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**POSITIVE BEHAVIOUR SUPPORT TO MANAGE  
CHALLENGING BEHAVIOUR OF CHILDREN ON AUTISM  
SPECTRUM**

(A systematic review of intervention studies)

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***Abstract***

Children with autism spectrum disorder (ASD) are at increased risk of having challenging behavior that can affect success to education and community inclusion. This review examined the use of positive behavior support (PBS) to address the challenging behavior of children with ASD. Using rigorous selection criteria, a total of nine PBS intervention studies was identified; all of them employed a single subject design with seven of them rated high quality using Evaluative Method for Determining Evidence-Based Practices in Autism. Results indicated that PBS had positive impact on the replacement of challenging behavior with desirable performance for children with ASD. The maintenance effect and generalization in natural and structured settings were also found positive. Findings suggested that PBS is a promising intervention approach for promoting appropriate behavior of children with ASD. Nevertheless, large scale of PBS clinical trials for children with ASD are needed for more vigorous assessment of its efficacy.

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**Keywords:** Autism spectrum disorder; positive behavioural intervention.



## **1. Introduction**

There has been a sizable increase in the number of children with autism spectrum disorder (ASD) throughout the world (Honda et al., 2009; Wong & Hui, 2007). Impairment in social communication and social interaction, and restricted, repetitive patterns of behaviour, interests, or activity characterize ASD (American Psychiatric Association, 2013). These deficits can adversely affect the quality of family life and access to education and community inclusion. In fact, children with ASD have more inappropriate behaviour when compared to their typically developing peers (Kozlowski, Matson, & Rieske, 2012; Mahan & Matson, 2011). Among children who display challenging behaviour, the majority of them have the diagnosis of ASD (Conroy et al. 2005).

Children with ASD are at risk of having complex and severe challenging behaviours such as aggression, noncompliance, property destruction, antisocial, bullying behaviour and self-injury (Matson, Hess, & Mahan, 2013; Matson & Nebel-Schwalm, 2007). These challenging behaviours lead to further difficulties in keeping up positive relationship with their teachers and become a burden on teacher stress (Lecavalier, Leone, & Wiltz, 2006; Robertson, Chamberlain, & Kasari, 2003). The behaviours could also create a hindrance to learning and teaching and children with ASD are often identified as “troublesome” (Barnard, Prior, & Potter, 2000; Robertson et al., 2003). It has been reported that unaddressed challenging behaviours lead to higher rate on severity over time and that childhood behavioural issues are associated with more extreme behavioural problems in adolescent and adult life, such as substance abuse, unemployment, mental health problems and criminal conduct (Conroy, Dunlap, Clarke, & Alter, 2005; Reid & Patterson, 1991). There is an alarming upsurge demand for evidence-based practice to address challenging behaviour of children with ASD.

## **2. Problem Statement**

Behavioural interventions that have adopted the proactive and positive approach to prevent or reduce challenging behaviour are highlighted in the literature (Dunlap & Fox, 2011). Among the behavioural interventions for challenging behaviour, Positive Behaviour Support (PBS) has attracted much attention in recent years. PBS has adopted the strength-based perspective and its key features include functional behaviour assessment, principles of applied behaviour analysis and positive reinforcement (Horner et al., 1990). It can be applied in family, school and community settings (Algozzine, Daunic, & Smith, 2010; Neitzel, 2010; Riffel, 2011). PBS has been applied to address the inappropriate behaviour of children and young people. PBS requires comprehension understanding of why children take part in challenging behaviours and intervention for preventing the incidence by replacing them with desirable performance (Fox & Duda, 2011). The holistic approach of PBS can be implemented through different stakeholders, such as parents, teachers, peers and organizations (Buschbacher & Fox, 2003; Carr & Sidener, 2002; Dunlap et al., 2006). PBS has also gained much attention as a valuable and socially valid approach for children with ASD (Cheremshynski, Lucyshyn, & Olson, 2013; Dunlap et al., 2006; McIntosh et al., 2014; Neitzel, 2010).

### **3. Research Questions**

Therefore, how efficient is PBS as an intervention approach for promoting appropriate behavior of children with ASD?

