

# Humor in Autism and Asperger Syndrome

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Research has shown that individuals with autism and Asperger syndrome are impaired in humor appreciation, although anecdotal and parental reports provide some evidence to the contrary. This paper reviews the cognitive and affective processes involved in humor and recent neurological findings. It examines humor expression and understanding in autism and Asperger syndrome in the context of the main psychological theories (Theory of Mind, Executive Functions, Weak Central Coherence and Laterization models) and associated neural substrates. In the concluding sections, examples of humor displayed by individuals with autism/Asperger syndrome which appear to challenge the above theories are analyzed and areas for further research are suggested.

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**KEY WORDS:** Autism; Asperger syndrome; humor; psychological theory; neural substrates.

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## AUTISM/ASPERGER SYNDROME AND MAIN PSYCHOLOGICAL THEORIES

Autism and Asperger syndrome are both recognized neuro-developmental disorders that are defined primarily in behavioral terms. Both are distinct categories within Pervasive Developmental Disorders as defined by the DSM-IV criteria (APA, 1994). According to this current conceptualization Asperger syndrome differs from autism in terms of language and cognitive functioning, which are not associated with early delay, whereas, like in autism, a severe impairment in social functioning and range of interests remains. However, there has been ongoing controversy whether the two disorders are two different conditions (e.g., Howlin, 2003; Klin, Volkmar, & Sparrow, 2000; Leekam, Libby, Wing, Gould, & Gillberg, 2000; Schopler, Mesibov, & Kuncie, 1998). Over the years various neuro-psychological theories have been proposed to account for the behavioral manifestations of autism/Asperger syn-

drome. These include lateralization models associating autism with left hemisphere impairment (e.g., Fein, Humes, Kaplan, Lucci & Waterhouse, 1984) and Asperger syndrome with right hemisphere deficits (Ellis, Ellis, Fraser & Deb, 1994), psychological theories based on the frontal hypothesis of autism (Damasio and Maurer, 1978), such as Theory of Mind (Baron-Cohen, Leslie & Frith, 1985) focusing on social and communicative deficits and the Executive Function hypothesis (Pennington & Ozonoff, 1996; Hughes, Russell & Robbins, 1994) with its emphasis on a primary cognitive impairment in a variety of mental processes. Finally, the weak central coherence model of autism (Frith, 1989; Frith & Happé, 1994) which also addresses cognitive abnormalities in information processing and apart from providing behavioral explanations also accounts for the unusual patterns of cognitive strengths found in autism.

## IMPORTANCE OF HUMOR AND REVIEW OF PAST RESEARCH STUDIES

Humor is a 'hardwired' characteristic of the human species (Darwin, 1872). Research shows that in normal development, laughter seems to be emerg-

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ing at around four months of age (McGhee, 1979; Sroufe & Waters, 1976). Humorous exchanges are vital to the social development of children; they encourage playfulness (Bruner & Sherwood, 1976), understanding of other's emotional attitudes, expectations and intentions (Dunn, 1988; Leekam, 1991; Reddy, 1991, Stern, 1985) and are considered to be precursors of joint attentional abilities (Bakeman & Adamson, 1984; Mundy, Sigman & Kasari, 1993), all areas of impairment in young children with autism.

Traditionally, there has been a general acceptance that individuals with autism and Asperger syndrome do not understand humor (Asperger, 1944; Wing, 1996). They are not able to laugh at themselves, they are ... "rarely relaxed and carefree and never achieve that particular wisdom and deep intuitive human understanding that underlie genuine humor" (Asperger, 1944; Frith 1991, p. 82). Empirical studies investigating humor in this population have been very sparse (Mesibov & Stephens, 1990; Reddy, Williams & Vaughan, 2002; St. James & Tager-Flusberg, 1994; Van Bourgondien & Mesibov, 1987). The general conclusion drawn from these studies is that simple forms of humor in very young children (e.g., tickling, funny sounds, teasing etc.) may be preserved and that some individuals with autism/Asperger syndrome also possess the ability to understand some basic forms of humor, both verbal and non-verbal, i.e., slapstick humor, simple jokes and puns, which, however, is not in accordance with their overall developmental level.

