



“Not in the mood”: The fear of being laughed at is better predicted by humor temperament traits than diagnosis in neurodevelopmental conditions

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ARTICLE INFO

Keywords:

Autism
Down syndrome
Williams syndrome
Gelotophobia
Humor temperament

ABSTRACT

Background: Research has shown that autistic individuals seem to be more prone to develop gelotophobia (i.e., the fear of being laughed at) than typically developing individuals. The goals of the present study were to discover whether the high levels of gelotophobia found in autism in previous studies were replicated here, to expand the research to Down syndrome (DS) and Williams syndrome (WS), and to assess the relation between individual differences and social impairments, affective predispositions, and humor temperament.

Methods: Questionnaires were distributed to parents of autistic individuals (N = 48), individuals with DS (N = 139), and individuals with WS (N = 43) aged between 5 and 25 years old.

Results: Autistic individuals were shown to frequently experience at least a slight level of gelotophobia (45%), compared to only 6% of individuals with DS and 7% of individuals with WS. Interestingly, humorless temperament traits (i.e., seriousness and bad mood) manifested as the strongest predictors of gelotophobia. This relation even transcended group differences.

Conclusion: The results confirm that gelotophobia seems to be particularly concerning for autistic individuals, whereas individuals with DS and WS seem to be more protected from developing such a fear. Moreover, it appears that gelotophobia seems to be more linked to high seriousness and irritability than diagnosis.

1. Introduction

Autism spectrum disorder (ASD) is characterized by difficulties in social interactions and communication, and repetitive restrictive behaviors (American Psychiatric Association, 2013). Autistic individuals also seem to have a particular socio-emotional profile, characterized by difficulties with Theory of Mind (Baron-Cohen et al., 1985), reduced social motivation (Chevallier et al., 2012), a tendency to experience negative emotions more frequently (Samson et al., 2012), and a tendency to express positive affect less clearly

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<https://doi.org/10.1016/j.ridd.2023.104513>

Received 25 February 2022; Received in revised form 1 March 2023; Accepted 9 April 2023

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(Joseph & Tager-Flusberg, 1997). Furthermore, autistic individuals have been described as having a particular relation to humor and laughter (Samson, 2013; Treichel et al., 2022). Indeed, Samson et al. (2011) found that autistic individuals have a greater tendency to develop a fear of being laughed at than their typically developing peers. However, there is little research to date about this fear in other neurodevelopmental conditions, nor much insight about the link to individual characteristics.

The fear of being laughed at is called *gelotophobia* (from the ancient Greek *gelos*, which means “laughter” and *phobos*, which means “fear”), and is associated with the tendency to interpret others’ laughter as if it were aimed towards oneself, feeling ashamed and ridiculed as a consequence. Also present in the general population, gelotophobes consequently tend to be “agelotic”, meaning they are less likely to appreciate any types of laughter than non-gelotophobes (Titze, 2009). Gelotophobes experience a higher level of shame, anger and fear when exposed to ridicule than non-gelotophobes and they are more likely to experience negative emotions, even in the case of good-natured teasing (Platt, 2008). Furthermore, they are more likely to ascribe negative attributes (such as unpleasantness) to laughter (Ruch et al., 2009a), and seem to express less joyful smiles and more expressions of contempt than non-gelotophobic individuals as a response to laughter-eliciting videos (Ruch et al., 2015). Recent research has also revealed how gelotophobia affects the ability to develop close relationships: it is related to a lower likelihood of being in a romantic relationship, it is positively associated with attachment anxiety and avoidance (Brauer et al., 2020), as well as a greater jealousy (Brauer et al., 2021), and it is negatively associated with romantic relationship satisfaction (Brauer & Proyer, 2018).

The causes of gelotophobia appear to be numerous, and still need to be explored to be fully understood. Several authors highlight repeated and persisting experiences of being ridiculed and bullied as risk factors of developing a fear of being laughed at (Leader et al., 2018; Platt et al., 2009; Ruch et al., 2014). Personality traits, including high neuroticism, emotionality, and Machiavellianism, as well as low extraversion, narcissism, and honesty-humility seem to be associated with the development of gelotophobia (Ruch et al., 2013; Torres-Marín et al., 2019; Tsai et al., 2018). (Ruch et al., 2009b) also highlighted the association with humor temperament. Unsurprisingly perhaps, gelotophobes appear to be rather serious, irritable and not very cheerful. Studies have also revealed how gelotophobia is related to mental health: It is positively correlated with the number of years spent in psychiatric care, with personality disorders, schizophrenic disorders (Forabosco et al., 2009), and in particular with Cluster A personality disorder (Weiss et al., 2012). Havranek et al. (2017) have also shown that gelotophobia is related to social anxiety disorder and avoidance personality disorder, even suggesting that gelotophobia be added as a diagnostic criterion for these two disorders. Furthermore, Brauer et al. (2022) examined the relation between gelotophobia and maladaptive personality traits (derived from the *Personality Inventory for DSM-5*; Krueger et al., 2012). Self- and other-reports revealed that gelotophobia correlated positively with Negative Affectivity, Detachment, and Psychoticism. To summarize, when considering individual factors, research has mainly highlighted the association with childhood experiences, personality traits, and mental health on the development of gelotophobia.

There is growing evidence of a high incidence of gelotophobia in autistic individuals without intellectual disability (ID), ranging between 40% and 45% of at least a ‘slight’ level of gelotophobia (Samson et al., 2011; Tsai et al., 2018; Wu et al., 2015). Leader et al. (2018) even found a higher rate in their study, with 87.4% of autistic individuals without ID experiencing gelotophobia. Tsai et al. (2018) further examined personality traits in relation to gelotophobia in autistic individuals, observing that a lower level of extraversion acted as a mediator to the higher level of gelotophobia in this group. Interestingly, their results revealed that lower levels of extraversion (rather than being on the autism spectrum) were related to higher levels of gelotophobia. This suggests that the higher fear of being laughed at in individuals with ASD is linked to some of the associated characteristics of ASD, rather than an integral part of the diagnosis itself. This finding is potentially very important when trying to understand the origins of gelotophobia in ASD. Furthermore, it is unclear whether this phenomenon is specific to ASD or whether it might concern neurodevelopmental conditions more generally. Indeed, to date, studies have only compared autistic individuals to TD individuals. A cross-diagnosis study is necessary to discern whether the origins of gelotophobia are specific to ASD or whether they are better explained by particular individual difference traits, for example.