### **4. Purpose of the Study**

There have been two review studies on problem behavioural interventions specifically for children with ASD (Horner, Carr, Strain, Todd, & Reed, 2002; Odom et al., 2003), but PBS was not included in these reviews. Another review study, the efficacy of PBS was examined for children with problem behaviour in general (Conroy et al. 2005). To our knowledge, none of the three reviews focused specifically on PBS for children with ASD. The research gap indicates that literature on the intervention effectiveness attributable solely to PBS in reducing challenging behaviour of children with ASD is relatively meagre. Through this context, we initiated the present systematic review (SR) to examine the efficacy of PBS in managing the challenging behaviour of children with ASD. In this synthesis, we concentrated on only intervention studies using solely PBS for this group of children.

### **5. Research Methods**

#### **5.1. Literature search strategies and inclusion criteria**

Two researchers conducted the literature search independently. PBS intervention studies were selected from the following 14 electronic databases: Academic search Premier, Education Research Complete, Wiley Online Library, Cochrane Library, ProQuest Database, ProQuest Social Science, Scopus, ProQuest Dissertation, Medline, ERIC, CINAHL, PsycINFO, Web of Science and Google Scholar. The databases were searched from their inception to April 2015. Keywords used in the search included the words “positive behaviour support” or “PBS” AND “autism” or “autism spectrum disorder” or “ASD” in article title, abstract or keywords. All articles identified were downloaded into EndNote X8 for finding the full text and also checking for duplication.

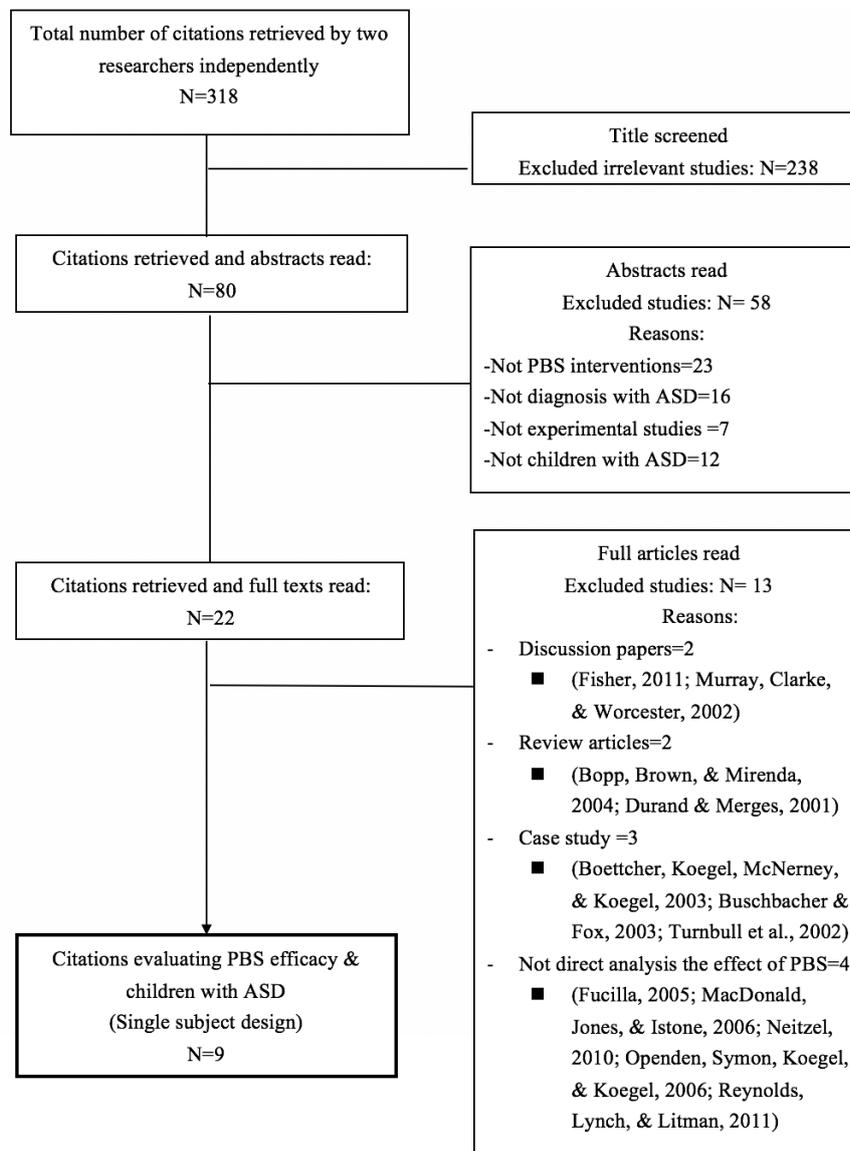
To be included in the present study, studies on PBS were required to meet all the specific criteria: (i) used experimental design: randomized clinical trial (RCT), controlled clinical trial (CCT), pre-post studies or single subject design; (ii) published in English peer-reviewed journals reporting an empirical intervention (editorials, correspondences, abstracts only without the full papers, discussion papers, review summaries and book chapters were excluded); (iii) the study used PBS as the only intervention method; and (iv) participants were children under the age of 18 with confirmed ASD diagnosis. Selection criterion (i) was screened on the basis of only the methods section of the searched studies. All other criteria were screened after examining the full report of each searched study. The overall percentage of agreement between the two researchers on the exclusion/inclusion status of the studies screened was 95%. Disagreements were settled by consensus and/or discussions with a senior author who had published several SRs before. The present study was in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009)

