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How cognitive, social, and emotional profiles impact humor appreciation: sense of humor in autism spectrum disorder and Williams syndrome

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Abstract: Humor is a complex and multi-faceted phenomenon composed of a variety of cognitive, social, and emotional processes. This paper will discuss humor appreciation in individuals with autism spectrum disorder (ASD) and individuals with Williams syndrome (WS), a rare genetic disorder mainly characterized by intellectual disabilities, high social approach tendencies and high positive emotions. Drawing on research on the comprehension and appreciation of humor in individuals with ASD, this paper aims to better understand how the particular cognitive, social, and emotional profile of individuals with WS might affect their appreciation of humor and how such research could ultimately lead to a greater understanding of the nature of humor.

Keywords: autism spectrum disorder; humor; social motivation; theory of mind; Williams syndrome

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1 Introduction

Humor is an important component of everyday life both for enhancing the quality of social interactions and for psychological well-being (Martin 2007). While habitually associated with its potential to trigger positive emotions, humor can also elicit negative emotions when it is either intentionally aggressive or hostile (Martin et al. 2003), or when good-natured humor is wrongly perceived, presented at the wrong moment, or delivered in an inappropriate context (Samson and Gross 2014). Humor also serves multiple functions in both intra- and interpersonal contexts related to regulating emotions individually (Samson and Gross 2014) or socially (e.g., Horn et al. 2018). As such, humor involves cognitive, social, and emotional processes (Martin 2007; Ruch 2008): Here, the cognitive processes particularly involve the detection and resolution of incongruity (Ruch 2008; Suls 1972) and the interpretation of such as humorous; social processes refer both to the motivation to share laughter with others (Reddy et al. 2002) and abilities related to the Theory of Mind (ToM) (Howe 2002; Samson 2012); and the term emotional processes refers to the valenced experience of humor, which is usually positive (Ruch 1993) but can also be negative (Ford 2015), and which depends notably on traits that render the individual more or less susceptible to engaging in or responding to humor (Martin et al. 2003).

Given its complexity and all the different components involved, it is perhaps unsurprising that individuals are sensitive to different elements or types of humor, according to some aspects (e.g., cultural and social background) that could have influenced the development of their cognitive, social and emotional profiles. This is as true in typically developing individuals (Martin et al. 2003) as in those with atypical development. So far, humor research on atypical populations has mainly focused on autism spectrum disorder (ASD), revealing a range of difficulties with ToM (Baron-Cohen et al. 1985; Happé 1993) and social communication, and reduced social motivation (Chevallier et al. 2012), positive affect and empathic skills (Baron-Cohen 2002; Lawson et al. 2004). Generally speaking, individuals with ASD also appear to be rather serious (Samson et al. 2013). As such, a general socio-emotional profile in ASD could seem, at first sight, inconsistent with the appreciation of humor.

In contrast, people with Williams syndrome (WS) seem to present with almost the opposite socio-emotional profile to people with ASD. This paper will address humor in individuals with WS, a rare genetic disorder (affecting about 1 in 7,500 live births, Strømme et al. 2002) involving intellectual disabilities although mainly characterized by their hypersociability, high positive affect, pronounced empathic responses (Järvinen and Bellugi 2013; Järvinen et al. 2013) and high social motivation and approach tendencies (Little et al. 2013). As such, the socio-emotional profile of individuals with WS seems to be much more consistent with the appreciation of humor. However, it is important to keep in mind that individuals with WS also typically show some difficulties in the social domain similar to those with

ASD, and that their social profile is thus not absolutely and uniquely in opposition to ASD. This important point will be developed below.

The primary motivation for this paper is to outline the prototypical differences in socio-emotional profile in ASD and WS with a view to shedding light on their respective relation with humor. With this goal in mind, this paper provides a selective review of studies on humor comprehension and appreciation in ASD relevant for their comparison with WS. Combined with the few studies that exist on humor in WS, this selective review will serve as inspiration to make hypotheses about how humor is affected in individuals with WS. It seems that studying humor in these two populations is a very promising way of getting a better understanding of the very nature of humor, particularly its social aspect. What better than understanding extremes to be able to get the variability of a phenomenon? Moreover, as humor is an important part of our everyday life and in social communication, it is important to better understand the difficulties individuals with developmental disorders might have with humor in order to help enhance their social relationships and regulate their negative emotions, thus improving their well-being. In summary, this paper has two goals: To use humor research to reveal the relative strengths and weaknesses of clinical populations at extreme ends of the social profile, and, by doing so, to provide insight into the nature of humor itself (Samson 2013).

