The Role of Physiological Arousal in the Management of Challenging Behaviours in
Individuals with Autistic Spectrum Disorders.

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Abstract

Challenging behaviors restrict opportunities and choices for people with autistic spectrum disorders (ASD) and frequently lead to inappropriate and costly service interventions. Managing challenging behaviors of people with autism is an important area of research. This paper examines some of the evidence for the role of physiological arousal influencing these behaviours. Evidence from the emerging literature about sensory differences is examined. It is proposed that sensory reactivity is associated with hyperarousal; catatonic type behaviors are associated with low levels of reactivity (hypoarousal). A low arousal approach is proposed as a generalised strategy to managing challenging behaviors with ASD. The use of non-contingent reinforcement and antecedent control strategies are recommended for use with challenging behaviors which have a sensory component. Examples are provided to illustrate the approach. The implications of arousal and the use of physical interventions are discussed. It is proposed that arousal is a construct which has significant heuristic value for researchers and practitioners.

*Keywords*: Autism, Challenging Behavior, Low Arousal, Physiological, Arousal, Sensory
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People with autistic spectrum disorders (ASD) can present behaviors that challenge and a recent survey of the behavioral intervention literature identified a diagnosis of autism as a risk marker for physical aggression (McClintock, Hall, & Oliver, 2003). A large number of behavioral intervention studies have tended to focus on long term interventions for physical aggression (Horner, Carr, Strain, Todd, & Reed, 2000) with short term management receiving less attention (McDonnell, 2010).

This paper will examine the low arousal approach to managing challenging behaviors in people with ASD (McDonnell, Waters, & Jones, 2002). This approach has become popular with autism services in the UK and Europe. The low arousal approach emphasises a range of behavior management strategies that focus on the reduction of physiological arousal and manipulation of antecedent triggers to prevent aggression and crisis strategies which avoid punitive consequences and seek low intensity solutions. The approach seeks to understand the role of sensory factors in the onset and maintenance of challenging behaviors in people with ASD. It will be argued that such an approach can greatly enhance crisis management strategies, functional assessment, and positive behavior support strategies. The implications for the application of physical interventions will also be discussed.

1.1 Arousal and Emotion

Arousal is a construct which has proved difficult to define with researchers adopting views that it is either a unitary or multifaceted construct; recent research in neurobiology
indicates that there is a generalised arousal mechanism in the brain which feeds cortical functions (Pfaff, 2005). “Generalised arousal is higher in an animal or human being who is; (S) more alert to sensory stimuli of all sorts, and (M) more motorically active, and (E) more reactive emotionally” (Pfaff, 2005, p. 5). This relatively simple definition relates arousal to information processing; novel, unpredictable stimuli will lead to an increased arousal response. The link between arousal and information processing was originally described by Yerkes and Dodson (1908). The law maintains that performance and arousal are linked in a classic inverted U shape; the Yerkes Dodson law proposes that high levels of arousal lead to decreases in human performance. The original study examined the performance of mice in a learning task where electric shocks were delivered for incorrect responses and has been used as an analogy to show arousal reducing information processing has an optimum level (Easterbrook, 1959). Critics of the Yerkes Dodson law often cite the case that high levels of arousal have survival value (Zajonc, 1980) and, in some circumstances, may increase performance (Hanoch & Vitouch, 2004). Despite these criticisms, the construct of arousal is considered useful in understanding the regulation of emotion (Pfaff, 2005) and both arousal and stress are considered to be important in the moderation of emotions (Reich & Zautra, 2002). To summarise there would appear to be a consensus that high states of arousal can have a negative effect on human performance.

1.2 The Link between Arousal and Autism.

Physiological arousal is not a new construct and has long been implicated in autistic spectrum disorders (Hutt, Hutt, Lee, & Ounsted, 1964). Two implications of this are that children and adults with ASD would be more reactive to sensory stimuli than the normal population and that they maybe slower to habituate to stimuli. There is some laboratory evidence of differences in physiological responses of individuals with ASD compared to non

There is mixed evidence across the spectrum for increased and decreased arousal in response to predicted stressors. Jansen et al. (2006) compared adults with ASD with non ASD adults in their response to public speaking and found that individuals with ASD showed decreased heart rate, but normal cortisol responses. Goodwin et al. (2006) compared children and reported higher baseline heart rates of ASD participants. Hirstein et al. (2001) reported unusually high and unusually low baseline skin conductance responses in autistic children compared to non autistic controls. These differences require replication using larger samples but there is an intriguing possibility that there may be considerable variation in physiological reactivity of both autistic children and adults.

Jennett, Hagopian, and Beaulieu (2011) investigated the relation between self-injury and arousal in an individual with autism under different conditions of restraint. When some form of restraint was used the heart rate of the individual remained close to the resting heart rate although, when this restraint was removed or signalled to be removed, the individual’s heart rate increased dramatically within a short time period.