However, so far, little is known about gelotophobia in neurodevelopmental conditions beyond ASD. With this in mind, the current study is the first to examine gelotophobia in other neurodevelopmental conditions, namely Down syndrome (DS) and Williams syndrome (WS). DS is a genetic disorder (affecting 1 in 800 live births, Lanphear & Castillo, 2007) characterized by non-verbal ID as well as specific language difficulties (Chapman & Hesketh, 2000). The associated behavioral skills are comparable to those of individuals with other neurodevelopmental conditions with ID, although individuals with DS are usually characterized as having fewer maladaptive behaviors than cognitively-matched individuals (Chapman & Hesketh, 2000). WS is a rare genetic disorder (1 in 20,000 live births, Morris et al., 1988) notably characterized by mild to moderate ID (Korenberg et al., 2000), maladaptive behaviors, a gregarious personality, and high positive affect (Järvinen et al., 2013). Individuals with DS or WS are generally described as having difficulties with Theory of Mind (Neitzel & Penke, 2021; Tager-Flusberg & Sullivan, 2000), with some social competences in the domains of social awareness, social cognition, social communication, and restrictive repetitive behaviors (Channell, 2020; Fisher & Morin, 2017), and experience similar rates and types of victimization than autistic individuals (Fisher et al., 2013), reporting increased incidences of being bullied (Fisher et al., 2017; Jackson et al., 2014) and difficulties sustaining friendships (Iarocci et al., 2008; Järvinen et al., 2013).

Given how many of the characteristics that might influence the perception of others’ laughter are shared with autistic individuals, it could be reasonably expected that individuals with DS and WS experience a similarly high level of gelotophobia. However, autistic individuals have been described as having temperament traits that are positively correlated with gelotophobia (Ruch et al., 2009b): they have been reported to typically be rather serious, not very cheerful, and to have a tendency to be irritable (to be in a bad mood) (Samson et al., 2013). This contrasts with individuals with DS and WS who are generally described as being cheerful (Grieco et al., 2015; Tager-Flusberg & Sullivan, 2000), highly sociable and as having abnormally high social approach tendencies (Little et al., 2013; Porter et al., 2007). As such, individuals with DS and WS can be described as being at the opposite extreme of a social motivation scale

to autistic individuals (Treichel et al., 2022). Cheerfulness and high social motivation might be expected to be protective factors against the development of a fear of being laughed at. One might therefore expect individuals with DS and WS to experience less gelotophobia than their autistic peers. In short, the question of whether gelotophobia is generally experienced by individuals with neurodevelopmental conditions, rather than being limited to autistic individuals, remains to be answered.

To summarize, the first goal of the present study was to discover whether the high levels of gelotophobia found in autism in previous studies were replicated here, and to expand the research to other neurodevelopmental conditions. The second goal was to gain a more in-depth understanding of the individual differences that could predict the existence and levels of gelotophobia. Traits were included that have been shown to be related to the appreciation of others' laughter, namely (1) social impairments, (2) predisposition towards positive and negative affect, and (3) one's humor temperament. With these two goals in mind, questionnaires were distributed to parents of young individuals with ASD, DS and WS. We hypothesized that autistic individuals experienced higher levels of gelotophobia than individuals with WS and DS, but we expected no difference between WS and DS. We also expected social impairments, predispositions towards negative and positive affect, and humor temperament to be correlated with gelotophobia. More specifically, we expected lower social motivation to be a significant predictor for a higher level of gelotophobia in ASD and that higher social motivation would act as a protective factor for DS and WS.

2. Methods

2.1. Participants

Parents of 48 autistic individuals, 139 individuals with DS and 43 individuals with WS between the ages of 5 and 25 years-old participated in a large survey-based online study. All participants answered the questionnaires in English. The majority of the children lived in England (83.48%, $N = 192$) or Scotland (8.70%, $N = 20$), while the remaining 9.13% ($N = 21$) were from various other countries. Almost all the parents (92.17%, $N = 212$) reported their child's ethnic origin as White (i.e., British, Welsh, Scottish, Northern Irish, Irish, or any other white background) (see supplementary section for full details).

2.2. Procedure

Parents were recruited through emails to participants from previous studies in the UK, to schools and associations, and through social media. The inclusion criterion was to be a parent of a child between 5 and 25 years-old on the autism spectrum, with DS or with WS. This study is a part of a larger survey-based study which includes 23 questionnaires on socio-emotional processing in neurodevelopmental conditions. Parents were paid £ 50 if they took part in the entire study. The study was approved by the local institutional review board of Unidistance Suisse.

2.3. Instruments

For this study, data from 4 questionnaires was analyzed to assess gelotophobia, social impairment, affective predispositions and humor temperament.

2.3.1. Gelotophobia

To assess gelotophobia, the 10 items assessing gelotophobia in the PhoPhiKat-30c (Proyer et al., 2012), a questionnaire assessing laughter and ridicule in 6–9 year-old children, were used. For the current study, the questions were translated and back-translated from German to English and then adapted for parents-report (e.g., “When *my child* hears others laughing, *s/he* thinks they are laughing at *him/her*”). Items were rated on a 4-point scale (1 = “strongly disagree”, 2 = “moderately disagree”, 3 = “moderately agree”, and 4 = “strongly agree”). Ruch and Proyer (2008) defined cut-offs for the use of the GELOPH-15 in an adult population, which were also used in this study, in order to differentiate between people who experience ‘slight’ (mean score ≥ 2.5), ‘marked’ (≥ 3) or ‘extreme’ (≥ 3.5) gelotophobia and those who experience ‘none’ (< 2.5). Note that these cut-offs were defined from a 15-item self-administered questionnaire for adults. However, the same version has previously been shown to be reliable for studying children and adolescents: Führ (2010) tested the reliability of the self-reported Danish version of the GELOPH-15 on 11–16 years-old individuals, and found good psychometric properties. Tsai et al. (2018) also used the GELOPH-15 and its cut-offs to examine gelotophobia in Taiwanese adolescents between 14 and 18 years-old. In the present study though, a shorter version of 10 items built for children was used. Therefore, the cut-offs defined by Ruch and Proyer (2008) need to be interpreted cautiously in the present study. Additionally, the questionnaire was adapted for parental report which could also influence the evaluation of individuals' gelotophobia. However, previous research has shown that gelotophobia seems to be accurately perceived by others (e.g., self-other agreement correlations: $r = 0.51$ in Brauer et al., 2021; $r = 0.49$ and $r = 0.53$ in Brauer et al., 2022).

