CRD summary
This review assessed the effectiveness of long-term applied behaviour analytic (ABA) intervention for young children with autism and concluded that it led to medium to large effects across considered outcomes. This was a well-conducted review. Presence of publication bias, moderate quality of the included studies and variation across studies should be borne in mind when considering the results.

Authors' objectives
To assess the effectiveness of intensive and long-term applied behaviour analytic (ABA) interventions for young children with autism.

Searching
MEDLINE, PsycINFO and The Cochrane Library were searched without language restrictions from 1985 to April 2009 for peer-reviewed published studies. Search terms were reported. Reference lists of reviews were searched for additional articles.

Study selection
Eligible studies assessed intensive long-term ABA interventions in at least five children with formally diagnosed autism and pervasive developmental disabilities. ABA interventions lasted at least 45 weeks and included at least 10 hours per week. Excluded studies: reported anecdotal, qualitative or non-standardised outcome measures; had no pre-test measurement; had biased subject selection; an intervention focus for specific areas or specific behavioural procedures; or from which means and standard deviations could not be calculated from the paper and following attempts to contact authors.

In the included studies a number of different measurement instruments were used to derive outcomes: full scale intelligence quotient (IQ); nonverbal IQ; receptive language; expressive language; language composite; adaptive behaviour-communication; adaptive behaviour-daily living skills; adaptive behaviour-socialisation; adaptive behaviour-motor skills; and overall composite adaptive behaviour scores. Mean age of participants ranged from 22.6 to 66.3 months. The proportion of males ranged from 55.6% to 97.7%. Pre-IQ, where stated, ranged from 15.00 to 76.53. More than half of the studies included children diagnosed with autism. Programmes were clinic- or school-based. Intervention intensity ranged from 5.85 to 45 hours per week and duration ranged from 12 to 407 weeks.

Two reviewers independently selected studies for the review; discrepancies were resolved by consensus.

Assessment of study quality
Two reviewers independently assessed study quality using a modified Downs and Black checklist; domains were rated on a 0 to 1 scale and the maximum possible score was 5.

Discrepancies were resolved by consensus.

Data extraction
Two reviewers independently calculated effect sizes (ES) and 95% confidence intervals (CI). Effect sizes for control group studies were estimated by post- minus pre-test mean scores divided by the pre-test standard deviation pooled across groups. Effect sizes for within-subjects designs were computed by dividing the mean difference between post- and pre-test outcomes by the pre-test standard deviation. Authors were contacted, where necessary, for missing data. Discrepancies were resolved by consensus.
Methods of synthesis
For each outcome of interest, pooled effect sizes were calculated by using an inverse variance weighted random-effects meta-analysis. Heterogeneity was assessed using the $I^2$ statistic. Sensitivity analyses were performed by restricting the analysis to controlled studies, type of intervention model (UCLA model, general ABA) and delivery format (clinic-based, parent managed). Publication bias was assessed using Egger's test.

Results of the review
Twenty-two studies were included (n=323). Mean quality score was 2.5 (range 1.2 to 3.6).

Intelligence quotient: ABA intervention produced a significant impact on general IQ (ES 1.19, 95% CI 0.91 to 1.47; 18 studies). ABA intervention had a significant impact upon non-verbal IQ (ES 0.65, 95% CI 0.17 to 1.13; 10 studies). There was evidence of heterogeneity for these comparisons.

Language skills: ABA intervention produced favourable effects on receptive language performance (ES 1.48, 95% CI 0.96 to 1.97; 11 studies). Favourable effects of ABA intervention were observed for expressive language skills measured by standardised assessments (ES 1.47, 95% CI 0.85 to 2.08; 10 studies). Favourable effects of ABA intervention were reported for general language skills (ES 1.07, 95% CI 0.34 to 1.79; five studies). There was evidence of heterogeneity for these comparisons.

Adaptive behaviour domains: ABA intervention produced significant effects for communication (ES 1.45, 95% CI 1.02 to 1.88; 11 studies). ABA intervention produced significant effects on socialisation (ES 0.95, 95% CI 0.53 to 1.37; 11 studies). ABA intervention produced significant effects on an adaptive behaviour composite measure that combined all four adaptive behaviour domains (ES 1.09, 95% CI 0.70 to 1.47; 15 studies). There was evidence of heterogeneity for these comparisons.

ABA intervention produced significant effects for daily living skills (ES 0.62, 95% CI 0.30 to 0.93; 11 studies). ABA intervention yielded significant effects on motor skills (ES 0.71, 95% CI 0.19 to 1.22, p=0.008); there was no evidence of heterogeneity for these comparisons.

Further results and sensitivity analyses were presented in the paper. Publication bias was present for all outcomes except for daily living skills, motor functioning and composite adaptation.

Authors’ conclusions
Long-term comprehensive ABA intervention led to (positive) medium to large effects in terms of intellectual functioning, language development, acquisition of daily living skills and social functioning in children with autism. Language-related outcomes (IQ, receptive and expressive language, communication) were superior to non-verbal IQ, social functioning and daily living skills.

CRD commentary
This review had a clear research question and inclusion criteria. The lack of restrictions on language reduced the chances of language bias; the restriction on publication status meant that some studies have been missed. There was evidence of publication bias. The authors reported that they used rigorous methodology at all stages of the review process, which reduced chances of reviewer bias and error. A suitable assessment of study quality was conducted. Methods of meta-analysis were appropriate. Appropriate assessment and exploration of heterogeneity between studies was undertaken. Presence of statistical heterogeneity among many of the pooled analyses suggested that the method of synthesis may not have been appropriate.

This was a well-conducted review, but the presence of publication bias, moderate quality of the included studies and variation across studies should be borne in mind when considering the results.

Implications of the review for practice and research
Practice: The author did not state any implications for practice.

Research: The author stated that future studies should consider intention-to-treat analysis, use randomisation and
should use no-treatment controls or match treatment intensity and duration across groups. Researchers should monitor therapist adherence to treatment protocols in the intervention group and in the comparison group whenever controls follow an alternative treatment. They should also implement specific approaches to treatment in order to provide direct comparisons of different intervention paradigms both within and between ABA intervention and other forms of treatment.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.