There are three prominent theories of autism: theory of mind (Baron-Cohen, 1995), weak central coherence (Frith, 1989; Frith, 2003; Happe, 1996), and executive dysfunction (Geurts, Verte, Oosterlaan, Roeyers, & Sargeant, 2004; Hill, 2004; Ozonoff, Strayer, McMahon, & Filouz, 1994) but all have difficulties accounting for sensory processing difficulties. A major criticism of all of these theories is that they attempt to provide a universal explanation of autism rather than viewing it as a collection of multiple deficits (Rajendran & Mitchell, 2007).

The role of physiological arousal is not explicitly clear in either the theory of mind or weak central coherence theories. The executive dysfunction theory does use the construct of
arousal in the form of inhibitory control. Inhibitory control limits a person’s ability to suppress the activation, processing, or expression of information. Some laboratory studies have reported evidence for inhibitory control (Geurts et al., 2004; Ozonoff et al., 1994) although mixed findings have also been reported (Christ, Holt, White, & Green, 2007). An alternative suggestion redefines executive functions (EF) in terms of hot and cool aspects (Zelazo & Muller, 2002); hot EF is needed to solve problems that have an affective component, whereas cool EF is elicited by abstract or decontextualised problems. Zelazo and Muller (2002) argued that autism may be a consequence of impaired hot EF. This link between emotion and perception is useful to consider in terms of physiological arousal.

Laboratory based problem solving tasks are often used to examine hypothesised cognitive processes. It is possible that physiological arousal may have a mediating effect on the behaviour of some people with ASD. Johnson, Yechiam, Murphy, Queller, and Stout (2006) investigated autonomic arousal using skin conductance in 15 people with Aspergers syndrome in a gambling task and reported differences in skin conductance between this group and the non autistic controls.

Hyperarousal is not universally accepted by all researchers and a recent review of sensory difficulties in autism concluded that the experimental evidence for hyperarousal was at best mixed (Rogers & Ozonoff, 2005). There are a number of problems with this view. First, ASD is a heterogeneous condition and the assumption that hyperarousal should be a general explanatory theory of autism was too broad. Second, sensitivity to arousing stimuli may be intermittently presenting in individuals with ASD. Third, the stimuli employed in habituation paradigms cannot easily mimic real life non laboratory based events; animal research on arousal has attempted to link deficiencies to conditions such as ADHD, Alzheimer’s disease, and autism (Garey et al., 2003).

Historically under arousal has also been proposed to specific stimuli (DesLauriers &
Carlson, 1969; Rimland, 1964) although with limited laboratory evidence (Rogers & Ozonoff, 2005). Repetitive movements may serve a de-arousing function (Kinsbourne, 1980). Unusual sensory experiences have been reported in autobiographical accounts of people with ASD (Grandin & Scariano, 1986; Jones, 1997; Mukhopaday, 2003; Shore, 2003). Sensory over activity has been explained as a possible response to over arousal (Liss, Saulnier, Fein, & Kinsbourne, 2006). An understanding of physiological arousal and sensory experiences may have great explanatory significance for some forms of challenging behaviors. Recently Schoen et al. (2009) compared the physiological differences in sensory processing in children with ASD and sensory modulation disorder (SMD) and noted a significantly lower physiological arousal level in the ASD group at baseline compared to the children with SMD and also controls. In contrast to the SMD group, a strong association between arousal level and reactivity was found in the ASD and control groups, with groups who had higher arousal tending to have higher reactivity, while those with lower arousal tended to have lower reactivity.

1.3 Sensory Differences in People with ASD

Relating sensory experiences to everyday behaviour is not a new phenomenon. Leo Kanner (1943) in his seminal paper that defined the term autism using 11 case examples described sensory issues; he reported the case of Herbert B: “He was tremendously frightened by running water, gas burners and many other things” (p. 231). Similarly, Frederick W had a fear of certain objects and the sensation of movement or confinement:

He is afraid of mechanical things; he runs from them. He used to be afraid of my egg beater, is perfectly petrified of my vacuum cleaner. Elevators are simply a terrifying experience for him. He is afraid of spinning tops. (p. 223)

In the 63 years since this paper the knowledge of information processing deficits in
autism has greatly increased (Frith, 2003). Damasio and Maurer (1978) produced a neurological model for childhood autism implicating the temporal lobe and mesolimbic systems. Lathe (2006) attempted to identify the limbic system as implicated in sensory differences and Ornitz (1988) argued that sensory inputs may have had a causal role. Gillberg (1992) refers to sensory differences as characteristic of autism symptomology but not necessary diagnostic criterion. Given the complexity of autism it is unlikely that one factor will have a clear causal role.

Dunn (2001) introduced sensory differences as being a continuum with sensory sensitivity and low response at the two extremes with a need to regulate or achieve equilibrium as a driver for much behaviour, particularly in the vestibular and proprioceptive systems. This is of particular relevance to our understanding of the symptoms of autism.

