“Ultimately, we are more than how our senses work, more than what our brains do with what’s coming in via our senses. Still, it is so easy to confuse ‘self’ with ‘the mechanics of perception or cognition’; our systems” (Williams, 1998, p. 19).

The previous chapter looked at the communication characteristics of PDD and attempted to understand these in terms of language processing. It was proposed that in order to understand better the communication difficulties in this population the cognitive processing of this population also needs to be looked at. The current chapter focuses on what is known about cognitive processing in PDD and controversies in this area are discussed. It would appear that the exact cognitive processing profile of PDD is not yet known. In this chapter it is proposed that the planning, attention, simultaneous and successive processing (PASS) model may be a useful model to look at in relation to the cognitive processing in PDD, as many of the cognitive processing characteristics described in this population are encompassed in this model.

It is accepted that children with PDD have different cognitive processing styles (Bogdashina, 2005). Differences in the area of cognitive processing have been used to attempt to explain the core difficulties seen in PDD. Results have, however, been conflicting with many different aspects of cognitive processing being proposed to account for the difficulties seen.

3.1 COGNITIVE CHARACTERISTICS AND EXPLANATIONS OF PDD

Cognitive characteristics that have been studied in PDD include: difficulties in the area of attention, difficulties in the area of memory, difficulties in the area of executive functioning, difficulties with central coherence, a detailed focused cognitive style, differences in perception, differences in sensory processing, differences in systemizing-empathizing and differences in imitation.
3.1.1 **Attention difficulties**

Attention has been proposed as a possible core deficit of autism (Burack, Enns, Stauder, Mottron, & Randolph, 1997); attention is integral to the selection of relevant as opposed to irrelevant information from the environment, and individuals with PDD typically respond inappropriately to and are unable to benefit from their environments (Burack et al., 1997). Furthermore, children with PDD have been noted to focus on irrelevant stimuli, to perseverate on self-initiated tasks or interests, to experience difficulty focusing on educational tasks and to have deficits in the area of joint attention (Burack et al., 1997; Charman et al., 1997; Kasari et al., 1990). Moreover, PDD and attention deficit hyperactivity disorder have been reported to occur often together (Gadow, DeVincenzo, & Pomeroy, 2006; Schatz, Weimer, & Trauner, 2002; Goldstein & Schwebach, 2004) and hyperactivity has been noted to be correlated with pragmatic ability (Farmer & Oliver, 2005). Furthermore, deficits have been reported in the operation of the reticular activating system (Minsheu, Sweeney, & Bauman, 1997) and in electrodermal responses to the presentation of stimuli (Burack et al., 1997) - these reflect neurological and physiological components that have been associated with attention (Burack et al., 1997).

Research in the area of attention has concentrated on a number of areas:

- **Arousal studies** have included studies looking at hyperarousal, underarousal and faulty modulation of arousal. Results have, however, been unclear and more recently research has focused on more specific attentional and/or physiological components (Burack et al., 1997).
- **Sustained attention** has been investigated. Sustained attention for simple repetitive visual information has been found generally to be intact in PDD. The efficiency of sustained attention appears to be related to the level of cognitive development rather than to the diagnosis of PDD (Burack et al., 1997). A study of attention in Asperger's syndrome may, however, suggest some difficulty in this area. Schatz et al. (2002) found that individuals with Asperger's syndrome showed greater variability in their responding on a continuous performance task, when compared to controls. They suggest that, while this may indicate an attention deficit, it may reflect differences in cognitive processing that could lead to a greater variability in performance.
Attentional gazing has been studied. Studies, however, appear to have mainly been conducted with low functioning individuals and it has been suggested that some of the deficits may be related to organicity, rather than to autism per se (Burack et al., 1997).

Filtering of attention has also been researched. Filtering deficits were not found in high functioning adolescents with autism, although it is suggested that they may be evident at lower developmental levels (Burack et al., 1997). Difficulty filtering between modalities was, however, noted in high functioning adults with autism (Burack et al., 1997).

Selective attention has also been suggested to be impaired in PDD. Individuals with PDD’s performance were more affected by the presence of non-target distractors on a target discrimination task than their developmentally matched controls (Burack, 1994, as cited by Tsatsanis, 2005). In a study by Ciesielski, Courchesne, and Elmasian (1990, as cited by Tsatsanis, 2005) adults with HFA experienced greater difficulty than their controls, ignoring competing stimuli in a divided attention task involving two modalities (vision and hearing).

Shifting attention has been studied. In an evaluation of expecting, persons with autism were noted to experience difficulty in rapidly changing expectations from one moment to another (Burack et al., 1997). Courchesne (as cited by Edelson, 1995) believes the problem in PDD to be one of shifting attention and suggests that differences in cerebellar processes may be responsible for this. Courchesne (2004) found that neocerebellar damage affects the ability to shift attention between auditory and visual information as well as between perceptual domains within the visual modality. This has also been said to occur due to parietal lobe dysfunction (Goldstein, Johnson, & Minshew, 2001). Pascuakvaca et al. (1998, as cited by Goldstein et al., 2001) suggested that this difficulty in shifting attention was at the level of executive control due to frontal lobe dysfunction. A study by Ozonoff et al. (2004) indicated that not all types of attention shifting are problematic in autism, with those relying on pre-frontal cortical function being impaired and others being intact. Shifting between categories, sets or rules was found to be deficient, while shifting within a category or rule was not (Ozonoff et al., 2004).

Orienting has been investigated. Studies have presented contrasting results, although results do appear to suggest the presence of a spatial orienting deficit (Burack et al.,
1997). Haist, Adamo, Westerfield, Courchesne, and Townsend (2005) recently reported a spatial attention deficit in PDD. They interpreted their results to suggest a profound deficit in automatic spatial attention, as well as deficient voluntary attention. According to Haist et al. (2005) these findings suggest a dysfunctional cerebello-frontal spatial attention system.

- Children with autism have been shown to experience difficulty with disengaging attention (Landry & Bryson, 2004). Townsend et al. (1996, as cited by Landry & Bryson, 2004) suggested that there are distinct sub-groups of autism, having problems in either disengaging and/or shifting attention.

- Attentional difficulties have been suggested to be due to different processing styles. A study of visual search in children with autism appeared to suggest that children with autism searched the display in a parallel manner, while the non-autistic children did so in a serial manner (Burack et al., 1997). Goldstein et al. (2001) found that individuals with autism experienced difficulty with attention measures that loaded on focus-execute and shift factors but not on sustain and encode factors. Differences were only seen on tasks that placed demands on cognitive flexibility or psychomotor speed. They, therefore, suggest that the attention deficits seen in autism may actually be secondary to their performance in other areas such as complex decision-making or psychomotor abilities. They felt that impaired shifting attention is due to problems with complex information processing and concept formation and not with perceptual shifting mediated by cerebellar function.