The following sections will first address how humor is processed in terms of cognitive, social and emotional competencies. The distinction between these three components is widely used in the literature to provide a complete definition of humor (Martin 2007; Ruch 2008). While this distinction will continue to be used in this paper, it is important to acknowledge that, in reality, they are of course interrelated and often overlapping rather than separate independent components. For each component and their relative competences, the relevant literature about the humor profile of individuals with ASD will be reviewed and, based on this, hypotheses will be formulated about the humor profile of individuals with WS and how such further knowledge could contribute to a better understanding of the nature of humor.

2 Cognitive competencies in humor

The basis of any type of humor is for something to be perceived as being “funny” (Ruch 2008). It is widely held that, at its core, humor is about solving an incongruity – a mismatch between two conflicting events or pieces of information, or, in other words, between expectations based on previous knowledge and a surprising turn of events. In this sense, to understand a joke, a person not only has to possess knowledge about the normality (or expectation) that will be violated, but also has to have the ability to identify that there is an incongruity in relation to

that normality (or expectation). However, it is equally important to be able to make sense of the incongruity, at least partially. This has been described as the “incongruity resolution process” (Suls 1972). An example would be if we see a fish restaurant called, “The Plaice to be”, this is humorous because 1) We know that ‘the place to be’ is normally written without an ‘i’; 2) We notice that it is not written as it normally should; 3) We understand that the incongruity makes sense because it is a fish restaurant and “plaice” is a type of fish.

Attardo and Raskin (1991) pinpoint that the cognitive processes involved in humor are somewhat dependent on the type of humor itself, i.e., on how an incongruity should be resolved on the basis of specific cognitive rules (e.g., role exchange, exaggeration, or juxtaposition). Thus, some forms of humor are either more cognitively demanding than others or involve different cognitive capacities (Attardo and Raskin 1991; Samson et al. 2008). As a consequence, there are important individual differences in the appreciation of particular types of humor depending on each individual’s cognitive profile. As such, populations with different cognitive and intellectual disabilities are likely to appreciate some aspects of humor more or less than others with different relative strengths and disabilities. The understanding and appreciation of humor also involve executive functions, which are a set of cognitive skills involved in controlling, regulating, and adapting the immediate behavioral response to a specific situation based on mental models and future perspectives (Miyake et al. 2000). More specifically, working memory, shifting abilities and selective attention are directly involved in humor (Lyons and Fitzgerald 2004).

The following sub-sections will address the cognitive specificities of humor appreciation in ASD and WS.

2.1 Cognitive competencies and humor in ASD

There is evidence that when individuals with ASD are able to understand the joke (i.e., for which they can solve the incongruity) they tend to appreciate it as much as typically developing (TD) individuals. Weiss et al. (2013), for example, showed that when presented with short nonverbal slapstick films in which the incongruity of the joke can be resolved independently of ToM requirements or language abilities (i.e., short scenes from the movies “Ice Age” and “Madagascar”), individuals with ASD enjoyed the humorous content as much as TD participants. However, several studies have shown that there are particular types of jokes that they typically find more difficult to understand. This, it has been suggested, is because they have a processing style of focusing on details rather than the “big picture” and that this makes it more difficult to extract a context-dependent meaning from particular

information (Happé 1997). This has notably been described in the “weak central coherence” hypothesis (Frith 1989; Happé 1997). Thus, instead of taking into account the general context of a humorous event, individuals with ASD seemed to focus at times on non-joke relevant details (see Lyons and Fitzgerald 2004; Samson and Hegenloh 2010). This is in line with the finding that individuals with ASD also show impairments in executive functioning. For example, two studies showed that individuals with ASD had more difficulty understanding cartoons and jokes because of impairments in cognitive flexibility (Emerich et al. 2003; Ozonoff and Miller 1996). While they had to find the right ending – or, more colloquially, the ‘punch line’ – they tended to choose more straightforward endings or endings they considered humorous but that were not coherent with the joke. These results suggest that individuals with ASD might have difficulty in processing a combination of both surprise elements (i.e., a surprising turn of events) and coherent aspects of funny content. Such findings not only help reach a better understanding of ASD, they also stress the importance of executive functions in processing humor. Indeed, it underlines the ability to make sense of incongruity (i.e., to understand a joke) as necessary to get and appreciate a joke.

