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The aggregation of marginal gains in relation to ecological intervention and support for children with additional needs

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Abstract

What do the heating of Formula 1 racing car tyres, one-piece skin suits in cycling and approaches to supporting children with additional needs all have in common? The answer is that they can all be related to the concept of the aggregation of marginal gains. This means that improvement in a particular activity is not the result of some magical one-off solution delivered by an expert in set sessions, but is the accumulation of many factors naturally occurring in daily life all contributing a small percentage gain to the overall picture. The concept of the aggregation of marginal gains has been a major contributor to the success of the British Cycling Team over the last two Olympic games with the Director of Cycling, Dave Brailsford breaking down the whole cycling activity into small component parts and achieving a small percentage gain in each one. In this paper the concept is taken and applied to children with additional needs, with specific reference to children with movement difficulties and incorporating this into an intervention approach known as Ecological Intervention (Sugden and Henderson, 2007). In this approach, instead of an 'expert' delivering a programme say once a week to children with difficulties, different individuals are assigned different roles within the child's activities of daily living. This involves slightly modifying the context of the child's life in a number of areas, each one small, but the totality of these marginal gains leads to an overall improvement in the child's functioning and is a cost effective approach, a recognition of the complexity of the lives of individuals and empowerment of stakeholders.

Traditional Approaches

For as long as children have experienced difficulties in learning, there has been a myriad of approaches aimed at supporting, remediating and correcting those difficulties. This includes children with differing abilities, strengths, weaknesses, preferences and ages. The approaches are often general, aimed at a range of difficulties and sometimes specific, targeting one individual problem a child may be experiencing. In addition, these approaches may involve principles that have evolved from the underpinning aetiological bases and are founded upon biological theoretical notions, cognitive substrates and/or behavioural manifestations (Morton, 2004).

A child with dyslexia may be exposed to a programme aimed at improving the function of the cerebellum, based upon the automatization deficit hypothesis, thus invoking a biological approach to intervention. (Nicholson and Fawcett, 1999). This theory postulates that the cerebellar difficulties culminate in reading, spelling, writing and articulation problems. At a cognitive level, approaches to intervention in children on the autistic spectrum have for many years used the construct of theory of mind to explain some of the difficulties autistic children face. The theory of mind involves the ability to place oneself in someone else's shoes, and take their position. It is about imagining the thoughts, feelings and motivations of others, a position that children with autism find difficult (Baron-Cohen et al., 1985). More recent positions have elaborated this theoretical base, but the fundamental principles remain and are still strong examples of how cognitions have been utilized (Baron-Cohen, 2008). At a behavioural level, a child with a general learning difficulty may be exposed to an enhanced programme of education involving differentiating all materials, thus showing how at a behavioural and functional, approaches have been incorporated. This brief, rather reductionist and non evaluative summary, shows only a few of the many approaches that have been employed but they serve to illustrate how biology, cognitions and behaviours have provided the source of principles and theoretical bases for types of intervention.

The above examples, although different, have a number of common elements. The first is that by and large they are delivered by specialists who are professionally trained and educated. These specialists are usually in the education and health fields involving teachers, occupational and physical therapists, and speech therapists. Others may include professionals from social services. Secondly, approaches to intervention are usually in specifically determined sessions, such as in the classroom or in various types of therapeutic health environments, with exceptions to this being parent programmes. Thirdly, the sessions tend to be organized with specific objectives for each occasion and the session deals with that objective. Fourthly, some of the approaches involve tasks that are not functional tasks but are more processes that are thought to underlie the behavioural problem, such as activities to stimulate the cerebellum. Thus we have specific programmes delivered by professionals, with specific objectives often utilizing tasks that are only tangentially related to activities of daily living.

Movement Difficulties

As an illustration of the above, the field of movement difficulties is presented to show how different intervention approaches could be incorporated. Movement is important and fundamental to our daily life and is the only way we have that allows us to interact with other human beings, animals and the environmental context (Wolpert and Flanagan, 2010). In addition one has only to think about what we do from rising out of bed in the morning to retiring at night and realise that hardly anything happens without us moving. Thus movement is the essence of our lives and difficulties with movement pervade our daily activities.