At this stage it does not seem clear whether attentional difficulties noted in PDD are due to difficulties at a higher order level (i.e. due to difficulties with executive control) or due to a more basic deficiency (Tsatsanis, 2005). While the relationship between attention difficulties and communication difficulties in PDD does not appear to have been researched, attention difficulties have generally been noted to be linked to difficulties in the area of communication (Armstrong & Nettleton, 2004; Tetnowski, 2004; Westby & Watson, 2004) and attention has been said to be one of the systems that supports language processing (Crosson, 2000a; Fischler, 2000). It would, therefore, be beneficial to further study the relationship between attention difficulties and communication difficulties in PDD.
3.1.2 Memory difficulties

Individuals with PDD have been shown to have intact visual recognition memory, verbal cued recall memory and short term auditory memory, with rote memory being an area of strength (O'Shea, Fein, Cillessen, Klin, & Schultz, 2005). Ozonoff and Strayer (2001) found that working memory is not seriously impaired in autism, while Bennetto et al. (1996, as cited by Tsatsanis, 2005) found working memory to be affected in a group of high functioning children with autism. Renner, Grofer Klinger, and Klinger (2000) found that the implicit and explicit memory of a group of children with autism was intact but that they used different organisational strategies during encoding and/or retrieval. Children with PDD have been noted to use different cognitive strategies on memory tasks (Summers & Craik, 1994).

Studies have suggested that individuals with PDD are less able than controls to utilize meaning to aid their recall (Summers & Craik, 1994). Their rote recall was noted to be better than the recall that required the use of encoding strategies (Sigman, Dissanayake, Arbelle, & Ruskin, 1997; Summers & Craik, 1994); they had strengths in rote and associative memory but deficits in semantic, declarative memory (Prizant, 1996). Difficulty with certain word fluency tasks has been suggested to be due to difficulty with semantic organisation and memory (Boucher, 1988). During free recall tasks they have been noted to experience difficulty using category relations between words to aid recall (Bowler et al, 1997, as cited by Gardiner, Bowler, & Grice, 2003; Bowler, Gardiner, & Berthollier, 2004). Tsatsanis (2005) reviewed a number of studies on memory in PDD and suggested that the problem is with retrieval, particularly with making use of context dependent cues, rather than with the encoding of information.

Difficulties with the recall of recent events and difficulties with memory for faces have been reported (O'Shea et al., 2005). Furthermore, difficulties with episodic memory (memory for personal information and experiences), including difficulties with source memory, have been reported (Gardiner et al., 2003; O’Shea et al., 2005; Toichi & Kamio, 2003). Some conflicting results, however, exist. Bowler et al. (2004) found that in a group of individuals with Asperger’s, a deficit in source memory was no longer evident when source was supported in the testing procedures used. Source memory difficulties have been suggested to be due to impairments in executive functions (Hala, Rasmussen, & Henderson, 2005).
A comparison of memory for verbal tasks versus tasks conducted in other modalities, such as visual tasks, does not appear to have been examined. Furthermore, the relationship between memory, communication skills and theory of mind abilities does not appear to have been studied in the PDD population. Moreover, the relationship between working memory and other executive functions, such as planning in the HFPDD population still appears to require clarification. Memory is an important system that supports language processing (Crosson, 2000b) and the influence that the memory style in PDD has on language and communication skills in this population requires further investigation.

3.1.3 Executive functioning difficulties

"Executive functioning is a uniquely human ability that permits an individual to plan, carry out, and monitor a sequence of actions that is intended to accomplish a goal" (Filley, 2000, p. 95). It encompasses functions such as goal-directed behaviour, attentional control, temporal organisation, planning and working memory (Lehto, Juujarvi, Kooistra, & Pulkkinen, 2003). Children with PDD have been noted to experience difficulties with executive functioning (Ozonoff, 1997, Verte, Geurts, Roeyers, Oosterlaan, & Sergeant, 2006); problem solving (Rumsey, 1992, Channon et al., 2001); self regulation (Bieberich & Morgan, 2004); and organisational skills (Prior & Hoffman, 1990, Ozonoff, 1997). Specific types of executive impairment have been found to be associated with the PDDs. Ozonoff and Jensen (1999) found that individuals with autism experience the most difficulty with planning and flexibility, while individuals with attention deficit hyperactivity disorder and Tourette's syndrome experience the most difficulty with inhibitory dysfunction.

These findings were supported by a study by Ozonoff et al. (2004) who found that their group of individuals with autism experienced difficulty with planning and shifting between categories, sets and rules (extradimensional shifting). They suggested that this pointed to frontal lobe (particularly pre-frontal lobe) involvement in autism. A study by Lopez, Lincoln, Ozonoff, and Lai (2005) replicated previous reports of impaired cognitive flexibility and planning in autism, but intact working memory and response inhibition. A review of the literature on executive functioning by Ozonoff, South, and Provencal (2005) confirmed these findings. They suggest that from the studies carried out to date, inhibitory control and possibly working memory appear to be relatively spared in PDD. However, mental flexibility, including set shifting and attention shifting, appears to be affected in PDD.
Kleinhans, Akshoomoff, and Delis (2005) administered a battery of executive functioning tasks to a group of adults and adolescents with HFA and Asperger’s syndrome. Deficits were found on complex verbal tasks that required cognitive switching and the initiation of lexical retrieval strategies, while cognitive inhibition was found to be intact. However, an impairment in visual attention, which was more prevalent in the HFA group, was also observed. Tsatsanis (2005) suggested that deficits in conceptual flexibility, rather than perceptual or attention flexibility, appeared to be the main deficit in individuals with HFA.

While working memory has generally been found to be intact in individuals with autism, a recent study (Verte et al., 2006) did find difficulties in visual working memory in children with HFA, Asperger’s syndrome and PDD-NOS. Hala et al. (2005) suggests that deficits in working memory are observed on tasks that require working memory in conjunction with other executive abilities, such as tasks where working memory and inhibitory control are required to work together to achieve a common goal (Hala et al., 2005).

