EARLY INTERVENTION

How relationship focused intervention promotes developmental learning

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Relationship focused intervention (RFI) is an early intervention model that encourages parents to engage in highly responsive interactions with their children. The purpose of this paper is to address the conceptual underpinnings for RFI. We discuss the process of developmental learning based upon brief observations of three children with Down syndrome playing by themselves. We observe that the most salient characteristic of children's play is the extent to which they practise or repeat the developmental behaviours that characterise their current developmental functioning. Although children's developmental functioning is assessed by their new and emerging developmental skills, consistent with Piaget's concept of assimilation, children's developmental learning appears to be highly dependent upon massive amounts of spontaneous practice of their existing developmental behaviours. In addition we review data from descriptive and intervention studies that we recently published which indicate that parental responsive interaction enhances children's spontaneous activity, and that children's spontaneous activity is correlated with their rate of development. We conclude that RFI enhances children's development *less* by teaching the skills and behaviours that characterise higher levels of developmental functioning and *more* by encouraging children's assimilative learning which results from their practising and repeating the developmental behaviours they have already learned.

How relationship focused intervention promotes developmental learning

Relationship focused intervention (RFI) is an approach to promoting the developmental and social emotional functioning of young children with developmental delays by encouraging parents to engage in highly responsive interactions with them. RFI was derived from two basic concepts supported by child development theory and research: (1) parents are likely to have a greater impact on their children's development than professionals or other adults because of the substantially greater number of opportunities they have to provide developmental stimulation and support to their children; and (2) parents promote their children's development by engaging in highly responsive interactions with them.

There is increasing evidence that relationship focused intervention can be effective at accelerating the development of young children with developmental delays and disabilities including children with Down syndrome. More then 20 RFI studies have been published which indicate that this intervention is effective at promoting the development of children with wide range of developmental risks and disabilities[1,2]. Most notable of these is a large randomised control study reported by Landry and her colleagues which indicated that pre-term children made significant developmental improvements after receiving 6 months of RFI[3,4]. Quasi-experimental RFI studies that included children with Down syndrome have also reported significant improvements in children's development which were associated with increases in maternal responsiveness[5,6,7]. Furthermore, research reported by Mahoney and Perales indicated that RFI resulted in a 50% improvement in children's rate of cognitive development and 150% improvement in their rate of communication development, point to RFI as a promising method for realizing the promise of early intervention[7].

Yet, despite its increasing empirical support, relationship focused intervention is viewed as controversial primarily because the procedures of this intervention are markedly different from those that are most often used in contemporary early intervention practice[1,8]. For the past 30 years, early intervention has been dominated by the use of behavioural instructional techniques to encourage children to learn and use the behaviours and skills that characterise higher levels of developmental functioning. There is considerable variability in the way behavioural techniques are implemented, ranging from orthodox behavioural procedures such as discrete trial training to modified behavioural techniques in which the incidental teaching paradigm is used to teach targeted behaviours and skills to children in the context of child initiated activities and routines. However, regardless of the types of methods used, the underlying assumption of most contemporary early intervention is that children's development can be enhanced by teaching and encouraging them to use higher levels behaviours that they would not have learned on their own.

In contrast to this model, Relationship focused intervention deemphasises teaching higher level developmental behaviours and encourages parents and adults to respond to and support actions and communications that children are already doing. Despite the extensive research literature indicating that parental responsiveness is associated with higher levels of development, many early intervention

professionals are concerned that rather than enhancing children's development, RFI may inhibit or have no impact on developmental growth because it does not focus on teaching advanced developmental skills. This concern is partly related to the fact that no credible theoretical model has yet been advanced to explain how responsive interaction promotes developmental learning.