However, anecdotal and parental reports of humor appreciation in individuals with mainly higher functioning autism/Asperger syndrome were documented throughout the years (Everard, 1976; Ricks & Wing, 1975). Werth, Perkins and Boucher (2001) describe a female (Grace) with high functioning autism (VIQ 86) who produces puns, jokes, neologism and word plays based on her obsessional interests. These puns are very original which is in accordance with the well documented idiosyncratic language and neologisms in autism (Asperger, 1944; Kanner, 1946). Her humor seems to derive to a certain extent from the acoustic properties of her word plays. However, what seems to be most extraordinary is that Grace has an ability to understand and produce ironic humor such as teasing and sarcasm. In addition, she also shares her humor with other people, which is probably due to positive reinforcement (Werth *et al.*, 2001). Even more intriguing is the fact that, contrary to expectation, Grace has

very limited mindreading skills. Another example is Jenny, a young woman who also has a good sense of humor (personal experience). Although she has a moderate level of functioning her verbal abilities are well developed and she produces and is responsive to verbal (her own word creations based on favorite movies/computer games) and non-verbal humor (acting out humorous scenes such as grimaces, funny walks in the style of Mr. Bean, and Basil Fawlty). In addition, she is a great mimic and is able to perfectly imitate the various utterances of other students in her school which is related to her very good musical abilities (has absolute pitch). She gets great enjoyment out of doing this which is possibly due to praise and reinforcement of staff. Humor was also successfully used as behavioral intervention when Jenny developed very high levels of aggressive and self-injurious behaviour during puberty.

## HUMOR — DEFINITIONS

"Humour is such a complex and human phenomenon, any understanding of it will necessarily enrich our understanding of thought in general" (Paulos, 1980 p. 102). Humor plays a major role in human life; humor helps in communicating ideas, feelings and opinions (Brownell and Gardner, 1988); it provides means of coping with stress (Lefcourt and Martin, 1986); humor is also a core part of human behavior and considered to be a defining human attribute (Nahemow, 1986).

Researchers agree that one of the main components of both verbal and also physical humor is 'incongruity' (e.g., Fry, 2002; McGhee, 1979; Morreall, 1989; Paulos, 1980; Raskin, 1985; Ruch, McGhee & Hehl, 1990). According to Paulos "incongruity is intended in a wide sense, comprising the following oppositions: expectation versus surprise, the mechanical versus the spiritual, superiority versus incompetence, balance versus exaggeration, and propriety versus vulgarity" (p. 102). The major theory of humor, the "incongruity-resolution model" (Suls, 1972) considers humor appreciation as a problem-solving task in which the punch-line, which is incongruous with the body of the text must be detected and then reconciled with the lead. However, apart from the cognitive processing of humor (incongruity and its resolution) there are also social affective and cultural processes involved. Humor involves reciproc-

ity, i.e., the sharing of humor and laughter with others, a common interest in the topic of the laughter and/or the sharing in the laughter of others as an affective state in its own right (e.g., Reddy *et al.*, 2002).

To summarize, humor involves a variety of cognitive functions including, problem solving, memory and mental flexibility, abstract reasoning and imagination. In addition to these cognitive functions real humor appreciation also requires an affective response and needs to be placed in a social context. Humor as pointed out by Paulos (1980) “essentially depends on so many emotional, social, and intellectual facets of human beings, and is particularly immune to computer simulation and therefore difficult for persons with autism” (p. 51).

## NEURAL SUBSTRATES OF HUMOR

Specific neural structures that mediate humor appreciation have been reported in both the right and the left hemisphere.

### The Right Hemisphere

The major brain region involved in humor appreciation is the right frontal lobe (Shammi & Stuss, 1999). These researchers found that damage to the right but not the left hemisphere affects verbal humor appreciation. Previous studies investigating humor in patients with brain lesions also found major deficits in patients who had right hemisphere damage (Gardner, Ling, Flamm & Silverman, 1975; Brownell, Michel, Powelson & Gardner, 1983). For example, right hemisphere damaged patients have the ability to recognize a joke but have great problems in understanding the meaning of the joke (Wapner, Hamby & Gardner, 1981). Similarly, Bihle, Brownell, Powelson and Gardner (1986) found that right hemisphere patients were able to comprehend slapstick humor that did not involve theory of mind abilities or sophisticated linguistic abilities. Shammi and Stuss (1999) concluded that “the ability of the right frontal lobe may be unique in integrating cognitive and affective information, an integration relevant for other complex human abilities, such as episodic memory and self-awareness” (p. 657).