A relationship between executive functioning and play development (Craig & Baron-Cohen, 1999; Rutherford & Rogers, 2003) has been noted, with the executive function of generativity being particularly strongly related to pretend play (Rutherford & Rogers, 2003). However, problems with executive functioning have been unable to account for imaginative creativity being more problematic than reality-based creativity in autism, with the theory of mind explanation being proposed to explain this better (Craig & Baron-Cohen, 1999). A relationship between executive functioning and theory of mind has been noted (Carlson & Moses, 2001; Hughes & Ensor, 2005; Perner, Lang, & Kloo, 2002) and advances in executive functioning between 3 and 6 years have been observed to coincide with the development of theory of mind (Bialystok & Semnan, 2004). Executive functions such as inhibitory control and working memory have been found to be related to performance on theory of mind tasks (Carlson & Moses, 2001). The nature of this relationship is, however, still not clear (Moses, 2001; Perner et al., 2002) and there is much debate in the literature between the executive functioning account of theory of mind, versus the conceptual change account. It has been suggested that while development in executive functioning facilitates theory of mind development, it is on its own not sufficient for the development of theory of mind and that other processes such as the learning of mental states needs to take place (Carlson & Moses, 2001). Furthermore, executive functioning difficulties as a core deficit in autism are not able to explain all the characteristics of these individuals, for example the
areas of remarkable strength seen in some individuals, including savant skills in music, art, calculation and memory (Happe, 2005).

With regard to communication, a relationship between executive functioning and understanding figurative speech has been noted (Rajendran, Mitchell, & Rickards, 2005). Difficulties in executive functioning have been suggested to be due possibly to executive failure using language for self regulation (Joseph, McGrath, & Tager-Flusberg, 2005), suggesting an impairment in inner speech. Russell, Jarrold, and Hood (1999) proposed that difficulty in executive functioning tasks may be due to difficulty encoding rules in verbal form, due to difficulty using internal self-directed speech. While executive functioning has been found to be associated with both theory of mind and language ability in PDD (Ozonoff et al., 2005), the relationship between executive functioning and the range of communication difficulties seen in HFPDD does not appear to have previously been evaluated. The extent to which executive functioning difficulties in PDD (particularly planning and flexibility) relate to the theory of mind and communication difficulties seen in this population appears to require further investigation.

3.1.4 Weak central coherence or a detailed focused cognitive style

Frith (1989a, 1989b) believed that the strengths and deficits in autism may have the same underlying origin. According to Frith (1989a, 1989b) a central drive for coherence allows a person to place his or her experiences in a wider context. The original weak central coherence account of PDD suggested this to be missing or impaired in autistic children (Brook & Bowler, 1992). This "weak drive for central coherence" was felt to bias the child to process information using an analytic rather than a global approach (Jarrold, Boucher, & Russell, 1997). As a result they were believed to be unable to integrate diverse information into a whole, and experienced difficulty taking the context into account when processing information (Hala et al., 2005). The weak central coherence account has, however, since been revised as consisting of a detail-focused cognitive style, rather than a deficit in central coherence (Happe & Frith, 2006).

Support for the weak central coherence account or detail-focused cognitive style account comes from studies of verbal-semantic coherence, visual-spatial constructional coherence, perceptual coherence and face processing (Happe, 2005). Studies of verbal-semantic
coherence, for example, have shown that individuals with autism do not benefit in the same way from meaning in memory tests and show good verbatim and poor gist memory of stories (Happe, 2005). While weak central coherence appears to result in individuals with autism experiencing difficulty in benefiting from meaning or coherence, it also accounts for their superior recalling and processing of information that to non-autistic children may appear meaningless (Martin & McDonald, 2004).

Individuals with PDD have been shown to present with better performance than controls on visual-spatial constructional tasks such as block design and embedded figures tasks (Martin & McDonald, 2004). This better performance has been proposed as being due to superior segmentation abilities and individuals with PDD have been described as detailed thinkers (De Clercq, 2003). This detailed thinking style in the visual-spatial area has also been shown in some PDD individuals who are able to recognise objects from detail, as well as from the detailed drawing style seen in some individuals (Happe, 2005).

On a perceptual level, individuals with PDD have shown enhanced discrimination ability and reduced generalization ability (Plaisted, Veronica, Bell, & Davis, 2006). According to Plaisted et al. (2006), global processing is intact in PDD but there is enhanced processing of the individual features of stimuli. According to this account, individuals with PDD are relatively good at processing features that are unique to an item (discriminating items), but relatively poor in processing features held in common between items (Happe, 2005). Plaisted and colleagues have shown that individuals with autism have superior visual search, superior discrimination in learning confusing patterns and poor prototype extraction, which they have used to support their account (Happe, 2005). This enhanced discrimination has mainly been assessed in the visual modality, although a recent study by O’Riordan and Passetti (2006) also demonstrated enhanced auditory discrimination in children with autism.

Another perceptual account of PDD is the enhanced perceptual functioning account proposed by Mottron, Dawson, Soulieres, Hubert, and Burack (2006). According to this account there is an over development of low level perception in PDD. In contrast to the original weak central coherence account, global processing is believed to be possible for individuals with PDD but local processing is generally preferred (Mottron et al., 2006). Mottron et al. (2006) cite a number of studies to support their account. This account is also supported by functional imaging studies that demonstrate that on a number of tasks individuals with autism show
enhanced activation in visuo-perceptual regions and diminished activation in "higher-order" (frontal) regions and regions known to be involved in processing of social information (Mottron et al., 2006). According to this account there appears to be a skewing of brain activation towards primary and early association areas (Mottron et al., 2006).

The central coherence account has also been used to explain the more piecemeal processing of faces noted in autism (Dawson, Webb, & McPartland, 2005; Serra et al., 2003). Individuals with autism appear to be more oriented towards processing the local aspects of faces, although this spontaneous orientation has been shown to be overcome by certain task changes (Jemel, Mottron, & Dawson, 2006).

The weak central coherence account of autism is, however, controversial and some studies have not supported this hypothesis (Burnette et al., 2005; Happe & Frith, 2006; Molesworth, Bowler, & Hampton, 2005; Pellicano, Maybery, & Durkin, 2005). A study by Molesworth et al. (2005) failed to find a prototype effect in autism, which would be expected in the presence of weak central coherence. Burnette et al. (2005) demonstrated that children with HFA did not show a local processing preference on visual-spatial measures. They suggest that weak central coherence in visual-spatial processing may not be a robust characteristic of all children with PDD.

A number of the negative findings has been interpreted as appearing to suggest a processing bias towards features and not a processing deficit for wholes, resulting in the revision of the original central coherence account (Happe & Frith, 2006). This processing bias towards features has not, however, been demonstrated in all studies assessing it (Happe & Frith, 2006). A further difficulty with this account is that only a sub-group of the PDD population present with a detailed focused cognitive style (Happe & Frith, 2006). Furthermore, with the change in weak coherence being seen as a cognitive style rather than a cognitive deficit, it has been proposed that this style may occur in the normal population. It also has been found to occur in the family members of some individuals with PDD, without these individuals presenting with social difficulties (de Jonge, Kemner, & Van Engeland, 2006, Happe & Frith, 2006).