The purpose of this paper is to address the conceptual underpinnings for relationship focused intervention. We will discuss the process of developmental learning as it occurs in infants and toddlers with Down syndrome. This discussion will be based upon brief observations of three children with Down syndrome who were 12, 24 and 36 months old when they were observed playing by themselves. We will argue that insofar as children's play is a critical element of developmental learning, the most salient characteristic of their play is the extent to which they practice or repeat the developmental behaviours that characterise their current stage of developmental functioning. Although children's level of developmental functioning is assessed by their new and emerging developmental skills, we will propose that children's developmental learning is highly dependent upon massive amounts of spontaneous practice of their existing developmental skills which is the basis for assimilative learning. We present data that indicates that one of the primary effects of parental responsiveness is that it enhances children's spontaneous activity. As a result, we propose that RFI enhances children's development less by teaching the skills and behaviours that characterise higher levels of developmental functioning and more by encouraging assimilative learning processes of practice and repetition.

Three children with Down syndrome

The following is a description of the play behaviour of three children with Down syndrome: Meghan who was 12 months old; William who was 24 months; and Natalie who was 36 months. Each of these children was videotaped while playing alone with a set of toys that were matched to their developmental level. Within a week of these observations, these children's developmental functioning was assessed with the Bayley Scales of Mental Development. Results indicated that Meghan's developmental age was 6 months; William's was 13 months and Natalie's was 18 months. Thus all three children had approximately a 50% delay in their rate of development and had developmental scores that were associated with moderate levels of mental impairment.

Meghan

Meghan is seated by herself in the floor of her living room. Spread out in front of her are: a bucket with several toys in it including a soft doll, rattles, a ball, snap beads and a soft cloth form. There are also a play xylophone which has a pull string and a mallet, a peg board and hammer, and a book. Our observation of Meghan lasted 5½ minutes. While mother and the person videotaping were present in the room, there was no prompting or encouragement for Meghan to perform any specific actions.

Meghan handled all of the objects with the exception of the book and the ball. She performed a total of 24 separate acts which could be classified into five categories: mouthing (N=2); shaking/waving (N=9); patting/clapping/banging (N=7); vocal play (N=2); and throwing/dropping (N=4). In addition, Meghan used her hands for vocal play (N=3) and clapping (N=2). Meghan distributed these play activities across objects, seldom engaging in any one activity for more than 10 seconds at a time. During the periods of time in which we were unable to code Meghan's behaviour, she remained active either by vocalising or engaging in gross motor activity.

William

William is seated on the floor of the living room with approximately 20 toys and pieces scattered about him. The toys he is involved with include a play telephone with a pull string and an attached receiver, an undressed doll with a bib, a bucket with plastic blocks or shapes, a shape sorter, a soft-cushion ball, a pull toy that is shaped like an insect that has wire antennas and wheels, an empty plastic box, and a plastic cylinder.

William attended to the details of objects by touching them with his finger or manipulating them (e.g., turning the wheels on the telephone) (N=5); used objects according to their intended function (e.g., hold the toy telephone to his ear) (N=2); activated the wire antenna to produce an effect (N=2); used the bib on the doll, and strings and appendages of objects to lift objects (N=6); engaged in object permanence activities such as playing peek-a-boo by covering and uncovering the eyes of the doll with the bib (N=4); and engaged in "in-and-out" activities such as putting objects in and out of a container or transferring objects from one container to another (N=6). William was highly attentive and performed a total of 25 acts in five minutes, distributing these activities across 9 different objects. Throughout the observation, he vocalised frequently using a combination of consonant-vowel vocalisations, word-like vocalisations, and three real words. While William was in a sitting position most of the time, twice he crawled to different locations. He interrupted his play with objects three times, but for less than 10 seconds each time.

Natalie

Natalie was seated in a high chair in her living room. On the tray of the high chair were two interlocking stacking blocks, a doll, a play bottle, a cup and spoon. Natalie was observed while seated at her chair for four minutes.

Natalie played without stopping throughout the entire observation. We observed four categories of play. This included 5 episodes of functional play including putting the stacking blocks together, drinking from the cup, eating with the spoon, and feeding the doll with the baby bottle; one episode of "in and out play" where she put one of the stacking blocks inside the cup; and one episode of simple pretend play where she drank from one of the staking blocks. During 75% of her play time she engaged in more elaborate pretend play in which she reenacted her mother feeding her. In this sequence she pretended to use the spoon to mix food in the cup, scoop the food from the cup and then feed herself with the spoon. She was animated and expressive during this sequence, constantly jargoning and occasionally using vocalisations that sounded like real words (e.g., hot, good) or familiar phrases (e.g., "Come and get it) that would be appropriate for this sequence.