2.3.2. Social impairments

Social impairments, restricted interests, and repetitive behaviors, were assessed using the second edition of the Social

Responsiveness Scale (SRS-2)¹ (Constantino & Gruber, 2012), which is a 65-item questionnaire intended for individuals on the autism spectrum or their parents. It is used to identify the severity of social impairments, and thus partially detect autistic symptoms. The items are divided into 5 subscales: social awareness (e.g., “His/her facial expressions send the wrong message to others about how he/she actually feels”), social cognition (e.g., “Takes things too literally, and because of that, he/she misinterprets the intended meaning of parts of conversation”), social communication (e.g., “Is able to communicate his/her feelings to others”), social motivation (e.g., “Would rather be alone than with others”), and restricted interests and repetitive behavior (e.g., “When under stress, engages in rigid or inflexible patterns of behavior that seem odd to people”). Two versions were used, according to the child’s age: a child version (age under 18) and an adult version (age equal or above 18). In both versions, items are similar but differentially formulated to correspond to the person’s age. The same 4-points scale was used in both versions (1 = “not true”, 2 = “sometimes true”, 3 = “often true”, and 4 = “almost always true”).

A total raw score including all subscales was calculated, ranging from 65 to 260. Cutoffs have been defined as part of the SRS-2 scoresheet, based on the raw score, to determine the presence and severity of social impairments: none (lower than 68), mild (between 68 and 84), moderate (between 85 and 112), and severe (equal or higher than 113). A raw score was calculated for each subscale separately, ranging from 8 to 32 for social awareness, from 12 to 48 for social cognition and restricted repetitive behavior, from 22 to 88 for social communication and from 11 to 44 for social motivation. It is important to specify that in the present study, the scores of the SRS were used to compare general tendencies in social impairments, not to establish a diagnosis.

2.3.3. Affective predisposition

To measure predisposition (or mood) towards more positive or more negative affect, we used the PANAS (Watson et al., 1988). The parents were presented a series of 20 affective states and asked about the extent to which their child had felt each of them during the past few weeks. There are two sub-scales: positive affect (i.e., interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, active) and negative affect (i.e., distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, afraid). Each answer was scored on a 5-point scale (1 = “very slightly or not at all”, 2 = “a little”, 3 = “moderately”, 4 = “quite a bit”, and 5 = “extremely”). A score between 10 and 40 for both positive and negative affect separately was calculated.

2.3.4. Humor temperament

To measure humor temperament, the 30-item trait version (STCI-T30) of the State and Trait Cheerfulness Inventory (STCI) (Ruch et al., 1996) was used. This questionnaire measures the level of three components that are related to the temperament influencing an individual’s experience towards humor: cheerfulness, seriousness and bad mood. Each of these components represents a subscale in the questionnaire, with 10 items for each. Cheerfulness (e.g., “Everyday life often gives my child the occasion to laugh”) is seen as a facilitator towards a humorous temperament, whereas seriousness (e.g., “One of my child’s principles is: “first work, then play”) and bad mood (e.g., “My child is often sullen”) are traits that make individuals less inclined to respond positively to humorous stimuli. For parents of adults (more than 18 years-old), the STCI-T30 short trait form was used and adapted for parents-report. For parents of children under 18 years-old, the STCI-T30 peers-evaluation form was used, because the questions were more adapted for reporting children’s experiences. The questions were rated on a 4-point scale (1 = “strongly disagree”, 2 = “moderately disagree”, 3 = “moderately agree”, and 4 = “strongly agree”). A score for each subscale was calculated, ranging from 10 to 40.

2.4. Data analysis

Analysis of the data consisted of three steps, (1) reliability analysis, (2) descriptive statistics of questionnaire scales, and (3) multiple linear regression of gelotophobia.

2.4.1. Reliability analysis

First, we evaluated the reliability of subscales (using the individual item scores) and total scales of the gelotophobia, SRS, PANAS, and STCI instruments by calculating Cronbach’s alpha for the general sample, and for each diagnosis group. The cutoff for acceptable reliability was set at $\alpha_C = 0.7$. Scales that scored lower than this cutoff were further subjected to a leave-one-item-out analysis, to check if reliability could be improved by dropping one or more items.

2.4.2. Descriptive statistics

Second, we calculated descriptive statistics for all three diagnosis groups (ASD, DS, WS) on the relevant measures (demographical variables, gelotophobia, SRS subscales, PANAS subscales, STCI subscales; see Table 1). The descriptive analysis also tested for significant group differences, using ANOVA *F*-tests to test mean differences in continuous variables, and a chi-square test to test for gender balance differences. In addition, we calculated and plotted Pearson correlations between all variables, using dummy variables (0–1 coded) to represent individual levels of the diagnosis and gender variables. For the autistic individuals, we additionally checked whether mean gelotophobia differed between participants with ID present (20), participants with ID absent (12), and participants with ID unknown (16).

¹ For the online administration of the SRS-2, we obtained the permission to adapt the format for specific, limited research use under license of the publisher, WPS (rights@wpspublish.com).

Table 1
Demographic and trait differences between groups.