It has been proposed that weak central coherence results in theory of mind difficulties, as the person is unable to adopt a global view of the situation and to integrate the perspective of
different individuals within that situation (Jarrold et al., 2000). However, central coherence was not found to be related to mind reading in typically developing pre-schoolers, although visual-spatial construction was found to be related to executive control (Pellicano et al., 2005). Moreover, detailed focused processing has been found to occur across the PDD spectrum regardless of theory of mind performance, suggesting that central coherence and theory of mind may be distinct entities (Happe & Frith, 2006). Studies investigating the relationship between central coherence and theory of mind have been mixed (Happe & Frith, 2006). In a study by Burnette et al. (2005), performance on the weak central coherence measure was correlated with performance on the theory of mind measure. Executive functioning deficits were suggested to link performance on these measures (Burnette et al., 2005).

The relationship between weak coherence and executive functioning is also not clear. It has been suggested that the difficulty in local processing may be due to poor executive control processes needed to guide attention to either local or global information (Iarocci, Burack, Shore, Mottron, & Enns, 2006). However, a study by Booth et al. (2003, as cited by Happe & Frith, 2006), found poor correlation between executive functioning and central coherence. It would appear that the relationship between central coherence, executive functioning and theory of mind needs to be investigated further. While weak central coherence has been suggested to affect language ability, particularly pragmatic skills (Burnette et al., 2005; Martin & McDonald, 2004), there appears to be a paucity of studies that look at the relationship between central coherence and communication skills in PDD. It would appear that the contribution of weak central coherence to explaining the symptoms in autism is complex and that the relationships between central coherence, theory of mind and executive functioning is still not clear.

3.1.5 Problems with specific modalities of processing

A strength in visual-spatial processing has been noted in children with PDD (Kleinhans et al., 2005). On the Wechsler Intelligence Scales, a frequently reported pattern is one where block design is a high point and comprehension a low point (Koyama, Tachimori, Osada, & Kurita, 2006; Minshew, Turner, & Goldstein, 2005a). However, this strength in visual-spatial processing is not consistently found and appears to be complex. Verbal IQ being significantly better than performance IQ has been more commonly reported in Asperger's syndrome, while
performance IQ being better than verbal IQ is more frequently reported in autism (Joseph, Tager-Flusberg, & Lord, 2002; Ghaziuddin & Mountain-Kimchi, 2004). Joseph et al. (2002), however, did report much individual variation in these profiles and Ghaziuddin and Mountain-Kimchi (2004) reported that mixed patterns also occur. Higher non-verbal skills on IQ testing have been noted to occur with greater social difficulties (Joseph et al., 2002). Moreover, Joseph et al. (2002) found with increasing age a growing disassociation between verbal and non-verbal skills in the PDD subjects that they studied. In their younger group when discrepancies were noted, they were more often noted in the direction of weaker verbal skills than non-verbal skills. In their older group when discrepancies were noted, they occurred in both the direction of verbal being greater than non-verbal skills and verbal being less than non-verbal skills. In both the younger and older groups profiles of verbal skills being equal to non-verbal skills were also found (Joseph et al., 2002). According to Joseph et al. (2002), one of the problems with studies that attempt to find a prototypical cognitive profile of autism is that this may occur at the expense of seeing if different cognitive profiles exist within this group. It has been suggested that individuals with PDD may choose or favour one sensory channel to process information (Blakeslee, 2002). This still requires further investigation.

3.1.6 Simultaneous versus successive processing

Related to the above is whether children with PDD favour simultaneous or successive processing of information, as simultaneous processing comprises mainly visual processing and successive processing comprises mainly auditory processing. There appears to be a difference of opinion as to whether children on the PDD spectrum use more of a sequential or a simultaneous means of processing information. Jarrold and Russel (1997) suggest that these children use more of an analytic processing approach, having more difficulty with simultaneous processing, while Tanguay (1984) suggests that they have more difficulty with sequential than simultaneous processing. Allen et al. (1991) examined sequential and simultaneous processing abilities of high functioning autistic and language impaired children and found that both groups presented with a relative sequential processing deficit and that there were no significant differences in the relationship between their sequential and simultaneous processing capacities. Gagnon, Mottron, Bherer, and Joanette (2004) suggest that a successive counting rather than a simultaneous subitizing processing strategy was used in quantification in HFA. Rosenthal (1994) suggested that children with non-verbal learning
disability may have greater difficulty with simultaneous than sequential processing. Similarities have been found between children with Asperger's syndrome and non-verbal learning disability (Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995).

It has been suggested that children on the PDD spectrum use gestalt cognitive processing, particularly in their processing of language (Prizant, 1983; Schoenbrodt et al., 1995). Communication symptoms such as echolalia and idiosyncratic intonation patterns and inflexibility in social interactive patterns have been used as evidence to support this view of gestalt type processing (Prizant, 1983). Furthermore, certain studies have reported that these children do better on non-language tasks that can be carried out using a holistic or gestalt processing approach (Hermelin, 1976; Prior, 1979). It has been suggested that when faced with a task requiring analytic processing, these children may attempt to process it using pattern reproduction or rote repetition (Prizant, 1983). However, according to Das et al. (1994) rote repetition indicates the use of sequential rather than simultaneous processing. These differences of opinion, may, therefore, be due to terminology being used in contrasting ways. Hoeksma, Kemmer, Verbaten, and van Engeland (2004) suggest that in the PDDs there is not a shortage of processing capacity but an abnormality in the using and allocation of this processing capacity.