Dunn (2001) identified a strong relationship based on fluctuating thresholds between sensory information processing and behaviour and distinguished four sensory categories of sensory perception (low and high registration) and overt behavioral responses (sensation seeking and sensation avoiding). Developing literature appears to show that these constructs may have some face validity with sensory sensitive and sensation avoiding groups being more responsive than low registration and sensation seeking groups (Brown, Tollefson, Dunn, Cromwell, & Fillion, 2001).

Sensory differences in individuals with ASD are increasingly being reported by researchers. Kern et al. (2006) used the sensory profile (Dunn, 1997) and found that there were differences in auditory, visual, touch, and oral sensory processing between participants with autism matched with a control group of persons without ASD. Baranek, David, Poe, Stone, and Watson (2006) and Cheung and Siu (2009) identified that children with autism have different responses to sensory stimuli and identified they can be hypersensitive to sound.
More recently Wiggins, Robins, Bakeman, and Adamson (2009) used the sensory profile and found that children with ASD show more auditory filtering difficulties and also more tactile and taste/smell sensitivities compared to other children with developmental delays. It was suggested that these sensory abnormalities may be a distinguishing symptom of ASD and Wiggins et al. propose the notion of incorporating sensory abnormalities into the diagnostic assessment of younger individuals. The significant abnormalities in sensory processing in children with autism found in a study by O’Brien et al. (2009) also led to the conclusion that, with further research, sensory processing may again be included in the diagnostic criterion for ASD.

A recent study by Lane, Young, Baker, and Angley (2010) proposes three distinct sensory processing subtypes in autism differing in taste and smell sensitivity and movement related sensory behavior.

There is emerging literature suggesting that there are abnormalities across multiple domains (Baranek et al., 2006; Leekam, Nieto, Libby, Wing, & Gould, 2007; Provost, Crowe, Aeree, Osbourn, & McClain, 2009; Rogers, Hepburn, & Wehner, 2003). A recent meta-analysis by Ben-Sasson et al. (2009) found significant evidence for sensory differences between individuals with ASD and both individuals without ASD and individuals with developmental delays and, in particular, noted that the magnitude of these differences was moderated by age. There is a current lack of research into the sensory differences in adult and adolescent individuals with ASD (Ben-Sasson et al., 2009).

The sensory measures developed by Dunn (2001, 1997) have also been used to compare children with a diagnosis of Aspergers syndrome and non learning disabled controls (Dunn, Myles, & Orr, 2002). The Aspergers sample reported both hyposensitivity and hypersensitive responses. There are however difficulties in interpreting questionnaire studies as they do not directly report behavioural measures of sensory difficulties and the use of
measures such as galvanic skin responses (Brown, et al. 2001) may be an appropriate way forward for practitioners.

Gomez and Danuser (2004) reported that sound can affect physiological responses; in general high arousal noises increased physiological responses and lower pleasant noises showed a decrease. Hypersensitivity to smells has also been reported where some odours decrease the heart rate and skin conductance (Campenni, Crawley, & Meier, 2004). Pernon, Pry, and Baghdadli (2007) reported differences in experiences to tactile stimuli and further behavioral assessments may help to identify the experiences of individuals more accurately than interview based methods.

Some evidence for sensory differences has been reported based on personal accounts of people with ASD (Grandin, 1992a, 1996; Grandin & Scariano, 1986; O’Neil & Jones, 1997; Mukhopaday, 2003). O’Neil and Jones (1997) identified sensory-perceptual abnormalities in people with autism, these included: hyper – and hyposensitivity, sensory distortion, overload, multi-channel receptivity, and processing difficulties. Grandin reported that sudden loud noises hurt her ears, likening the experience to a dentist’s drill hitting a nerve (1992a); she also argued that her fear of a noise was a factor for her challenging behaviour (Grandin, 1996).

In summary the sensory profile of individuals across the autism spectrum suggests a significant difference to those of the general population. However useful they are, the personal accounts of people with ASD do not constitute strong empirical data for a population as a whole (Iarocci & MacDonald, 2006; O’Neill & Jones, 1997). To date there are only a limited number of studies which primarily use checklist based measures (Brown et al., 2001; Kern et al., 2006) and more emphasis is required on empirical studies using direct behavioural observation.
1.4 A Low Arousal Model of Challenging Behavior in People with ASD

Sensory experiences may account for a significant proportion of challenging behaviors in people with ASD. Unpredictable sensory experiences (Pfaff, 2006) may increase stress and elevate physiological arousal. If an individual cannot easily avoid or escape from these stressful stimuli or communicate distress appropriately, and effectively, they may develop a functional means of escape (Goodwin et al., 2006).

