly intelligent group, the magnitude of the correlation between intelligence and humor ability was much higher in this group (Table 3), implying a linear and strong relationship between the two constructs even among high-ability children. Further, Fisher's z was used to test correlation differences among the clusters (Table 4). The difference between the average and the upper boundary was

Table 1: Means and standard deviations of humor scores.

Intelligence cluster	*N*	Total humor score[a]				Funniness				Relevance			
		$\overline{X}$	Min	Max	SD	$\overline{X}$	Min	Max	SD	$\overline{X}$	Min	Max	SD
Lower boundary (74–84)	18	54.48	38.00	74.83	9.82	20.96	11.83	32.83	5.85	33.53	24.00	42.00	5.00
Average (−1 SD) (85–100)	67	69.76	46.33	85.67	9.85	28.55	13.83	40.5	6.6	41.21	30.33	48.50	4.01
Average (+1 SD) (101–115)	62	81.11	60.83	88.83	5.97	35.02	19.67	40.5	3.97	46.09	32.5	49.83	3.34
Upper boundary (116–129)	32	86.07	57.67	93.00	6.10	38.63	16.33	43.5	4.6	47.43	41.00	49.83	2.36
Highly intelligent (130 and above)	38	92.38	85.17	98.33	3.29	43.61	39.5	48.33	1.97	48.76	44.17	50.00	1.76
Total sample	217	78.10	38.00	98.33	13.05	33.9	11.83	48.33	8.2	44.20	24	50	5.46

[a]*Note*. The total score is the sum of the funniness and relevance of captions.

Table 2: Post Hoc comparisons for the total humor score.

Intelligence cluster		Mean difference[a]	SD	t	SE	Cohen's d
Lower boundary	Average (−1sd)	−15.28	1.978	−7.72	2.61	1.55
	Average (+1sd)	−26.63	1.994	−13.35	2.43	3.81
	Upper boundary	−31.58	2.195	−14.39	2.55	4.14
	Highly intelligent	−37.90	2.132	−17.78	2.37	6.16
Average (−1 sd)	Average (+1 sd)	−11.35	1.313	−8.64	1.42	1.38
	Upper boundary	−16.30	1.601	−10.18	1.61	1.84
	Highly intelligent	−22.62	1.513	−14.95	1.31	2.78
Average (+1 sd)	Upper boundary	−4.95	1.621	−3.05	1.31	0.82
	Highly intelligent	−11.26	1.535	−7.34	0.92	2.19
Upper boundary	Highly intelligent	−6.31	1.787	−3.53	1.20	1.32

[a]*Note.* All the differences are significant at p<0.01.

significant. Similarly, the highly intelligent group differed significantly from the upper boundary.

3.2 The relationship between humor and intelligence scores

Correlations between the ASIS scores and the humor ability scores are presented in Table 5. All the correlations between the two constructs were significant (p<0.01). However, the magnitude of correlations was considerably different across component and subtest scores, ranging from 0.47 to 0.82. The highest correlation was found between general intelligence and the total humor score (0.82). At the subtest level, verbal analogical reasoning had the highest correlation with the total humor score (0.75). The lowest correlation was obtained between visual-ordered memory and the relevance aspect of humor (0.47). The funniness aspect of humor had relatively larger correlations with all the measures of intelligence than the

Table 3: Within-group correlations between intelligence and humor ability.

Intelligence clusters	*N*	Correlations
Lower boundary (74–84)	18	0.32
Average (−1sd) (85–100)	67	0.53**
Average (+1sd) (101–115)	62	0.32*
Upper boundary (116–129)	32	0.08
Highly intelligent (130 and above)	38	0.59**
Total sample without the highly intelligent group	179	0.77**

Note. *. p<0.05; **. p<0.01.

Table 4: Fisher's z Transformations.

Intelligence clusters		Fisher's z
Lower boundary	Average (−1sd)	−0.90
	Average (+1sd)	0
	Upper boundary	0.79
	Highly intelligent	−1.12
Average (−1sd)	Average (+1sd)	1.43
	Upper boundary	2.27*
	Highly intelligent	−0.42
Average (+1sd)	Upper boundary	1.11
	Highly intelligent	−1.62
Upper boundary	Highly intelligent	−2.37*

Note. *. p<0.05.

relevance aspect of humor. Overall, the correlations, ranging from 0.47 to 0.75, between the subtest scores of intelligence and the funniness and relevance aspects of humor ability were relatively larger than the correlations, ranging from 0.37 to 0.76, that existed among the subtests of intelligence.