Since most of the studies have been carried out with high-functioning individuals with ASD, difficulties with some types of humor can be principally attributed to the socio-emotional characteristics of ASD itself, rather than to intellectual disability. As such, it would be important to either compare these results to individuals with ASD with intellectual disabilities¹ or to individuals with intellectual disabilities of different origin (without ASD traits), to be better able to tease apart what is specific to ASD, and what can also be explained by cognitive impairments.

2.2 Cognitive competencies and humor in WS

Individuals with WS present cognitive impairments in the range of mild to moderate intellectual disability² (Korenberg et al. 2000). Despite high variability within the WS population (Porter and Coltheart 2005), their cognitive profile is marked by an important dissociation between rather well-developed general language abilities compared to other types of intellectual disability (e.g., vocabulary, grammatical abilities, pragmatic language) and relatively spared verbal short-term memory (Mervis and John 2010; Tager-Flusberg and Sullivan 2000), but marked

¹ A recent study estimated that 33% of 8 years-old children diagnosed with ASD had an IQ \leq 70 (Maenner et al. 2020).

² IQ scores range between about 40 and 80, with an average of 55 (Korenberg et al. 2000).

difficulties in visuo-spatial abilities (Heiz and Barisnikov 2016), non-verbal reasoning and some aspects of executive function (Porter and Dodd 2011; Rhodes et al. 2010). In terms of humor processing, and similarly to individuals with ASD, individuals with WS seem to have difficulties with working memory and selective attention. However, unlike individuals with ASD and other intellectual disabilities, notably Down syndrome (DS), their shifting abilities seem to be unimpaired (Constanzo et al. 2013; Menghini et al. 2010).

Generally speaking, individuals with intellectual disabilities seem to appreciate humor but show difficulties with certain types (in particular verbal humor) that require higher cognitive skills (for a review, see Chadwick and Platt 2018). Thus, given the intellectual disability present in individuals with WS, difficulties in understanding and appreciating complex forms of humor are likely.

Indeed, one study showed that individuals with WS can have more difficulty understanding nonliteral language, namely sarcasm, metaphor and simile, than chronological age-matched controls (i.e., TD individuals who have the same age, based on the date of birth, Godbee and Porter 2013). However, such differences were not apparent between WS and mental age-matched controls (i.e., TD individuals who have similar scores for cognitive ability tests). This suggests these difficulties could be related to intellectual disability. Furthermore, authors reported a strong correlation between non-literal language comprehension and general cognitive abilities in TD individuals, which was not the case for WS participants. These results indicate that the linguistic and cognitive systems on which non-literal language comprehension is based interact and integrate differently in WS than in TD individuals. Furthermore, according to the authors, difficulties in understanding sarcasm observed in individuals with WS might be due to the fact that sarcasm is more demanding on executive functions, such as cognitive flexibility and integration of context. The authors also suggest that it might be because of their hypersociability and bias toward positive affect that they tend toward a nicer or happier interpretation of sarcastic comments (Godbee and Porter 2013). Importantly, these results suggest that the cognitive processes involved in solving the incongruity of a humorous content differ from one individual to the next. In other words, humor style is unlikely to be linked to a general measure of intelligence, such as IQ, since it is a complex cognitive phenomenon. Furthermore, these results indicate that the cognitive components of humor seem to be heterogeneous: Different jokes necessitate different cognitive processes to be understood.

Overall, a better understanding of which forms of humor are spared and which are impaired in WS while considering their specific cognitive profile could help us better understand the variability of cognitive processes involved in the understanding and appreciation of humor in general. Considering their general cognitive impairments, individuals with WS would be expected to have difficulties with

humor involving more complex incongruity resolution. Moreover, considering their relatively spared verbal skills but impaired visual-spatial competencies, it is likely that non-verbal humor would be more difficult to process than verbal jokes. Further research is necessary to more thoroughly investigate the impact of cognitive impairments in the appreciation and comprehension of different types of humor – for example, visual or verbal jokes involving different cognitive rules (Attardo and Raskin 1991; Samson et al. 2008) – in individuals with WS.