General observations about the play of children with Down syndrome

1. *Without prompting, all three children continually interacted with the toys that were near them.* Despite the fact all three children had substantial delays in their rate of development, they all spontaneously played with the toys provided them.
2. *The most dominant feature of children's play was the repetition of the same actions.* Meghan and William repeated the same type of activities with several different toys, while Natalie reenacted the same eating sequence with the same toys. On several occasions each of the children paused briefly from playing. However, after little more than a few seconds they resumed their play without any prompting or encouragement.
3. *The activities the children did typify the play behaviours that children without developmental problems commonly do at these children's respective developmental ages.* Meghan who was at the 6 month developmental age level engaged in banging, waving, throwing/dropping vocal play and occasional mouthing. These are the kinds of behaviours that typically developing children commonly do in the 4 to 8 month developmental age range. William, whose developmental age was 13 months, engaged in "in and out" play, used objects to produce an effect, used levers (e.g., strings, bibs) to obtain objects, and used objects functionally. These behaviours typify the play of children at the 10 to 14 month developmental age range. The pretend sequence that Natalie engaged in was typical of the type of pretend that children engage in from 15 to 18 months developmental age.
4. *Differences between the levels of play observed in these three children appeared to reflect their thinking and understanding much more than their skill at using objects.* For example, many of the behaviours Natalie did while playing did not require a greater amount of skill at using objects than the behaviours that William did. Yet there were obvious differences between the play of these two children. The overriding theme of Natalie's play was pretending her mother was feeding her. The theme of William's play was exploring the functional, spatial and relational features of the objects that were near him. Differences between these children appeared to result from their having different cognitions, or knowledge and understanding, about what objects could be used for.

The role of repetitive experience in children's developmental learning

Adolph and her colleagues from New York University have been investigating how children's motor experience contributes to the development of their gross motor competencies. In one study, they examined how children's neurological maturation (e.g., chronological age), body dimensions and motor experience contributed to the quality of their crawling from their first attempts at crawling until they began walking[9]. Results indicated that children's age and body dimensions alone could not account for the speed and efficiency of later forms of crawling. However, the amount of children's experience with early crawling patterns (e.g., belly crawling) was the best predictor of the speed and efficiency that they attained the more advanced form of crawling using their hands and knees.

In another study, Adolph et al. attempted to both identify the changes that occur as toddlers become more proficient walkers, and the factors that contributed to these changes[10]. As children became bigger, older and more experienced their steps became longer, narrower, straighter and more consistent. They conducted regression analyses to examine how children's body dimension, neurological maturation and experience predicted their walking skill. Results indicated that the amount of experience children had walking was the only significant predictor of the rate they improved their ability to walk.

Results from these studies suggest that children's rate of motor development is more dependent upon their amount of experience in engaging in gross motor behaviours than it is on other factors that are often thought to effect motor development, including children's body shape and neurological maturation. To explain why motor experience might be such a major influence on children's motor development, Adolph et al. described their observations of children who were learning to walk. According to these investigators:

> *"Infants' everyday experiences with locomotion occur in truly massive doses, reminiscent of the immense amounts of daily practice that promote expert performance in world class musicians and athletes. … walking infants practice keeping balance in upright stance and locomotion for more than six accumulated hours per day. They average between 500 and 1500 walking steps per hour so that by the end of each day, they may have taken 9,000 walking steps and traveled the length of 29 football fields".*

> *"infants everyday walking experiences occur in a wide variety of events, places and surfaces. … the variety of everyday walking experience resembles variable and random practice schedules …. (that) lead to a process of continually generating solutions anew".* [10: P 494-495]

Based upon these observations, Adolph et al. concluded that the *magnitude and diversity of experience children have in engaging in spontaneous or self initiated movement lies at the heart of motor learning and developmental change*[10].

