Universiteit Utrecht

How does age relate to humor production and cognitive functioning?

Panagiotis Tsiftsis (6815146)

Department of Clinical Psychology, Utrecht University

Course: 201500819

Supervisor: Doosje, Sibe PhD

August 02, 2020

Words count: 4999

Abstract

Since there are two different tasks measuring humor production ability, there is confusion how humor production is actually defined. Also, since there are no studies that examined aging factors by applying actual humor production tasks next to cognitive functioning, the research question "how does age relate to humor production and cognitive functioning?" was examined. Specifically, 157 Dutch and Greek speaking participants in the age range from 18 to 83 produced humor by filling in funny cartoon captions and by undergoing a Digit Span test. This study attempts to understand the human's strengths and restrictions in order to improve the mental health system by giving rise to a more positive approach in Clinical Psychology and psychotherapy. The study's results reveal a negative relationship between aging and cognitive functioning and another negative one between aging and humor production. Finally, a positive relationship was found between cognitive functioning and humor production after conducting a correlation and a stepwise multiple regression analysis. A further moderated regression analysis revealed no moderation of age between cognitive functioning and humor production ability. However, a mediated regression analysis showed an indirect effect of age on humor production through cognitive functioning. From those findings, it is assumed that younger mental health specialists are more capable in applying humor as an adjunct to psychotherapy compared to older, more experienced mental health specialists and that elderly people, due to age-related decline of humor production ability, do need cognitive training to improve this social skill in order to enhance their well-being.

How does age relate to humor production and cognitive functioning?

Humor production, originating from Positive Psychology, plays a significant role in our daily life, since it can improve mood and well-being, minimize tensions and empower social bonds (Maiolino & Kuiper, 2014; Ruch & Heintz, 2019). According to psychiatrist Bohne (2010), psychotherapy without humor is like a surgery without anesthesia, addressing the importance of humor in Clinical Psychology. In this regard, humor has always been a valuable component not only for its positive effects, but also due to its utility in helping clients improving their emotional distress and finally their negative way of thinking (Davidhizar & Bowen, 1992; Hull et al., 2017). Furthermore, it doesn't play only an important role in building a good therapeutic relationship with patients, but by directly applying it as an adjunct to other psychotherapeutic techniques, symptoms, such as fear and depressive mood can be addressed as well (Sultanoff, 2013;Ventis et al., 2001, Wellenzohn et al., 2016).

Humor production can be empirically distinguished from humor production tasks on the one hand and from humor reproduction tasks on the other. To define, humor production generally is a cognitive skill, in which someone makes specific comments that bring other people to laughter (Greengross, 2014). Humor production tasks have a creative, open nature and require from participants to write something funny, when captionless cartoons are presented (Christensen et al., 2016; Feingold & Mazzella, 1991; Koppel & Sechrest, 1970). Most of the studies measured humor production by using independent judges in order to rate the participant's produced captions by employing measurement scales (Christensen et al., 2016; Greengross & Miller, 2011; Greengross, 2014; Greengross et al., 2020; Mickes et al., 2012).

On the contrary, humor reproduction tasks comprise a test, in which individuals receive a beginning joke, which has to be finished by producing a funny ending to joke fragments (Bihrle et al., 1986; Brown et al., 2005; Brownell et al., 1983; Feingold & Mazzella, 1991; Mak & Carpenter, 2007; Shammi & Stuss, 1999; 2003; Uekermann et al., 2006). Those are generally available either in a cartoon or in a verbal form.

When speaking of the relation between cognitive abilities and humor production, still concerning humor reproduction tasks, general schemata, such as knowledge (Chan et al., 2013), language and perceptual processing, cognitive flexibility and the working memory seem to be necessary components for this task (Brownell et al., 1983; Greengross, 2013; Shammi & Stuss, 1999; 2003; Uekermann et al., 2006).

Furthermore, only humor reproduction tasks empirically examined the association with aging factors. Specifically, Greengross and Miller (2013) maintain that humor does

differ among several age groups, with older age groups (i.e., participants above 60 years) performing worse than younger ones by choosing the wrong joke ending instead of the correct one and therefore making more errors (Greengross, 2013; Mak & Carpenter, 2007; Shammi & Stuss, 2003; Uekermann et al., 2006).