3 Social competencies in humor

Humor is however not only about cognitive processing; it also involves socio-emotional processing. Indeed, humor is fundamentally social, as it oftentimes occurs in social interactions and serves social functions including relieving tensions, sustaining social control and ensuring social cohesion (Kuipers 2008). Reddy et al. (2002) underlined how the presence of others and how the laugh of at least one other person facilitates laughter and elicits an increased appreciation of humorous content. Some jokes can also involve complex socio-cognitive processes such as perspective taking and ToM. However, the relation between humor processing and ToM is not very clear. While some researchers support the mind-reading hypothesis (Howe 2002) – that ToM is necessary for humor processing – more recent data does not support the idea of such a tight link between the two, and suggests, rather, that while some jokes require the ability to understand another person or character's mind in order to make sense, other, simpler forms of humor do not require such complex socio-cognitive abilities (Samson 2012; Samson and Hegenloh 2010). Considering the great differences in socio-emotional profiles of individuals with ASD and individuals with WS, it is here where the greatest differences in sense of humor is likely to be found and where most can be learned about humor itself. The following section will address social competencies, since the comparison of ASD and WS allows us both to draw on the existent literature and to hypothesize about the link between humor and social competencies.

3.1 Social competencies in humor in ASD

As described above, individuals with ASD tend to understand and produce specific types of humor without any difficulty, but they often do so with less intent of sharing it with others (Lyons and Fitzgerald 2004). Thus, even when they show no cognitive impairments, individuals with ASD can still be said to

have a particular humor profile, notably in relation to its social functions. This theory has indirect support from the fact that individuals with ASD also tend to show difficulties with empathy (Baron-Cohen 2002; Lawson et al. 2004). One study showed that typically developing individuals with high empathy scores compared to those with low empathy scores seem to process humor differently, in the sense that, even though they do not show any better humor comprehension in general, they refer more often to the mental and emotional states of the characters in the joke when asked to explain the punchline (Samson 2012). In line with these results, and given the fact that they tend to show less empathy, individuals with ASD seem to refer less frequently to (false) mental states of others when explaining cartoons, and they seem to understand and appreciate ToM cartoons less than TD individuals (Samson and Hegenloh 2010). This is again consistent with studies that highlight difficulties with ToM in individuals with ASD (Baron-Cohen et al. 1985; Happé 1993).

Some studies have compared humor comprehension and appreciation in individuals with ASD and individuals with DS, principally revealing differences in social competencies (James and Tager-Flusberg 1994; Reddy et al. 2002). Based on parents' reports and analysis of videotaped interactions, Reddy et al. (2002) showed that children with ASD had more difficulties than mental age-matched children with DS concerning the interpersonal relevance of laughter. Even though there was no difference in the frequency of laughter, children with ASD responded less to others' laughing by looking up or smiling and showed difficulties in sharing humorous moments. Furthermore, children with ASD almost did not engage in clowning, suggesting again less interest in sharing laughter. Indeed, they engaged in solitary laughs more often than children with DS.

Again then, research with DS seems to confirm that individuals with ASD tend to have a type of humor characterized by its link with social competencies. In sum, it seems that individuals with ASD use humor less in social interactions with the purpose of sharing with others compared to TD participants and individuals with DS. This could be explained by their diminished social motivation (Silva et al. 2017). Indeed, humor serves multiple social functions as described above, which can be seen as social rewards for the appreciation and production of humor. However, Kohls et al. (2013) have shown a general dysfunction in the reward system (social and non-social) in individuals with ASD, which may explain diminished social motivation and can be a cause of difficulties in social cognition in general (Chevallier et al. 2012), and more specifically in relation to humor (Silva et al. 2017). Moreover, their difficulties with ToM impair their understanding of some types of jokes involving others false beliefs.

To summarize, research in ASD has stressed the social competencies involved in the appreciation of humor to understand specific types of jokes that require

advanced socio-cognitive competencies, and also to have the motivation to share laughter or positive experiences with others. Future research could expand the understanding of the role of social motivation in humor appreciation and production. Considering that WS can be seen as being situated at the opposite extreme of a social continuum (although, see below), looking at their specificities concerning humor in the social domain will improve our knowledge of humor itself.