No other human facility allows us to (interact) in so many ways whether speaking, walking, writing, climbing, touching, and a child progressing from birth to some level of maturity in movement sheds light not just on this developmental process but also on the evolutionary nature of our being (Sugden and Wade, 2013, p.1).

A number of children show movement difficulties and can be broadly divided into two groups. First there are those children who have movement difficulties as a defining characteristic such as those with cerebral palsy or developmental coordination disorder, the former being our most prevalent disorder with a known constitutional base and accounting for around 2-3 per 1000 in developed nations (Stanley et al., 2000); the latter, often known as dyspraxia, usually of unknown aetiology and showing impairment of everyday movement tasks, have a prevalence of around 2-4% (Lingham et al., 2009). These two are defined by their movement difficulties. Secondly, there are groups of individuals who are not defined by movement difficulties but they do have them as a secondary or co-occurring characteristic. Thus in groups of children who have learning difficulties, whether general or specific, those with developmental disorders, social and emotional problems and those with sensory difficulties will all evidence a higher prevalence of movement difficulties than a population of typically developing children.

Approaches to supporting children with movement difficulties, like other areas of difficulties, are multiple. They have mainly involved health professionals such as occupational and physiotherapists with some help from education (Missiuna, 2012a; 2012b). In primary schools, teachers use their knowledge to help children with the everyday tasks one sees in the classroom such as the manual skills activities of writing and drawing and occasionally one sees support for the gross motor skills of agility, balance and ball skills. There are reports of good practice by physical education teachers who have the skills to help but this is not nationwide. There is support for disabled sport and the Olympics showed us all just how skillful that disabled athletes can be. However I would argue that these are not individuals with movement problems-they are disabled elite athletes!

Health professionals have engaged in intervention approaches with children showing movement difficulties (Missiuna et al., 2012a; 2012b; Polatajko et al., 2001a; 2001b). Different terms have been used to describe the multitude of approaches that have been used in intervention studies and in clinical practice, and have been placed in a range of organizational categories by different authors. One way of organizing the approaches is to divide them into the two categories of process and functional task approaches recognising that while reductionist, they do serve to place a big picture on the area. There are more fine grained analyses that can be conducted but this is the simplest and clearest way to examine these approaches. The process oriented approach examines the underlying factors or processes that are thought to influence skill acquisition; the second takes a more direct approach by addressing the functional skills themselves. Various reviews in the last ten years have included, among others, these two large categories of approaches in their analyses of interventions, (Sugden, 2007; Polatajko and Cantin, 2006; Wilson, 2005; Pless and Carlsson, 2000).

These two large categories of approaches can aid in providing evidence for our practice and education, like the health services is looking for evidence to support approaches that are deemed to be helpful to children experiencing difficulties with evidence taking many forms. Sugden and Dunford (2007) note that evidence can be theoretical, empirical and/or professional and often there is not a seamless progression from one to the next. The theoretical evidence should inform and be informed by both empirical and professional evidence but this is not always the case. A good example of this is shown from the field of occupational therapy.

Sensory Integration Therapy (SI) is a popular example of a process oriented approaches, emerging from the seminal work of Jean Ayres in the 1960s, 1970s and 1980s (Ayres, 1989; 1979). This approach is widely used in occupational therapy and yet theoretical and empirical evidence is not altogether convincing. In their review at the end of a chapter on Sensory Integration, Roley and Jacobs (2009) note that although SI is probably the most widely researched area of occupational therapy, the empirical evidence for effectiveness remains inconclusive. Another way to look at this is to take a theoretical viewpoint about whether the principles upon which an approach is based are strong. Process oriented approaches, and particularly SI, are very much based on relatively old information processing models with an emphasis on the input and in particular the sensory side of the motor control process. This is made clear in the name or sensory integration but by comparison in its original form, it gives little attention to the cognitive decision making and the motor output side of the motor control process. Wilson (2005) makes the point that these approaches are not consistent with modern theories of motor control. When the empirical evidence is examined, the results are again inconclusive. The diagnostic and remediation programme have been questioned on psychometric grounds and others have conducted review articles that have called into question the effectiveness of sensory programmes (Sugden, 2007; Polatajko and Cantin, 2006; Wilson, 2005; Pless and Carlsson,