Still regarding cognitive functioning, younger participants had better results on cognitive tests by measuring the short-term or either the working memory's contribution (Mak & Carpenter, 2007; Shammi & Stuss, 1999; 2003; Uekermann et al., 2006). To relate, the study's findings revealed that poor performance on cognitive tests was related to poorer results on humor reproduction tasks, which shows that weaker performance on humor reproduction tasks was related to declines in cognitive abilities (Shammi & Stuss, 1999; 2003).

So far, only Mak and Carpenter (2007) examined the short-term memory's contribution on humor production ability by utilizing a humor reproduction task. They found that the short-term memory particularly is not statistically correlated with humor production ability, whereas other cognitive tests seem to be. Yet, it is still not known how far the short-term memory as a cognitive functioning ability is related to actual humor production, even though it is expected that age and cognitive functioning affect humor production and that cognitive abilities as well as humor production abilities decline due to aging. Next to that, humor production is not clearly defined in previous studies since this term is inconsistently used in two different tasks that measure humor production ability, as stated above (Greengross & Miller, 2011; Greengross, 2013; Greengross et al., 2020; Mak & Carpenter, 2007). For this reason, there is a need for a consistent definition of humor production and a clear distinction of this term in order to improve methodologies by finally drawing more valid conclusions. Additionally, as also mentioned above, research that measures aging in relation to humor production mainly focuses on humor reproduction tasks and it still remains unclear, how far aging relates to humor production ability (Mak & Carpenter, 2007; Shammi & Stuss, 1999; 2003; Uekermann et al., 2006).

Since humor may benefit Clinical Psychology and psychotherapy by facilitating therapeutic alliance and by improving existing techniques, it is worth fostering research regarding humor production ability (Davidhizar & Bowen, 1992; Hull et al., 2017; Sultanoff, 2013; Ventis et al., 2001). Knowing more about the client's or the mental health specialist's abilities and cognitive constraints and by considering Positive Psychology research regarding humor production ability, the mental health service can be significantly facilitated and improved. In this regard, rise can be given towards a positive and alternative approach in

Clinical Psychology and psychotherapy and helping clients to enhance their well-being (Wood & Tarrier, 2010).

Therefore, this study aims to fill that niche by considering a diverse sample in terms of age in order to draw conclusions about age differences regarding cognitive functioning and humor production (Greengross & Miller, 2011). In order to do so, the following research question will be examined: How does age relate to humor production and cognitive functioning?

Participants will be asked to actively produce humor on request, as did Christensen et al. (2016) in their study. Furthermore, we aim to measure the short-term memory's contribution as a cognitive functioning ability by means of a Digit Span Test (Mak & Carpenter, 2007).

Method

Participants

165 healthy Dutch and Greek speaking participants took part in the study. Inclusion criteria were to be fluent in those languages and at the minimum age of 18. Eight participants had to be excluded from the study due to vagueness of responses or sudden cessation of the study. After cleaning the data, 157 participants were included in the analysis (67 males, 42.70 %, 90 females, 57.30 %). The participants' overall age range was between 18-83 years with a mean age of 40.92 (*SD* = 16.77). 74 Dutch participants were included in the analysis (30 males, 40.54 %, 44 females, 59.46 %) with a mean age of 38.59 (*SD* = 15.39). 83 of the participants were Greek (37 males, 44.58 %, 46 females, 55.42 %) with a mean age of 42.98 (*SD* = 17.74). 63 of the participants were between 19 and 30 years of age, from which the most are undergraduate and master's students, who live in Utrecht and in Athens accordingly. Many of the older age groups were recruited at a Greek orthodox church in Krefeld, Germany or were either relatives or friends of the younger participants who live in the Netherlands and in Greece. Also for those participants, it was necessary to be fluent in Greek. Due to illiteracy and visual problems, some of the participants received help from another person in order to respond to the online survey.

Materials

The present study was part of a larger research project, which investigated different factors that were associated with humor and aging.

Cognitive functioning. In order to examine participants' cognitive abilities, the forward version of the Digit Span Test by Woods et al. (2011) was administered, which measures the short-term memory. This tool, which had to be adjusted, was already included in the online survey tool Gorilla (Anwyl-Irvine et al., 2020), the researchers made use of. This

test consisted of 14 trials in total with several groups of Digit Span lengths (the length of three, four and five digits appeared once, the length of six digits appeared twice, the length of seven digits appeared four times, the length of eight digits appeared three times and finally, the length of nine digits appeared twice). The lowest score that could be reached was 0 and the highest was 7. Every correct answer was added up and divided through the number of the trials of the group of length. Finally, every quotient was added up in order to build each participant's average score. Considering all participants together, the mean score for cognitive functioning was 2.84 (*SD* = 1.42).