Humor appreciation involves the interpretation of current information based on past experience (Shammi & Stuss, 1999). This process requires

episodic memory, i.e., the memory for personal experiences. PET studies (Tulving, Kapur, Craik, Moscovitch, & Houle, 1994) have confirmed that the right frontal lobe is implicated in retrieval of episodic and autobiographical memories. The neuropsychological processes of remembering personal experiences are closely linked to an awareness of self (Wheeler, Stuss, & Tulving, 1997). The frontal lobes are of crucial importance for self awareness (Stuss & Benson, 1986; Damasio, 1994) with recent research findings particularly emphasizing the role of the right frontal lobes (Stuss, Picton, & Alexander, 2001).

In conclusion, the main neural basis of humor appreciation seems to be the right frontal lobe, given its ability to integrate cognitive and affective information. However, in addition to the strong right hemisphere involvement in humor appreciation research also indicates contributions of the left hemisphere and diverse neural networks.

### Left Hemisphere and neural networks

A recent fMRI study of humor (Goel and Dolan, 2001) demonstrated that separate and different networks are activated depending on the type of humor under investigation. These researchers found that for example semantic juxtaposition (incongruity) uses a bilateral temporal lobe network, whereas phonological juxtaposition (puns) activates a left hemisphere network involving areas of speech production. Just, Carpenter, Keller, Eddy, Thulborn, (1996) also employing fMRI technology found involvement of the left temporal cortex (Wernicke’s area) and the left inferior frontal gyrus (Broca’s area) in incongruity tasks. The equivalent right hemisphere brain areas were also activated however, with lesser intensity. The above mentioned fMRI study by Goel and Dolan (2001) also identified a separate and distinct network for the affective components of humor, by showing a significant activation in the medial ventral prefrontal cortex and the bilateral cerebellum. In addition to the prevailing theory of right hemisphere involvement in humor appreciation these researchers were able to present evidence for differential systems underlying the cognitive and affective processing of humor. “We were able to separate the cognitive aspects of jokes from the affective aspect. The cognitive aspect involves the mental set shift. I could tell you a joke and you may get the joke but not find it funny. There you have the mental set shift but you don’t have the

component associated with the funny joke" (Goel & Dolan, 2001).

It appears that both hemispheres are involved in humor appreciation. Traditionally the left hemisphere has been associated with analytical, logical, local and rational processing while the right hemisphere is synthetic, Gestalt holistic, global and intuitive with respect to processing in several domains (Kolb & Whishaw, 1996). The left hemisphere seems to be involved in the cognitive interpretation of humor whereas the right hemisphere is needed for the more affective appreciation, i.e., seeing the funny side of the joke, bursting out in laughter etc.

In addition, the limbic system, particularly the amygdala, also plays an important part in processing emotional responses, emotional information and mindreading (e.g., Aggleton, 1992; Kling & Brothers, 1992). Patients with bilateral amygdala lesions have been found to be impaired in recognizing facial and vocal expressions of emotions (e.g., Adolphs, Tranel, Damasio, & Damasio, 1994; Young *et al.*, 1995). Failure in processing these affective signals will certainly impair humor interactions.

In the following section we will examine how the neural findings of humor relate to autism/Asperger syndrome with regard to the underlying neurological substrates and associated psychological theories.

#### **RELATIONSHIP BETWEEN NEUROLOGICAL FINDINGS OF HUMOR AND UNDERLYING NEUROLOGICAL SUBSTRATES OF AUTISM/ASPERGER SYNDROME AND ASSOCIATED PSYCHOLOGICAL THEORIES**

A frontal theory of autism was originally put forward by Damasio and Maurer (1978) based on analogies between the main behavioral characteristics found in autism and frontal lobe symptomatology. Similar to patients with frontal lobe damage, individuals with autism are impaired in their social development, show stereotyped and compulsive behaviors, have communication and attention deficits, show a great resistance to change, lack initiative and spontaneity, have very concrete thinking and fail to integrate various sources of information or apply their knowledge usefully (e.g., Kolb & Whishaw, 1996). The two main competing psychological theories of autism, Theory of Mind and Executive Function are based on a possible frontal

lobe dysfunction. The Weak Central Coherence theory of autism (Frith, 1989; Frith & Happé, 1994; Happé, 1999) although not implicating any specific brain regions for subserving a central coherence also has the potential to explain the lack of humor. Finally, we will also examine the lateralization models for autism and Asperger syndrome.