2000). There were some earlier studies showing effectiveness and the methods are still popular within the physiotherapy and occupational therapy professions, but overall, more recent theoretical, empirical and/or experiential evidence is required to justify the cost and level of practical engagement.

As the name suggests functional skill approaches involve the teaching of those skills that are required for everyday functioning in a child's life. There are a number of programmes available that take this approach. The ones that have been shown to be most successful are those that have involved cognitive and problem solving methods to teach these functional skills (Sugden and Henderson, 2007; Polatajko and Mandich, 2004; Schoemaker et al., 2003; Revie and Larkin, 1993; Henderson and Sugden, 1992). Early approaches by Henderson and Sugden (1992) in their Cognitive-Motor Approach and Revie and Larkin (1993) in their task specific approach employed methods that had long been popular in the motor learning domain drawing upon research literature in the sporting arenas and in the work place. These were followed by a popular Canadian approach that further developed the idea of working with cognitive processes allied to functional tasks (CO-OP). The evidence to support functional approaches has been positive. In the CO-OP approach for example the original approach was worked out with graduate students under supervision of Helen Polatajko and with various colleagues. (Polatajko and Mandich, 2004; Polatajko et al., 2001a; Polatajko et al., 2001b). The evidence from CO-OP is mirrored in the evidence from other functional approaches.

Aggregation of Marginal Gains

This is a concept that is not new, and indeed has been around for a long time and is one that has a strong face validity to it. Now it has increased in visibility by its popular appeal and efficacy in the sport. If one can improve performance of any skill area by a small percentage, there may only be a marginal improvement. However if the small gains are in a number of different areas then the overall result has the potential to be large. This concept has been utilized widely in the sporting arena the most notable for the UK being the success of the British Cycling Team directed by Dave Brailsford. The programme includes detailed examination of all areas that will have an effect on a cyclist's performance. A not-exhaustive list would include working from data, being cyclist centred with individual needs, daily routines including hygiene, sleep and diet, audacious yet achievable goals, equipment including clothing and bikes, training regimes from research evidence, comfort in hotels, sharing with like minded others, different professionals providing different levels of support, and most importantly key individuals who coordinate this life style operation. Although these actions would not on their own seem to be remarkable, the cumulative product is. One of the challenges is how all of these marginal gains are coordinated into the aggregated whole. The same is true of children with additional needs and in the example provided, those children with movement difficulties.

Ecological Intervention

There are a number of key features of ecological intervention (EI) (Sugden and Henderson, 2007) with a starting point being that difficulties do not solely reside in the child but are a function of a transaction between the child's resources, the environmental context and the manner of presentation of tasks to be taught (Fig. 1: Sugden and Wade 2013; Keogh and Sugden, 1985). Ecological intervention (EI) is a way of thinking and acting, an approach rather than a rigid package that must be delivered by a highly skilled professional in a specified way. The starting point is that intervention cannot be viewed as an add-on to normal daily life but should be an integral part of daily life. As movement pervades every aspect of our daily life, the logic is that approaches to improving movement capabilities should encompass daily life and not be restricted to specialist sessions delivered only by professionals.