### 5.2. Data extraction and assessment of study quality

Two researchers rated independently the methodological rigor of each selected study using the guidelines prescribed in the Evaluative Method for Determining Evidence-Based Practices in Autism (Reichow, Volkmar, & Cicchetti, 2008). These guidelines can assess the study quality of group and single subject research with reliable and valid assessment results (Knight & Sartini, 2015; Watkins et al., 2015). For the assessment of study quality, there are primary and secondary quality indicators. Using these guidelines, each PBS intervention study was assessed as having strong, adequate or weak methodological quality.

### 5.3. The assessment of PBS as evidence-based practice for children with ASD

The guidelines developed by Reichow and colleagues (2008) were used to assess PBS whether it reached the requirement as the category of “established or promising evidence-based practice” for children with ASD. There are criteria for group and single subject research. The two researchers completed the assessment exercise independently and the agreement was nearly 100%.



**Figure 01.** Flowchart showing the study selection process

## 6. Findings

A total of nine intervention studies from peer-reviewed journals were extracted from 318 identified in the initial search. All of the included studies used single subject design and neither clinical trials nor pre-post studies were found in the search process. The nine included studies were published between 1999 and 2013. Among these studies, three were from the United States, three from Canada, two from South Korea and one from Ireland. Figure 1 summarizes the selection process and results.

### 6.1. Quality of included studies

Table 1 shows the detailed scores of the methodological quality of the nine studies included. Two studies (Blair et al., 2011; Cheremshynski et al. 2013) were classified as having strong quality. Five studies were categorized as having adequate quality (Binnendyk & Lucyshyn, 2009; Blair, Lee, Cho, & Dunlap, 2011; Dunlap & Fox, 1999; Lee, Poston, & Poston, 2007; Lucyshyn et al., 2007; McClean & Grey, 2012). The quality of the rest of the studies was neither strong nor adequate. The agreement of the two researchers was 90% for the primary indicators, 96% for the secondary indicators, and 93% for the total rating exercise.

**Table 1.** Critical appraisal of study quality (N=9)

| Study                  | Six primary quality indicator |    |    |    |    |    | PI score<br>Max. 6 | Six secondary quality indicator |    |   |    |    |    | SI score<br>Max. 6 | Quality<br>rating |
|------------------------|-------------------------------|----|----|----|----|----|--------------------|---------------------------------|----|---|----|----|----|--------------------|-------------------|
|                        | PC                            | IV | DV | BC | VA | EC |                    | IOA                             | Kp | F | BR | GM | SV |                    |                   |
| Becker-Cottrill (2003) | 1                             | 1  | 1  | 0  | 0  | 0  | 3                  | 0                               | 0  | 0 | 0  | 1  | 1  | 2                  | Weak              |
| Binnendyk (2009)       | 1                             | 1  | 1  | 1  | 1  | 0  | 5                  | 1                               | 0  | 0 | 0  | 1  | 1  | 3                  | Adequate          |
| Blair (2011)           | 1                             | 1  | 1  | 1  | 1  | 1  | 6                  | 1                               | 0  | 1 | 0  | 1  | 1  | 4                  | Strong            |
| Cheremshynski (2013)   | 1                             | 1  | 1  | 1  | 1  | 1  | 6                  | 1                               | 0  | 1 | 0  | 1  | 1  | 4                  | Strong            |
| Dunlap (1999)          | 1                             | 1  | 1  | 1  | 1  | 0  | 5                  | 1                               | 0  | 0 | 0  | 0  | 1  | 2                  | Adequate          |
| Lee (2007)             | 0                             | 1  | 1  | 1  | 1  | 1  | 5                  | 0                               | 0  | 0 | 0  | 1  | 1  | 2                  | Adequate          |
| Lucyshyn (2007)        | 1                             | 1  | 1  | 1  | 1  | 0  | 5                  | 1                               | 0  | 0 | 0  | 1  | 1  | 3                  | Adequate          |
| Marshall (2002)        | 1                             | 1  | 1  | 0  | 0  | 0  | 3                  | 0                               | 0  | 0 | 0  | 1  | 1  | 2                  | Weak              |
| McClean (2012)         | 1                             | 1  | 1  | 0  | 1  | 1  | 5                  | 0                               | 0  | 1 | 0  | 1  | 1  | 3                  | Adequate          |