Stress and anxiety have been proposed as factors in challenging behaviors of people with ASD (Howlin, 1998; Groden, Cautela, Prince & Berryman, 1994). Lazarus and Folkman (1984) described a transactional model of stress emphasising interaction between an individual and his/her environment. Stress occurs when the demands of stressors outweigh coping responses and there is a clear interaction between environmental and physiological events. Implicit in this model is the cognitive appraisal of threat as some individuals with ASD have difficulties in regulating their emotional responses and communicating them (Frith, 2003). There does appear to be a strong association between physiological arousal and sensory experiences of people with ASD (Liss et al., 2006). To help account for challenging behaviors such as aggression and self injurious behaviours we propose that physiological arousal may mediate stress.

A model of arousal which mediates certain forms of challenging behaviors could provide a useful explanatory framework. A central premise is that an individual’s internal physiological state of arousal influences cognitive processing of environmental sensory stimuli. Extending this view we would contend that the regulation of arousal mediates behavioral responses to environmental stressors. Individuals seek a state of *arousal equilibrium*; that is the optimum individual arousal level required for an individual to
function in an environment; this is similar to the bodily state of homeostasis. We propose that arousal can be thought of in three distinct areas of a Gaussian curve; the majority of individuals spend time in a state of arousal equilibrium. In the case of people with ASD two distinct arousal groupings will have an effect on behavior; both appear in the tail end of the arousal curve. Individuals will be hyperaroused and highly reactive to environmental sensory stimuli (Liss et al., 2006) or hypoaroused and exhibit low responses to sensory stimuli.

A number of people with ASD who present with challenging behaviors may experience either constant or intermittent states of hyperarousal. Dunn (2001) argued that people often experience modulation of sensory input. The mixed results of empirical studies on hyperarousal may be accounted for by individuals whose arousal level may fluctuate on a regular basis. This model suggests that there is a transaction between the person’s internal state of arousal and interaction with environmental stressors. The reduction of environmental arousal should decrease stress and anxiety and therefore reduce the frequency and intensity of challenging behaviors. Correspondingly, techniques to reduce internal arousal such as behavioural relaxation training (Groden et al., 1994), cognitive behavioral therapy (Attwood, 2010), or multisensory environments (Lancioni, Cuvo, & O’Reilly, 2002; Stephenson, 2002) may also increase an individual’s ability to tolerate sensory stimuli.

Extreme levels of hyperarousal may lead to a person becoming less responsive to environmental stimuli and literally appearing to “shut down”. Goodwin et al. (2006) reported lower sensitivity to environmental stimulation in five individuals with ASD compared to their controls; these individuals also had higher baseline heart rates than their controls. It is possible that higher levels of internal arousal may make some individuals less responsive to
environmental stimuli. In this instance the internal arousal state becomes more dominant; this may provide an explanatory framework for some forms of catatonic type behaviors observed in some individuals with autism. Other forms of catatonia may be a result of low levels of physiological arousal which has an effect on movement. A recent case study reported positive outcomes for the use of electroconvulsive (Ghazuddin, Quinlin & Ghazuddin, 2005). The altering of physiological arousal states may be an important mechanism in developing interventions for catatonia.

There are several testable hypotheses that can be extrapolated from this low arousal model of challenging behaviours in individuals with ASD. First, basal physiological arousal measures should be able to identify groups of individuals with high and low responsivity in measures such as heart rate and skin conductance (See Goodwin et al., 2006; Hirstein et al., 2001). Second, reducing generalised physiological arousal should reduce challenging behaviors. Third, the more unpredictable sensory stimuli there are the greater the levels of arousal should be experienced, which should lead to increases in challenging behaviors. Fourth, extreme forms of hyperarousal may lead to reduced attention to external stimuli. Finally, people with ASD who present with frequent challenging behaviors and show high sensory reactivity, should also show higher or extremely fluctuating levels of physiological arousal.

1.5 Low Arousal approaches to Crisis Management

Positive behaviour support strategies are used with people with ASD (Becker-Cottrill, MacFarland & Anderson, 2003) with positive outcomes in the published literature (Horner et al., 2000). A common theme of these interventions is that the approach does require considerable time and staff resources. Behavior management strategies are often required by
The short-term management of aggressive behaviors has been acknowledged to be important (Carr et al., 1994; LaVigna & Willis, 2002; McDonnell & Sturmey, 1993); the expression “crisis procedures” has been adopted by some authors (LaVigna & Donnellan, 1986). A distinction has been made between behavior management and behavioural treatment goals (Gardner & Cole, 1987). The objective of behavior treatment is to produce “enduring behavior change that will persist across time and situations” (Gardner & Moffatt, 1990, p. 93).