We were further interested in exploring how well each specific intellectual skill best predicted humor ability. Therefore, a subtest-level standard multiple regression analysis was conducted. Preliminary analyses were carried out to check assumptions of multiple regression analysis. As seen in Table 5, correlations ranging from 0.32 to 0.76 between the subtests showed no multicollinearity. No outliers were detected in Mahalanobis distances and histogram and scatter plots. Tolerance and VIF values showed no singularity. The model included the following subtests: verbal analogical reasoning, vocabulary, visual analogical reasoning, visual ordered memory, perceptual relations, verbal short-term memory, and visual pattern memory (Table 6).

The model was found significant ($R = 0.83$, $R^2 = 0.69$, $\Delta R^2 = 0.681$, $F_{(7,209)} = 66.918$, $p<0.001$). It accounted for 69% of the variance in humor ability. Significant predictors were verbal analogical reasoning ($\beta = 0.325$, $p<0.001$), visual pattern memory ($\beta = 0.185$, $p=0.001$), vocabulary ($\beta = 0.170$, $p=0.008$), perceptual relations ($\beta = 0.149$, $p=0.003$) and verbal-short term memory ($\beta = 0.110$, $p<0.05$). Visual analogical reasoning ($\beta = 0.031$, $p>0.05$) and visual ordered memory ($\beta = 0.073$, $p>0.05$) did not make a statistically significant unique contribution to the model. As seen in Beta values, verbal analogical reasoning made the strongest unique contribution (about 10%) to explaining the model. Each of the other variables had a unique contribution of less than 5% to explain the variance in humor

Table 5: Correlations between the ASIS scores and the humor scores of the total sample.

	Scores	2	3	4	5	6	7	8	9	10	11	12	13	14
Humor scores	1. Humor ability total score	0.97	0.93	0.82	0.75	0.73	0.73	0.52	0.75	0.59	0.66	0.56	0.64	0.70
	2. Funniness		0.82	0.81	0.76	0.72	0.72	0.51	0.75	0.57	0.67	0.55	0.63	0.70
	3. Relevance			0.73	0.67	0.67	0.65	0.47	0.67	0.56	0.58	0.51	0.57	0.62
ASIS components	4. General intelligence				0.89	0.90	0.92	0.69	0.85	0.70	0.84	0.68	0.76	0.82
	5. Verbal ability					0.73	0.72	0.51	0.93	0.52	0.73	0.60	0.56	0.94
	6. Visual-spatial ability						0.75	0.56	0.71	0.82	0.89	0.49	0.69	0.66
	7. Memory							0.79	0.69	0.58	0.69	0.74	0.79	0.65
ASIS subtests	8. Visual-ordered memory								0.49	0.44	0.52	0.32	0.50	0.46
	9. Verbal analogical reasoning									0.52	0.70	0.59	0.54	0.76
	10. Perceptual relations										0.56	0.37	0.57	0.46
	11. Visual analogical reasoning											0.47	0.63	0.67
	12. Verbal short-term memory												0.40	0.53
	13. Visual pattern memory													0.52
	14. Vocabulary													–

Note. $p<0.01$ for all the correlations.

Table 6: Multiple regression analysis of the predictors of humor ability.

Model	Variable	B	SE	β	t	p
1	Constant	15.281	3.084		4.95	0.000
	Visual-ordered memory	0.08	0.053	0.073	1.52	0.129
	Verbal analogical reasoning	0.355	0.075	0.325	4.71	0.000
	Perceptual relations	0.16	0.054	0.149	2.95	0.003
	Visual analogical reasoning	0.037	0.076	0.031	0.49	0.624
	Verbal short-term memory	0.122	0.054	0.110	2.27	0.024
	Visual pattern memory	0.223	0.066	0.185	3.40	0.001
	Vocabulary	0.189	0.070	0.170	2.69	0.008

$R = 0.83$, $R^2 = 0.69$, $\Delta R^2 = 0.681$, $F_{(7,209)} = 66.918$, $p<0.001$.

ability. The sum of unique contributions of all the variables in the model was about 18%. The shared variance explained by more than one variable was about 51%.