An important question to consider is whether the magnitude and diversity of experience children have in engaging in spontaneous or self initiated play also lies at the heart of cognitive learning and developmental change. Comparable to Adolph's descriptions of children's motor activity, the patterns of play we observed in the brief observations of the three children with Down syndrome are likely repeated throughout their day whenever similar play opportunities occur. Had we observed Meghan when she was in her crib, play pen or on the floor with her parents or other children, she would have likely engaged in the same patterns of "banging, waving throwing and mouthing" (BWTM) that we had observed, particularly if toys and material were near her that were similar to the ones we used in our observation. In fact, Meghan was so intensely involved in the patterns of play that we observed, it seems unlikely that we would have been able to get her to do anything else with toys and materials other than these behaviours.

Most children engage in massive amounts of repetition of their play behaviours before transitioning to higher levels of play behaviour. For example, as dis-

	Typically developing child	Meghan
Developmental quotient (DQ) (% delay)	100 (0%)	50 (50%)
Chronological age range to transition from Banging, Waving, Throwing, Mouthing	4-8 months	8-16 months
Developmental age range of Banging, Waving, Throwing, Mouthing activities	4-8 months	4-8 months
Months to transition from Banging, Waving, Throwing, Mouthing	4 months	8 months
Banging, Waving, Throwing, Mouthing acts per month	15,000 (500/day)	15,000 (500/day)
Total Banging, Waving, Throwing, Mouthing acts to transition	60,000	120,000

[1.] Assumes no pivotal behaviour deficits

Table 1 | **Learning efficiency model**[1]. Repetitions needed to transition through Banging, Waving, Throwing and Mouthing.

	Typically developing child	Meghan
Developmental quotient (DQ) (% delay)	100 (0%)	50 (50%)
Chronological age range to transition from Banging, Waving, Throwing, Mouthing	4-8 months	8-16 months
Developmental age range of Banging, Waving, Throwing, Mouthing activities	4-8 months	4-8 months
Months to transition from Banging, Waving, Throwing, Mouthing	4 months	8 months
Banging, Waving, Throwing, Mouthing acts per month	15,000 (500/day)	7,500 (250/day)
Total Banging, Waving, Throwing, Mouthing acts to transition	60,000	60,000

[1.] Assumes no learning inefficiencies

Table 2 | **Pivotal behaviour deficit model**[1]. Repetitions needed to transition through Banging, Waving, Throwing and Mouthing

played in TABLE 1, it is well documented through developmental tests and play profiles that typically developing children engage in banging, waving throwing and mouthing from approximately the time they are 4 months until they are 8 months old. Assuming that children play as much as four hours per day, and that at the "Meghan stage of development" children engage in at least two BWTM episodes per minute, in the course of one day children engage in approximately 500 repetitions of this type of play behaviour. If they sustain this rate of play each day of the month over a four month period of time, a typically developing child would engage in approximately 60,000 repetitions of banging, waving throwing and mouthing before transitioning to the next level of developmental play.

Piaget described two processes that contribute to children's cognitive development: assimilation and accommodation[11]. Assimilation is the process in which children incorporate the world into their existing modes of perceiving, thinking and acting. Accommodation is the process in which children modify their ways of perceiving, thinking, and acting to better fit the structure and demands of their world. During assimilation children become increasingly proficient with their current modes of thinking, perceiving, and acting. They also learn how their behaviours can be used across a wide range of toys and materials in a variety of contexts. As this occurs, they are learning about the uses of recently acquired perceptions, cognitions and behaviours as well as the limitation of these behaviours. Accommodation which is manifested by children developing new ways of thinking and acting is likely motivated both by children's dissatisfaction with the adequacy of current forms of thinking, perceiving and acting as well as by their discovering different ways of thinking, perceiving and acting. As a result, accommodation, or learning new skills, may be as dependent on children's willingness to give up current ways of perceiving, thinking and acting as it is on their discovering and learning new ways of perceiving, thinking and doing.