A recent survey of 625 service users with learning disabilities in Canada reported that only 26.9% of service users had some form of crisis intervention plan (Feldman, Atkinson, Foti-Gervais, & Condillac, 2004). Crisis interventions are a critical component of community supports for people with a learning disability who present with aggressive behaviors (Hanson & Weiseler, 2002; Lakin & Larson, 2002). The development of more effective behavior management technologies would significantly benefit researchers and practitioners (Allen, 2002).

If some challenging behaviors are mediated by a heightened state of physiological arousal, the reduction of this physiological arousal state should reduce challenging behaviors at least in the short term. Low arousal approaches are strategies used to manage these crisis situations. McDonnell (2012) defined four key components of low arousal approaches. First, decreasing staff demands and requests to reduce potential points of conflict around an individual. Second, avoidance of potentially arousing triggers, e.g. direct eye contact, touch and removal of spectators to the incident. Third, the avoidance of non verbal behaviors that may lead to conflict, e.g. aggressive postures and stances. Fourth, challenging staff beliefs...
about short term management of challenging behaviors.

In a reformulated cognitive behavioral framework the four key areas of the approach are (a) the reduction of staff demands and requests in a crisis; (b) the adoption of verbal and non-verbal strategies that avoids potentially arousing triggers (direct eye contact, touch, avoidance of non-verbal behaviors that may lead to conflict, aggressive postures, and stances); (c) the exploration of staff beliefs about the short-term management of challenging behaviors; (d) the provision of emotional support to staff working with challenging individuals. A cognitive formulation of this model emphasises the role of staff behavior in the maintenance of aggressive behavior which has some support from the literature (Hastings, 2002; Hastings & Brown, 2000; Hastings & Remington, 1994ab; Taylor & Carr, 1992).

The reduction of staff demands and requests in a crisis is a key component of a low arousal approach (McDonnell et al., 2002; McDonnell, Reeves, Johnson, & Lane, 1998) as a reduction in staff demands can lead to reductions in aggressive behavior (Taylor & Carr, 1992). A possible negative effect on staff is to reinforce an avoidance model (Hastings, 1997). Whilst an avoidance model should not be seen as a long term strategy to crises approaches it may well be the most effective staff response. Task demands are a component of many interventions that adopt positive behavioral supports (Carr et al., 1999). Terms such as “strategic capitulation” (LaVigna & Willis, 2002) have been used to describe demand reduction in crisis situations. Reducing demands should decrease the level of processing required by individuals and therefore decrease hyperarousal.

The evidence for the efficacy of low arousal approaches is emerging but scarce. Whilst the construct may have face validity, to date there is little empirical data for approach. In addition reducing arousal may not always be the strategy of choice for some individuals.
with ASD. The sensory model proposed by Dunn (2001) would imply strongly that there may be times where individuals actively seek sensations. It is here that more formal assessments of sensory profiles coupled with changes to the environment and programme are particularly helpful and relevant; in circumstances where it is necessary to increase physiological arousal as part of the individual’s programme. This is supported by anecdotal reports of the use of bespoke ‘squeeze machines’ (Grandin, 1992).

1.6 Arousal Reduction Intervention Strategies

Identifying sensory factors within individuals with ASD using functional assessment methods is an important practice. It has been argued that sensory processing difficulties may be lifelong (Dunn, 2001), although the processes may become less intense with age (Kern et al., 2006). The literature at present strongly indicates modest effects of auditory and sensory integration approaches with regard to altering such processes (Baranek, 2002). Dunn (2001) argued cogently that: “Sensory processing patterns are a reflection of who we are: These patterns are not a pathology that needs fixing” (p. 617). The implication is that not all sensory related behaviors require modification and managing arousal mechanisms may be a more achievable goal for clinicians.

1.6.1 Relaxation Techniques.

Relaxation techniques to reduce physiological arousal are a significant tool in alleviating sensory processing difficulties and positive results of training individuals in relaxation techniques have been reported in the literature (Groden et al., 1994). Training in techniques based on CBT has also been advocated for people with intellectual disabilities (Dagnan & Jahoda, 2006) as well as anxiety management techniques (Attwood, 2007; Sofronoff, Attwood & Hinton, 2005; Sofronoff & Attwood, 2003). In a recent study, Singh
et al. (2011) demonstrated that adolescents with autism are able to learn and utilise a mindfulness based strategy for self-management of aggressive behavior.

1.6.2 Sensory Environments.

Positive effects of multi-sensory environments appear to indicate that increased relaxation and reduced overt signs of anxiety can be achieved (Lancioni et al., 2002; Stephenson, 2002). A 10 week observational study which compared the effect of Snoezelen (controlled multisensory stimulation), skills training and vocational skills training reported lower levels of aggressive behavior and self-injurious behavior (Singh et al., 2004). Sensory rooms may reduce anxiety levels which may have an impact on behavior; there are a limited number of studies that imply that lower levels of physiological arousal may be accompanied by reduced frequencies of challenging behaviors. Shapiro, Parush, Green, and Roth (1997) reported lower heart rate levels and fewer stereotyped behaviors during Snoezelen sessions. Dunn (2001) identified the association between physiological arousal and sensory input; people who have a profile of avoiding sensory stimuli may benefit from strategies which aim to reduce sensory stimulation by the regulation of their physiological arousal. Strategies which aim to reduce arousal should, in our view, be a primary intervention strategy.