3.2 Social competencies in humor in WS

As noted earlier, the particular social profile of WS is characterized by high social approach tendencies, in particular toward strangers. They are also described as having a uniquely gregarious personality, high empathic responses and high positive affect (Järvinen et al. 2013). This hypersociability is often combined with inadequate social skills, which cause difficulties in sustaining friendships (Järvinen and Bellugi 2013). However, there are also some overlaps between ASD and WS in the social domain: Individuals with WS show difficulties in several social competencies, but not in social motivation (Fisher and Morin 2017; Klein-Tasman et al. 2011). This social pattern seems to be very specific to WS: There seems to be somewhat of a contradiction between their high motivation to seek social interaction and their difficulties understanding and maintaining these social interactions. These results also suggest that individuals with ASD and those with WS cannot really be placed on opposite extremes of a social continuum (Fisher and Morin 2017), as previously suggested (Jones et al. 2000), but rather, more prudently, on opposite extremes of a social motivation continuum.

There seems to be a dissociation in WS between the social and cognitive profiles in terms of mentalizing skills (which is the ability to make inferences about other people's thoughts and beliefs, in ToM, for example), although there is conflicting evidence. Initial research suggested that ToM (as well as language and face processing) was spared in WS, contrary to other cognitive abilities (Karmiloff-Smith et al. 1995). However, Tager-Flusberg and Sullivan (2000) nuanced these conclusions somewhat by distinguishing social-perceptual and social-cognitive components of ToM. The first component, which seems to be spared in WS, refers to the ability to make inferences about others' minds based on perceptual information such as facial expression, bodily behaviors or vocal prosody. The latter component, which seems to be typically impaired in WS, refers to complex cognitive abilities such as language, and is related to the understanding of false belief (Sullivan et al. 2003). Additionally, Porter et al. (2008) showed that ToM abilities in WS are below that which would be expected at their mental age when assessed using a non-verbal task, and therefore do not rely on verbal skills (which

are known to be relatively preserved in WS). However, the researchers also showed that there were differences in the understanding of false belief between two cognitive subgroups (Porter and Coltheart 2005), giving strength to the idea of a heterogeneity of WS cognitive profiles and mentalizing abilities. Thus, it is difficult to reach a clear conclusion about mentalizing abilities in WS, although it seems that their potential difficulties in this domain relate rather to the social-cognitive rather than the social-perceptual component. The conflicting evidence in the research concerning socio-cognitive ability could perhaps be linked to the great variability in cognitive ability present in WS.

Some types of humor are directly linked to mentalizing abilities and, given the tendency for individuals with WS to have difficulties with the social-cognitive component of ToM, it can be expected that they would have more difficulties processing such humor. Sullivan et al. (2003) compared adolescents in three groups, with either WS, Prader-Willi syndrome (a genetic disorder also associated with mild to moderate intellectual disabilities), or intellectual disability of a non-specific origin, in their ability to differentiate between a lie and a joke. Participants were presented with four short stories that each ended with a false statement, two of which were lies and two of which were ironic jokes. The difference was based on the understanding of one character's second-order belief, which refers to what both characters know about each other's thoughts and knowledge. The results showed that almost all participants misclassified the jokes as lies and justified their answer with more realistic responses (referring to the actual state of affairs) and less second-order reasoning (referring to the knowledge states of the characters). Furthermore, individuals with WS gave significantly fewer second-order justifications and more realistic justifications than the two other groups. In short, it seems that, on average, adolescents with WS show great difficulty in making the link between others' minds and nonliteral language.

One recent study directly investigated the link between ToM and humor in WS (Krishan et al. 2017). The participants consisted of WS and DS participants, as well as a chronological age-matched control group for both clinical groups, and one mental age-matched control group for each clinical group. Each participant was shown a series of cartoons containing jokes that required them to infer a character's beliefs, desires or emotions. Participants were then asked to explain each joke. Individuals with WS and DS did not differ significantly in their level of comprehension of the jokes, nor with their respective mental age-matched TD peers. However, they showed poor humor comprehension in comparison to their chronological age-matched peers. This suggests that the difficulties these clinical groups seem to have with types of humor involving ToM are related to their intellectual disabilities and are not syndrome-specific. Furthermore, concerning the explanation of the jokes, the results showed that WS participants did not differ with both control groups in

their use of mental state language, suggesting that humor comprehension was not related to ToM abilities. These results are consistent with studies suggesting that humor appreciation is not necessarily related to ToM (Samson 2012).