Humor production. In order to examine each participant's humor production ability, four cartoons from 'The New Yorker' magazine were utilized in a non-random order. Those were published in the period between 1985 and 2005 and were taken from the topics crime, business, religion and psychology. In particular, the first picture comprised two prisoners, the second one an employer shouting at an employee and pointing his finger to a different direction, the third one an angel judging a dead person in heaven and finally the fourth one a psychotherapy session, with the therapist talking and the client lying on the couch (The New Yorker, 1925). Given each cartoon, participants were instructed to fill in a funny caption. For that, it was made clear that they can write anything, as long as they perceived it funny. In order to create the humor production variable, every participant's produced humor was rated by 10 independent judges. Each score was added up into a sum and then divided by the total number of the provided pictures in order to calculate the average humor score for every single participant (Greengross et al., 2020). The sample's mean humor production score was 2.39 (*SD* = .59).

Procedure

Initially, the researchers asked the *New Yorker* for permission to make use of some of their cartoons for the present study. After gaining permission, four cartoons were utilized as a humor production task.

The participants were recruited via convenience sampling. After receiving consent, the participants answered the online questionnaire which was provided via the platform Gorilla online survey. The Greek questionnaire was addressed to Greek participants, whereas the Dutch questionnaire was targeted at Dutch participants. The first page of the questionnaire included information about the research. For the case they agreed to that, they subsequently provided their active informed consent and were invited to fill out the questionnaire. In order to create the humor production task, the cartoons with the original captions initially were chosen from the *New Yorker* magazine. Afterwards, the captions of the cartoons had been

erased and the pictures were projected to the participants in a non-random order and without any time limit. The task was to write a funny caption for each given context, without any limitations. Finally, the forward version of the Digit Span Test as a visual version was administered in order to measure the short-term memory as a cognitive functioning ability. Since there was no measurement of verbal reasoning, no translation was necessary for this task.

At the end of the test battery, by clicking on another link, the participants had the opportunity to see the actual cartoons with their authentic captions from the *New Yorker* in order to make a personal comparison. Furthermore, the participants had the opportunity to get informed about the results of the present study. For the Utrecht University psychology students, a hyperlink was provided on Gorilla in order to add participant hours.

The average time to fill in the questionnaire lasted about 35 minutes. The data collection took approximately 1.5 months.

After collecting the data, the produced humor of every single participant was quantified by 10 independent judges between 20 and 63 years of age (five Dutch speaking for the Dutch sample and five Greek speaking for the Greek sample) in order to assess the funniness of the captions produced by participants. Two other judges had to be excluded due to negligence of their task. By using the Gorilla online survey tool again, those rated every produced humor from all 157 participants on a five-point scale, beginning from 1, not funny at all and ending at 5, very funny (Greengross et al., 2020). Next to that, invalid jokes (for instance those consisting of symbols or punctuations) that didn't comprise a word at least could be rated by using a special button called invalid.

Data analysis

For the calculations of the dataset, the 25th version of the SPSS program has been utilized (IBM Corp., 2017).

For analyzing the data, the Spearman's Rho correlation analysis has been utilized. Next to that, a stepwise multiple regression, a moderated regression as well as a mediated regression analysis by using the Process tool have been conducted (Field, 2013; Hayes, 2017).

Interrater reliability

In order to examine the 10 judges' agreement, the internal consistency on the rated produced humor of the 157 participants' was measured by considering both samples, the Dutch and the Greek as one. The focus was on the four provided pictures for the participants'

humor production. With this data, the Cronbach's α has been calculated for each of the four provided pictures for humor production.

As can be seen, there was an acceptable reliability among the judges' ratings, especially for cartoon three and four. Cartoon one and two were slightly under the limit, which means that the judges' agreements were questionable, but according to Gliem & Gliem (2003) not problematic (see Table 1 below).