1.6.3 Physical Exercise.

There are obvious benefits of regular exercise in reducing anxiety (Petruzello, Landers, Hatfield, Kubitz & Salazar, 1991). Studies have demonstrated reductions in stereotyped behaviors of people with ASD (Allison, Basile & MacDonald, 1991; Kern, Koegel & Dunlap, 1984; Rosenthal-Malek & Mitchell, 1997). In this model repetitive behaviors may be a by-product of irregularities in physiological arousal and serve a de-arousing function (Kinsbourne, 1980).
The role of physical exercise in managing aggressive behavior is less well understood. McGimsey and Favell (1988) found that when severely aggressive and hyperactive clients were exposed to two daily periods of jogging and strenuous activities there was a systematic reduction in problem behavior for 8 of the 10 participants to levels considered “not a problem” or only “an occasional problem”. They argued that physical exercise may offer promise as an effective, benign, and practical adjunct to other treatment and management techniques. Physical exercise may have positive effects on reducing physiological arousal.

**1.6.4 Reinforcement Based Methods.**

Sensory reinforcement may in some individuals be automatic in nature that is the behaviour itself has reinforcing properties that are not related to the social environment (Vollmer, 1994). If behaviour is maintained by individuals seeking sensory reinforcement, it may be possible to adopt strategies using differential reinforcement of alternative behavior (DRA). This approach requires that alternative access to sensory reinforcers be provided and the responses of staff to the challenging behaviors are maintained. In this instance sensory reinforcers are provided in the absence of challenging behaviors. Extinction based strategies could potentially cause high levels of distress to individuals and, as such, should be avoided.

A second approach would be to apply sensory reinforcement in a non contingent manner where the reinforcer is provided on a regular schedule regardless of the presence or absence of the target behavior (Vollmer, 1994). This is similar to the approach of a sensory diet where sensory experiences are made an integral part of an individual’s life (Bogadashina, 2003). There is some evidence for the effectiveness of non-contingent reinforcement strategies for reducing difficult behaviors (Carr et al., 2000). Recent evidence has reported some reductions in self injurious behavior using such approaches (Lindberg, Iwata, Roscoe, Wordsell & Hanley, 2003). The advantages to this approach are that the individual receives a
reinforcing stimulus in other contexts and times and extinction bursts are avoided. A third 
behavioural strategy involves antecedent control; these methods are used in other areas of 
applied behavior analysis (Luiselli, 1998). The association between sensory experiences and 
challenging behaviors would strongly suggest that removal of some of the stimulus 
characteristics may be a useful form of behavior management, creating environments to avoid 
sensory stimuli that may elicit challenging behaviors (specific noises, sounds, smells). The 
design of houses specifically with regard to low arousal strategies is a newly developing area 
but there is good anecdotal evidence from individuals with ASD that certain environments 
create significant difficulties for them. For the most part, the literature refers to problems 
associated with light and sound frequency but there is a relative dearth of good empirical 
evidence and, in practice, there seems to be little accommodation.

Teaching self control strategies through the use of noise cancelling headphones, ear 
plugs or wearing of walkmans for individuals who are sensitive to sounds may be a beneficial 
area of research. The wearing of sunglasses or specialist filters (often referred to as ‘Irlen’ 
lenses) are often recommended for individuals who are sensitive to light. Even the types of 
clothing material worn by people may be important as a trigger of challenging behaviors and 
may relate to acceptance of a novel sensation or habituation to certain fibres.

1.7 Physical Interventions

Physical interventions are used to manage individuals who may be hyperaroused and 
overtly distressed and agitated. The physical contact required may in many cases increase 
physiological arousal at least initially. A central tenet of the low arousal approach is to create 
environments where the need for physical interventions will be significantly reduced. The 
authors accept that this may not be achievable in all care environments. Given, this caveat
this remaining section will examine the application of low arousal philosophy to use of physical interventions with people with ASD.

Physical interventions are described as “any methods of responding to challenging behavior which involves some degree of physical force to limit or restrict movement of mobility” (Harris et al., 1996). There are categories of physical interventions, the two most common are breakaway skills and physical restraint. Breakaway skills can be defined as “physical strategies which assists a person to break free of an aggressor, where actual physical contact has taken place” (McDonnell, 2010). Physical restraint has been defined as “actions or procedures which are designed to suppress movement or mobility” (Harris, 1996, p100).