3.1.7 Sensory integration and perception

One of the possible reasons for the variability in processing seen in the PDDs could be due to sensory integration difficulties. Sensory integration difficulties are prevalent in the PDDs (Paris, 2000). Based on a review of the literature, sensory processing difficulties have been suggested to occur in 30 to 100% of individuals with PDD depending on the study (Dawson & Watling, 2000, as cited by Iarocci & McDonald, 2006). Sensory abnormalities have been described in the five main sensory modalities, as well as in the senses of kinaesthesia and proprioception (Harrison & Hare, 2004). Sensory difficulties have included hyper and hyposensitivity, distortions, tune-outs and sensory overload (Harrison & Hare, 2004). These have included difficulty processing information from more than one modality at a time and identifying the source modality of sensory stimulation (Harrison & Hare, 2004; Iarocci & McDonald, 2006).
Sensory difficulties in PDD, therefore, appear not only to be intra-modal but also inter-modal (i.e. occurring between modalities). Difficulty understanding speech in noise has been noted in individuals with HFA and Asperger's syndrome and this has been suggested to be due to both perceptual and central processing difficulties (Alcantara, Weisblatt, Moore, & Bolton, 2004). Speech in noise difficulty may also partly be due to difficulties integrating visual and auditory speech cues (Alcantara et al., 2004). Furthermore, it has been suggested that, when children with PDD are faced with processing multiple sensory stimuli, they will often over focus on one modality of sensory input as they experience difficulty integrating all the sensory information (Bogdashina, 2005; Paris, 2000). Difficulty integrating information possibly results in learning by memorisation and difficulty in generalising information (Paris, 2000). Ayres (1973, 1975, 1980, 1989, in Paris & Murray-Slutsy, 2000) suggested that the development of higher level cortical functions relies on the integrity and integration of information from the different sensory systems.

According to Iarocci and McDonald (2006) a number of the psychological theories of PDD reflect the difficulty with sensory integration seen. The weak central coherence view acknowledges the difficulty: integrating information from a variety of contexts to form higher-level meaning (Frith, 1989, in Iarocci & McDonald, 2006). Furthermore, certain approaches acknowledge the enhanced perceptual discrimination and enhanced perceptual processing in various modalities, including the work of Plaisted and colleagues and Mottron and colleagues (Iarocci & McDonald, 2006). Difficulty shifting attention both within the visual modality and also between the visual and auditory modality has been suggested by a number of studies (Iarocci & McDonald, 2006). Even the executive dysfunction account of PDD is not in conflict with a sensory integration account, as executive functioning difficulties may result in co-ordinating information from different sources and modalities being difficult (Iarocci & McDonald, 2006). However, while these other cognitive processing theories are not in conflict with a sensory integration account, the way in which they relate to such an account is still not clear.

Bogdashina (2005) believes that individuals with PDD may demonstrate perceptual thinking, where thoughts evoke real sensations. Bogdashina (2005) also believes that individuals with PDD may choose a modality with which to store their memories. While the preferred modality is often the visual one, this is not necessarily so and individuals with PDD may have auditory, kinaesthetic, tactile or olfactory memories (Bogdashina, 2005). Synaesthesia,
which has been reported in some individuals with PDD (Harrison & Hare, 2004), would also appear to point to multi-sensory processing difficulties. Synaesthesia type difficulties involve multi- and cross-channel perception (Harrison & Hare, 2004), so that an individual may experience sensations in one modality when another modality is stimulated; for example, a person with synaesthesia may experience a certain colour when they hear a certain tone (Ramachandran & Hubbard, 2001). Iarocci and McDonald (2006) suggest that when studying autism more than one modality needs to be assessed and that multi-sensory processing needs to be given more consideration in future studies.

It has been proposed that children with sensory modulation difficulties will have difficulty with language learning, concept formation, motor planning and organising behaviours (Murray-Slutsky & Paris, 2000). It would appear that when looking at the communication difficulties of children with PDD it may be useful to compare cognitive processing in more than one modality.

3.1.8 Differences in systemizing-empathizing

Baron-Cohen (2002) proposed an “extreme male brain” theory of autism, which has grown out of the theory of mind paradigm of autism (Lawson, Baron-Cohen, & Wheelwright, 2004). This approach appears to take into account both the theory of mind characteristics and some of the cognitive characteristics seen in autism. This theory is based on an empathizing-systemizing model. Empathizing is the drive to identify and respond appropriately to the thoughts and emotions of others (Baron-Cohen, 2002). It includes what is meant by theory of mind, as well as including some affective reactions such as sympathy (Baron-Cohen et al., 2005). Systemizing is the drive to analyse and build systems and involves understanding and predicting non-agentive events (Baron-Cohen, 2002). In order to make sense of systems the individual needs to make sense of the underlying rules and regularities (Baron-Cohen et al., 2005). Males have been found to be superior on tasks that involve systemizing, while females have been found to be superior on tasks involving empathizing (Baron-Cohen, 2002). PDD is seen as following an extreme of the male brain (Baron-Cohen et al., 2005). Baron-Cohen et al. (2005) suggest that together with empathizing deficits, individuals with PDD may have intact or superior systemizing skills. Baron-Cohen and Wheelright (1999, in Baron-Cohen et al., 2005) did a survey of obsessions of children with PDD and found that these clustered in the area of systems. A study by Lawson et al. (2004) found that on an empathizing task
females without Asperger’s syndrome performed better than males without Asperger’s syndrome, who performed better than males with Asperger’s syndrome. On a systemizing task the females without Asperger’s syndrome performed worst, while the males without Asperger’s syndrome and the males with Asperger’s syndrome did not perform significantly differently (Lawson et al., 2004).

Baron-Cohen et al. (2005) point out that there are individuals with autism who do not demonstrate executive functioning difficulties and who have deficits in empathizing and good abilities in systemizing. While both the empathizing-systemizing and central coherence theories predict good attention to detail, the empathizing-systemizing theory indicates that as long as there are underlying rules and regulations which can be grasped, high functioning individuals with PDD should be able to understand the whole system (Baron-Cohen et al., 2005). According to Baron-Cohen et al. (2005) the empathizing-systemizing theory is able to account for some of the weaknesses of the executive functioning and central coherence theories. It would seem that one of the most useful contributions of the empathizing-systemizing theory is that it acknowledges that theory of mind and cognitive explanations for PDD should be viewed together to understand better the difficulties seen in this population.

3.1.9 Imitation and the problem with mirror neurons

It is well accepted that deficits in imitation skills are common in PDD and that this affects the acquisition of many complex behavioural and social skills (Ingersoll & Schreibman, 2006). The imitative disturbance in individuals with PDD appears to involve both a disturbance in copying actions and in inhibiting the stereotypical mimicking seen in some individuals (Williams et al., 2001a). It has been suggested that the problem with imitation in PDD may be due to difficulty with the mapping between sensory and motor modalities of neural codes for actions (Williams, Whiten, & Singh, 2004). A class of neurons called mirror neurons was recently discovered in the frontal cortex; they show activity both when an action is performed by an individual and when the individual observes someone else perform the action (Williams et al., 2001a). Dapretto et al. (2005) demonstrated that children with autism did not show mirror neuron activity in the inferior frontal gyrus when imitating and observing emotional expressions. Williams et al. (2001a) suggest that mirror neurons appear to be a 'supra-modal representation' of action and that they act as a bridge between areas of high visual processing and the motor cortex. They suggest that co-ordinated activity between
different sensory modes may be most affected in PDD. While still in its infancy, this research would again appear to support difficulty with inter-modal processing in PDD. This might help explain the praxis deficits reported in some children with PDD (Baranek, Parham, & Bodfish, 2005).