The 60,000 repetitions of banging, waving throwing and mouthing may be critical to developmental learning because this is the amount of experience typically developing children need to: (1) learn the uses of these behaviours; (2) learn the limitations of these behaviours and (3) discover new ways of perceiving, thinking and acting. These are the assimilation processes that appear to be prerequisite to children making the accommodative modifications in which they learn to use the next higher levels of perceiving, thinking and acting. Since the overwhelming focus of children's play is on practising or repeating their current developmental behaviours, it is possible that developmental learning may be much more dependent on assimilative learning than it is on accommodation, or learning new skills, behaviours and ways of thinking.

Developmental learning and Down syndrome

Early developmental learning generally proceeds through the same sequence for children with Down syndrome as it does for typically developing children. As depicted on TABLE 1, Meghan, like typically developing children, will engage in BWMT when she is at the developmental age range of 4 to 8 months. However, because Meghan has a 50% delay in her rate of development, she will be functioning at the 4 to 8 month developmental age range when her chronological age is between 8 to 16 months.

There are at least two possible reasons why children with Down syndrome experience delays in their rate of development. First, the compromised neurological processes that are associated with Down syndrome are thought to result in less efficient learning[12,13]. Consequently, children with Down syndrome must experience substantially more repetitions to learn the same amount of information as children whose neurological processes are not compromised. As illustrated on TABLE 1, if Meghan engages in the same amount of banging, waving throwing and mouthing each day as do typically developing

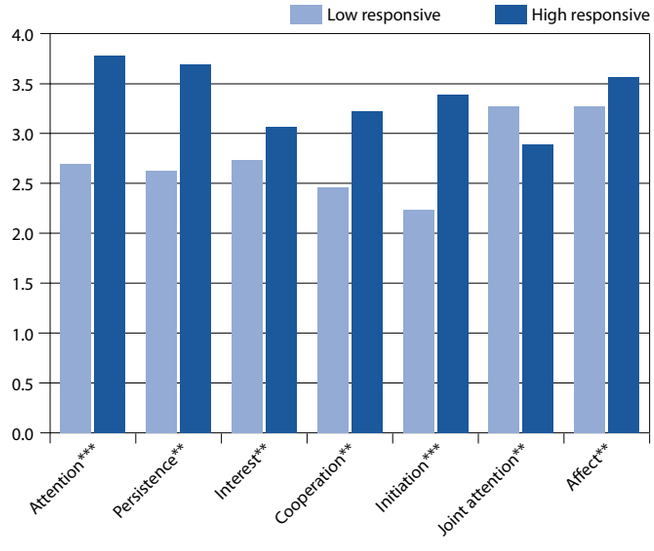

Figure 1 | **The relationship between mothers' level of responsiveness and children's level of pivotal behaviour use (N = 45)** [16]

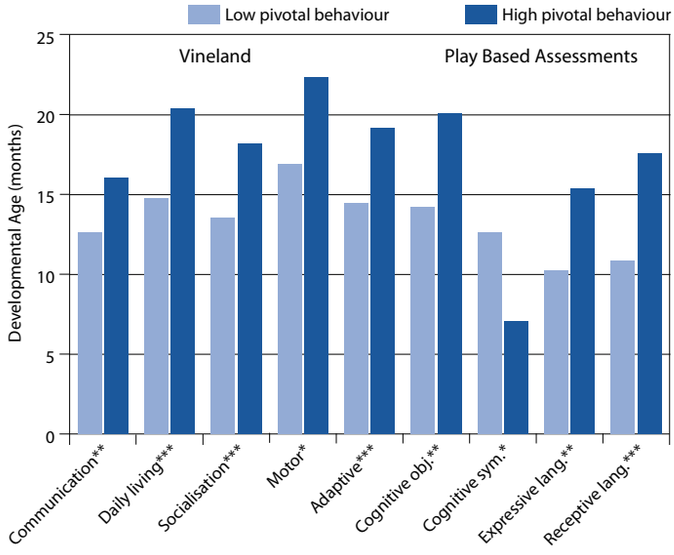

Figure 2 | **The relationship between children's level of pivotal behaviours and their developmental age as assessed by the Vineland Adaptive Behaviour Scale and play based assessment (N = 45)** [16]

children, she would experience twice as many, or 120,000, repetitions of these behaviours before she transitions to the next higher level of development. Perhaps because of her learning inefficiencies, it takes eight months for Meghan to obtain the amount of repetitive play experience she needs to transition to the next phase of development. The 120,000 repetitions represent the amount of experience that Meghan must "bang, wave, mouth and throw" to effectively progress through the assimilation processes of (1) learning the uses of these behaviours, (2) learning the limitations of these behaviours, and (3) discovering alternative ways of thinking and acting.

