

## Research Article

# Cognitive Orientation to (daily) Occupational Performance (CO-OP) with children with Asperger's syndrome who have motor-based occupational performance goals

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**Background/aim:** Motor difficulties associated with Asperger's syndrome (AS) are commonly reported, despite these not being diagnostically significant. Cognitive Orientation to daily Occupational Performance (CO-OP) is a verbal problem-solving intervention developed for use with children with developmental coordination disorder to address their motor-based difficulties. This paper reports on two case studies of children with AS illustrating the outcomes of CO-OP to address motor-based occupational performance goals.

**Methods:** A case study approach was used to document how two children with AS engaged in 10 weekly sessions of CO-OP addressing child-chosen motor-based occupational performance goals and the outcomes of this intervention.

**Results:** Pre and post-intervention assessment using the Canadian Occupational Performance Measure, Vineland Adaptive Behaviour Scales and the Performance Quality Rating Scale indicated that both children were able to engage in CO-OP intervention to successfully improve their occupational performance.

**Conclusions:** Further research into the application of CO-OP with children with AS is warranted based on preliminary positive findings regarding the efficacy of this intervention to address motor-based performance difficulties in two children with AS.

**KEY WORDS** *Asperger's syndrome, children, cognitive intervention, motor performance, occupational performance.*

## Introduction

Asperger's syndrome (AS) is one of the disorders on the autistic spectrum (ASD) and is characterised by functional difficulties in social interaction, communication, and restricted, repetitive behaviours or interests (American Psychiatric Association (APA), 2000). In order to fulfil the DSM-IV TR (APA) diagnostic criteria for AS, a child must display a qualitative impairment in social interaction, for example, impairment in the use of non-verbal behaviours, failure to develop appropriate peer relationships, lack of spontaneous attempts to share enjoyment or interests with others and lack of social or emotional reciprocity. Children must also display restricted, repetitive or stereotyped behaviours such as preoccupation with restricted patterns of interest, inflexible adherence to non-functional routines or rituals, stereotyped and repetitive motor mannerisms or persistent preoccupation with parts of objects. These disturbances must cause clinically significant impairments in social, occupational or other areas of functioning (APA).

## Motor function in Asperger's syndrome

In addition to the characteristics included as diagnostic criteria, AS is commonly associated with motor clumsiness, however, these deficits are not considered diagnostically significant (Attwood, 1998; Smith, 2004). Motor difficulties in AS have been widely reported with some studies indicating the prevalence of such difficulties as exceeding 80% (Ghaziuddin, Tsai & Ghaziuddin, 1994; Miyahara *et al.*, 1997). Difficulties with specific aspects of motor function have been reported as well as general clumsiness associated with poor motor planning, coordination and fine motor difficulties (Attwood; Green *et al.*, 2003). It has been reported that some children with AS display sufficient motor difficulties to meet criteria for disorders of motor function according to the DSM-IV (Jansiewicz *et al.*, 2006).

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A study conducted by Green *et al.* (2003) compared motor function in children with AS to that of a matched group of children with Developmental Disorder of Motor Function using the Movement Assessment Battery for Children (Henderson & Sugden, 1992). Results of the study found that all 11 children in the AS group met the criteria for a diagnosis of motor impairment with the children with AS having a slightly higher mean motor impairment score than the comparison group of nine children with developmental disorder of motor function. These results are consistent with the suggestion of a high prevalence of motor impairment in AS, however, these need to be viewed with caution because of the small sample sizes in each group.

Many children with AS display an unevenness in their development of motor skills and achievement of developmental milestones, however, considerable variability exists and therefore there are no particular motor difficulties that are universal or specific to AS (Baranek, 2002; Miller & Ozonoff, 2000; Stone, Ousley, Hepburn, Hogan & Brown, 1999). According to Baranek many children with AS also have significant difficulty generalising newly learned skills to other contexts or applying component motor skills to functional tasks. It is therefore essential that interventions not only target specific motor skills, but also provide opportunities for these to be practised within an ecologically valid context in order to facilitate transfer of skills.