Scale	ASD (n = 48) N	DS (n = 139) N	WS (n = 43) N	F / χ	DF	P	ϵ_p^2/φ_c
Gender (F/M)	9/38	60/79	15/28	8.796	(2)	0.0123	0.20
	Mean (SE)	Mean (SE)	Mean (SE)				
Age (average in years)	10.3 (0.80)	11.5 (0.46)	11.7 (0.83)	1.070	(2,226)	0.3449	0.00
Gelotophobia	2.4 (0.09)	1.4 (0.05)	1.5 (0.09)	50.294	(2,225)	< 0.0001	0.30
SRS – Social motivation	19.1 (0.88)	11.2 (0.52)	10.0 (0.94)	34.390	(2,224)	< 0.0001	0.23
SRS – Social awareness	13.0 (0.57)	10.6 (0.34)	11.5 (0.61)	6.596	(2,224)	0.0016	0.05
SRS – Social cognition	20.7 (0.90)	16.8 (0.53)	20.5 (0.96)	10.342	(2,224)	< 0.0001	0.08
SRS – Social communication	37.2 (1.56)	24.0 (0.93)	27.5 (1.67)	26.320	(2,224)	< 0.0001	0.18
SRS – Restricted interests and repetitive behavior	22.0 (1.11)	16.0 (0.66)	18.9 (1.19)	11.184	(2,224)	< 0.0001	0.08
SRS – Total	111.9 (4.51)	78.6 (2.67)	88.5 (4.82)	20.244	(2,224)	< 0.0001	0.15
PANAS – Positive affect	30.4 (0.98)	33.8 (0.58)	32.8 (1.04)	4.527	(2,225)	0.0118	0.03
PANAS – Negative affect	28.0 (1.07)	19.9 (0.64)	23.7 (1.14)	21.772	(2,225)	< 0.0001	0.15
STCI – Cheerfulness	26.6 (0.61)	32.6 (0.36)	32.0 (0.64)	36.756	(2,223)	< 0.0001	0.24
STCI – Seriousness	25.3 (0.61)	16.9 (0.36)	17.4 (0.64)	74.141	(2,223)	< 0.0001	0.39
STCI – Bad mood	27.7 (0.76)	17.9 (0.46)	18.5 (0.81)	62.596	(2,223)	< 0.0001	0.35

Note. ASD autism spectrum disorder, DS Down syndrome, WS Williams syndrome, SRS social responsiveness scale, PANAS positive and negative affect scale, STCI state trait cheerfulness inventory. One parent in the ASD group did not indicate their child's gender.

2.4.3. Multiple linear regression

Third, we conducted a stepwise multiple linear regression, with mean gelotophobia as the dependent variable, and three blocks of variables as independent variables (IVs), which were entered sequentially into the model. The first block consisted only of the diagnosis group variable, the second block added the demographical variables, and the third block added the questionnaire variables (subscales of SRS, PANAS, and STCI). As such, four models in total were fitted, with the first consisting of the “empty” null model, containing only an intercept parameter, and the three subsequent models adding variable blocks incrementally. For each added block of IVs, we inspected the significance of effects with *F*-tests, and conducted pairwise contrasts between diagnosis groups using *t*-tests. As measures of effect, we computed partial ϵ^2 for *F*-tests, and standardized mean differences for *t*-tests.

At each stage of model building, we evaluated the goodness-of-fit of the model with R^2 and adjusted R^2 . Furthermore, model diagnostics were run to check violations of regression assumptions, including multicollinearity, outliers and influential cases, heteroscedastic residuals, and non-normal residuals. Multicollinearity (i.e., excessive correlation between IVs) was diagnosed by inspecting variance inflation factors (VIF) for effects, with effects exceeding a VIF of 10 removed from the final model (Kutner et al., 2005). Influential cases were diagnosed by the combined information of DFBETAs, DFFITs, covariance ratios, Cook's distances, and the hat matrix diagonals (Kutner et al., 2005). Heteroscedasticity (i.e., non-constant variance of residuals) was diagnosed with the Breusch-Pagan test. Non-normally distributed residuals were diagnosed by visual inspection of quantile-quantile (QQ) plots of residual quantiles against quantiles expected under a normal distribution. In case of heteroscedasticity, we adjusted standard errors of inferential tests using the heteroscedasticity-corrected HC3 estimator (Long & Ervin, 2000). In case of non-normality, we calculated as a back-up non-parametric *p*-values from an equivalent permutation regression model, using the Freedman-Lane method for permutation, and 5000 random permutations to obtain permutation *p*-values (Frossard & Renaud, 2019).

All inferential tests were conducted at a reduced significance level of $\alpha = 0.005$. We chose this as a general correction for reducing the likelihood of finding false positive results, in accordance with recent proposals for improving the reproducibility of findings (Benjamin et al., 2018).

2.4.4. Software

All analyses were run using the R statistical software, version 4.0.3 (R Core Team, 2020), using packages “car” (Fox & Weisberg, 2019), for general Type II ANOVA, heteroscedasticity-corrected ANOVA, and variance inflation factors, “psych” (Revelle, 2020), for reliability analysis with Cronbach's alpha, “corrplot” (Wei & Simko, 2017), for visualizing correlations, “permuco” (Frossard & Renaud, 2019), for permutation regression, effect size (Ben-Shachar et al., 2020), for effect sizes, “emmeans” (Lenth et al., 2020), for model-based contrasts, “lmtest” (Zeileis & Hothorn, 2002), for heteroscedasticity-corrected pairwise contrasts.

3. Results

3.1. Reliability analysis

Reliability analyses with Cronbach's alpha revealed generally good reliability for all scales and subscales, and for all groups, with alpha values exceeding 0.7 and sometimes approaching 1.00 (see [supplementary material](#)). Total scales were more reliable than subscales. SRS – Social awareness had the lowest overall reliability, although not much below 0.7. An inspection for this subscale with a leave-one-item-out analysis did not identify any individual item that could be dropped, such that the desired reliability could be reached. The ASD group revealed some slight instabilities compared to the other two groups, with reduced reliability for SRS – Social awareness, STCI – Cheerfulness, and STCI – Bad mood.

3.2. Descriptive statistics

As revealed in Table 1, autistic individuals, individuals with DS, and individuals with WS did not differ regarding their age. The groups differed regarding gender, there were more male autistic individuals (see Table 1).