Table 1

Judges' agreement for the participants' humor production

Cartoon	Judges	Cronbach's alpha
1	10	.690
2	10	.683
3	10	.725
4	10	.730

Note. N = 157. Judges indicates the amount of raters used in the current analysis

Results

Correlation analysis. Since the assumptions for the Pearson r correlation (normality, linearity, homoscedasticity) have not been met and due to the fact that the data for aging and for cognitive functioning were not normally distributed, the correlation between aging, cognitive functioning and humor production has been measured by the non-parametric Spearman's Rho test.

It was expected that age and cognitive functioning would affect humor production. Furthermore, it was assumed that cognitive functioning as well as humor production abilities will decline due to aging. Those hypotheses could be confirmed, since there was a statistical significant correlation among aging, cognitive functioning and humor production. The negative correlation between age and cognitive functioning (r_s = -.291, p < .01) indicates that with increasing age, cognitive functioning decreases. Moreover, the negative correlation between age and humor production (r_s = -.335, p < .01) reveals that increasing age is associated with decreased humor production ability. Also, the positive correlation between cognitive functioning and humor production (r_s = .285, p < .01) shows that better cognitive functioning leads to better produced humor (Table 2).

Table 2

Summary of Intercorrelations based on Spearman's Rho for the total sample

Variable	1	2	3
1. Age		-.291**	-.335**
2. Cognitive functioning	-.291**		.285**
3. Humor production	-.335**	.285**	

Note. $N = 157$.

*$p < .05$. **$p < .01$, ***$p < .001$

Stepwise multiple regression analysis. Afterwards, a stepwise multiple regression analysis has been conducted, since all assumptions, including normality, linearity, multicollinearity and homoscedasticity have been met.

Table 3 and Table 4 describe the two models. The first model depicts the age's contribution alone and the second one the contribution of age and of cognitive functioning on humor production ability. As expected above, aging alone [$b = -.011$, $t(155) = -4.229$, $p = .000$] does predict humor production significantly. Considering the second model, it can be seen that age [$b = -.010$, $t(154) = -3.432$, $p = .001$] and cognitive functioning [$b = .077$, $t(154) = 2.353$, $p = .020$] also significantly predict humor production, with aging ($\beta = -.269$) having a stronger impact than cognitive functioning ($\beta = .184$) on humor production. The negative relationship of humor production with aging and the positive one with cognitive functioning reveals that with increasing age, humor production becomes worse while increased cognitive functioning increases humor production.

Table 3

Summary of the Regression Models

Model	*R*	R^2	*Adjusted* R^2	R^2 Change	*F*	*df1*	*df2*	*p*
1.	.322	.103	.098	.103	17.883	1	155	.000***
2.	.367	.135	.123	.031	11.971	1	154	.020*

Note. $N = 157$.

Model 1 predictor: Age

Model 2 predictor: Age, cognitive functioning

Dependent variable: Humor production

*$p < .05$. **$p < .01$, ***$p < .001$

Table 4

Regressions of Associations Between Different Variables and the Outcome Variable humor production

Model		Estimate	*SE*	β	*t*	*p*	95 % CI	
							LL	*UL*
1.	Intercept	2.857	.119		24.024	.000***	2.622	3.092
	Age	-.011	.003	-.322	-4.229	.000***	-.017	-.006
2.	Intercept	2.563	.171		14.957	.000***	2.225	2.902
	Age	-.010	.003	-.269	-3.432	.001***	-.015	-.004
	Cognitive Functioning	.077	.033	.184	2.353	.020*	.012	.141

Note. *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit; *N* = 157; *SE* = Standard error; *β* = beta value

Dependent variable = Humor production

*$p < .05$. **$p < .01$, ***$p < .001$

Moderated regression analysis. After conducting a moderated regression analysis including a moderator, by using the Process tool by Hayes (2017) in which aging was set as the moderator between the relationship of cognitive functioning and humor production, it came out that for the overall model of $F(3, 153) = 8.679$, $p < .001$, $R^2 = .145$, the R^2 explains 14.5% of the total variance on humor production. In particular, it turned out that only cognitive functioning was a significant predictor of humor production [$b = .193$, $t(153) = 2.158$, $p = .033$], which shows that the better the cognitive functioning is, the better the produced humor will be. In this model, age alone wasn't a significant predictor of humor production [$b = -.002$, $t(153) = -.380$, $p = .701$]. The interaction between cognitive functioning and age on humor production was not significant [$b = -.003$, $t(153) = -1.396$, $p = .165$] either.