#### **Humor and Linguistic, Pragmatic and Theory of Mind difficulties in Autism and Asperger Syndrome**

##### *Impairment in Communication*

One of the major problems in individuals with autism in understanding humor is of course their qualitative impairment in verbal communication which is one of the three main diagnostic criteria for autism (APA, 1994). The very limited capacity for language in the majority of lower functioning individuals with autism explains their deficits in verbal humor appreciation. The lack of acquiring alternative modes of communication, i.e., non-verbal communication such as gesture or mime, which are also diagnostic in autism, might explain the impairment in understanding non-verbal humor. The verbal impairments in autism include deficits and delay in the acquisition of language, and if language is acquired, the primary impairments seem to be the pragmatic aspects of language (e.g., Tager-Flusberg, 1981). Being able to communicate effectively is necessary in any social context and vital for the appreciation of verbal humor. Pragmatic impairments in autism have been found across different contexts, including conversational deficits, literal interpretation of everyday utterances, inability to understand the speaker-listener relationship, non-conforming to conversational rules, inability to maintain an ongoing topic of discourse, problems with storytelling, etc. (e.g., Happé, 1993, 1994; Minshew, Goldstein, & Siegel, 1995).

##### *Theory of Mind in Autism and Asperger Syndrome*

These pragmatic deficits in individuals with autism are closely linked to theory of mind, the ability to think about and act on information about one's own and others mental states. Lack of theory of mind has been suggested by many researchers to be the core deficit in autism (Baron-Cohen, 1988; Happé, 1993; Tager-Flusberg, 1993). Evidence for lack of theory of mind has also been found in individuals of all developmental levels even in sub-

jects with higher functioning autism (e.g., Ozonoff, Pennington, & Rogers, 1991). Happé (1993, 1994) reported a strong correlation between the ability to explain non-literal messages e.g., lies, jokes, pretence, irony, sarcasm and theory of mind abilities. Although there is general agreement of a close association between pragmatics and theory of mind, the direction of the influence has yet to be determined. Some researchers hold that some theory of mind abilities are necessary for the development of language (e.g., Tager-Flusberg, 1997). The counter argument is that only through verbal discourse, children are able to develop a theory of mind (e.g., Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991). Happé (1995) argues that language is needed for theory of mind development. Taken together, there is substantial evidence that the lack of appreciating humor derives from difficulties in pragmatic and theory of mind skills in autism.

Early studies reported that individuals with Asperger syndrome (Bowler, 1992; Ozonoff, Rogers, & Pennington, 1991) were less impaired on experimental theory of mind tasks. It has been suggested that individuals with Asperger syndrome arrive at the correct solution by applying verbal or other cognitive strategies (Bowler, 1992; Happé, 1995) but they still lack mentalistic insight into their own or others behavior and remain impaired in their everyday social interaction (Frith, Happé & Siddons, 1994). Research has also shown that verbal abilities and performance on experimental theory of mind tasks are closely linked (e.g., Eisenmajer & Prior, 1991; Happé, 1994, 1995; Sparrevohn & Howie, 1995). Current diagnostic criteria distinguish Asperger syndrome from autism on the basis of language skills, which explains their better performance on theory of mind tasks. Once the higher verbal abilities of the Asperger group are controlled by covariance and close matching procedures as documented in a more recent study (Miller & Ozonoff, 2000) group differences were no longer evident. Furthermore, there is research evidence of mindreading impairment in both very high functioning individuals with autism and Asperger syndrome in very advanced tests of theory of mind (e.g., Baron-Cohen, Wheelwright, Hill, Raste, Plumb, 2001; Kaland *et al.*, 2002).