Parents were asked to estimate their child's ID (i.e., learning disabilities) level on a 3-point scale: 1) mild to moderate, 2) severe, or 3) none. The distribution of the general ID estimation per group can be seen in Table 2. As expected, all individuals with DS and WS for whom such data was reported showed at least mild to moderate ID, whereas the group with autistic individuals was more cognitively diverse. In addition, the severity of autistic symptoms related to social impairments was measured with the total score of the Social Responsiveness Scale (SRS-2) (Constantino & Gruber, 2012). All but one of the autistic children showed clinically significant social impairments. Individuals with DS and WS showed more diverse levels of social impairments. The distribution of the severity of social impairments in all groups can be found in Table 2.

The percentages of individuals who experience gelotophobia differed in each group: (see Fig. 1): 60% of the autistic individuals displayed at least a slight level of gelotophobia: 37.5% slight ($N = 18$), 20.8% marked ($N = 10$) and 2.1% extreme ($N = 1$). 39.6% ($N = 19$) showed no particular fear of being laughed at. A great majority of the DS individuals, 94.3% ($N = 131$) experienced no such fear, only 6% experienced gelotophobia: 3.6% ($N = 5$) slight, 0.7% ($N = 1$) marked and 1.4% ($N = 2$) extreme. Individuals with WS displayed almost identical results to individuals with DS: 93% experience no fear ($N = 40$), 4.8% slight ($N = 2$), 2.3% extreme ($N = 1$) and no participant displayed a marked fear.

The three groups differed significantly on all measures (gelotophobia, SRS subscales, PANAS subscales, STCI subscales), at $\alpha = 0.005$, with the exception of the PANAS-Positive affect subscale, age, and gender (Table 1). Within the autistic individuals, there were no significant differences in mean gelotophobia between different levels of ID (present, absent, unknown), $F(2,45) = 1.256$, $p = .2947$, $\epsilon_p^2 = .01$.

Correlation analysis using Pearson correlation (Fig. 2) revealed that being on the autistic spectrum was significantly positively correlated with all questionnaires' (sub)scales, except PANAS – Positive affect (not significant), and STCI – Cheerfulness (negative). The reverse pattern was observed for the DS group, for whom group membership was negatively correlated with all the tested individual characteristics, except for PANAS – Positive affect and STCI – Cheerfulness (positive). The diagnosis of WS was not significantly correlated to any questionnaire (sub)scale. Age and gender were also not significantly correlated to questionnaire (sub)scales, with the exception of a negative correlation between age and PANAS – Positive affect. SRS subscales were significantly intercorrelated, as were STCI subscales. The two PANAS subscales were not significantly correlated.

3.3. Multiple linear regression

Results of the stepwise regression procedure are summarized in Table 3. Group differences in mean gelotophobia were significant (Model 1). Pairwise contrasts revealed that mean gelotophobia was significantly higher for autistic individuals ($\mu_{ASD} = 2.40$) versus individuals with DS ($\mu_{DS} = 1.40$), $t(225) = 9.825$, $p < .0001$, $\beta_z = 1.38$, and versus individuals with WS ($\mu_{WS} = 2.40$), $t(225) = 7.437$, $p < .0001$, $\beta_z = 1.30$. Mean gelotophobia did not differ significantly between individuals with DS and WS, $t(225) = -0.494$, $p = .62$, $\beta_z = -0.07$. These differences remained significant after controlling for demographical variables (Model 2), but disappeared after additionally controlling for questionnaire variables (Model 3). In Model 3, no pairwise contrasts between diagnosis groups reached significance (all $p > .05$).

Model 3 explained about 60% of the observed variance in gelotophobia, $R_{adj}^2 = .595$. Only effects of STCI – Seriousness and STCI – Bad mood were significant. Respectively, higher STCI – Seriousness and higher STCI – Bad mood predicted higher mean gelotophobia. Effects of other individual characteristics were not found to be significant in Model 3. However, there were trend effects for SRS – Social communication and age. Respectively, higher SRS – Social communication and higher age predicted higher mean gelotophobia.

Model diagnostics did not reveal any important violations of assumptions. No issues with multicollinearity, influential cases, or non-normal residuals were detected. Regarding heteroscedasticity, the Breusch-Pagan test was significant for Model 3, $\chi(14) = 43.397$, $p < .0001$, suggesting evidence against constant variance of residuals. However, a heteroscedasticity-corrected ANOVA using the HC3 estimator resulted in identical conclusions regarding the effects of diagnosis group and questionnaires. Finally, permutation regression p -values were calculated for all models, as a back-up against violations of non-normality, but these differed little from the parametric p -values (see Table 3).

Table 2

Description of the children's characteristics.

Group (total n)	ID				SRS (severity of autistic symptoms)			
	None	Mild to moderate	Severe	Answer missing	None	Mild	Moderate	Severe
ASD (n = 48)	25% (n = 12)	35.4% (n = 17)	6.3% (n = 3)	33.3% (n = 16)	2.08% (n = 1)	6.25% (n = 3)	50% (n = 24)	41.7% (n = 20)
DS (n = 139)	0% (n = 0)	43.9% (n = 61)	25.2% (n = 35)	30.9% (n = 43)	46.8% (n = 65)	12.9% (n = 18)	22.3% (n = 31)	18% (n = 25)
WS (n = 43)	0% (n = 0)	60.5% (n = 26)	18.6% (n = 8)	20.9% (n = 9)	30.2% (n = 13)	16.3% (n = 7)	30.2% (n = 13)	23.3% (n = 10)

Note. ID intellectual disabilities, SRS social responsiveness scale, ASD autism spectrum disorder, DS Down syndrome, WS Williams syndrome

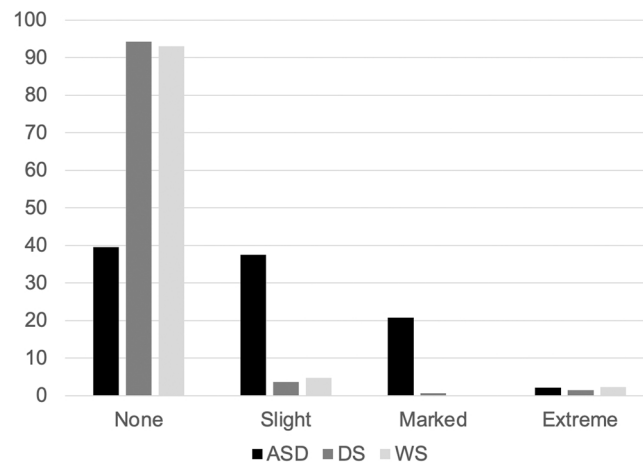


Fig. 1. Percentage of gelotophobia per group. Percentages of participants in each group (ASD autism spectrum disorder, DS Down syndrome, WS Williams syndrome) who have gelotophobia according to the following cut-offs: none < 2.5; slight ≥ 2.5 ; marked ≥ 3 ; extreme ≥ 3.5 .