Mediated regression analysis. After examining for a mediated regression analysis of cognitive functioning between age and humor production by using the Process tool by Hayes

(2017) again, specifically for the model of $F(1,155) = 14.001$, $p < .001$, $R^2 = .083$, it came out that aging significantly predicts cognitive functioning [$b = -.025$, $t(155) = -3.742$, $p = .000$]. This indicates a negative relationship. In particular, when someone grows older, cognitive abilities do fade. The R^2 shows that aging can explain around 8.3% of the total variance in cognitive functioning. On the other hand, by considering the model of $F(2,154) = 11.971$, $p < .001$, $R^2 = .135$, it can be seen that aging significantly predicts humor production [$b = -.010$, $t(154) = -3.432$, $p = .001$] even with cognitive functioning [$b = .077$, $t(154) = 2.353$, $p = .020$] which indicates that with increasing age, humor production ability decreases and the better the cognitive functioning is, the better the produced humor will be. The R^2 shows that the model including age and the mediator cognitive functioning can explain about 13.5% of the variance on humor production. Overall, there is a significant indirect effect of age on humor production through cognitive functioning, $b = -.002$, BCa CI [-.0040, -.0002].

Discussion

The results of the present study reveal a negative relationship between aging and cognitive functioning, also between aging and humor production and a positive one between cognitive functioning and humor production when a correlation analysis has been utilized. A stepwise multiple regression analysis showed that aging alone in one model and also together with cognitive functioning in a second model significantly contribute on humor production ability. Furthermore, a moderated regression analysis revealed that there is no significant interaction between aging and cognitive functioning on humor production. Lastly, a mediated regression analysis showed a significant indirect effect of age on humor production through cognitive functioning.

To begin with the negative relationship between aging and cognitive functioning, which means that increasing age leads to decreased cognitive functioning, Uekermann et al. (2016), who utilized a working memory test, similarly with Mak and Carpenter (2007), who used a short-term memory test as a cognitive functioning ability as we did, found that older age groups perform worse on cognitive functioning tests than younger age groups. This finding makes us assume that the working memory as well as the short-term memory can be seen as two valid and similar cognitive functioning tools, which indicate that aging decreases cognitive functioning in general (Aben et al., 2012).

Regarding the negative relationship between aging and humor production, meaning that older age groups produce decreased humor compared to younger ones, the current findings are in line with former studies, in which humor reproduction tasks have been utilized and in which aging factors seem to be correlated with worse humor production scores. In

particular, older age groups tend to choose the wrong ending instead of the correct one compared to younger age groups (Greengross 2013; Shammi & Stuss, 2003; Uekermann et al., 2006). Even though humor production in our study has been measured by means of a humor production task, cartoons as humor stimuli have been utilized in both humor production tasks and also in both tasks, the effect seemed to be the same, namely that older age groups score lower on humor production, compared to younger age groups.

In terms of the positive relationship between cognitive functioning and humor production, it was found that the better the scores were at the Digit Span Test (as the cognitive functioning), the better the produced humor also was. This result is consistent with Greengross (2013), who states that a low performance on cognitive tests is related with decreased humor production ability and vice versa. Other studies, which utilized humor production tasks, such as ours, similarly found that participants with better cognitive functioning abilities produce better humor (Christensen et al., 2016; Greengross & Miller, 2011; Greengross, 2014; Koppel & Sechrest, 1970). Here again, we can assume that both humor production tasks (humor production and humor reproduction) do measure the same humor production ability, since the effects of cognitive functioning on humor production were similar in both humor production tasks (Mak & Carpenter, 2007; Shammi & Stuss, 2003).

Furthermore, there was a non statistical significant moderation of age on the relationship between cognitive functioning and humor production, meaning that age does not influence the relationship between cognitive functioning and humor production. A plausible explanation for this inconsistency may be the fact that our sample does not have enough participants aged above 80, whereas other samples have a broader age range, including participants even until 93 years of age (Mak & Carpenter, 2007), making it difficult to proof the age's deficits on the relationship between cognitive functioning and humor production. Future studies should therefore consider research with a broader age range with the emphasis on older age groups in order to test for this effect on the other two variables.