Notes: **Six primary quality indicators:** *PC* participant characteristics, *IV* independent variable, *DV* dependent variable, *BC* baseline condition, *VA* visual analysis, *EC* experimental control, *PI* score: total score for the primary quality indicators.

**Six secondary quality indicators:** *IOA* inter-observer agreement, *Kp* kappa, *F* fidelity, *BR* blind raters, *GM* generalization and/or maintenance, *SV* social validity, *SI* score: total score for the secondary quality indicators.

**Quality rating criteria:**

**Strong:** scores on all six primary quality indicators and at least three secondary quality indicators;

**Adequate:** scores on at least four primary quality indicators and at least two secondary quality indicators;

**Weak:** scores on less than four primary quality indicators and less than two secondary quality indicators.

The nine studies together had a total of 17 participants (14 males; 3 females). The age of the participants ranged from 2.4 to 17 years old. Six studies had the single diagnosis of ASD (Binnendyk & Lucyshyn, 2009; Cheremshynski et al., 2013; Dunlap & Fox, 1999; Lee et al., 2007; Marshall & Miranda, 2002). Two studies had dual diagnoses: cerebral palsy and intellectual disabilities (Blair et al., 2011; Lucyshyn et al., 2007). One study had triple diagnoses included intellectual disabilities, bipolar depression and attention deficit disorder (McClean & Grey, 2012). The intervention time to outcome assessment ranged from four to 152 weeks. Seven studies were conducted in the home setting, one study in two settings: home and school and one study in the community setting.

The nine included studies used four different types of single subject research designs. Four studies used the basic design (Becker-Cottrill, McFarland, & Anderson, 2003; Binnendyk & Lucyshyn, 2009;

Dunlap & Fox, 1999; Marshall & Mirenda, 2002); two studies used the withdrawal/reversal design (Cheremshynski et al., 2013; Lee et al., 2007); two employed the multiple baseline design (Blair et al., 2011; Lucyshyn et al., 2007); and one study adopted the multiple-element baseline design (Blair et al., 2011; McClean & Grey, 2012). Table 2 presents the summaries of the nine PBS intervention studies for children with ASD.

**Table 2.** Summaries of the nine included PBS intervention studies for children with ASD

| Study<br>(First author, year) | Country     | Gender:<br>Age (year)                | Diagnosis               | Design | Setting      | Target challenging<br>behavior | Quality<br>rating |
|-------------------------------|-------------|--------------------------------------|-------------------------|--------|--------------|--------------------------------|-------------------|
| Becker-Cottrill (2003)        | US          | 1M: 4.7                              | ASD                     | AB     | Home         | DesB, DisB, StB                | Weak              |
| Binnendyk (2009)              | Canada      | 1M:6                                 | ASD                     | AB     | Home         | DistB, DesB                    | Adequate          |
| Blair (2011)                  | South Korea | 2M:4.5;5.5<br>1F:4.5                 | 2M:ASD+ID<br>1F: ASD+CP | MB     | Home, School | DesB, DisB, StB                | Strong            |
| Cheremshynski (2013)          | Canada      | 1M:5                                 | ASD                     | ABAB   | Home         | DistB, DesB                    | Strong            |
| Dunlap (1999)                 | US          | 5M:2.6;3.1;<br>3.7;2.4;2.8<br>1F:2.4 | ASD                     | AB     | Home         | DesB, DisB, PR, StB            | Adequate          |
| Lee (2007)                    | South Korea | 1M:17                                | ASD                     | ABAB   | Home         | DesB, DisB                     | Adequate          |
| Lucyshyn (2007)               | US          | 1F:5                                 | ASD + ID                | MB     | Home         | DesB, DisB, PR                 | Adequate          |
| Marshall (2002)               | Canada      | 1M:4                                 | ASD                     | AB     | Home         | DesB, DisB                     | Weak              |
| McClean (2012)                | Ireland     | 2M:15;17                             | ASD+ID+ADD<br>ASD+ID+BD | MB     | Community    | DesB, DisB                     | Adequate          |