### **Intervention for children with Asperger's syndrome**

Many children with AS experience motor difficulties that impact on their functional abilities in a variety of settings. Much literature to date has focussed on comparing motor skills of children from across the autistic spectrum with children diagnosed with other conditions. Comparatively little research has been conducted into the effectiveness of interventions to improve motor skills (Rodger & Ziviani, *in press*). Interventions for children with ASD, which includes AS, can be broadly divided into: (i) psychodynamic treatment that is seldom used today as it is now well recognised that ASD is a developmental rather than emotional disorder; (ii) biological treatments, such as medication, vitamin and dietary supplements, and exclusion diets; (iii) educational/behavioural interventions; (iv) communication therapies; (v) sensory motor therapies; and (vi) combined approaches (Roberts, 2004). Interventions commonly used with children with AS include behavioural modification, social skills training, parent education and interventions to address school and educational needs (Sofronoff, Leslie & Brown, 2004). Occupational therapists often use motor and sensory strategies to assist children with AS to perform activities and enhance their participation. Sensory motor treatments focus on the underlying sensory hypo or hypersensitivities seen in children with autism and their difficulties with sensory modulation so that they can maintain optimal

arousal and focussed attention. Sensory Integration (SI) (Ayres, 1979) is one approach used by some occupational therapists to address these issues. Dawson and Watling (2000) reviewed the evidence on SI, traditional occupational therapy and auditory integration training and found poor quality and at best equivocal support for these interventions. Given the limited evidence for some of these approaches, better motor outcomes may be achieved through interventions that enable the child to perform tasks or through modification of the environment (Case-Smith, 2001). Given the variation that exists in the presentation and severity of AS, it is essential that intervention is highly individualised (Klin & Volkmar, 2000).

In summary, motor difficulties experienced by children with AS are widely reported in the literature, however, there is relatively little exploration of or evidence for specific intervention techniques. Motor difficulties are not a problem exclusive to AS and significant research into the effectiveness of intervention strategies for other motor conditions such as Developmental Coordination Disorder (DCD) has been conducted. One intervention that has been used to address such motor difficulties is Cognitive Orientation to (daily) Occupational Performance (CO-OP) (Polatajko & Mandich, 2004).

### **Cognitive Orientation to Occupational Performance (CO-OP)**

CO-OP is a task-orientated problem-solving approach which utilises cognitive skills to improve occupational performance. It is a verbally based approach, focussing on teaching children to use self-talk and problem-solving to address performance problems (Missiuna, Mandich, Polatajko & Malloy-Miller, 2001). CO-OP is highly individualised and involves moving from therapist verbal guidance to internal self-dialogue and finally to independent application of problem-solving strategies (Polatajko & Mandich, 2004). The three main objectives addressed by CO-OP are skill acquisition in child-chosen tasks, development of cognitive strategies, and the generalisation and transfer of learned skills and strategies (Missiuna *et al.*).

Children are taught a global cognitive strategy and are guided in the process of discovering other specific cognitive strategies relevant to their chosen goals (Polatajko & Mandich, 2004). The global strategy used in CO-OP is the 'goal, plan, do, check' strategy that involves identifying what needs to be done, planning how to achieve this, carrying out the plan and then evaluating its effectiveness (Polatajko, Mandich, Miller & Macnab, 2001). Domain specific strategies (DSS) are specific cognitive strategies that are task, child or situation specific and focus on facilitating or improving performance (Missiuna *et al.*, 2001). The child is guided to develop his/her own strategies based on the problems encountered during tasks (Polatajko *et al.*, 2001).

CO-OP was developed by Polatajko and colleagues in the early 1990s to assist children with DCD to achieve their motor goals. Subsequent studies have provided strong

convergent evidence that CO-OP is an effective approach for use with children with DCD (e.g. Miller, Polatajko, Missiuna, Mandich & Macnab, 2001; Polatajko *et al.*, 2001; Ward & Rodger, 2004). These studies have demonstrated that children with DCD are able to utilise cognitive strategies to improve their performance on motor-based tasks.

Children with AS commonly experience a range of motor difficulties similar to those associated with conditions such as DCD. Given its success with children with DCD, CO-OP may also be effective in addressing motor goals with children with AS. In addition, children with AS have difficulties generalising and transferring skills across performance settings. As this is a key component of CO-OP, it may be an effective intervention for these children. Hence, this paper will present case studies of two children with AS who engaged in CO-OP. The aim of this paper is to investigate whether CO-OP enabled these two children to master their chosen motor-based occupational performance goals. Goal mastery would provide some preliminary evidence for the utility and effectiveness of CO-OP with children with AS. One paper involving these same children (Rodger, Springfield & Polatajko, 2007) has already provided some evidence that CO-OP can assist with generalisation and transfer of skills learned during intervention.

## Methods

### Study design

Given the exploratory nature of this research, case studies were used to explore the outcomes of CO-OP intervention for two children. Case study research is appropriate when a study is descriptive, focussed on contemporary issues and seeks to cover the context in which the phenomenon under study occurs (Babbie, 2004; Yin, 2003). Ethical clearance for this study was provided by the appropriate institutional ethics committee at the University of Queensland.