UK guidance specifies that the use of physical interventions should be a last resort (British Institute of Learning Disabilities [BILD], 2002). There are several good arguments to avoiding physical interventions altogether. In evaluating physical intervention methods it is useful to consider three dimensions of safety, effectiveness, and social validity. First, people with intellectual disabilities may be vulnerable to abuse (Baker, 2002). Second, physical restraint can lead to both staff and service user injuries (Baker & Allen, 2001; Lee et al., 2003). Third, there is the possibility that physical interventions may become positively reinforcing as in the case of some mechanical restraints (Favell, McGimsey, & Jones, 1978). Fourth, restraint methods such as prone holds may be associated with fatalities (Allen, 2008). Some experts have called for a ban on all prone restraint holds in care (McDonnell, 2010); other academics refute the claims that these postures are strongly associated with sudden deaths (Paterson, 2006). Incorrect application of methods is associated with some childhood deaths in care in the United States (Nunno, Holden & Tollar, 2006).
Dunn’s (1997, 2001) model identifies four clear profiles all of which have implications for people with ASD who may be physically restrained. People who are identified as “low registration” may be particularly vulnerable to injury as they lack sensitivity to tactile and other stimuli. In these circumstances care staff may apply restraint methods too robustly as the individual does not appear to show overt signs of distress. Conversely, individuals with hypersensitivity to touch may feel extreme pain at minimal levels of contact or restraint (Harris, Cornick, Jefferson, & Mills 2008). Dunn (2001) also describes individuals who do not show signs of distress to sensory stimuli at least initially but, who are sensitive and do experience considerable internal distress. A good example involves the teaching of physical restraint skills which can include the hyperflexion of joints. From an ethical viewpoint the deliberate infliction of pain to suppress behaviour raises major ethical concerns; Leadbetter (2002) used the expression “High tariff techniques” to describe these types of methods. There are good practical reasons why these methods should be avoided with service users with ASD.

Applying a hold which involves the abnormal rotation of the wrists has additional risks. An individual with low registration may not appear to respond to the painful stimulus in the way that is intended. There is considerable evidence from the sensory literature that indicates that some people may respond to painful stimuli with a limited behavioural response. Bromley, Hare, Davison, and Emerson’s (2004) survey of parents reported that 45% of children were hyposensitive to pain. Some cases of infantile ASD and self injury reported a lack of response to painful stimuli (Tordjman et al., 1999). Seven out of 18 cases of infantile autism clearly stated that the child either ignores or appears to be insensitive to pain (Hauser, DeLong & Rosman, 1975). In conclusion physical intervention methods which involve the infliction of pain would need to be applied so robustly to some people with ASD who have low registration difficulties that they would be unethical and unacceptable by
reason of the increased risk of harm.

Individuals who avoid specific sensory stimuli may attempt to escape from situations where the stimuli are present. Bromley et al.’s (2004) survey of parents reported that 23% of their children were hypersensitive to pain and some people with ASD are sensitive to particular types of light physical contact. A Swedish woman with a diagnosis of ASD, Gunila Gerland (1997), described touch as making her nervous system “whimper”. Touch may also elicit extreme arousal in individuals with ASD who are hypersensitive. Hypersensitivity to touch was reported identified by parents in 52% of 75 children (Bromley et al., 2004). Holds which restrict movement could potentially increase physiological arousal. It is also possible that people with ASD who are hypersensitive to touch may be more at risk of sudden deaths. The authors acknowledge that this comment is speculative and would require data.

The application of physical restraint methods by definition involves touch and immobilisation of limbs which may have paradoxical effects particularly among people with autism (O’Neill & Jones, 1997). Occupational therapists have observed how light touch seems to alert the nervous system but deep pressure is relaxing and calming (Grandin, 1992b). Dunn (2001) described individuals as sensory seeking. Some individuals with autism seek out sensory stimulation, as their senses are ‘hyposensitive’. Grandin (1992b) reported how deep pressure seemed to have calming affects on individuals and that “relaxation was physically evident”. There is some limited empirical evidence for so called squeeze machines. It is possible to speculate that touch using deep pressure may serve a function for some individuals.

The recent evidence for differences in processing of vestibular stimulation (Kern et al., 2007) has major relevance for the application of physical interventions. It is possible to
speculate that some individuals may find restraint procedures which require movement more effective than immobilisation holds. Intermittent physical contact may represent a safer alternative. We would argue that if physical restraint is required to keep an individual with autism safe there are some guiding principles based on low arousal philosophy. It would be practical to keep the duration of any hold to a minimum. If an individual has a need for deep pressure contact, then this could be applied by the use of tight fitting garments or by the use of staff holding a person in a seated position. Holds that require immobilisation on the ground either in prone or supine positions should be avoided. A technique which involves teaching multiple movements known as the ‘walkaround method’ can be used with people with ASD (McDonnell, 2012). The use of unexpected movements may operate by overloading the person’s sensory system, or by increasing vestibular stimulation. Further work to evaluate the usefulness of this approach is indicated.

