Neuromotor task training
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Summary
Despite normal intelligence, about 5 to 10% of school-aged children have difficulty adequately performing movement tasks that are part of their daily routine. Examples of such tasks are tying shoelaces, buttoning, eating neatly, bicycling, playing ball, climbing stairs, swimming, but also drawing and handwriting. Because of their motor difficulties, children might not get asked to play by peers, or they might withdraw from leisure activities because they feel they lack sufficient skills to enjoy participating. The term which is fast becoming internationally accepted to describe the motor difficulties of these children, is developmental coordination disorder (DCD; APA, 1987; 2000). It can be used when the motor difficulties cannot be explained by any other medical condition or mental retardation, yet they are severe enough to interfere with activities of daily living.

There is a strong need for intervention as, contrary to what lay people, teachers and healthcare professionals often believe, most children with DCD do not outgrow their problems (Cantell et al., 1994; Christiansen, 2000; Geuze & Borger, 1993; Hellgren et al., 1993; Losse et al., 1991). Lack of practice, due to not participating in physical activities, may inhibit further motor development, possibly aggravating existing performance differences between a child with DCD and its peers. In addition, DCD can influence behavioural development or increase the long-term risk of chronic disease (Peters et al., 2004).

General practitioners (GPs), when consulted by parents about a child’s poor motor performance, may refer the child to a paediatric physiotherapist (PPT). PPTs can draw on an array of treatment approaches. Evidence for the effectiveness of treating children with DCD, however, is scarce. Dutch physiotherapists often use what they have learned on various courses in an eclectic fashion (Schoemaker et al., 1994). Instead of practising functional skills, treatment focuses on prerequisites which are believed necessary for adequate task performance. As the effectiveness of the treatment provided in the past has been disappointing (Mandich et al., 2001; Pless & Carlsson, 2000), we developed a new treatment approach called Neuromotor Task Training (NTT).

Neuromotor Task Training (NTT) was developed especially for children with DCD. NTT incorporates recent scientific knowledge on the variables affecting motor control and motor learning in order to enhance motor learning in general, in particular as regards the transfer of skills to activities of daily living. Special attention is paid to the best ways to give instruction and feedback. The treatment programme is child-centred and mainly task-oriented, focusing strictly on teaching those skills that a child needs in daily life. The tasks selected are different for each child, depending on its individual needs as well as the expectations, capabilities and motivation of both the child and its parents/carers. In training functional skills, it is assumed that therapists stimulate deficient motor control processes. The higher the resemblance between the treatment situation and the circumstances in which the skills are needed in daily life, the more successful the transfer of skills practised to daily life activities.
The main objective of this thesis was to evaluate Neuromotor Task Training. Because NTT is task-oriented and pays special attention to the question of how children are taught motor skills, we also wanted to gain an understanding of the assumed intervening mechanisms of NTT (opening the black box).

**A controlled trial**

We conducted a controlled trial to investigate whether NTT was effective for children suffering from DCD. For this trial, 40 paediatric physiotherapists (PPTs) who had received instruction in NTT during their three-year professional training followed two extra refreshers sessions that were organised especially for this study. The participation of a fairly large number of therapists was expected to enhance the external validity of our results.

Two groups of children with DCD (6-10 years) were recruited: a treatment group and a non-treatment control group. The treatment group consisted of children who had been referred to physiotherapy by their GPs and who received either 9 or 18 ‘weekly’ 30-minute sessions of NTT. We recruited children for the non-treatment control group by putting up posters in ordinary primary schools, offering free motor testing of children for parents concerned about their children’s motor development. This non-treatment group was tested twice with a 3-month interval. The results of this group were used to control for possible testing effects and spontaneous development. The two groups of children were not randomly selected because parents would not have been willing to participate if there had been a chance that their child would have been put on a hypothetical waiting list. Moreover, because PPTs regarded their treatment as effective, they felt it was unethical to withhold treatment when a child was referred to them.

To ensure internal validity, inclusion criteria were formulated to make the groups of children as homogeneous as possible. One possibly important difference nevertheless remained: parents of the children in the control group had not – as yet – tried to access professional help. It is likely, therefore, that there was a difference between the two groups, that might be reflected in the spontaneous rate of development.

In chapter 2, we describe how we tried to get more insight into why some parents – in this case, of children in the treatment group – had arranged treatment for their children, while others had not. In order to study the use of special care services, we used a model developed by Andersen and Newman (1973). In a study, not published in this thesis, we found no differences in children’s social background (including parents’ educational level), living environment, or the age at which motor milestones were reached (Niemeijer et al., 2003). We did not think that enabling factors were relevant for the difference in use of care between the groups because nearly everyone in the Netherlands has healthcare insurance and there is a good spread of services throughout the country, with equal quality of care and equal pricing. We therefore compared the
health needs (motor and behavioural symptoms) of both groups of children more closely. Although the groups performed equally poorly on the Movement Assessment Battery for Children (M-ABC; Henderson & Sugden, 1992), a popular general motor test to select children with DCD (Geuze et al., 2001), we found that the nature of the difficulties differed. Children in the control group had more difficulty with manual dexterity, but better ball skills and better quality of movement patterns compared to the treatment group. Children in both groups displayed similar socio-emotional behaviour, although the control group did have a stronger tendency to internalise problems. We concluded that, despite differences in the nature of the difficulties, children in the two groups did not differ and had the same need for physiotherapy.