#### *Neural Substrates for Theory of Mind*

There is substantial evidence that theory of mind capacities may be lateralized to the right cerebral hemisphere. Research shows that patients

with right hemisphere damage have problems with theory of mind (Brownell, Pincus, Blum, Rehak, & Winner, 1997; Happé, Brownell, & Winner, 1999, Winner & Gardner, 1977). The right hemisphere is necessary for activation of representational sets and integration of meaning (Brownell, Griffin, Winner, Friedman, & Happé, 2000) and episodic memory (Schacter, Curran, Galluccio, Milberg, & Bates, 1996). The right hemisphere is also considered to be necessary for 'hot' or more affectively charged theory of mind problems (Brothers and Ring, 1992). It has been suggested (Brownell *et al.*, 2000) that impairments in theory of mind play a major role in the problems right hemisphere damaged patients have in humor appreciation. In addition, functional imaging studies (Baron-Cohen *et al.*, 1999) also implicated the amygdala in mindreading abilities.

#### *Personal Memory*

The right frontal lobe also plays a role in personal or episodic memories and self-awareness (e.g., Damasio, 1994; Stuss, Picton, & Alexander, 2001) which as described previously is necessary for humor appreciation. There are also very strong developmental connections between self-awareness and episodic memory (Tager-Flusberg, 1991). Research shows that self-awareness (e.g., Hobson, 1989; Powell & Jordan, 1993) and equally episodic memory is impaired in individuals with autism (Jordan & Powell, 1995) and Asperger syndrome (Bowler, Gardiner, & Grice, 2000). It has been suggested that impairment in experiencing self prevents children with autism from recalling personally experienced events (Millward, Powell, Messer, & Jordan, 2000).

#### *Executive Functions*

The right hemisphere and prefrontal cortex, apart from being implicated in social cognition, interpersonal skills, theory of mind abilities and humor, are also associated with executive functions. Executive function is an umbrella term for mental operations which enable an individual to disengage from the immediate context in order to guide behavior by reference to mental models of future goals (Hughes *et al.*, 1994). For example the ability to hold information in mind (working memory) is related to both verbal jokes and non-verbal cartoon tests of humor appreciation (Shammi & Stuss, 1999). Their research also showed that verbal humor was correlated with verbal abstraction ability

and shifting of mental set and non-verbal humor was associated with focus attention to details. Impairment in executive functions has been found across the autistic spectrum including Asperger syndrome (McEvoy, Rogers, Pennington 1993; Miller & Ozonoff, 2000; Ozonoff *et al.*, 1991; Prior & Hoffmann, 1990; Rumsey, 1985).

### Weak Central Coherence

Individuals with autism and Asperger syndrome also have specific problems with integration of diverse information at different levels, which impairs their ability to construct higher-level meaning in context, i.e., 'central coherence' (Frith, 1989; Happé, 1997). They are said to have a weak central coherence which would explain their inability to understand the global meaning or gist of a story/joke. A more recent study (Jolliffe & Baron-Cohen, 2000) examining the ability to integrate linguistic information globally in order to derive a comprehensive meaning confirmed the impairment in coherence in individuals with high-functioning autism and Asperger syndrome, with the autism group showing a greater deficit. The precise cognitive and neurological mechanisms underlying weak central coherence are not known. Happé proposed diffuse abnormalities of brain structure, citing evidence of brain overgrowth (Piven *et al.*, 1995).

### Lateralization Models of Autism and Asperger Syndrome

Individuals with Asperger syndrome have been frequently associated with right hemisphere dysfunction (e.g., Ellis *et al.*, 1994). Various researchers have suggested similarities between Asperger syndrome and developmental disabilities of the right hemisphere and nonverbal learning disabilities (Gunter, Ghaziuddin & Ellis, 2002; Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995; Rourke, 1989; Voeller, 1986; Weintraub & Mesulam, 1983) based on nearly identical neuropsychological profiles. There is also some evidence for right hemisphere abnormalities in individuals with Asperger syndrome (Berthier, Bayes, & Tolosa, 1993; Volkmar *et al.*, 1996).