It may be useful to consider allowing service users to experience physical touch or restraint non-contingently but the ethical basis of this approach will need careful consideration. This may allow graded exposure to the methods and lead to less distress when the methods are applied in more aroused situations. This approach is similar to stress inoculation training (Meichenbaum, 1996). Importantly such rehearsal trials may also reduce staff anxiety created by physical interventions. Services users may find the method less aversive (Blackburn, 2006).

The use of physical interventions to manage crisis situations is regarded as a taboo subject (Leadbetter, 2002). Whilst the authors strongly support the reduction of physical intervention methods in general, we would make a strong case that sensory factors makes their use on people with ASD particularly problematic.
1.8 Implications for Research

Theories of autism such as executive dysfunction (Ozonoff et al., 1994), theory of mind (Baron-Cohen, 1995), and weak central coherence (Frith, 2003) need to account for physiological arousal and sensory processing differences in the ASD population. The concept of hot and cool processes (Zelazo & Muller, 2002) clearly fits with the arousal mechanism described in this paper. Problem solving tasks should have affective components combined with physiological measures and the level of physiological arousal should be positively associated with performance. In addition, the use of standardised sensory screening tools (Dunn, 1999) and correlating these profiles with cognitive performance would identify individuals who are hypo or hyper aroused.

Behavioral (Groden et al., 1994) and cognitive based anxiety management methods (Attwood, 2007; Dagnan & Jahoda, 2006) may be especially important for individuals who are hyperaroused or experience fluctuations and identifying high risk individuals using baseline heart rate may be beneficial. Sensory rooms (Stephenson et al., 2002) may be beneficial for individuals experiencing regular states of hyperarousal. Individualised assessments of sensory experiences may improve the efficiency of these methods.

Studies investigating the effects of arousal should contain physiological measures (Althaus et al., 2004; Hirstein et al., 2001; Johnson et al., 2006; Van Engeland et al., 1991) although some may be too intrusive for individuals who are tactile defensive. Heart rate monitors have been used by researchers (Goodwin et al., 2006) and may be a useful method to use in care environments.

The assessment of sensory differences is a complex task. Several studies (Brown et al., 2001; Dunn, 1997; Kern et al., 2006) have used an assessment tool developed by Dunn
(1999) which appears to have both face validity and reasonable reliability (Liss et al., 2006). Brief and psychometrically robust measures would be of great benefit for researchers in this area (Harrison & Hare, 2004). Measures based on behavioral approach avoidance tests would appear to be lacking in the area although they are becoming more commonplace (Pernon & Rattaz, 2003) and provide a template for researchers.

Functional assessment techniques are based on good environmental analysis (Mace, Page, Ivancic, & O’Brien, 1986; Toogood & Timlin, 1996). Using Dunn’s (2001, 1997) definitions of sensory differences, it is possible to construct a speculative assessment framework for employing sensory approaches. Interventions based on sensory reinforcer assessments using strategies such as non contingent reinforcement are testable. The arousal model described in this article would also imply that many challenging behaviors may not necessarily be under the control of the individual.

The individual variation in responses to sensory stimuli single case designs would be of great benefit as currently only one case study has formally evaluated the implementation of low arousal approaches (McDonnell et al., 1998) and there is a paucity of direct research (Allen, 2001; McDonnell, 2010).

Investigating arousal states and physical interventions in relation to the apparent presence of sensory differences in this population (Kern et al., 2006; Brown et al., 2001; Dunn, 2001) would suggest a need for empirical investigations of specific physical interventions. Identifying individuals who seek out physical holding for positive reinforcement and individuals who are tactile defensive should help determine the merits of specific physical interventions. Currently the effectiveness of intermittent holding and training of individuals with ASD about physical intervention using cognitive and behavioral
strategies (Meichenbaum, 1996) requires empirical investigation. Using feedback from individuals with autism about experiences of physical interventions (Blackburn, 2006) may represent a useful methodology as consumer based methods have been used successfully by researchers in this field (Fish & Culshaw, 2005; Cunningham, McDonnell, Easton, & Sturmey 2002).

2. Conclusion

This paper has proposed that physiological arousal is an important mediator variable in challenging behaviors. An individual’s internal state of arousal works in a transactional manner with their experiences of the world. Low arousal approaches (McDonnell et al., 2002; McDonnell et al., 1998) in the management of challenging behaviors in adults with ASD do appear to have face validity.

Systematic research of environmental and programmatic features in relation to sensory differences is overdue and would help to answer questions around maximising access and reducing problematic behaviors. Anecdotal accounts provide a good starting point for this work but larger scale studies are needed. Apart from one case study (McDonnell et al., 1998) the majority of evidence for this approach would appear to be predominantly anecdotal. Recent research which examines the sensory experiences of people with ASD would appear to provide further support for the approach however more research is required in this area.
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