Notes: *DesB* Destructive behavior, *DisB* Disruptive behavior, *PR* Physical resistance, *StB* Stereotype behavior, *ASD* autism spectrum disorder, *ID* intellectual disabilities, *CP* cerebral palsy, *BD* bipolar depression, *ADD* attention deficit disorder, *AB* Basic design, *ABAB* Withdrawal/Reversal design, *MB* Multiple baseline design

## 6.2. Intervention outcomes

Study characteristics are found in Table 3. The nine included studies all reported positive intervention effect of PBS in reducing the challenging behaviour of the 17 children with ASD. Six studies involved only parents (Becker-Cottrill et al., 2003; Cheremshynski et al., 2013; Dunlap & Fox, 1999; Lee et al., 2007; Lucyshyn et al., 2007; Marshall & Mirenda, 2002), and one study involved residential staff members (McClean & Grey, 2012). Two studies involved parents with either one therapist or teachers (Binnendyk & Lucyshyn, 2009; Blair et al., 2011). Four types of challenging behaviours were identified: destructive behaviour, disruptive behaviour, stereotype behaviour and physical resistance. These challenging behaviours were replaced with appropriate behaviour in social interaction, improvement in skill performance and engagement in daily routines.

**Table 3.** Characteristics of the nine included PBS intervention studies for children with ASD

| Study                  | PBS program procedure   | Participant                  | Duration | Intervention outcome | M       | G   | SV score | TF score | PND Score (mean)  |
|------------------------|---|------------------------------|----------|----------------------|---------|-----|----------|----------|---|
| Becker-Cottrill (2003) | Used task analysis of toileting routine, posted as a visual reminder, modeled appropriate verbalizations and specific phrases to request attention            | One parent                   | 24wks    | Positive effect      | 1yr     | NR  | NR       | NR       | Could not be calculated                                 |
| Binnendyk (2009)       | Implemented PBS plan and strategies designed to establish stimulus control over eating behavior; provided parent training in vivo at the kitchen table.       | One parent;<br>One therapist | 20wks    | Positive effect      | 2.2 yrs | YES | 4.6/5    | 0.68     | Challenging behavior: 100%<br>Desirable behavior: 100%  |
| Blair (2011)           | Used visual schedules and cues, increased peer, sibling, and adult involvement, increased novel activity, providing activity choices, frequent verbal praises | Parents;<br>Teachers         | NR       | Positive effect      | 3 wks   | YES | 3.7/4    | 0.85     | Challenging behavior: 100%<br>Desirable behavior: 100%  |
| Cheremshynski (2013)   | Used behavioral strategies: modeling, coaching, self-monitoring and self-management, behavioral rehearsal, and problem-solving discussions                    | One parent                   | 7wks     | Positive effect      | 3 wks   | NR  | 4.8/5    | 0.94     | Challenging behavior: 100%<br>Desirable behavior: 87.5% |

Notes: *wks* weeks, *yrs* years, *NR* not report, *M* maintenance, *G* generalization, *SV* social validity (means out of total score), *TF* treatment fidelity

### 6.3. Calculation of effect size: Percent non-Overlapping Data (PND)

The method of PND described by Parker, Vannest, and Davis (2011) was used to calculate the effect sizes for the nine included PBS intervention studies. This method was specifically designed for single subject research design. For challenging behaviour, PND was calculated by summing the quantity of treatment data points that fell below the lowest baseline data point, divided by the total number of treatment data points, and the scores were multiplied by 100. For appropriate behaviour, the treatment data points above the highest baseline data point were divided by the total number of treatment data points, and the scores were also multiplied by 100. PND score could range from 0-100%. PND of 50% and above has been considered large for treatment effect. PND was not calculated for maintenance or generalization data.