3.1.10 Neurological explanations

Neuropsychiatric assessments of individuals with PDD have indicated that approximately 90% show signs of brain damage or dysfunction (Steffenberg, 1991) and central nervous system dysfunction has been very common in population studies of PDD (Gillberg & Coleman, 1996). Neurological findings are, however, varied. Possible areas that have been suggested to be affected are: the cerebellum (Allen & Courchesne, 2003; Filipek, 1996; Minshew et al., 1997; Muller et al., 1999); the brainstem including the reticular activating system (Minshew et al., 1997); the thalamic area and the lenticulate (Filipek, 1996); the basal ganglia and amygdala (Arehart-Treichel, 2001); the corpus callosum (Arehart-Treichel, 2001; Filipek, 1996; Minshew et al., 1997); the limbic system (Filipek, 1996; Minshew et al., 1997; Saitoh, Karns, & Courchesne, 2001; Szatmari, 2003; Voeller, 1996); the frontal lobes, particularly the pre-frontal areas (Ozonoff et al., 2004); fronto-parietal areas (Gillberg, Steffenburg, & Jakobsson, 1987); the temporal lobe (Bigler et al., 2003; Bachevalier, 1996; Jones & Kerwin, 1990; Voeller, 1996) including the auditory cortex (Muller et al., 1999); and the parietal lobe (Arehart-Treichel, 2001).

Herbert et al. (2003) found the white matter to be larger and the cerebral cortex to be smaller in the autistic brain. Muller, Kleinhans, Kemmotsu, Pierce, and Courchesne (2003) suggest abnormal disturbances in the development of cerebello-thalamo-cortical pathways. Furthermore, different patterns of cerebral dominance have been reported (Chiron et al., 1995; Escalante-Mead, Minshew, & Sweeney, 2003; Filipek, 1996; Muller et al., 1999) and it has been suggested that PDD may be due to right hemisphere (Gunter, Ghaziuddin, & Ellis, 2002) or bilateral dysfunction (Shields, Varley, Broks, & Simpson, 1996a, 1996b; Snow & Swisher, 1996), as well as due to problems with inter-hemispheric communication (Gunter et al., 2002).

An overall increase in brain weight has been reported in the PDDs (Minshew, 1996; Minshew et al., 1997; Palmen, Hulshoff, Kemner, Schnack, Janssen, Kahn et al., 2004).
Woodhouse et al. (1996, in Bishop, 1999) reported unusually large brain size in a sub-group of children with SPD. A recent study by Courchesne, Carper, and Akshoomof (2003) found that children with autism tend to be born with a smaller head size at birth, with there being a sudden and excessive increase in head size between 1 and 2 months, and 6 and 14 months. By 2 to 3 years of life the brain is found to be abnormally large (Courchesne et al., 2003). Bishop (1999) suggests that this increased brain weight may be due to the normal massive destruction of neurons and connections that are not functional, which usually occurs in the developing brain, not occurring. Another hypothesis is that an abnormal brain map develops if in utero neurons fail to arrive at their correct destination. As a result, different types of brain cells may occur in the wrong region (Bishop, 1999). There appears to be general consensus that some kind of early aberrant neural development underlies PDD (Muller et al., 1999; Rice et al., 2005). It is suggested that this may be localised at early stages of development but eventually affects many cerebral regions (Muller et al., 1999).

Minshew (1996) suggests that PDD is a developmental disorder of the brain that involves an abnormality in neural organisation, resulting in impairments in information processing abilities. According to the complexity deficit hypothesis of Minshew et al. (1997, as cited by Berone & Faubert, 2005) complex perceptual processing is affected by dysfunction of neuro-integrative mechanisms. It has been suggested that the problem in autism may be due to local over-connectivity and lack of connectivity between cerebral areas (Bertone & Faubert, 2005). It would appear that an informational processing account of PDD needs to take cognisance of these neurological aspects.

3.2 THE PLANNING, ATTENTION, SIMULTANEOUS AND SUCCESSIVE PROCESSING (PASS) MODEL

Investigations of the neuropsychological abilities of children with PDD have often studied isolated areas and have not looked at how these are related. Furthermore, they have generally not attempted to link this to an overall model of brain functioning in any way. It appears that what is needed is an overall assessment framework that can obtain a measurement on a number of the areas previously studied in order to obtain an overall cognitive profile. This would be useful in gaining a better understanding of the cognitive profile that may underlie the communication impairments in this population.
A number of the neuropsychological cognitive areas that have been proposed as being impaired in PDD are encompassed in a neuropsychological assessment model known as “PASS – Planning, Attention, Simultaneous and Successive Processing” (Das et al., 1994). This model has been used predominantly in the past with children with learning disabilities, dyslexia, attention deficit disorder, delinquents, developmental handicaps and mental retardation (Das, Kirby, & Jarman, 1979; Naglieri & Das, 1990). In the researcher’s knowledge, this model does not appear to have ever been applied to children with PDD. Rosenthal (1994), however, did apply this model to a limited number of primary school children with non-verbal learning disability, a disorder with similarities to Asperger’s syndrome (Klin et al., 1995). This method was reported to be useful in providing insights into the cognitive strengths and weaknesses of these children. The PASS model is based on the neuropsychological model of Luria (Bournot-Trites, Jarman, & Das, 1995) and, therefore, takes the neurological aspects into account. Below is a description of Luria’s model of brain functioning as it relates to the PASS model, how this has been extended into the PASS model and how it relates to research on cognitive processing carried out in PDD.

3.2.1 Luria’s neuropsychological approach

Luria conceptualised higher mental functions as functional systems requiring the cooperation of many different brain areas (Kagan & Saling, 1988). Luria divided the brain into three functional units. Unit 1 is concerned with arousal-attention (Das, 1992). Unit 1 structures occur in the brainstem, including the reticular activating system, and on the medial surfaces of the cerebral hemispheres, including the limbic system (Kagan & Saling, 1988). There is a close reciprocal relationship between these structures and the cortex (Kagan & Saling, 1988), particularly the pre-frontal areas of the third functional unit (Naglieri & Das, 1990).