Lastly, cognitive functioning significantly mediates the relationship between aging and humor production ability. This outcome seems plausible for the reason that as long as humor production depends on aging, aging in turn depends on cognitive functioning, which does fade due to the course of time and which can be seen through the altered brain regions and their activities, such as that the prefrontal cortex is not working adequately in older ages (Moscovitch & Winocur, 1992; Shammi & Stuss, 2003; Tisserand & Jolles, 2003; West & Covell, 2003). In particular, the frontal lobes, which are part of the human brain, do degenerate when people become older. It is hypothesized that the frontal lobes are necessary

components for humor understanding (Shammi & Stuss, 2003). In this regard, humor understanding might precede humor production ability when people get inspired and identify the surprise effect when a joke is going to be produced, making the frontal lobes therefore even more valuable to justify their mediation on the other two variables.

Viewing this topic from another point, Koppel and Sechrest (1970) claim that "writing cartoon captions upon demand is rather different from the spontaneous jokes on which reputations for wittiness depend", which simply means that it is difficult to measure humor production through simple given tests, since impulsive humor production can be viewed in a different way (pp. 83). The present test however clearly expected from participants to be funny.

Focusing on the internal consistency analysis as the between 10 judges' agreement on the participants' produced humor on the four provided pictures for both samples, the Dutch and the Greek as one, we can see that overall, there was an acceptable reliability among the judges for cartoon three and four (in particular, the pictures with the angel judging a dead person in heaven and the psychotherapy session). The judges' agreement for cartoon one and two were slightly below the threshold, rendering those values questionable. This outcome may raise questions why there was a lower agreement among the judges for the first two pictures. This however is still a respectable range according to Gliem & Gliem (2003). As a future implication, it might be worth still using such topics and types of pictures in other studies with greater samples and with a greater number of judges in order to check for possible replications of this finding.

Even though the present study has significant findings, there are some limitations that have to be considered as well: The results can be barely generalized since a convenience sample, mostly consisting of students and a lesser extent of older age groups has been collected and utilized. Also, the cognitive functioning test, which has been provided online, didn't measure the participants' verbal, face to face response, which requires auditory perception, but rather the visual perception of the digits, which had to be typed (Anwyl-Irvine et al., 2020; Woods et al., 2011). Also the visual representation of the test may have been problematic, since many older age groups have visual deficits. The performance on the cognitive functioning test may have biased the end result also somewhat, since in between strange answers were given, assuming that the 14 trials distracted the participants' attention and made them respond inappropriately. This can be an indication that the cognitive functioning test was too long. Additionally, older age groups who took part in this study were illiterate, which means that sometimes a second person was required in order to help them

participating. This mediation also may have changed the actual outcome, since the transference from the elderly human's response to the second person and the transference of this response to the online survey had to be done quickly when the testing numbers rapidly were changing and only less time for processing the information was available.

Another limitation comprises the fact that in a way to justify the present study's findings, results were compared with those from another context (humor reproduction tests) rather than exclusively from one that is similar with the present study. Even though the effects of some variables and measures seem to be similar, assuming that humor production in general is the same for humor production tasks and for humor reproduction tasks, nothing to little is still known about how far those two humor production tests differ from each other.

Furthermore, little is known how far the short-term memory's and the working memory's contribution on two different humor production tasks can be generalized, since for the humor production task, other factors, such as creativity may also contribute besides the memory as a cognitive functioning in general (Martin & Ford, 2018). This might be a reason, why Mak and Carpenter (2007) had a non-statistical significant outcome regarding humor production ability, whereas we found one. Future research might also specify this uncertainty.

The present study's findings show that since aging is related to weaker cognitive functioning, which is important for humor production ability, we therefore can assume that younger age groups are more appropriate in utilizing humor as an adjunct to psychotherapeutic interventions and as an alternative approach, even though they might be less experienced than older mental health specialists (Ventis et al., 2001). This means that not only experience matters for an adequate psychotherapeutic intervention, but also that inexperienced younger age groups can benefit the clinical field of psychology, which is important information in order to improve the mental health service.

As from the above, since older age groups' humor production ability may become weaker due to weaker cognitive functioning, future research should emphasize the field of neuropsychology in helping older age groups to train their cognitive abilities (Beck, 1997; Tisserand & Jolles, 2003; West & Covell, 2001). While helping them, older age groups can be enriched with significant social skills, so that their quality of life can be enhanced (Maiolino & Kuiper, 2014).