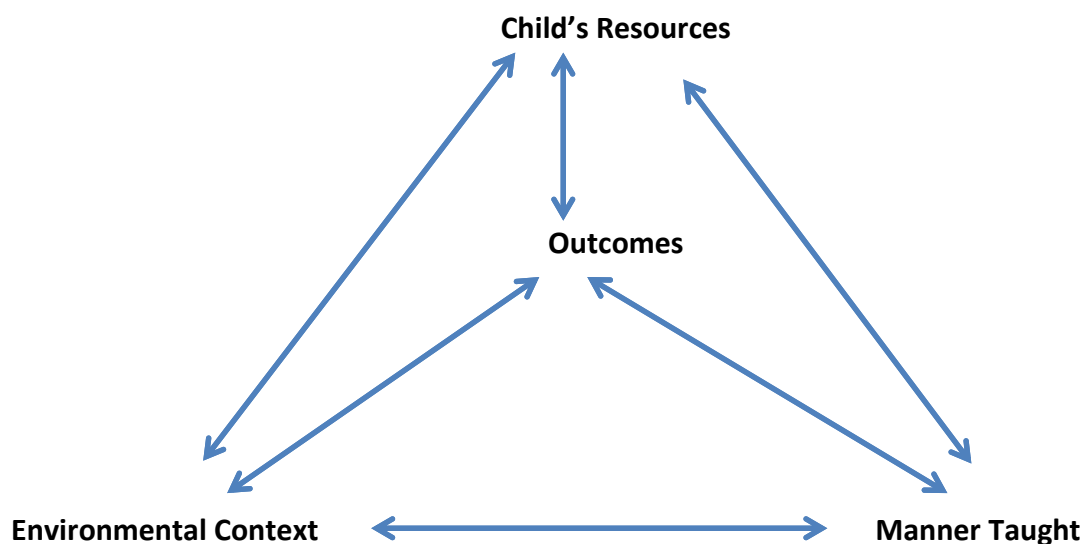


Fig. 1: The interaction of the child's resources, the environmental context and the type and manner in which the task is taught.

In order to achieve this, EI involves different individuals playing different but equally important roles with the accumulation of these roles providing the cumulative effect, a concept that is very close to the aggregation of marginal gains. These different individuals would include parents, siblings and other family members, friends in and out of school, teachers and other education professionals and health professionals. In order to implement EI two prerequisites are paramount. The first is participation and involves engineering, manipulating, reordering the environmental context such that a child can participate fully in

the activities of daily living. The second involves learning where the resources of the child are targeted directly for improvement.

Participation

Participation is not a unitary concept but involves different parts including how easily accessible appropriate contexts are made, ensuring that real life situations are personally and socially meaningful for the child, and how positive an influence they have on the child's life as viewed by all interested parties. Chen and Cohn (2003) report on how participation involves a range of activities in different contexts such as household work in the home; community based leisure activities and full participation in school activities.

The extent to which this participation is achieved is dependent upon intrinsic factors such as the self worth and esteem of the child, and the extrinsic factors of attitudes, culture and gender issues (Sugden and Wade, 2013, p.346).

This line of thought follows directly the World Health Organisation (2001) model that clearly separates functioning from ability or disability and has a strong emphasis on participation, with factors outside of the child being the major influences. Progress in participation can be made in small steps by different individuals. At school more reasonable adjustments can be made both in the classroom, on playing fields, science laboratories and gymnasia. It has to be more than simply providing opportunities; it has to be more positive with the school environment making small changes in a number of areas that all serve to invite and promote, encourage and indeed cajole the child into participation. Progress is built up from first principles of entitlement and not an addition to the school's policies; adapting the materials for ease of manual skills should be common place; giving choice to a range of activities; selection of supportive individuals for group work; a no-option positive attitude from members of staff and other children. The same is true of the community with built in access for all. In sports centres for example this is not just disabled sport but movement activities for all children showing different abilities, strengths and weakness. Can sports officers in clubs and centres go out and seek children with difficulties rather than wait for them to come in? How can they show the community that they want these children, that they will add to the kudos and popularity of the Centre and that their contribution will be valued as much as with any other child? In the home how can the family build participation into the child's life, with activities that are expected of him/her everyday? These may be simple things like collecting plates, putting out cutlery, helping with food preparation and showing how they did it and receiving praise. In other areas such as recreational activities where it is expected that all the family will participate such as swimming, walking, running, which are all life-long activities and all can be easily accessed to give all children full participation. With the health professionals, it is slightly different as they are involved in the more therapeutic side of intervention which often does not involve participation outside of

the formal sessions. However, encouragement to work outside of these sessions would appear to be an obvious outlet if only because of diminishing resources within the health services. In addition, health professionals will have access to participatory activities in the community and can ensure that this information is available to the parents and child. The point being made is that the ecology of the child's life can be slightly modified with thought and little effort, but together these will bring marginal gains that in turn will aggregate to significant improvements in the participatory experiences of the child. Participation is an end in its own right but only with participation can learning take place.