### Participants

Recruited through University of Queensland's Occupational Therapy Children Life Skills Clinic using a purposive sampling approach (Patton, 2002), the two participating children met the following inclusion criteria: (i) aged between 5 and 12 years, (ii) had a diagnosis of AS, and met the AS criteria of the Gilliam Asperger's Disorder Scale (GADS) (Gilliam, 2001), and (iii) at least average intelligence as assessed using a standardised intelligence measure (e.g. Wechsler Intelligence Scale for Children-III (WISC-III)) (Kaplan, Fein, Kramer, Morris & Delis, 1990). Parents were provided with written information regarding the study, and were required to sign consent forms prior to commencement of the study. The two participants were siblings whose parents had concerns regarding their performance of motor tasks. Upon commencement of the study the children were assessed using the Movement Assessment Battery for Children (M-ABC) (Henderson &

Sugden, 1992) in order to establish the degree of motor difficulties. This assessment has good psychometric properties, covers the age range 4–12 years and has been used extensively to identify the presence of motor difficulties (e.g. Rodger *et al.*, 2003). Each case will be described individually. The pre-post intervention measures will be addressed in Case Study 1 only, as they were identical between the two children.

### Case study 1

*Alice.* Alice was 11 years and 5 months and the middle child with an older and younger brother, both of whom also had a diagnosis of AS. Alice was diagnosed with AS at age 8 and also had a diagnosis of attention deficit disorder (ADD) for which she took regular medication (methylphenidate hydrochloride – Ritalin®). Alice was in year 6 at a local Catholic primary school. She sang in a girls' choir, played the violin and attended Girl Guides. Her Asperger's Disorder Quotient was 105 (63rd percentile) on the GADS (Gilliam, 2001), confirming the paediatrician's AS diagnosis. Assessment on the WISC-III revealed above average intelligence. Alice's performance on the M-ABC resulted in a total impairment score of 11.5 (9th percentile), indicating that she was 'at risk' for motor difficulties (Henderson & Sugden, 1992). Alice's chosen goals addressed during CO-OP intervention in order of importance to her were to: (i) tie her shoelaces so that they stay done up, (ii) brush and style her long hair, (iii) get organised for school and (iv) use a knife and fork efficiently to cut up meat.

*Pre-intervention and post-intervention assessments.* Three assessments were utilised to document change pre to post-intervention — the Canadian Occupational Performance Measure (COPM) (Law *et al.*, 1998), the Vineland Adaptive Behaviour Scales (VABS) (Sparrow, Balla & Cicchetti, 1984), and the Performance Quality Rating Scale (PQRS) (Polatajko & Mandich, 2004).

The COPM (Law *et al.*, 1998) is an outcome measure used to determine a client's rating of his/her performance and satisfaction before and after intervention. The child first identifies activities that are difficult within the performance areas of self-care, productivity and leisure. Once identified, the importance of these activities is rated using a 10-point scale. The child then rates his/her performance and satisfaction on each of these tasks. Rating occurs according to two 10-point scales with a score of 1 indicating 'not able to do' or 'not satisfied at all' and 10 indicating 'able to do it extremely well' or 'extremely satisfied'. Changes in scores are determined separately for performance and satisfaction scores by subtracting the pre from the post-intervention rating for each goal. Mean change can then be determined. An increase of two or more points indicates clinically significant change (Law *et al.*). In this study at both pre and post-intervention both the child and his/her mother independently rated the child's performance and satisfaction on each of their goals.

The VABS (Sparrow *et al.*, 1984) provides an estimate of a person's adaptive function across the domains of communication, daily living, socialisation and motor skills. The VABS is suitable for use from birth through to adulthood and was conducted through interview with the children's mother. The VABS has good psychometric properties and has been used in previous studies of the use of CO-OP with children aged 7–12 years (Miller *et al.*, 2001).

The PQRS (Polatajko & Mandich, 2004) is a criterion-referenced performance-based observation rating scale. Quality of task performance is rated according to a 10-point scale based on the competency of the performance with a score of 1 indicative of the child being unable to perform the task even in part and a score of 10 indicating competent performance. Two independent raters viewed video tapes of each child's performance on their chosen tasks both before and after intervention. Sections of video were presented randomly with raters blind to pre or post-intervention status. Two raters were trained using video clips of motor-based performance in children not involved in this study. Training continued until raters reached 100% agreement. Percentage agreement was calculated based on perfect agreement and agreement plus or minus one rating on the 10-point PQRS rating scale (Helene Polatajko, personal communication, 15 October 2006). The first rater rated all video clips, with the second rater independently rating 30% of these to ensure interrater reliability. One hundred percent agreement was achieved for both children. Intraclass correlation coefficients (ICC) (model 2.1) were calculated to account for agreement by chance. The ICC for training was 0.928 and subsequently for Bob was 0.867 and Alice 0.976, providing excellent agreement beyond chance (Tabachnick & Fidell, 2001). The PQRS has been used in previous studies to determine the effectiveness of CO-OP intervention with children with DCD (e.g. Miller *et al.*, 2001). In this study, between one and five segments of video were rated for each goal at pre and post-intervention. An average rating for each goal at pre and post-intervention was calculated.