Overall, previous studies show that individuals with WS have difficulties understanding jokes that involve mentalizing abilities. It would seem that, similarly to individuals with ASD, they might have more difficulty understanding and appreciating forms of humor that require high socio-cognitive abilities (Samson and Hegenloh 2010). Future research should investigate the comprehension and appreciation of different types of humor in WS, including jokes requiring mentalizing abilities, in contrast to simple jokes (for an example of how this could be done, see Samson et al. 2008). Such research would provide more knowledge on how humor is processed by individuals who have difficulties with ToM, which would help define the extent to which humor appreciation in general is related to ToM.

The social profile of individuals with WS is also characterized by high social approach, namely a tendency to seek out the social world and social interactions, particularly with strangers. Contrary to individuals with ASD, individuals with WS seem to have high social motivation as they show a particular interest in social stimuli (Barak and Feng 2016), especially human faces (Riby and Hancock 2009). Individuals with WS are often described as being “excessively friendly” (Järvinen et al. 2013). This hypersociability is likely to lead to paradoxical reactions to certain jokes, in the sense that, even if they do not understand the punch line (i.e., are not able to cognitively resolve the incongruity), they may nonetheless laugh. Thus, future research should try to disentangle the links between the level of comprehension (whether they understand the joke or not), the sociability of the occasion (who and how many people are present to share the joke) and the level of appreciation (how funny they thought the joke was) of different types of jokes. The correlation between level of comprehension and appreciation can be expected to be weaker in individuals with WS than in TD controls or individuals with ASD, particularly in social situations where the individuals’ enjoyment could be influenced by others who did get the joke. Such an interaction would suggest that the implicit assumption that one should understand the incongruity of a joke might not be necessary for some individuals to still enjoy a shared humorous occasion. Future investigations should thus also contrast humor processing in a shared social context and in an individual, non-social context.

As stated before, studies on WS and ASD would be a great tool to expand our knowledge on humor in the social domain particularly. Indeed, ASD and WS can be seen as being at two extremes of a social motivation continuum. By studying ASD with intellectual disabilities in comparison to WS (thus with similar cognitive competencies), we would have a concrete way of looking at how the social profile influences humor perception and what it tells us about humor in general.

4 Emotional competencies in humor

Besides the cognitive and social competencies involved in humor processing, the appreciation of humor involves a subjective emotional experience that often has been referred to as amusement, mirth, or exhilaration (Ruch 1993), but that can also involve mixed emotions (Kreibig et al. 2013) and even purely negative emotions (Ford 2015). It also involves an emotional response, including psychophysiological changes (Lackner et al. 2013; Shiota et al. 2011) as well as overt emotional expressions such as changes in the face, voice, or body – most typically smiling and laughing (Ruch 2008).

Generally speaking, individuals differ in how strongly they react emotionally to humorous stimuli. For example, state and trait cheerfulness in contrast to seriousness and bad mood have been shown to be important factors impacting humor appreciation (Ruch et al. 1996). Individuals also seem to differ in relation to their preferred humor styles, e.g., if they prefer benevolent or rather aggressive, dark humor. For example, Martin et al. (2003) made the distinction between four different humor styles: Two positive (affiliative and self-enhancing) and two negative (aggressive and self-defeating).³ Affiliative humor is a non-hostile type of humor, which is positively correlated with social approach, positive emotions, and cheerfulness. Individuals who have high scores in affiliative humor appreciate telling jokes during social interactions. Self-enhancing humor designates the tendency to laugh at the incongruities of life. Individuals who have this sense of humor frequently use humor to regulate their negative emotions. Aggressive humor describes a negative humor style that is directed towards others. Finally, self-defeating humor consists in saying funny things about oneself at the expense of making oneself look ridiculous. Related to rather dark sides of humor, some individuals have more difficulty in dealing with mockery towards themselves, which can lead to gelotophobia, namely, the fear of being laughed at by others. At its extremes, gelotophobia can lead to paranoia and high social difficulties (Ruch and Proyer 2008). The following sub-sections will focus on the influence of the emotional profile of individuals with ASD on their relation towards humor and draw a few hypotheses about humor and individuals with WS, before pointing out the relevance to the conceptualization of humor.