In chapter 3, we give an analysis of the pretest and posttest scores of children with an M-ABC pretest score in or below the 15th centile. We used scores on the M-ABC (Henderson & Sugden, 1992) and the Test of Gross Motor Development-2 (TGMD-2; Ulrich, 2000) as measures of motor performance. The non-treatment group showed no improvement on the M-ABC after a 3-month period, while their average TGMD-2 score actually deteriorated. The treatment group, however, did make remarkable progress. These results indicate that motor performance does not improve spontaneously in a 3-month period and that NTT is effective.

We found that the positive effects of NTT, a mainly task-oriented approach, were most pronounced in tasks that were comparable to the tasks trained. We also explored whether other child-related characteristics influenced the success of NTT. Older children with poorer motor patterns had benefited more from NTT. Although, many children scored high on the attention problems scale (Child Behaviour Checklist, CBCL; Achenbach, 1991), the severity of attention problems was not associated with NTT’s effectiveness. The degrees to which children were withdrawn, had thought problems, were anxious/depressed, or showed signs of delinquency (subscales of the Child Behaviour Checklist) did show low but statistically significant associations with the degree of success achieved with NTT, but PPTs were nevertheless able to bring about positive changes in children’s motor performance.

To find out whether participating therapists were actually following the NTT guidelines regarding the best ways to give instruction and feedback when treating the children, we observed videotaped treatment sessions. The tool used, the Motor Teaching Principle Taxonomy (MTPT), is described in chapter 4. The MTPT enables systematic observation of a therapist’s verbal actions aimed at enhancing motor learning. In the MTPT, we distinguished three categories of teaching principles used by therapists: ‘giving instruction’, ‘providing or asking feedback’, and ‘sharing knowledge’. The MTPT’s reliability and validity were satisfactory. Through our observations, we found that therapists were treating children according to NTT’s guidelines for motor teaching. Therapists’ gave instructions most frequently. In addition, the frequency with which the principles were used showed little correlation with the children’s initial
motor performance level, indicating that the choice of principle was not related to the child’s entry level.

Since the actions of therapists were aimed at improving motor performance, we examined whether the frequency of their use was associated with treatment success after 9 or 18 sessions (chapter 5). We found that actions clustered as principle ‘providing clues on how to perform a task’ (a way of giving instruction), ‘asking children about their understanding of a task’, and ‘explaining why a movement should be executed in a certain way’ (ways of sharing knowledge) were significantly associated with improved motor performance. In the light of these results, it would be worthwhile to carry out more research, with larger sample sizes, into the relationships between the assumed intervening mechanisms of NTT, such as the therapist’s actions, the children’s behavioural characteristics, and the degree of success of NTT.

Changes in grapho-motor behaviour

In another study, we evaluated the effectiveness of NTT in children with grapho-motor problems. The research described in chapters 2 to 5 were based mainly on general motor tests to select children or evaluate NTT. But one of the most common reasons for remediation is problems with handwriting. Handwriting is a very complex fine motor skill, and children with poor grapho-motor ability might thus form a specific subgroup of children with DCD. The DSM-IV explicitly mentions handwriting as an example of daily motor activities which pose difficulties for children with DCD (APA, criterion A). In chapter 6, therefore, we describe a study in which we selected children with DCD on the basis of poor grapho-motor ability. To evaluate NTT for this group, we used the Concise Assessment Method for children’s handwriting (BHK; Hamstra-Bletz et al., 1987) to assess handwriting quality, and one of the manual dexterity test items (the flower trail) of the M-ABC (Henderson & Sugden, 1992).

Besides changes in the outcome on the flower-trail drawing item, we wanted to gain insight into changes in the underlying drawing process brought about by NTT. For this reason, the children performed the flower-trail item on an XY-digitizer. After 3 months of NTT, their quality of handwriting, writing speed and accuracy had improved. We also found changes in the underlying writing process. The children were drawing more fluently and lifted their pen from the paper less often. These results indicate that the children with poor handwriting had learned to use their typical movement strategy in a more effective way.

Conclusion

Our sample sizes were sufficiently large to show that NTT is an effective treatment approach for children with DCD. Children in the treatment groups showed improved motor performance on several tests, whereas a non-treatment control group remained stable or even deteriorated in a 3-month period. Detailed information on what took
place during the 30-minute sessions of NTT (the ‘black box’) revealed that children improved most on tasks comparable to those trained. The strategies therapists used in teaching the children were also associated with the degree of treatment success. As NTT, which was developed especially for children with DCD, has been found to be an effective treatment approach, we urge other physiotherapists to start treating children with DCD according to the NTT guidelines, too.

References