*Procedure.* The treating therapist assessed the child at both pre-intervention (1 week prior to commencing intervention) and post-intervention (within 2 weeks of ceasing intervention) using the COPM and the VABS. PQRS rating of pre-intervention and post-intervention performance were conducted after the completion of the study.

Following pre-intervention assessment and the identification of intervention goals, each of the children participated in 10 individual 1-h CO-OP sessions once a week. Intervention was completed for one child (Alice), prior to the second sibling (Bob) commencing intervention. Sessions were conducted both in the clinic setting and in the child's home. During sessions, the children were taught the global problem-solving framework (Goal, Plan, Do and Check) and guided to discover domain-specific strategies in formulating plans to enhance performance of their chosen goals. Approximately equal time was devoted to

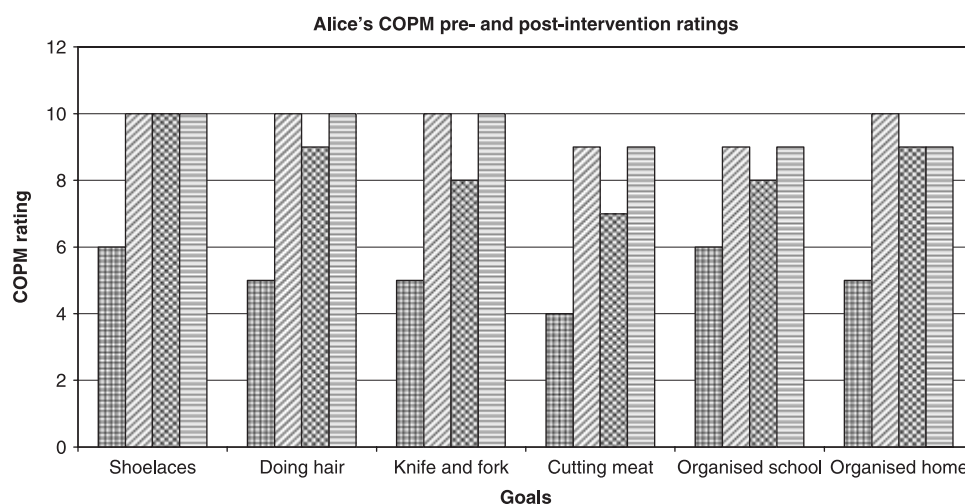
each goal; however, this was flexible to allow for the child's needs. The CO-OP intervention protocol undertaken was based on that described by Polatajko *et al.* (2001).

*Alice's intervention.* Alice was very receptive to learning the global strategy and engaged well with the therapist (SR) in problem-solving solutions to her performance difficulties. Tying shoelaces up tight to stay done up was achieved within a few sessions. She knew how to tie them, however, she needed to learn how tight to pull them. During sessions she used her black school shoes, gym shoes and she brought in hiking boots with purple laces to practise prior to a bushwalking holiday. These had long laces and many more eyelets than her school shoes. She used the strategy 'pulling tight as you can', so that the finger could not fit under the crossed laces as her 'feel the movement strategy'. This DSS 'pulling tight' was able to be transferred to the goal of styling her hair in a pony tail. One of the DSSs she needed for this task was to pull her hair back and tight; once she had brushed it through with no knots. Her hair styling/brushing goal focussed first on brushing through with no knots, then on single pony tail, and double pony tails. She used other DSSs such as 'body position' to check the height and evenness of pony tails in the mirror, lining up the distance with the top of her ears. She also used a 'feel the movement' strategy to practise parting her hair at the back for double pony tails using the edge of the comb.