4 Discussion

The study shows that intelligence and humor ability are highly correlated constructs. An increase in intelligence leads to an increase in humor ability. Among intellectual skills, verbal analogical reasoning is the best predictor of humor ability. An important finding of the study is that the contribution of intelligence to humor ability might be significantly higher than prior studies' findings. While other researchers found correlations ranging from 0.23 to 0.58 in similar measurements (e.g., Christensen et al. 2018; Feingold 1983; Greengross et al. 2012; Greengross and Miller 2011; Kellner and Benedek 2016), this study yielded a very high correlation (0.82) between general intelligence and humor ability in the total sample. The highest correlation (0.59) was observed in the highest intelligence group compared to those with lower intelligence. The correlation between the two constructs was still high (0.77) when even the highly intelligent group was excluded from the correlational analysis. The high correlation was reflected in the comparison of intelligence clusters, as well. The highly intelligent group outperformed all the other groups.

Several reasons can be postulated to explain the substantial correlation between intelligence and humor ability obtained in this study. First, reasoning involved in humor may be strongly related to intelligence. According to the incongruity theory, humor presents incongruities that do not fit our mental patterns and violate our expectations (Morreall 1982). As a precursor of the incongruity theory, Schopenhauer relates humor to the discrepancy between our perceptions of objects and our abstract rational knowledge about the same objects. For Schopenhauer, the cause of humor is the sudden perception of the incongruity between a concept and the real objects related in some ways. Likewise, Schultz (1976) maintains that it is not incongruity in humor people enjoy but conceiving incongruity. Similarly, the verbal analogical reasoning subtest of the ASIS used as a component of verbal ability in the current study requires resolutions of verbal analogies by conceiving contradictions and relations between two stimuli and by applying these relations to resolve other contradictions between two other stimuli. The high relationship between verbal analogical reasoning and humor ability found in this study may be explained by similar logical mechanisms used to resolve incongruities in humor (Hempelmann and Attardo 2011) and decode contradictive relations in verbal analogies. All logical mechanisms in humor involve some forms of reasoning (Attardo et al. 2002). An analogy is one of these forms used in humor (Attardo 2002).

As humor requires resolutions of incongruities by using logical mechanisms, which is a form of abstraction, one can postulate that humor production requires a high level of intelligence because logical mechanisms involved in humor are not specific to humor only; instead, they are general (Hempelmann and Attardo 2011) and are somehow related to intelligence (Karwowski et al. 2017; Kaufman and Plucker 2011). In the current study, the assessment of humor ability involved both the funniness and relevance of captions produced by children. The relevance criterion requires apprehending contexts in cartoons to produce captions that fit these contexts. People can produce humorous captions as much as they can comprehend contexts (Attardo 1994; Feingold 1983). As comprehension is highly related to intelligence (Eagly and Warren 1976; Miele and Molden 2010; Stanovich et al. 1984), people with higher intelligence better comprehend intellectual abstractions in humor (Masten 1986). Thus, intelligence should contribute both to the production processes of humor and comprehension processes in productions.

Second, the high correlation between intelligence and humor ability obtained in this study shows that intelligence might be more related to humor ability in teenage years than adulthood. Prior studies found substantially lower correlations between the two constructs in adult samples (e.g., Christensen et al. 2018; Greengross and Miller 2011; Howrigan and McDonald 2008; Kellner and Benedek 2016). Although both humor ability (Greengross 2013; Martin et al. 2003) and intelligence develop rapidly from childhood to adulthood (e.g., Schneider et al. 2014), the strength of the relationship between the two constructs may not increase in the same way. This hypothesis, indeed, needs further investigation involving both children and adults. Different components of humor ability, such as appreciation and wittiness, and various intelligence components, such as perceptual reasoning and verbal ability, might be differentially related at specific developmental stages. For example, in adults, humor ability may be more related to verbal ability, or crystallized intelligence than perceptual reasoning or fluid intelligence since prior studies involving adults show low correlations between humor ability and perceptual reasoning and relatively higher correlations between verbal ability and humor ability (e.g., Christensen et al. 2018; Feingold 1983; Greengross and Miller 2011; Howrigan and McDonald 2008). On the other hand, in children, fluid and crystallized intelligence may be equally related to humor ability, as found in this study. Perceptual reasoning components of fluid intelligence seem to be more related to humor in children than in adults. Further, the type of humor used and appreciated in various stages of life differs substantially. Adults use humor often for socialization, whereas teenagers and adolescents may use it for peer acceptance (Fine 1984; Martin et al. 2003; Masten 1986; Ransohoff 1975; Ziv 1984).