There were 28 behavioural outcomes included for the calculation of PND score. The mean PND score across the nine included PBS intervention studies was 93.7% (SD=11.8%, range=45.5-100%). For the challenging behaviour, the mean PND score was 92.5% (SD= 13.7%). For the appropriate behaviour, the PND mean score was 96.2% (SD=5.8%). PND score could not be calculated for two studies due to limited data for visual analysis and data point information in baseline and intervention phases. PND scores are presented in Table 3.

**Table 3.** continued

|                    |  |                           |             |                 |            |        |       |      |  |
|--------------------|--|---------------------------|-------------|-----------------|------------|--------|-------|------|--|
| Dunlap<br>(1999)   | Prevention strategies: use of stimulus control techniques associated with desirable behavior; replacement skills for challenging behavior                                  | Parents                   | 8-24<br>wks | Positive effect | NR         | NR     | NR    | NR   | Challenging behavior: 100%, 100%, 100%, 94.74%, 92.86%<br>78.26% (Mean=94.31%) |
| Lee<br>(2007)      | Used self-reinforcement and self-monitoring, for each target behavior, mark on the self-monitoring sheet after doing each behavior, and provided choices of reinforcements | One parent                | 4wks        | Positive effect | 1.5<br>yrs | Failed | NR    | NR   | Challenging behavior: 45.45%<br>Desirable behavior: 91.91 %                    |
| Lucyshyn<br>(2007) | Provided BPS plan, routine-specific implementation checklists, modeling and coaching, behavioral rehearsal, and problem-solving discussions                                | One parent                | 23wks       | Positive effect | 10<br>yrs  | YES    | 4.7/5 | NR   | Challenging behavior: 75%, 91.67%, 100%, 87.71%<br>(Mean=88.6%)                |
| Marshall<br>(2002) | Used visual support, demonstration and role playing, provided verbal directions; gave praise or corrective feedback  | One parent                | 6wks        | Positive effect | 1 yr       | YES    | NR    | NR   | Could not be calculated  |
| McClean<br>(2012)  | Used five specific sequence of intervention strategies to reduce severe challenging behavior: aggression and self-injurious behavior                                       | Residential staff members | 152<br>wks  | Positive effect | 3 yrs      | NR     | NR    | 0.95 | Challenging behavior: 100%<br>Desirable behavior: could not be calculated      |

Notes: wks weeks, yrs years, NR not report, M maintenance, G generalization, SV social validity (means out of total score), TF treatment fidelity

#### 6.4. Maintenance, Generalization, Treatment fidelity, and Social validity

Seven of the included studies reported positive maintenance effect (Becker-Cottrill et al., 2003; Binnendyk & Lucyshyn, 2009; Blair et al., 2011; Cheremshynski et al., 2013; Lee et al., 2007; Lucyshyn et al., 2007; Marshall & Mirenda, 2002; McClean & Grey, 2012). One study reported the negative maintenance effect (Lee et al., 2007). The maintenance period ranged from three weeks to 10 years.

Four studies reported positive generalization: two studies illustrated the generalization to new skills (Binnendyk & Lucyshyn, 2009; Marshall & Mirenda, 2002), and another two studies showed that the generalization was across settings (Blair et al., 2011; Lucyshyn et al., 2007). One study reported that the generalization was failed (Lee et al., 2007).

Four studies reported the treatment fidelity with reliability greater than 0.80 (Blair et al., 2011; Cheremshynski et al., 2013; McClean & Grey, 2012). One study reported moderate level of treatment fidelity at 0.68 (Binnendyk & Lucyshyn, 2009). Four studies provided social validity with high statistics outcomes and the range was from 0.92 to 0.96. (Binnendyk & Lucyshyn, 2009; Blair et al., 2011; Cheremshynski et al., 2013; Lucyshyn et al., 2007).

#### 6.5. PBS as evidence-based practice for children with ASD

For the assessment of evidence-based practice, this SR found that PBS was reported effective in two strong and five adequate quality studies, and implemented by seven different research teams across four countries (Binnendyk & Lucyshyn, 2009; Blair et al., 2011; Dunlap & Fox, 1999; Lee et al., 2007; Lucyshyn et al., 2007; McClean & Grey, 2012). These findings indicated PBS had the potential to be considered promising evidence-based practice for children with ASD.