³ There exists other conceptualizations of different humor styles, for example such as recently described by Ruch et al. (2018). However, we focus here on those questionnaires that have been used in the context of ASD research.

4.1 Emotional competencies in humor in ASD

Studies concerning emotional responses have shown that individuals with ASD generally appreciate humor less than TD individuals, although, as described above, this depends strongly on the stimulus characteristics and the context (e.g., Samson and Hegenloh 2010), and display, at times, facial expressions that are incoherent with their emotional experience (Weiss et al. 2013). In relation to individual differences that impact the susceptibility to (different types of) humor, a recent study (Samson et al. 2013) showed that individuals with ASD define themselves as having lower affiliative and self-enhancing humor than TD individuals (but no differences in aggressive and self-defeating humor). According to the authors, this suggests that individuals with ASD might be less social in their humor – which is in line with their social difficulties as described above – although it does not mean they engage more in negative forms of humor. Individuals with ASD also seem to be less cheerful, more serious, and more likely to be in a bad mood than TD individuals (Samson et al. 2013). Finally, individuals with ASD tend to have high scores of gelotophobia (i.e., the fear of being laughed at). Indeed, one study revealed that 45% had slight, marked or extreme levels of gelotophobia, compared to 6% of the TD comparison group (Samson et al. 2011). This is relevant for better understanding humor in ASD, since gelotophobes tend to enjoy humor less (Ruch and Proyer 2008). In general, these intra-individual differences are also important to understand why humor is more difficult to be processed and appreciated by individuals with ASD. Future studies should investigate more thoroughly the correlation between ASD's rather negative emotional profile and their subjective experience of humor, which would lead to a better conceptual mapping of different emotional profiles in relation to humor.

4.2 Emotional competencies in humor in WS

As mentioned earlier, individuals with WS tend to show a high level of empathy (Dykens and Rosner 1999; Klein-Tasman and Mervis 2003). These empathic skills originate from their high social approach tendencies (Little et al. 2013), characterized by their lack of shyness (no fear of strangers) and their tendency for direct eye contact (Järvinen et al. 2013). It is possible that their higher level of empathy might lead individuals with WS to be more sensitive to even mildly aggressive forms of humor directed at third parties. To explore the influence of the socio-emotional profile in individuals with WS, it would be informative to investigate their emotional responses to benevolent, mildly aggressive and hostile forms of humor while controlling for their comprehension (Ford 2015; Kreibig et al. 2013). Given the research

presented here, it can be hypothesized that individuals with WS would experience more negative emotions and show more aversion with mildly aggressive and hostile forms of humor than would TD controls or individuals with ASD.

Additionally, WS is characterized by a bias toward positive affect (Järvinen et al. 2013) and a rather cheerful personality (Tager-Flusberg and Sullivan 2000) which suggests they may have a marked inclination to engage in humorous interaction. Indeed, based on their socio-emotional phenotype, individuals with WS would be expected to score high on cheerfulness, and low on seriousness and bad mood (Ruch et al. 1996), as opposed to individuals with ASD (Samson et al. 2013). Moreover, whereas individuals with ASD tend to have a low affiliative humor style, individuals with WS are likely to engage more in positive (particularly affiliative) humor, considering it is positively correlated to social approach tendencies, positive emotions, and cheerfulness (Martin et al. 2003). On the other hand, considering the high positive affect and empathy associated with WS, it can be postulated that such individuals are unlikely to engage in aggressive humor (Martin et al. 2003).

Whereas it has been argued here that the WS emotional phenotype would result in higher sensitivity to aggressive forms of humor, further research is required to ascertain whether individuals with WS would also be more sensitive in situations where they are the target of such humor and, as a consequence, experience gelotophobia (Ruch and Proyer 2008). This is an open question. One could hypothesize, for example, that because gelotophobia is related to social anxiety (Edwards et al. 2010), individuals with WS would not have a particular tendency to experience gelotophobia. However, given their probable aversion to aggressive humor, coupled with the high rates of bullying they experience (Fisher et al. 2017), one could also argue that they would react negatively to being subjected to social mockery.