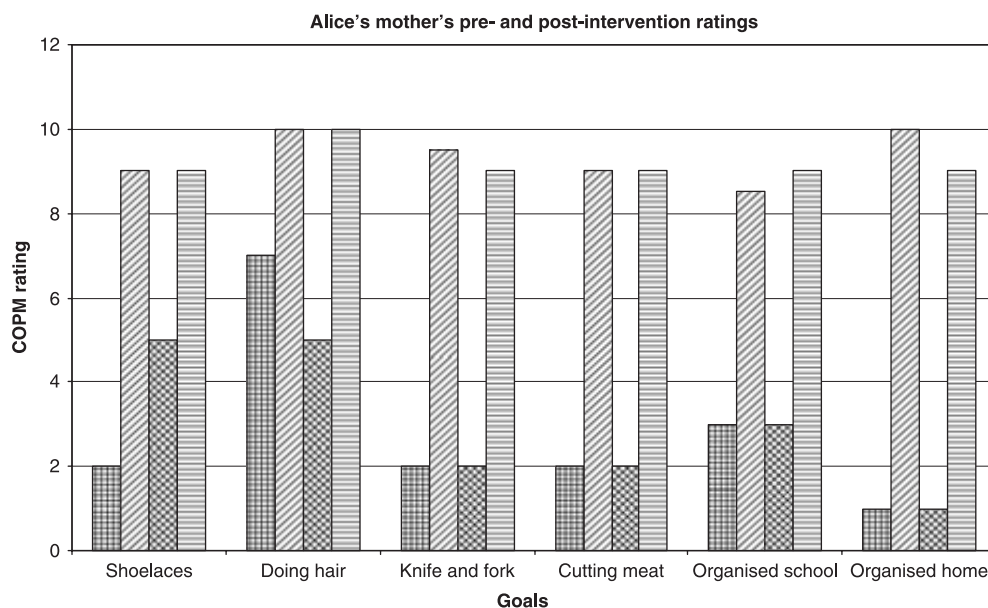
With respect to cutting with knife and eating with fork, she focussed in sessions on the forward/backward cutting action of the knife ('feel the movement') and straight index/pointer fingers for grasping fork and knife (guiding it with straight pointer) ('body position'). This index finger position was transferred to positioning her violin bow and knitting. In terms of getting organised, she developed a number of strategies focussing on using lists, sticking up pictures/plans in her bedroom regarding where things should go and writing timetables for school and extracurricular activities. These were often drawn as a tree with trunk (the goal) and branches (the plans with one written on each branch) which were displayed in her room or on the fridge in the kitchen.

*Pre and post-intervention results for Alice.* Alice's pre and post-intervention COPM results are summarised in Figures 1 and 2. Alice's ratings of her goals on the COPM resulted in a mean change score for performance of 4.75 and mean change in satisfaction of 1.25. A difference of two or more points indicates a clinically significant change (Law *et al.*, 1998). Hence, Alice's mean change in performance was clinically significant but not her mean change in satisfaction. Alice's mother's mean change in performance and satisfaction ratings was 6.13 and 5.75, respectively. Both of these indicate her view of clinically significant changes in Alice's goal achievement.

Alice's pre and post-intervention PQRS ratings were completed for her goals of tying shoelaces, brushing and



**FIGURE 1:** Alice's pre- and post-intervention Canadian Occupational Performance Measure (COPM) scores, ■ Pre-performance, □ Post-performance, ▨ Pre-satisfaction, ▩ Post-satisfaction.



**FIGURE 2:** Alice's mother's pre- and post-intervention Canadian Occupational Performance Measure (COPM) scores, ■ Pre-performance, □ Post-performance, ▨ Pre-satisfaction, ▩ Post-satisfaction.

styling hair and using cutlery, and revealed improvements in performance on all three of these goals. At post-intervention, Alice's PQRS ratings had improved by 1 point for tying shoelaces, 3.5 points for brushing and styling hair and 3 points for cutlery use.

Alice's pre and post-intervention VABS scores (summarised in Table 1) indicate minimal changes in standard scores in the socialisation domain, moderate changes in the communication domain and considerable changes in the daily living skill domain. Alice's goals related primarily to daily living skills, hence this was the main area of performance targeted during intervention. Alice's performance in the daily living skills and socialisation

domains as well as her adaptive behaviour composite score remained below the first percentile.

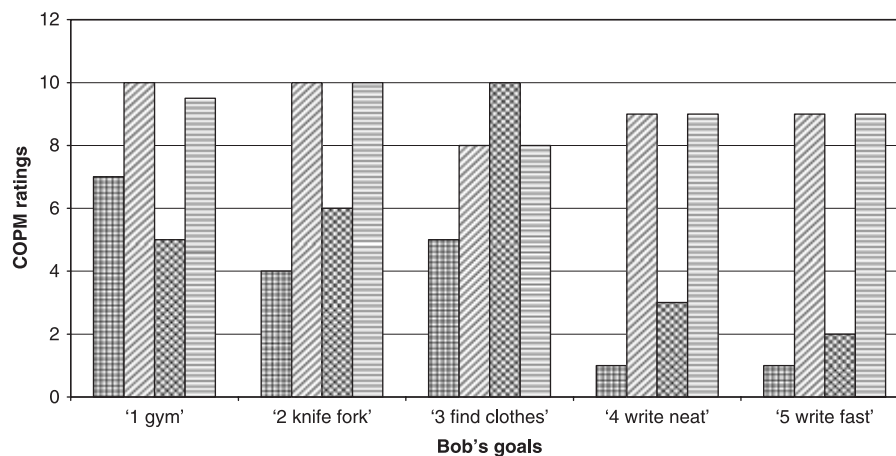
### Case study 2

**Bob.** Bob was 9 years and 6 months and was in year 5 at a local Catholic primary school. He was Alice's younger brother and commenced CO-OP two months after she had completed intervention. Bob was diagnosed with AS at age 6. He had been taking Ritalin® (methylphenidate hydrochloride) since age 4 to help with attention difficulties and took risperidone (Risperdal®) intermittently for anxiety. Bob managed well with academic work at school