Unit 2 and 3 occur on the outer surfaces of the cortex. Unit 2, which consists of the parietal, temporal and occipital lobes, is said to be needed for receiving, analysing and storing information (Kagan & Saling, 1988). The modes of input represented in unit 2 include audition, vision and tactile-kinaesthetic sensation (Kagan & Saling, 1988). Unit 3, which consists of the frontal lobes, is said to be the executive of the brain and is needed for the planning, regulation and verification of behaviours (Kagan & Saling, 1988). It is important to note that unit 3 has many complex reciprocal connections, with both lower levels of the brain...
Luria believed that many different cortical areas contributed to the performance of a functional system, such as communication (Kagan & Saling, 1988) and stressed the importance of the interrelationship between the units (Naglieri & Das, 1990).

Unit 2 and 3 are divided into a number of cortical zones - the primary, secondary and tertiary zones. In unit 2 the primary zone is modality specific and receives neural impulses from the relevant sense organ. The senses of vision, audition and tactile-kinaesthesia each have their own primary zone, with the primary visual cortex occurring at the occipital pole, the primary auditory cortex in the superior region of the temporal lobe and the primary tactile-kinaesthetic cortex in the parietal lobe behind the central fissure (Kagan & Saling, 1988). The secondary zones, which are also modality specific, occur in association with each of the primary zones forming the next level of the hierarchy. The function of the secondary zones is to synthesise sensory information received from the primary zones into organised perceptual wholes (Kagan & Saling, 1988). The secondary visual cortex occurs in the occipital lobe, lying behind the primary visual cortex. The secondary auditory cortex occurs in the temporal lobe partially surrounding the primary auditory cortex. The secondary tactile-kinaesthetic cortex occurs in the parietal lobe, posterior to the primary tactile-kinaesthetic cortex (Kagan & Saling, 1988). The secondary zones are also known as sensory association areas (Naglieri & Das, 1990). These sensory association areas have connections with other areas, allowing information to be processed at a higher level than it is in the primary zones (Naglieri & Das, 1990). For example, the primary auditory cortex reflects variations in physical sound energy, while the secondary auditory cortex synthesises these into the phonemes of language (Kagan & Saling, 1988). The tertiary zone of unit 2 receives information from the three association areas of unit 2. The tertiary zone is, therefore, not modality specific and the most complex processing in unit 2 occurs here. This tertiary cortex takes up large areas of the parietal lobe and also extends into the occipital and temporal lobes (Kagan & Saling, 1988). The function of the tertiary zone appears to be to integrate information from the three secondary zones, its function being that of inter-modal synthesis (Kagan & Saling, 1988).

Unit 3, unlike unit 2, is concerned with output, having a single output channel, with intended actions being realized in movement. In unit 3, information flows from the tertiary zone, to the secondary zone and then to the primary zone. The tertiary zone of unit 3 is not modality specific and is required to assemble and plan information needed to execute action and
consists largely of the pre-frontal lobe. Its complexity is reflected in it having afferent connections with almost every other part of the brain (Kagan & Saling, 1988), including unit 1 and unit 2 (Naglieri & Das, 1990). The secondary zone of unit 2 uses the information from the tertiary zone to prepare programmes of action. The primary zone is involved with transmitting impulses to the individual muscles to bring about the action (Kagan & Saling, 1988).

Luria believed that the primary zones of the two hemispheres were bilaterally symmetrical, but that the secondary and tertiary zones became progressively dissimilar on the left and right sides. The secondary and tertiary zones of the left hemisphere have been shown to be more specialised for language and aspects of symbolic cognition, while these zones in the right hemisphere have been found to be important for spatial, pictorial and musical concepts (Kagan & Saling, 1988).

3.2.2 The PASS model

Das et al. (1994) extended Luria’s model into the PASS model of ability, in order to assess neuropsychological cognition in children. This model is presented in figure 3.1. This model is based on contemporary research in cognitive psychology (Das et al., 1994). This model also consists of three functional units, the first dealing with arousal and attention, the second with simultaneous and successive processing and the third with planning (Das et al., 1994). These are based on the three functional units of Luria. They further divide each of these functional units into memory, conceptual and perceptual processes (Das et al., 1994). These three functional units occur within the person’s knowledge base. The base of knowledge consists of all the information that the person has stored up from his or her culture, education and social experiences (Das, Kar, & Parrila, 1996). In this way prior knowledge is used to access incoming information (Das & Abbott, 1995). They may receive input (that is either serial or concurrent) and produce output (that is either serial or concurrent) (Das et al., 1994). A short description of the different components of the model follows:
3.2.2.1 Arousal-attention

This encompasses unit 1 of Luria’s model. Arousal is responsible for cortical tone and wakefulness, while attention is more complex (Das et al., 1994). Attention is mainly under voluntary control, although it is affected by cortical arousal. It includes components such as selective attention, where the individual is required to focus on relevant stimuli, while ignoring irrelevant stimuli and divided attention, which requires the individual to carry out
different activities without losing efficiency (Das et al., 1994). Attention is not an autonomous system as it is regulated by higher systems of the cerebral cortex and works in co-operation with these (Das et al., 1996). This means that attention-arousal and planning are closely related as attention is often under the conscious control of planning (Das et al., 1996).

3.2.2.2 Simultaneous and successive processing

These encompass unit 2 of Luria’s model. Simultaneous processing allows stimuli to be interrelated into groups (Naglieri & Das, 1997). Its most important feature is surveyability so that each element is related to every other element at a particular time (Das, Kar, & Parrila, 1996). It is related to the visual, kinaesthetic and vestibular systems that are responsible for orienting the body in space (Naglieri & Das, 1990). It is associated with the occipital-parietal areas of the brain (Das et al., 1996).

Successive processing allows for information to be organised into a successive series, where the elements form a specific chain-like progression (Naglieri & Das, 1990). The essential difference between this and simultaneous processing is that in successive processing the system is not totally surveyable at a given point in time (Das et al., 1979). It is associated with the fronto-temporal areas of the brain (Das et al., 1996), with successive processing being associated with the motor and auditory systems (Naglieri & Das, 1990).

It is, however, stressed that these types of processes are interconnected and occur in all the modalities (Naglieri & Das, 1990). Both simultaneous and successive processing have been found to be involved with language. Simultaneous processing is involved with understanding language where, in order to understand the sentence, one must obtain the meaning of words combined into groups, i.e. the meaning is derived from more than just the direct order of the words and involves logical-grammatical relationships (Cummins, 1979; Naglieri & Das, 1988). Successive processing is, however, involved with the syntactic relationships among words (Naglieri & Das, 1988), underlying the processing of contextual grammatical structures (Cummins, 1979). While successive processing is strongly associated with expressive syntax, it has an important role in a number of both receptive and expressive language functions (Cummins, 1979). Successive processing is said to be more associated with processing in the left hemisphere, while simultaneous processing is said to be more
associated with processing in the right hemisphere, although both successive and simultaneous processing occur in both hemispheres (Das et al., 1994).