References

Aben, B., Stapert, S., & Blokland, A. (2012). About the distinction between working memory and short-term memory. *Frontiers in psychology*, *3*, 1-9. https://doi.org/10.3389/fpsyg.2012.00301

Anwyl-Irvine, A.L., Massonnié, J., Flitton, A. Kirkham, N., Evershed, J.K. (2020). Gorilla in our midst: An online behavioral experiment builder. *Behav Res*, *52*, 388-407. https://doi-org.proxy.library.uu.nl/10.3758/s13428-019-01237-x

Beck, C. T. (1997). Humor in nursing practice: A phenomenological study. *International journal of nursing studies*, *34*(5), 346-352. https://doi.org/10.1016/S0020-7489(97)00026-6

Bihrle, A.M., Brownell, H.H., Powelson, J.A.,& Gardner, H. (1986). Comprehension of humorous and nonhumorous materials by left and right brain-damaged patients. *Brain and cognition*, *5*(4), 399-411. https://doi.org/10.1016/0278-2626(86)90042-4

Bohne, M. (2010). *Klopfen mit pep. prozessorientierte energetische psychologie in therapie und coaching*. Carl-Auer-systeme verlag und verlagsbuchhandlung GmbH.

Brown, W. S., Paul, L.K., Symington, M. & Dietrich, R. (2005). Comprehension of humor in primary agenesis of the corpus callosum. *Neuropsychologia*, *43*, 906-916. https://doi.org/10.1016/j.neuropsychologia.2004.09.008

Brownell, H. H., Michel, D., Powelson, J., & Gardner, H. (1983). Surprise but not coherence: Sensitivity to verbal humor in right hemisphere patients. *Brain and Language*, *18*(1), 20-27. https://doi.org/10.1016/0093-934X(83)90002-0

Christensen, A. P., Silvia, P. J., Nusbaum, E. C., & Beaty, R. E. (2016). Clever People: Intelligence and humor production ability. *Psychology of Aesthetics, Creativity, and the Arts*, *12(*2), 236-143. https://dx.doi.org/10.1037/aca0000109

Davidhizar, R., & Bowen, M. (1992). The dynamics of laughter. *Archives of psychiatric nursing*, *6*(2), 132-137. https://doi.org/10.1016/0883-9417(92)90009-8

Feingold, A., & Mazzella, R. (1991). Psychometric intelligence and verbal humor ability. *Personality and Iíndividual differences*, *12*(5), 427-435. https://doi.org/10.1016/0191-8869(91)90060-O

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.

Gliem, J. A. & Gliem, R. R. (2003, October 8-10*). Calculating, interpreting, and reporting cronbach's alpha reliability coefficient for likert-type scales* [Conference session].

Midwest research to practice conference in adult, continuing, and community education, Ohio, United States. https://scholarworks.iupui.edu/bitstream/handle/1805/344/Gliem+&+Gliem.pdf?sequence=1

Greengross, G., & Miller, G. (2011). Humor ability reveals intelligence, predicts mating success, and is higher in males. *Intelligence*, *39*(4), 188-192. https://doi.org/10.1016/j.intell.2011.03.006

Greengross, G. (2013). Humor and aging-a mini-review. *Gerontology*, *59*, 448-453. https://doi.org/10.1159/000351005

Greengross, G. (2014). Male production of humor produced by sexually selected psychological adaptations. In V. W. Shackelford & T. Shackelford (Eds.), Evolutionary psychology. *Evolutionary perspectives on human sexual psychology and behavior* (p. 173–196). Springer Science + Business Media. https://doi-org.proxy.library.uu.nl/10.1007/978-1-4939-0314-6_9

Greengross, G., Silvia, P. J., & Nusbaum, E. C. (2020). Sex differences in humor production ability: A meta-analysis. *Journal of Research in Personality*, *84*, 1-17. https://doi.org/10.1016/j.jrp.2019.103886

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A Regression-based approach*. Guilford publications.

Hull, R., Tosun, S., & Vaid, J. (2017). What's so funny? Modelling incongruity in humor production. *Cognition and emotion*, *31*(3), 484-499. https://doi-org.proxy.library.uu.nl/10.1080/02699931.2015.1129314

IBM Corp. (2017). *IBM SPSS Statistics for Windows*. Armonk. IBM Corp.