**TABLE 1:** Alice's pre- and post-intervention Vineland Adaptive Behaviour Scales (VABS) scores

VABS domains	Pre-intervention standard score	Pre-intervention percentile	Post-intervention standard score	Post-intervention percentile
Communication	73	4	80	9
Daily living skills	27	< 1	63	1
Socialisation	49	< 1	50	< 1
VABS adaptive behaviour composite	46	< 1	59	< 1

(mean = 100, standard deviation = 15).

**FIGURE 3:** Bob's pre- and post-intervention Canadian Occupational Performance Measure (COPM) scores, ▨ Pre-performance, □ Post-performance, ▩ Pre-satisfaction, ▤ Post-satisfaction.

and also participated in extracurricular activities including gymnastics, Boy Scouts and model-building. Bob received an Asperger's Disorder Quotient of 96 (39th percentile), confirming the paediatrician's diagnosis of AS. His results on the WISC-III fell within the above average intellectual functioning range. On the M-ABC, Bob received a total impairment score of 19, which placed him below the first percentile and confirms the presence of significant motor difficulties (Henderson & Sugden, 1992). Bob's goals for interventions were to: (i) remember his gymnastics routines, (ii) find clothes to get dressed, (iii) use a knife and fork to eat, (iv) write neater, and (v) write faster. Bob's goals of remembering gymnastics routines, using cutlery and improving writing were the initial focus of intervention. Halfway through the sessions, Bob decided that he had improved enough on his first goal as he had won a medal for gymnastics. This was replaced with the goal of organising his clothes at home. Refer to previous description of assessments and procedure described in Alice's case study.

*Bob's intervention.* Bob also responded well to intervention, grasping the problem-solving concepts quickly and adapting them to his situation. Because he had heard his sister describing goal, plan do, check and strategies, he

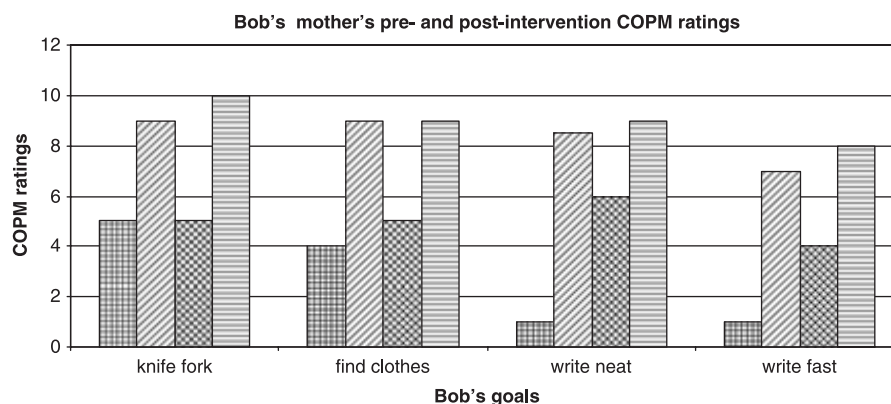
seemed to manage both intervention sessions and home practice well. His mother commented (Rodger *et al.*, 2007) that his sister sometimes prompted his planning strategies during mealtimes when he was trying to use a knife and fork to cut and eat. She would prompt: what is your plan? Bob where are your fingers? etc. This shared problem-solving language seemed to be of assistance. Bob developed strategies about organising clothes in his room for getting dressed in the morning and packing his school bag for swimming/PE such as laying clothes out the night before, labelling drawers, etc. He used 'body position' and 'feel the movement' strategies for using knife and fork which was practised with his favourite foods. With writing, he developed strategies such as how much pressure to place on pencil ('feel the movement'); writing between lines, letter size and spacing between words ('task specification/modification') as well as some rote scripts for letters and numbers ('8 is like an S and a backwards S') and fitting numbers in the square ruled maths pad (start in the middle of the square). These strategies are discussed in more detail by Rodger, Pham and Mitchell (in press).

*Pre and post-intervention results for Bob.* Bob's pre and post-intervention COPM results are summarised in Figures 3 and 4. Bob's mean performance change in score was 5.6

**TABLE 2:** Bob's pre- and post-intervention Vineland Adaptive Behaviour Scales (VABS) scores

VABS domains	Pre-intervention standard score	Pre-intervention percentile	Post-intervention standard score	Post-intervention percentile
Communication	75	5	89	23
Daily living skills	44	< 1	51	< 1
Socialisation	54	< 1	58	< 1
VABS adaptive behaviour composite	53	< 1	61	< 1

(mean = 100, standard deviation = 15).