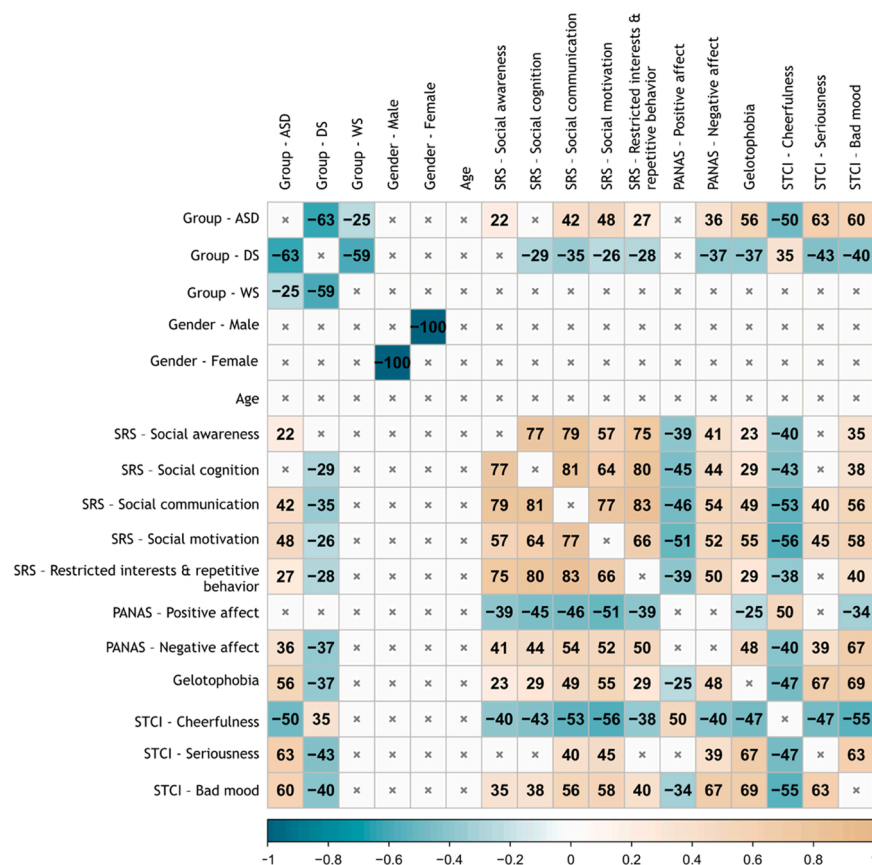


Fig. 2. Correlations scores between all demographic variables and subscales of each questionnaire. ASD autism spectrum disorder, DS Down syndrome, WS Williams syndrome, SRS social responsiveness scale, PANAS positive and negative affect scale, STCI state trait cheerfulness inventory.

Results of stepwise modelling suggested that gelotophobia was predicted by high scores on STCI – Seriousness and STCI – Bad mood traits, rather than by a specific categorical diagnosis (e.g., ASD). To test this result further, we conducted two follow-up analyses, (a) checking the association between individual questionnaires and gelotophobia, and (b) testing the group \times STCI – Seriousness and group \times STCI – Bad mood interactions. For analysis (a), we added the SRS, PANAS, and STCI variables separately to the model containing diagnosis group and demographics effects (Model 2), in all possible combinations (SRS-alone, PANAS-alone, STCI-alone,

Table 3

Results of the stepwise linear regression analysis.

Effect	Beta	F	DF	P	P _{perm}	P _{Hc3}	ϵ_p^2
<i>Model 1 - Group model (R² = 0.309)</i>							
Diagnosis	1.38	50.294	(2,225)	< 0.0001	0.0002	-	0.30
<i>Model 2 - Demographics model (R² = 0.337)</i>							
Diagnosis	1.40	50.71	(2,222)	< 0.0001	0.0002	-	0.31
Age	0.18	11.175	(1,222)	0.0009	0.0010	-	0.04
Gender	0.05	0.226	(1,222)	0.6351	0.6356	-	0.00
<i>Model 3 - Traits model (R² = 0.620)</i>							
Diagnosis	0.10	0.211	(2,208)	0.8101	0.8008	0.9008	0.00
Age	0.14	8.043	(1,208)	0.0050	0.0064	0.0072	0.03
Gender	0.11	1.501	(1,208)	0.2209	0.2170	0.2783	0.00
SRS – Social awareness	-0.09	1.162	(1,208)	0.2822	0.2846	0.4014	0.00
SRS – Social cognition	-0.02	0.029	(1,208)	0.8652	0.8708	0.8881	0.00
SRS – Social communication	0.23	4.372	(1,208)	0.0378	0.0352	0.0323	0.02
SRS – Social motivation	0.15	3.608	(1,208)	0.0589	0.0592	0.1299	0.01
SRS – Restricted interests & repetitive behavior	-0.17	3.718	(1,208)	0.0552	0.0584	0.0401	0.01
PANAS – Positive affect	0.04	0.432	(1,208)	0.5118	0.5226	0.5269	0.00
PANAS – Negative affect	0.06	0.742	(1,208)	0.3899	0.3878	0.4124	0.00
STCI – Cheerfulness	0.00	0.003	(1,208)	0.9582	0.9646	0.9671	0.00
STCI – Seriousness	0.26	15.946	(1,208)	< 0.0001	0.0006	< 0.0001	0.07
STCI – Bad mood	0.37	22.367	(1,208)	< 0.0001	0.0002	< 0.0001	0.09