In contrast, autism has been associated with left hemisphere dysfunction based on evidence that individuals with autism are impaired in functions traditionally ascribed to the left hemisphere such as language and sequential processing whereas right hemisphere abilities such as visual spatial

abilities have been found to be intact (Dawson, 1983; Fein *et al.*, 1984). However, in the last two decades the emphasis has moved away from the left hemisphere position of autism. Basic language abilities known to be mediated by the left hemisphere (e.g., syntax, semantics, phonology) have been found to be intact in autism whereas the pragmatics of language which is a characteristic of the right hemisphere has been found to be impaired. There is some empirical evidence (Chiron *et al.*, 1995) suggesting that individuals with autism and Asperger syndrome may both have right hemisphere impairments, whereas only in autism left hemisphere damage can be found which results in the impaired/delayed language development. Similarly, a recent lateralization study (Rinehart, Bradshaw, Brereton & Tonge, 2002) reported left hemisphere dysfunction in individuals with autism during executive function tasks, in contrast, no such deficit was found in the Asperger group.

In summary, the above review revealed that almost all mental operations involved in humor appreciation including linguistic abilities, pragmatics, theory of mind skills, executive functions, episodic memory, self awareness, central coherence are impaired in individuals with autism and some to a lesser extent in Asperger syndrome. Apart from the differential involvement of both the left (language functions) and the right hemisphere (integration of cognitive and affective functions) in humor, imaging technology has revealed that extensive neural networks are involved in the appreciation of humor. The main brain regions involved are the frontal lobes, which have extensive reciprocal connections with the hippocampus (memory), temporal lobe/limbic system and amygdala (memory and affect) and cerebellum (affect, cognition, attention). All these brain regions have been implicated in the neuropathology of autism (e.g., Bachevalier, 1994; Courchesne *et al.*, 1994; Damasio & Maurer, 1978).

### RELATIONSHIP BETWEEN MATHEMATICAL GIFTEDNESS, AUTISM AND HUMOR

It appears that specific types of humor, such as philosophical and mathematical humor are preserved in very gifted individuals with autism/Asperger syndrome. Paulos (1980) in his book on mathematics and humor points out that 'reversal or permutation of the grammar of a sentence often results in humor' ... 'a grammatical or combinatorial

humor such as found in spoonerism, puns, transformation etc'. He also refers to 'a deeper sort of humor' based on misunderstandings derived from the 'confusion of the logic of a given statement or situation', which he defines as 'philosophical humor'. He refers to the statement of the Austrian philosopher Wittgenstein (1953, 1958) 'that a serious work in philosophy could be written that consisted entirely of jokes. One "gets" the joke if and only if one understands the relevant philosophical point'. Paulos (1980) highlights the similarities between mathematics (which is predominantly lateralized to the left hemisphere) and humor. 'Understanding the "correct" logic, pattern, rule, or structure is essential to understanding what is incongruous in a given story — to "getting the joke"', (p. 11). 'In addition, both mathematics and humor are economical and explicit' ... 'they are short and make sense without much context' (p. 16). As alerted to previously, individuals with autism have problems with context. Paulos further points out that 'the beauty of mathematical proof depends to a certain extent on its elegance and brevity. A clumsy proof introduces extraneous considerations and is long winded. Similarly, a joke loses its humor if it is awkwardly told, is explained in redundant detail, or depends on strained analogies' (p. 11). Paulos also notes that mathematicians more than any other professional group have a robust sense of humor 'Mathematicians are notoriously fond of word play, jokes, and humorous verse'. An example of an individual with highly developed linguistic and mathematical abilities is Ludwig Wittgenstein, one of the most influential philosophers of the 20th century, keenly interested in mathematics, logic and science who suffered from Asperger syndrome (Fitzgerald, 2000). Baron-Cohen (2003) put forward the theory that autism/Asperger syndrome is 'an example of the extreme male brain'. Individuals with autism have intact or superior abilities in 'folk physics' (understanding of inanimate objects) (Baron-Cohen, 1997) based on their good understanding of object properties and physical causality (Baron-Cohen, Leslie, & Frith, 1986), obsessive interest in mechanical or physical structures, or topics with mathematical/spatial regularities (e.g., transport networks and calendars) (Baron-Cohen, 1997). In addition, Baron-Cohen *et al.*, (1998) has demonstrated that there is a significant association between individuals who work in the area of mathematics, engineering and physics and who have a biological relative with autism.