Koppel, M. A. & Sechrest, L. (1970). A multitrait-multimethod matrix analysis of sense of humor. *Educational and psychological measurement*, *30*, 77-85. https://doi-org.proxy.library.uu.nl/10.1177/001316447003000107

Maiolino, N. B., & Kuiper, N. A. (2014). Integrating humor and positive psychology approaches to psychological well-being. *Europe's journal of psychology*, *10*(3), 557-570. https://doi.org/10.5964/ejop.v10i3.753

Mak, W. & Carpenter, B. D. (2007). Humor comprehension in older adults. *Journal of the international neuropsychological society*, *13*, 606-614.

Martin, R. A., & Ford, T. (2018). *The psychology of humor: An integrative approach*. Academic press. https://www.elsevier.com/books/the-psychology-of-humor/martin/978-0-12-812143-6

Mickes, L., Walker, D.E., Parris, J. L., Mankoff, R., & Christenfeld, N. J. (2012). Who's funny: Gender stereotypes, humor production, and memory bias. *Psychonomic bulletin & review*, *19*(1), 108-112.

Moscovitch, M. & Winocur, G. (1992). The neuropsychology of memory and aging. In F.I.M. Craik & T.A. Salthouse (Eds.), *The handbook of aging and cognition* (pp. 315-372). Lawrence Erlbaum. https://pdfs.semanticscholar.org/1f40/3eaa349f6ff4918ba837354fcc8342d3225b.pdf

Ruch, W., & Heintz, S. (2019). Humor production and creativity: Overview and recommendations. In S. R. Luria, J. Baer, & J. C. Kaufman (Eds.), *Explorations in creativity research. creativity and humor* (p. 1–42). Elsevier Academic Press.

Shammi, P. & Stuss, D. T. (1999). Humour appreciation: A role of the right frontal lobe. *Brain, 122*, 657- 666. https://doi.org/10.1093/brain/122.4.657

Shammi, P. & Stuss, D. T. (2003). The effects of normal aging on humor appreciation. *Journal of the international neuropsychological society, 9*, 855-863. https://doi-org.proxy.library.uu.nl/10.1017/S135561770396005X

Sultanoff, S. M. (2013). Integrating humor into psychotherapy: Research, theory, and the necessary conditions for the presence of therapeutic humor in helping relationships. *The humanistic psychologist*, *41*(4), 388-399. https://doi.org/10.1080/08873267.2013.796953

The New Yorker Cartoons. (1925, February 21). The cartoon bank. https://cartoonbank.com/

Tisserand, D.J. & Jolles, J. (2003). On the involvement of prefrontal networks in cognitive aging. *Cortex, 39*, 1107-1128. https://doi.org/10.1016/S0010-9452(08)70880-3

Uekermann, J., Channon, S., & Daum, I. (2006). Humor processing, mentalizing, and executive function in normal aging. *Journal of the international neuropsychological society*, *12*, 184-191. https://doi-org.proxy.library.uu.nl/10.1017/S1355617706060280

Ventis, W. L., Higbee, G., & Murdock, S. A. (2001). Using humor in systematic desensitization to reduce fear. *The journal of general psychology*, *128*(2), 241-253.

Wellenzohn, S., Proyer, R. T. & Ruch, W. (2016). Humor-based online positive psychology interventions: A randomized placebo-controlled long-term trial. *The journal of positive psychology*, *11*(6), 584-594. https://doi-org.proxy.library.uu.nl/10.1080/17439760.2015.1137624

West, R. & Covell, E. (2001). Effects of aging on event related neural activity related to prospective memory. *Neuroreport*, *12*(13). 2855-2858. https://doi-org.proxy.library.uu.nl/10.1097/00001756-200109170-00020

Wood, A. M., & Tarrier, N. (2010). Positive clinical psychology: A new vision and strategy for integrated research and practice. *Clinical psychology review*, *30*(7), 819-829. https://doi.org/10.1016/j.cpr.2010.06.003

Woods, D. L., Kishiyama, M. M., Yund, E. W., Herron, T. J., Edwards, B., Poliva, O., Hink, R. F. & Reed, B. (2011). Improving digit span assessment of short-term verbal memory. *Journal of clinical and experimental neuropsychology*, *33*(1), 101-111. https://doi-org.proxy.library.uu.nl/10.1080/13803395.2010.493149