Note. Linear regression analyses with three variable blocks added incrementally, Group, Group+Demographics, and Group+Demographics+Traits. ASD autism spectrum disorder, DS Down syndrome, WS Williams syndrome, SRS social responsiveness scale, PANAS positive and negative affect scale, STCI state trait cheerfulness inventory, P_{perm} permutation p-value, P_{Hc3} Heteroscedasticity-corrected p-value

SRS-PANAS, SRS-STCI, PANAS-STCI SRS-PANAS-STCI). This analysis confirmed that group differences in mean gelotophobia only disappeared in the presence of the STCI variables, and not in the presence (or combination) of SRS and PANAS variables. The effect of age was reduced somewhat by the presence of SRS variables, while highly significant effects of PANAS – Negative affect, SRS – Social communication and SRS – Social motivation disappeared in the presence of the STCI variables. For analysis (b), no evidence was found that the effects of STCI – Seriousness and STCI – Bad mood were modified by diagnosis group, with $F(2,204) = 2.046$, $p = .1318$, $\epsilon_p^2 = .01$ for group \times STCI-SE, and $F(2,204) = 0.567$, $p = .5682$, $\epsilon_p^2 = 0.00$ for group \times STCI – Bad mood. This suggested that the association between these two STCI scales and gelotophobia generalized across the three diagnosis groups.

4. Discussion

The present study had three main goals: (1) determine whether the high levels of gelotophobia found in autism in previous studies were replicated here (2) expand research on other neurodevelopmental conditions, i.e., DS and WS and (3) examine which individual differences (traits and moods) might be associated with potential group differences in gelotophobia amongst autistic individuals, individuals with DS and individuals with WS.

Consistent with the existing literature suggesting that autistic individuals experience more gelotophobia than other groups, 60% of autistic children in the current study were reported as having at least a slight level of gelotophobia (which is a higher rate than rates previously reported in the literature), in comparison to only 7% of children with WS and 6% with DS. Results also indicated a positive correlation between autism and the level of gelotophobia, meaning that individuals have a greater chance of experiencing gelotophobia if they are on the autism spectrum. Indeed, given the results, individuals with DS and individuals with WS seem to be rather protected from developing a fear of being laughed at. Additionally, a significant difference in the level of gelotophobia between autistic individuals and both individuals with WS or DS was revealed, but no difference appeared between DS and WS. These results confirmed our first hypothesis, i.e., that young autistic individuals (with or without ID) experience a higher level of gelotophobia than individuals with WS and DS, and that there would be no difference between WS and DS groups.

To answer the second hypotheses a regression analysis explored the potential predictors of gelotophobia that might be associated with these group differences. The second regression model added the demographic information of age and gender and showed that age was also a strong predictor of gelotophobia: in other words, the older the individual, the more gelotophobic they are likely to be. It is however important to keep in mind that a majority of the sample of the present study lies within the age-range that seems to be most sensitive to gelotophobia (before 20 years-old, according to Platt et al., 2010). The significant relation between age and gelotophobia in the present study shows that for individuals with neurodevelopmental conditions, gelotophobia seems to manifest itself more strongly during adolescence and the beginning of adulthood rather than during childhood.

We also investigated the association between individual differences and the level of gelotophobia. The results showed that gelotophobia increased as autistic symptoms became more severe, and also increased with a tendency to experience more negative and less positive affect. It also correlated negatively with cheerfulness, and positively with seriousness and bad mood, consistent with (Ruch et al., 2009a). Other studies have shown that several processes are involved in the appreciation and understanding of humor and laughter (Ruch, 2008), and that moods and traits tendencies might drive individuals to be more or less inclined to be offended by others' laughter. The next step was then to investigate the association of such trait and mood characteristics with the observed groups

differences. Indeed, we expected the higher social impairments commonly associated with autism, in particular in the social motivation subscale (Porter et al., 2007; Treichel et al., 2022), to be related to group differences.

The results showed a trend effect of social communication, as well as restricted interests and repetitive behaviors (subscales from the SRS), suggesting that higher difficulties in these social domains are associated with a higher fear of being laughed at. Surprisingly, there was no effect of social motivation on gelotophobia, contrary to expectations. This means that the inclination to engage with people is not a protective factor of the fear of being laughed at, and that low social motivation is not a risk factor for gelotophobia. The variables that had the strongest association with gelotophobia were, in fact, seriousness and bad mood. Both share similarities in being negatively correlated with a humorous temperament. They differ however on the fact that seriousness refers to a frame of mind (a way to approach everyday life's stimuli in a serious way, e.g., to prefer activities with rational and concrete goals), whereas bad mood, or irritability, is rather an affective state composed of bad mood, sadness, and ill-humoredness (Ruch et al., 1996). In short, the more a person has a tendency to approach life in a serious manner or to be in a bad mood, or, in other words, the more a person will have a non-humorous temperament, the more they tend to experience others' laughter negatively and as directed towards themselves. Importantly, the current analysis also showed that once these variables were added to the regression model, the group effect disappeared, meaning that the diagnosis of ASD was no longer a significant predictor for gelotophobia. In other words, the degree to which an individual scores highly on seriousness and bad mood predicts gelotophobia over and above an overall developmental disability classification such as ASD, WS or DS (or their associated social impairments). These results still relate to group differences though as autistic individuals scored significantly higher in seriousness and bad mood than individuals with WS and DS. In other words, if autistic individuals have such a fear of being laughed at, it may be because they have a temperament less consistent with the appreciation of laughter and humor (Samson et al., 2013). Therefore, autistic individuals are at greater risk to develop gelotophobia linked to low extraversion (Tsai et al., 2018) and, as the present study reveals, high seriousness and irritability.