Learning

In Ecological Intervention (EI), the second partner in the process is learning, or therapy depending on which discipline is being addressed. Participation and learning work together; one can take any walk of life from the workplace to school to recreation and time-on-task is such a powerful and influential variable. It has research empirical evidence from the workplace, from music, from the sporting arena, from the arts and many other walks of life. In addition to the academic evidence, there is also speculation in the popular book 'Outliers: The Story of Success' by Malcolm Gladwell, (2008) which although being challenged on some of its propositions, does show how time on task is an important factor for in many walks of life such as industry, business, technology, sport and the arts. Participation is necessary for time on task and time on task is required for true learning to take place.

In order to plan for learning a full assessment of the child's resources can be taken from these profiles developed and priorities for action determined. One could argue that unless an accurate assessment of a child's needs is made, then any approach to successful intervention will be based on chance. Assessment can take many forms but would ideally include standardised tests, dynamic assessment-observation by skilled professionals, criterion referenced tests-various checklists for teachers, parents and others, interviews with the child, teachers, parents and other and school reports.

Once this has been carried out ecological intervention involves numerous parts with seven major sections for guidance (Sugden and Henderson, 2007):

- The Movement Coach, who is responsible for the organisation and delivery of EI, argues the case, plans the action, negotiates for agreement with families and professionals organises the context. A crucial position for any child with additional needs.

- Working in a meaningful context. EI advocates the employment of functional skills not underlying processes and the meaningfulness is geared to the child's life and interests. This is supported by strong empirical and professional and theoretical evidence.
- Learning specific skills through task analysis, task adaptation and expert scaffolding.
- Learning specific skills is not enough: broadening the learning through generalisation. True learning can be achieved when a child takes a skill, knowledge, and preferences from one situation to a novel context. The use of cognitive strategies is crucial for this to occur.
- Instructions, practice and feedback are employed using evidence from learning studies such that these are tailored to the needs and resources of the child and the stage of learning they are at.
- Monitoring and evaluation is essential in all programmes and thus formative evaluation goes on continually to determine whether ongoing changes are required and evaluation at the end looks at the success of any approach to determine if a different or extended or modified one is required.

Each one of the above bullets is elaborated in some detail. All are supported by strong theoretical, empirical and professional evidence. If implemented to a small degree by different individuals, each one in turn will make a marginal step forward but providing an overall gain of some magnitude. Some progress has been made in implementing parts of this (Sugden and Chambers, 2007; 2003; Mandich and Polatajko, 2005; Missiuna et al., 2003; Schoemaker et al., 2003; Polatajko et al., 1995; Revie and Larkin, 1993).

Concluding Comments

A number of strands run through this article. First, at the macro level, the evidence for the position taken here comes from various theoretical standpoints concerning learning and development. Empirical evidence is in good supply from psychology, health and medicine, motor learning and education. Finally, professional evidence is in abundance from not only our usual professionals in health and education but this time from the very visible sporting environment, in this case cycling, where the aggregation of marginal gains has ruled over the last few years. In addition, our concept of any form of additional need does not just come from the child but from the ecological context in which the child is situated. Put succinctly, the difficulties a child experiences do not solely reside in the child. The concept of Ecological Intervention has been used to parallel the aggregation of marginal gains with great similarities noted, and if a popular sport with a populist strap line can be utilized to good effect with children showing difficulties then so be it. Different individuals in a child's life

changing small aspects of the context and delivery can bring about overall major changes in the way a child functions in daily activities.

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