## SUMMARY

Each of the neuropsychological/lateralization theories and underlying brain bases reviewed can account for some aspects of impaired humor appreciation in autism/Asperger syndrome. The well documented deficits in linguistic abilities, pragmatics, mindreading, executive functions, episodic memory, self awareness, central coherence and affective processing in individuals with autism and to a lesser extent in Asperger syndrome all contribute to these difficulties. However, despite this overwhelming evidence there are many anecdotal and parental reports of humor in individuals with autism/Asperger syndrome of all levels of functioning. Examples range from basic slapstick humor to highly sophisticated humor based on nonsense and logical confusion of language. These accounts seem to contradict the assumptions of our humor understanding in autism/Asperger syndrome and challenge some of the psychological theories with regard to creativity, imagination, reciprocal social interaction, executive functioning and mindreading.

It appears that some individuals with autism/Asperger syndrome are highly creative, imaginative and original and their humor 'can range from word-play and sound associations to precisely formulated, truly witty comments' (Asperger, 1944; Frith, 1991, p. 82). Highly creative and metaphorical language in children with autism has also been reported by Kanner (1946). Creativity and imagination are characteristics which are not usually expected to be found in individuals with autism/Asperger syndrome; impoverished imagination is part of the triad of impairments (Wing, 1996). Research shows, however, that autistic creativity is mainly limited to topics of special interests and restricted to imagination within the non-social world, e.g., drawing skills, concrete visual imagery (Selfe, 1983; Hurlburt, Happé, & Frith, 1994; Grandin, 1996) and is more reality-based than imaginative (Craig and Baron-Cohen, 1999).

Some individuals with autism/Asperger syndrome also seem to master the cognitive processing of humor, i.e., incongruity and its resolution and switching of meanings as portrayed by the production of relatively sophisticated puns and word games. It is obvious that individuals with autism/Asperger syndrome with highly developed linguistic and computational abilities approach humor from a more cognitive/intellectual perspective and are able to grasp the cognitive basis of humor. This is

congruent with the above mentioned fMRI evidence of differential systems underlying cognitive and affective humor processing (Goel & Dolan, 2001). Also supporting this theory is research evidence for a specific impairment in autistic children in understanding of non-verbal humor, e.g., not laughing at funny faces (Reddy *et al.*, 2002). It appears that the autistic type of humor mainly centers around obsessive topics without the intention to share enjoyment/laughter with others, which is the main purpose of telling jokes. Individuals with high functioning autism and more so Asperger syndrome with their largely unimpaired linguistic skills are able to produce and comprehend verbal humor but the quality seems to be more of a cognitive nature, based on linguistic and logical principles and motivated by obsessional characteristics. In many instances this type of humor appears to be learned and does not seem to have the purpose of sharing interaction with others. The most important ingredients, affective response and reciprocity are missing. Humor and laughter are pleasurable and social experiences (Bergson, 1911; Freud, 1905; Koestler, 1964) which help to create feelings of community and closeness and the main difficulties even high functioning individuals with autism/Asperger syndrome have are their socio-communicative impairments. Congruent with this interpretation is Baron-Cohen's hypothesis (2003) that autism/Asperger syndrome is an example of the extreme male brain. 'It can explain why those who live with this condition are brilliant at analyzing the most complex systems, yet cannot relate to the emotional lives of those they live with'.

Finally, there is still this minority of people with autism/Asperger syndrome who as described in some of the anecdotal reports are able to produce, apprehend, share and enjoy humor despite of difficulties with mindreading. Interestingly, the majority of these accounts are based on females with autism (Mesibov, 1992; van Bourgondien and Mesibov, 1987; Werth *et al.*, 2001). Is it possible that females with autism/Asperger syndrome are less socially impaired than males?

## FUTURE RESEARCH

Given that humor is such a universal human ability already displayed by very young infants future research investigating whether lack of humor is an early sign or marker for autism would

be especially useful. Also, an examination of possible sex differences in humor appreciation in autism/Asperger syndrome might be very informative, particularly with regard to Baron-Cohen's theory of the 'extreme male brain'. In the literature of gender differences in humor it appears that men's humor is more competitive and focused on self-enhancements, whereas on the other hand women's humor is more supportive and concerned with sharing of experiences (Lampert & Ervin-Tripp, 1998). Finally, the use of humor as behavioral intervention to reduce anxiety and stress in people with autism/Asperger syndrome as mentioned in this review may also be of great practical importance. Similarly, humor as a tool in educational settings might also be very beneficial and worth exploring.

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