To our knowledge, this is the first study to explore gelotophobia in DS and WS. The present results showed that only 6% of young individuals with DS and 7% of young individuals with WS experience at least a slight level of gelotophobia, which is very close to the 6% of TD adults found in a previous study (Samson et al., 2011), although less than that found in self-reports from TD children and adolescents (26.3% in Tsai et al., 2018; 28.8% in Proyer et al., 2012). This difference might notably be explained by the fact that the questionnaires in this study were answered by adults for their children which might impact how well or frequently the phenomenon is perceived. Previous studies have shown the consistency of peer-reported gelotophobia in adults by adult-informants (Brauer et al., 2021, 2022), but this study is, to our knowledge, the first to use parent-reports for children and adolescents. It has been reported that adults experience less gelotophobia than children and adolescents (Platt et al., 2010). As such, they might reliably report gelotophobia observed in other adults, but perceive it less strongly than children and adolescents would. Therefore, although there seems to be no particular reason to question the validity of our results, future studies should include both self-report and parent-report in order to compare them. Furthermore, individuals with WS and DS even show mean levels of gelotophobia which are lower than the scores reported for TD individuals in the literature: e.g., 2.42 in 6–9 years-old (Proyer et al., 2012), 2.3 in 11–14 years-old (Tsai et al., 2018), and 1.76 in adults (Samson et al., 2011). Moreover, in the present study, individuals with DS and WS showed a high level of cheerfulness, and a low level of seriousness and bad mood. This is consistent with the general prototypical socio-emotional profile of individuals with DS (Grieco et al., 2015) and those with WS (Järvinen et al., 2013), which have both been described as being rather cheerful (Grieco et al., 2015; Tager-Flusberg & Sullivan, 2000). As such, individuals with DS and WS might be protected from developing gelotophobia due to their tendency to appreciate humor and laughter which allows them to interpret others' laughter rather positively, or at least not negatively. The experience of others' laughter thus seems to be rather positive for individuals with DS and WS and not a source of social anxiety as can be the case for autistic individuals. Indeed, this positive temperament towards humor may even partly explain why individuals with DS and WS appear to have a lower tendency to develop social anxieties, compared to autistic individuals (Evans et al., 2005; Rodgers et al., 2012), a potentially important hypothesis concerning their wellbeing.

4.1. Limitations and future studies

Given that this study has been conducted anonymously online and that we wanted to keep the study simple for parents (with just one link to follow), we were unable to confirm the diagnosis of the children. However, care was taken during recruitment by sending emails only to special education schools and associations and by selecting specific social media pages on which the research was advertised. A second limitation also relates to the online design of this study which made it difficult to assess general cognitive skills. To address this issue, we asked parents whether their child had mild to moderate, severe or no learning disabilities. The parents' reports suggested the group is cognitively diverse and there were no differences in gelotophobia between the participants whether they were reported to have ID or not.

We would like to mention that our findings should ideally be replicated including a higher number of participants, especially for autistic individuals, as gelotophobia was most prevalent in that group. Future research should also examine gelotophobia in neurodevelopmental conditions in a longitudinal study to capture any developmental aspect. Indeed, while the current study focused on the period of life where gelotophobia seems to be at its most prevalent (i.e., childhood and adolescence), it would be important to examine such processes later in the lifespan. Finally, gelotophobia in ASD needs to be examined in more detail, notably by investigating whether all three components of gelotophobia described by Platt et al. (2012), namely “*paranoid sensitivity to anticipated ridicule*”, “*disproportionate negative response to being laughed at*”, and “*defensive coping with derision (control, withdrawal, internalizing)*”, equally contribute to a higher level of gelotophobia in ASD, or whether one factor in particular might contribute to a better understanding of the phenomenon.

5. Conclusion

Autistic individuals have repeatedly been shown to experience gelotophobia at a higher rate than TD individuals (Leader et al., 2018; Samson et al., 2011; Tsai et al., 2018; Wu et al., 2015) and, it can now be revealed, than individuals with WS or DS. The present study showed that this particularity of autistic individuals was related to specific temperament traits which seem to render them less inclined to positively appreciate humor and laughter. Indeed, they appear to be more serious and more irritable than individuals with DS or WS, or when compared to TD individuals (Samson et al., 2013). Moreover, seriousness and bad mood appear to be important predictors of gelotophobia, transcending even groups differences, suggesting that high gelotophobia is better predicted by these temperamental traits than by the diagnosis itself. Future studies should examine the cognitive, social and emotional origins of these particular humor temperaments in neurodevelopmental conditions to gain a better understanding of the potential risk and protective factors of developing a fear of being laughed at. Future research should also look into the different levels of intensity of both autistic traits (regardless of the diagnosis) and gelotophobia to better understand whether the former might be associated with the latter also in a TD population. With such knowledge, prevention programs and interventions potentially targeting a playful attitude (by improving cheerfulness and decreasing seriousness in humorous situations) and improved emotion regulation skills to decrease negative and increase positive emotions and moods could be designed to prevent the development of gelotophobia in prone individuals.

What this paper adds?

Gelotophobia, i.e., the fear of being laughed at, implies interpreting and experiencing any laughter (even benevolent) in a negative manner, which can be a real impairment in everyday social interactions. Since previous studies have shown particularly high levels of gelotophobia in autistic individuals, it is important to better understand the origins of such a fear. This study replicates previous findings, showing that autistic individuals seem to be particularly prone to develop gelotophobia. Additionally, it shows for the first time that individuals with Down syndrome and individuals with Williams syndrome are not at risk of developing such a fear of being laughed at, compared to autistic individuals. Our findings also highlight that among several individual difference characteristics, the temperament traits of seriousness and bad mood seem to predict high levels of gelotophobia in autistic individuals, more than the diagnosis itself. As such, it seems to be because autistic individuals tend to be rather serious and irritable that they tend to develop a fear of being laughed at, whereas individuals with Down syndrome and Williams syndrome show no such tendency.

Data Availability

Data is available here: <https://osf.io/qxwgj/>

Acknowledgements

The authors would like to acknowledge the Swiss National Science Foundation for funding this research (SNSF Professorship PP00P1_176722 for A.S.) and the Research Funds of Unidistance Suisse. The authors would also like to thank all the parents who participated in the survey.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ridd.2023.104513](https://doi.org/10.1016/j.ridd.2023.104513).

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