**FIGURE 4:** Bob's mother's pre- and post-intervention Canadian Occupational Performance Measure (COPM) scores, ■ Pre-performance, □ Post-performance, ▨ Pre-satisfaction, ▩ Post-satisfaction.

and his mean satisfaction change in score was 3.9. These changes in scores both represent clinically significant differences between his pre and post-intervention ratings. His mother's mean change in performance and satisfaction ratings was 5.6 and 4.0, respectively, also indicating her perception of clinically significant changes in both performance and satisfaction.

PQRS ratings of Bob's goals related to handwriting and cutlery use were conducted for pre and post-intervention performance. Bob displayed an improvement of two points on the 10-point scale in the performance of his goal of handwriting. Bob's PQRS ratings for his goal of using cutlery revealed a negligible difference (0.2 point decrease) in rating at post-intervention.

Bob's pre and post-intervention VABS scores are summarised in Table 2. Bob displayed the greatest improvements in standard scores between pre and post-intervention in the communication domain, followed by the daily living skills domain with the smallest changes occurring in the socialisation domain. Bob's goals for intervention included written communication and daily living skills such as eating with a knife and fork and organisation at home, and therefore these performance areas were the focus of intervention. Bob's adaptive behaviour composite score as well as his performance in

the daily living skills and socialisation domains remained below the first percentile.

## Discussion

The results of this study add to the literature suggesting that although motor difficulties in AS are not diagnostically significant they are commonly present. These motor-based difficulties were confirmed by low M-ABC percentile scores for both children. Bob's performance on the M-ABC placed him below the first percentile, which is indicative of significant motor difficulties (Henderson & Sugden, 1992). Alice's M-ABC impairment score fell below the 15th percentile, indicating that she was 'at risk' of motor difficulties. Previous studies of children with DCD have used the M-ABC to confirm the presence of motor difficulties associated with the disorder and have used the 15th percentile as a cut-off for inclusion (Green *et al.*, 2003; Miller *et al.*, 2001). In applying this cut-off level, both children in this study were found to experience motor difficulties consistent with those associated with DCD.

Pre and post-intervention COPM ratings for both children indicated self and parent reported improvements in performance for all goals. For both children, these improvements exceeded 2 points on the 10-point scale



and therefore represent clinically significant improvements in performance (Law *et al.*, 1998). These improvements in performance ratings suggest that both children were able to successfully engage in CO-OP to improve their perceived performance on each of their motor-based goals.

Improvements were also apparent in COPM ratings of pre- and post-intervention satisfaction. Bob's ratings of satisfaction, as well as the mother's ratings for both children, increased by clinically significant margins of greater than 2 points (Law *et al.*, 1998). Alice's pre- and post-intervention satisfaction ratings, however, resulted in only minimal improvements. This is likely to have been influenced by the fact that prior to intervention Alice rated her satisfaction with her goals of styling her hair, tying shoe laces and getting organised at home highly (score of 9 or 10 out of 10), despite her performance ratings being lower (5 or 6 out of 10). Alice's goals related to personal presentation such as tying shoe laces and brushing and styling hair are related to social acceptability and others' perceptions of her as being neat and tidy. Some literature suggests that children with AS often do not understand and are not motivated by social rules or the expectations of others (Attwood, 1998; Gilberg, 2002). This may provide an explanation as to why Alice rated her satisfaction highly (i.e. her appearance was acceptable to her) despite being aware that her performance was lacking, indicating a lack of awareness of the social impact or meaning of her performance deficits.

PQRS ratings of the two children's pre- and post-intervention performance of their goals revealed improvements in all goals for Alice and in one of two goals for Bob. PQRS ratings of Bob's goal of using cutlery did not indicate that his performance had improved through intervention. This, however, may have been impacted by the type of food he was required to cut. During pre-intervention video clips, Bob used cutlery to cut and eat a sausage, however, at post-intervention, he cut and ate a piece of steak, which is a much more difficult task. Differences in the types of food used were related to the availability of food in the children's home at the time. The lack of improvement in PQRS ratings for Bob's goal of eating may have been a result of the use of foods which were easier to cut at pre-intervention than those used at post-intervention. This has implications for future studies as in order to gain more accurate ratings the type of food cut should remain identical at pre and post-intervention. Both Bob and his mother noted considerable improvement in his cutting abilities and his mother reported she no longer needed to assist him at any meals and such was his confidence that he had started using a knife to peel and cut fruit (Rodger *et al.*, 2007).