#### 6.6. Discussion

The present study aimed to critically appraise existing intervention studies to examine the efficacy of PBS for children with ASD following strictly the standardized criteria of SR. With rigorous process, we

identified nine PBS intervention studies; all of them used single subject design. In the search process, no PBS group research for children with ASD was found. Seven of the included studies were ranked as having good methodological quality using the guidelines developed by Reichow and colleagues (2008). The high PND scores of these seven studies indicated that PBS was found effective in reducing challenging behaviour and at the same time could enhance desirable performance for children with ASD. The positive outcomes reported in all included studies suggested that PBS was a promising evidence-based practice for managing challenging behaviour for children with ASD.

An interesting finding in this review was that PBS targeted both challenging behaviour and desirable performance in social interaction and community inclusion. Given that one of the core characteristics of ASD behaviour is the lack of appropriate social and communication skills, this imperative finding would further assist this group of children for engagement in school and community settings. Another finding is the PBS was implemented in home environment. This outcome suggested PBS can be used in unstructured settings and that parents as the main caregivers are the key intervention agent. Another encouraging finding is the positive maintenance effect of the appropriate behaviour and skills. The ability to sustain appropriate behaviour is an important indicator of the overall effectiveness of an intervention (Watkins et al., 2015). Not all of the included studies reported generalization, social validity and treatment fidelity. This kind of practice is also reported in the review by Conroy et al. (2005) of PBS for children with challenging behaviour in general. The absence of these measures has impact on the research validity and future studies are encouraged to take this into considerations.

It is forecasted that the use of single subject design is a developing trend in studying ASD. Single subject research is an approach used to establish evidence-based clinical practice (Barlow, Hersen, Barlow, Nock, & Hersen, 2009; Feuer, Towne, & Shavelson, 2002; Kazdin, 2011). It is argued that systematic and detailed analysis of single subject research method in fact has been growing in the acceptance among the research disciplines (Kazdin, 2011; Lekwa & Ysseldyke, 2010). In addition, single subject design is particularly useful for circumstances in which parents, teachers, therapists or other intervention resources are scarce (Horner et al., 2005; Kratochwill & Levin, 2010; Levin, 2007).

The trend of providing integrated intervention programs for children with ASD is witnessed to match with the learning needs and behavioural characteristics of this group of children (McConkey, Truesdale-Kennedy, Chang, Jarrah, & Shukri, 2008). Although large scale and long-term RCTs examining solely PBS for further efficacy evidence is very desirable, the feasibility might not be high due to ethical considerations and the trend of integrated intervention programs for persons with ASD. Boyd et al. (2014) suggested that the shift in thinking around the models designed for children with ASD is worth considering. They argued perhaps it is not the unique features of the models that most contribute to child growth; instead it is the common features of the models that affect the performance of children with ASD (i.e., the common factory theory).

This SR has limitations. The comparatively high PND score of PBS intervention outcome might be due to the small number of included studies and the stringent inclusion criteria. The authors are aware of the development of the new model of Prevent-Teach-Reinforce (PTR) which adopted the idea of PBS (Dunlap, Iovannone, Wilson, Kincaid, & Strain, 2009). PTR is in the early phase of its development and two studies about the use of PTR on children with ASD were identified in the search process (Dunlap et

al., 2006; Strain, Wilson, Wilson, & Dunlap, 2011). Since the concepts of PTR are still evolving, it was decided that these two studies were not included in this SR but would be an area for future research. Another limitation was our decision to restrict selection to intervention studies written in English; that was partly due to the lack of resource for translation, and that the authors believe restricting to intervention studies is a desirable strategy for investigating efficacy.

## 7. Conclusion

In conclusion, the present SR of nine single subject design studies indicated that PBS was beneficial to children with ASD, particularly in replacing challenging behaviour with desirable performance. However, this review should not be seen as providing a definitive statement about PBS efficacy; rather, it is intended to describe what appears to be known to date as well as to explore the knowledge gaps. Care must be taken to generalize the results of the present study as the evidence is still not strong enough for us to make any definite conclusive remarks. Large scale and well-designed RCTs with long-term follow-up durations, if achievable, are required to further confirm the effect of PBS on children with ASD.

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- (Studies included in the review were marked with an asterisk (\*).)**