Third, a high level of heterogeneity in the participants' intelligence in the current study can contribute to the high relationship between intelligence and humor ability. A correlation will be greater if there is a higher variability among observations than less variability (Glass and Hopkins 1996). The intelligence distribution of the sample is extensive, ranging from an IQ of 74–155, with a standard deviation of 20. The highly intelligent group has the highest IQ range (24 points), which indicates a less restriction of variance and may result in relatively higher correlations. Indeed, the highest correlation between intelligence and humor ability exists in this group. However, it should be noted that this group has the lowest heterogeneity in humor ability and the lowest humor score range (13), which implies a restriction of variance, whereas the other groups have very high humor score ranges, nearly three times larger than the highly intelligent group. Based on these findings, one can postulate that a high level of humor ability is a sign of higher intelligence.

Fourth, culture may play an essential role in how intelligence and humor ability are related. This relationship should be higher in a culture that values wittiness, not just jokes in humor. Similarly, humor is expected to be a product of intelligence in Turkish culture and is considered the mind's art (Boysan 2005; Sak 2007). Thus, humor based on rationality and unorthodox thinking is more appreciated in Turkish culture. This appreciation is depicted in legendary characters in folk stories (Sak 2007). Therefore, in the current study, the experts may have assigned higher ratings to the captions with quirky humor and rationality.

Fifth, the intelligence scale and the humor assessment used in this study may be more related to each other than the humor and intelligence assessments used in prior studies, yielding an inflated correlation between the two constructs. The ASIS used to measure intelligence in this study is composed of verbal and nonverbal subtests. These subtests measure both fluid intelligence and crystallized intelligence. As discussed before, measures of analogical reasoning included in the ASIS are highly related to humor ability. Both analogical reasoning and humor require resolutions of incongruities or contradictions. Prior studies using nonverbal and culture-free intelligence tests only in the assessment of intelligence show relatively lower correlations between intelligence and humor ability (e.g., Christensen et al. 2018; Greengross and Miller 2011; Howrigan and McDonald 2008; Kellner and Benedek 2016). However, general intelligence tests with verbal and nonverbal scales yield relatively higher correlations (Christensen et al. 2018; Feingold 1983).

Finally, a combination of verbal reasoning and crystallized knowledge is the best predictor of humor ability in children. The verbal analogical reasoning subtest, a measure of verbal reasoning and crystallized knowledge, has the strongest unique contribution to humor ability. It should be noted that the verbal analogical reasoning subtest of the ASIS is not a pure measure of reasoning because verbal analogies are constructed on simple to advance relational knowledge. Besides, verbal analogical reasoning together with crystalized knowledge seems to be plausibly related to humor; because the use of several humor elements, such as metaphors, humor rhymes, jokes, puns, satires, and sarcasm, requires advanced language development and verbal reasoning (Bergen 2009; Couturier et al. 1981; Ghayas and Malik 2013; Shade 1991). Although the visual analogical reasoning subtest, a measure of fluid intelligence, also measures analogical reasoning and highly correlates with humor ability, it is not a significant predictor in the regression model. The insignificance of its unique contribution to the model could result from its overlap with verbal analogical reasoning, as seen in Table 5. The high level of shared variance (51%) in the model provides evidence for several overlaps among the variables. In short, prior studies found crystallized intelligence to be the best predictor of humor ability in adults (e.g., Christensen et al. 2018; Kellner and Benedek 2016; Greengross and Miller 2011). This study shows that verbal reasoning, particularly verbal analogical reasoning, combined with crystallized knowledge, is the best predictor of humor ability in children.

5 Limitations

Several factors may limit the generalizability of the findings in the current study. First, producing captions for cartoons is not the full measure of humor ability. Caption writing is only one indicator of humor ability but not an indicator of being humorous in real social life. Second, we had no evidence of whether the participants saw one or more of the cartoons before participating in this study. We only assume that they were not exposed to the cartoons before. Last, the study included a dissimilar number of participants in each intelligence cluster; thus, categorical comparisons should be interpreted cautiously.

Acknowledgments: This study was supported by a grant from Anadolu University (Grant No: 1504E151).We thank Mr. Selçuk Erdem for sharing the cartoons with us for use in this research.

Appendix

Cartoons used in the study

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