The PQRS rating system involves rating only short segments of videotape, however, some aspects of task performance could not be fully observed or rated in this period. For example, Alice's goal of tying shoelaces was related to the ability to tie laces tightly enough that they would not come undone. It was not possible to deter-

mine from a short segment of video whether or not the laces would have remained done up and therefore PQRS ratings related only to the technique used to tie them. This may have affected the accuracy of PQRS ratings in reflecting the actual change in performance for this goal. In this case, child's and parent's ratings of shoe lace tying may be more accurate depictions of success. Alice's mother reported that her laces remained tied up for a 17-km bushwalk after about five sessions of intervention (Rodger *et al.*, 2007).

The results of this study provide preliminary evidence for the application of CO-OP to children with AS experiencing motor difficulties. CO-OP appears to have been effective in enabling the two participants to achieve their motor-based occupational performance goals. This is consistent with previous studies providing evidence for the effectiveness of CO-OP as an intervention to improve motor performance in children with DCD aged between 7 and 12 years (Miller *et al.*, 2001) and aged 5–6 years (Ward & Rodger, 2004). The strategies used by these two children with AS to address motor-based goals such as 'body position', 'feel the movement' and 'task specification/modification' are consistent with some of the most frequently utilised DSSs in studies of children with DCD (Bernie & Rodger, 2004; Rodger *et al.* in press).

Similarities exist between the goals identified by Bob and Alice and those identified by children with DCD documented in previous CO-OP studies (Bernie & Rodger, 2004; Polatajko *et al.*, 2001; Ward & Rodger, 2004). Bob and Alice identified goals related to personal care, cutlery use and handwriting, all of which have been reported to be goals commonly chosen by children with DCD during CO-OP intervention (Polatajko *et al.*). Bob and Alice however, both identified goals involving personal organisational issues. This appears to be different to previous studies involving children with DCD, as organisational goals were not reported as being identified in some of these studies to date (Polatajko *et al.*).

Both children's pre and post-intervention VABS scores revealed improvements in the daily living skills and communication domains. Daily living skills were a focus of intervention with both children identifying goals associated with eating and Alice also identifying goals related to tying shoe laces and hair. Verbal communication skills, however, were not a focus of intervention for either child. Bob identified goals relating to written communication; however, this is only one aspect of the communication domain and does not account entirely for the improvements noted. The improvements displayed by both children in this domain may have been related to the nature of CO-OP intervention in that CO-OP is a verbally based intervention with a focus on problem-solving. It is possible that the verbal nature of intervention and the children's verbal problem-solving skills contributed to the improvements in communication indicated by the VABS scores. The impact of CO-OP on communication skills as a secondary outcome of intervention is worthy of further investigation.



Bob and Alice both displayed minimal improvements in the socialisation domain, however, this was not a focus of intervention. Despite improvements occurring in individual domain scores, post-intervention adaptive composite scores for both children remained significantly below that expected for their ages. As with the COPM, the VABS is based on parental report, however, the clinically significant changes apparent in scores of the COPM were not seen on the VABS. This indicates that the VABS assessment may not have been sensitive enough to independently measure the goal-specific improvements. This raises questions regarding the sensitivity of the VABS in measuring small changes and may have implications for its use in future studies.

The main limitations of this study are that case studies of only two children were conducted and that these children were siblings, both of whom were intellectually capable and were of a similar age. Additionally, the same therapist provided intervention to both children. Further research involving different children and therapists is therefore necessary to determine if there were factors related to the children's home environment or the treating therapist which may have impacted on the success of CO-OP. Further research should include more children across a diverse range of ages, cognitive abilities and types of goals in order to investigate the application of CO-OP to other children with AS. Future research should also investigate comparisons of the effectiveness of CO-OP intervention to conventional occupational therapy treatments for motor issues. The findings of the study also raise issues regarding the measurement of improvements in motor performance. The minimal changes in VABS scores at pre and post-intervention may indicate that this assessment was not sensitive enough to detect small changes over a short time period and that other assessment tools should be investigated for use in future studies. Additionally, this study identified that in order for the PQRS to provide an objective measure of changes in performance it is important that conditions are identical for pre and post-intervention ratings.

## Conclusion

Given that CO-OP was designed for use with children with DCD to address motor performance difficulties, this study aimed to investigate its use with children with AS who experience similar motor performance issues. The results of these two case studies indicate that CO-OP intervention was successful in enabling children with AS to achieve motor-based occupational performance goals. Both Bob and Alice were able to participate in CO-OP and displayed improvements in performance on all of their goals following 10 intervention sessions. The results of this study are promising and provide preliminary information about the use of CO-OP with these children. Further research is required in this area to determine whether these findings can be replicated with other children with AS and a broader range of goals.

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