The relation between the emotional profile and humor appreciation in individuals with WS still has to be investigated. In the same sense that studies on ASD should investigate the extent to which their negative emotional profile leads to a lower appreciation of humor, further research on WS could confirm that a more positive emotional profile leads to a greater appreciation of humor. If this proved to be the case, it would suggest that even though cognitive, social and emotional components of humor are interrelated, they influence an individuals' appreciation of humor independently of one another. Moreover, getting knowledge about these two emotional profiles and their influence on how they experience humor would naturally help us draw a variety of emotional profiles and understand better individuals' differences in their experience of humor.

5 Conclusions

Humor is very important for social interaction and psychological well-being. It helps to establish social bonds, can be used to accentuate our role in a group, can help to regulate our own or others' emotions in difficult situations and can generally be considered as a trigger for positive emotions (Kuipers 2008; Martin 2007; Ruch 2008; Samson and Gross 2014). It is a complex phenomenon involving cognitive, social, and emotional competencies. This paper aimed to gain a better understanding of how the particular cognitive, social, and emotional profiles of individuals with WS could affect their comprehension and appreciation of humor in contrast to individuals with ASD and of what these profiles and their comparison tell us about the nature of humor. It is important to keep in mind that these cognitive, social and emotional processes are interconnected and that studying them separately is a way to catch the most defined specificities of humor processing. However, it is equally important to study them together to better understand their separate and combined impact on humor.

The literature presented here shows how the executive functioning of individuals with ASD could explain why they have difficulties with some types of jokes (Lyons and Fitzgerald 2004) but can appreciate simple forms of humor (Weiss et al. 2013), and how the cognitive impairments present in individuals with WS might prevent such individuals from understanding the incongruity of a joke. Given their tendency for hypersociability, it is possible that individuals with WS would laugh even if they do not get the joke – either for affiliative reasons or simply because they enjoy the laughter of others, for example, particularly when their high propensity for cheerfulness is taken into account. However, the reverse is observed in individuals with ASD, who have a tendency to engage less in shared social laughter (Reddy et al. 2002). Furthermore, particular difficulties in social perspective taking associated with WS (Tager-Flusberg and Sullivan 2000) would be expected to impact the understanding of jokes based on false belief (i.e., ToM humor), as it is the case for individuals with ASD (Samson and Hegenloh 2010). Finally, while individuals with ASD seem to appreciate and produce fewer positive forms of humor (Samson et al. 2013) and have a higher tendency to experience gelotophobia (Samson et al. 2011), the emotional profile of individuals with WS, characterized by unfiltered and high levels of empathy (Klein-Tasman and Mervis 2003), suggests that they might not appreciate even mild forms of aggressive humor or find aggressive elements in harmless jokes.

This paper set out to improve understanding of the humor profiles in ASD and WS and to highlight the importance of taking into account population characteristics and individual differences when considering humor. Specifically, focus was

given to the contribution of specific cognitive, social and emotional profiles to the understanding and appreciation of different types of jokes. Further studies on humor in WS, perhaps in direct comparison to those already undertaken in ASD, would provide a better understanding of the nature of humor. While the assumptions and hypotheses made here already recommend and signal new directions of research to be taken, they suggest that definitions of humor should include more nuanced appreciations of cognitive, social and emotional profiles. While these remain necessarily speculative without empirical testing, this paper suggests such studies should evaluate the association between individual cognitive traits and the cognitive processes of humor appreciation by testing 1) the importance of higher cognitive competencies when it comes to understanding certain types of jokes with a more complex logical mechanism (e.g., sarcasm, irony, jokes involving ToM, etc.), 2) the variability of cognitive competencies involved in humor, and 3) the fact that humor is not necessarily linked to ToM. Such studies would also help draw a variety of social and emotional profiles of humor, based on two extremes of a socio-emotional continuum (mainly based on high differences in social motivation). Furthermore, such knowledge about which types of humor individuals with WS understand and appreciate could positively impact their social experiences and serve as inspiration for training programs to help individuals who have difficulties in social interaction by using humor as a tool to strengthen their social relations and deal with their negative emotions (about the effectiveness of such training in adolescents with ASD see e.g., Wu et al. 2016).

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