3.2.2.3 Planning

This encompasses unit 3 of Luria’s model. It involves forming plans of action, carrying them out and verifying the effectiveness of the plans (Das et al., 1994). It is also responsible for higher level activities such as impulse control, regulating voluntary actions and spontaneous language (Das et al., 1994). Planning is thought to be mediated by a symbolic or sign system. As language is the most powerful symbol system, it is therefore often verbally mediated (Das et al., 1996). Planning involves goal setting, problem solving and using strategies and tactics (Das et al., 1996). Planning can be measured by perceptual, mnemonic (memory) or conceptual tasks. A visual search task would consist of a perceptual task, a task such as matching numbers would involve both perceptual and memory abilities and a story telling task would consist of a conceptual planning task (Das et al., 1996). Important developments in children’s planning capacity occur by 4 to 5 years of age (Das et al., 1996).

One of the aims of the development of the PASS model was to determine whether a relationship exists between an individual’s cognitive processing competence and overall functioning (Das et al., 1994). It would, therefore, be particularly useful to apply this model to individuals’ communication functioning, in order to determine in what way specific communication difficulties are linked to underlying cognitive processing abilities. As this model takes a broad perspective in viewing cognitive processes, it has increased potential to being sensitive to personal variations (Das et al., 1994). This model has factorial validity, can be effectively operationalized, is related to general functioning/achievement and provides a theoretical perspective that attempts to understand different diagnostic groups (Das et al., 1994).

Naglieri and Das (1990) and Naglieri (1999) evaluated studies that had identified different profiles for different diagnostic groups according to the PASS model. Reading disabled children with poor decoding skills were found to have particularly poor performance on tasks of successive processing (Naglieri, 1999). Children with a developmental handicap were found to score low in all four areas with the lowest score being in the area of planning (Naglieri & Das, 1990). Children with attention difficulties were found to score lowest in the
area of attention but also scored poorly in planning and successive processing, with simultaneous processing being in the average range (Naglieri & Das, 1990). Children with delinquency problems were found to score lowest in the area of attention with average planning, simultaneous processing and successive processing (Naglieri & Das, 1990). Children with traumatic brain injury were found to experience significant difficulty in the areas of planning and attention, scoring poorest on planning tasks. Their performance on simultaneous and successive processing was, however, also not strong (Naglieri, 1999).

3.2.3 The usefulness of the PASS model in studying cognitive processing in PDD

It appears that a number of the cognitive areas of impairment that have been identified and studied in PDD are encompassed in this model. These are mentioned below:

- **Attention** – This is encompassed in the arousal-attention unit or functional unit 1 of the model.

- **Memory** – Certain aspects of memory are incorporated into simultaneous processing (which includes visual memory) and successive processing (which includes auditory memory).

- **Executive functioning** - Executive functioning and frontal lobe difficulties are encompassed in the planning unit, i.e. functional unit three. Planning has been found to be a specific area of executive functioning that is problematic in PDD (Lopez et al., 2005; Ozonoff & Jensen, 1999; Ozonoff et al., 2004) and this is directly assessed in the PASS model.

- **Weak central coherence and advanced low level perception** – Weak central coherence and advanced low level perception have been supported by good performance on the block design test (Martin & McDonald, 2004). According to Das and Abbott (1995) block design is found to load high on simultaneous processing.

- **Difficulty within specific modalities of processing** – While simultaneous and successive processing are said to encompass all the modalities, it is accepted that simultaneous processing encompasses more visual processing, and successive processing encompasses more auditory processing or verbal processing. Comparing simultaneous and successive processing may, therefore, provide an idea of the difference between visual and verbal processing in PDD individuals.
Simultaneous and successive processing – It has been queried whether individuals with PDD have impaired simultaneous processing or impaired successive processing. These factors are directly included in the PASS model. Furthermore, specific difficulties related to the left hemisphere are included in tasks of successive processing, while specific difficulties related to the right hemisphere are included in tasks of simultaneous processing.

Sensory integration – An idea of sensory integration processing in PDD can be established by looking at which aspects of the PASS model involve inter-modal processing (planning and the tertiary zone of unit 2) and which aspects involve uni-modal processing (the primary and secondary zones of unit 2).

Systemizing-empathizing differences – All the different tasks that form part of the PASS model appear to require an understanding of the underlying rules and regulations of that particular task. Evaluating the different performance on these tasks should, therefore, give an idea of the individual’s systemizing abilities.

Imitation – Imitation is incorporated into successive processing tasks in the model, as part of testing successive processing involves testing verbal imitation.

Neurological aspects – As the PASS model stems from Luria’s model, which aims to understand the structure and functioning of the brain, assessing PDD using a model such as this as a basis may provide useful insights into certain neurological aspects.

The use of a model such as this should allow for a broader perspective in gaining a better understanding of individuals with PDD’s underlying cognitive processing abilities. Furthermore, it would appear to be a useful model to look at in relation to the communication and theory of mind difficulties in PDD.

3.3 SUMMARY AND CONCLUDING COMMENTS

A number of cognitive processing characteristics have been identified and put forward in an attempt to explain the symptom complex in PDD. These have included attention difficulties, memory difficulties, executive functioning difficulties, weak central coherence or a detailed focused cognitive style, a problem with specific modalities of processing, simultaneous versus successive processing difficulties, sensory integration difficulties, perceptual processing differences, differences in systemizing-empathizing and differences in imitation.
Studies have, however, sometimes presented conflicting results and the relationship between the different cognitive processing characteristics and difficulties proposed is not clear. Furthermore, none of these explanations on their own are able to account for all the features of PDD. It is proposed that using the PASS model as a framework for assessment may provide valuable insights into the cognitive processing profile in PDD, as many of the reported cognitive characteristics in this population are encompassed in this model. This in turn may provide insights into the cognitive processes that may underlie the communication difficulties seen.

At this stage our understanding of how the cognitive processing characteristics and difficulties outlined relate to the communication difficulties seen in PDD is still limited. The nature of their relationship with the theory of mind difficulties seen is also controversial. It is unclear to what extent the cognitive processing characteristics underlie the theory of mind difficulties seen or whether the cognitive processing difficulties and theory of mind difficulties seen occur as separate entities. While this chapter has focused primarily on the cognitive processing characteristics in the PDD population, the next chapter will focus on the theory of mind difficulties seen in this population and the relationship between theory of mind and language, and theory of mind and cognition will be discussed.