Second, children with Down syndrome have also been reported to have "pivotal behaviour deficits" that limit the degree to which they engage in the repetitive play and social activities that are the foundations for developmental learning (e.g., REF 14). In other words, as illustrated on Table 2, while a typically developing child might engage in 500 repetitions of banging, waving throwing and mouthing per day, children with Down syndrome who are at the same developmental age level may have pivotal behaviour deficits, such as limited persistence[15], that result in their engaging in only one half as many repetitions each day. Assuming that Meghan who has a 50% delay in development has a pivotal behaviour deficit which results in her engaging in one half as many repetitive acts as a typically developing child, even if she had no learning inefficiencies, she would need twice as much time as a typically developing child (e.g., 8 months) to obtain the 60,000 repetitions that are needed to transition to the next phase of development.

How relationship focused intervention promotes children's development

In RFI parents are taught to use Responsive Interaction (RI) strategies to interact more responsively with their children. RI strategies such as "imitate your child" or "follow your child's lead" encourage parents to become highly supportive of their children's previous behaviours; strategies such as "take one turn and wait" promote high levels of parent child-reciprocity; while strategies such as "do what my child can do" help parents match their children's current level of developmental functioning.

Clearly, the effects of RFI do not result from parents teaching developmental skills to their children. While Responsive Interaction strategies were derived from the child development literature describing what parents appear to do to promote their children's development, they are not well suited to encouraging children to say or do advanced developmental behaviours that they are currently unable to do[16]. The question is what child behaviours do these strategies encourage that could account for the apparent impact they have on children's development?

In our research we have found that rather than teaching the skills and behaviours that characterise higher levels of developmental functioning, responsive interaction strategies primarily impact children's participation and engagement in interactions. As displayed in FIGURE 1 when parents engage in high levels of responsive interaction, children display high levels of behaviours such as attention, persistence, interest, initiation, cooperation, joint attention and affect. We refer to these as "pivotal developmental behaviours" both because these are the child behaviours or processes that are described as the foundations for developmental learning and because, as displayed in FIGURE 2, we have found that the degree to which children use these behaviours are highly correlated to their level of developmental functioning[17].

We maintain that when parents use responsive interaction strategies they encourage their children to develop the habit of using pivotal behaviours. The more children habitually use pivotal behaviours either while playing alone or communicating and socialising with their parents and others, the more children practise and repeat their current behaviours. By using responsive interaction strategies that increase their responsiveness with their children, in addition

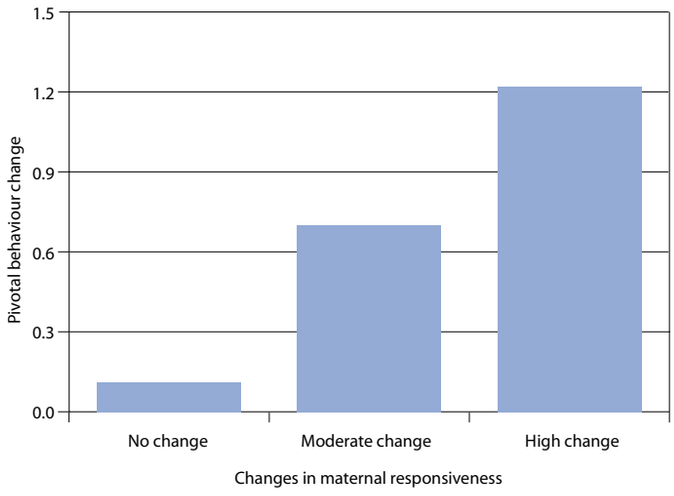

Figure 3 | **The impact of RFI changes in mothers' responsiveness to changes in children's pivotal behaviour (N=50)** [16]

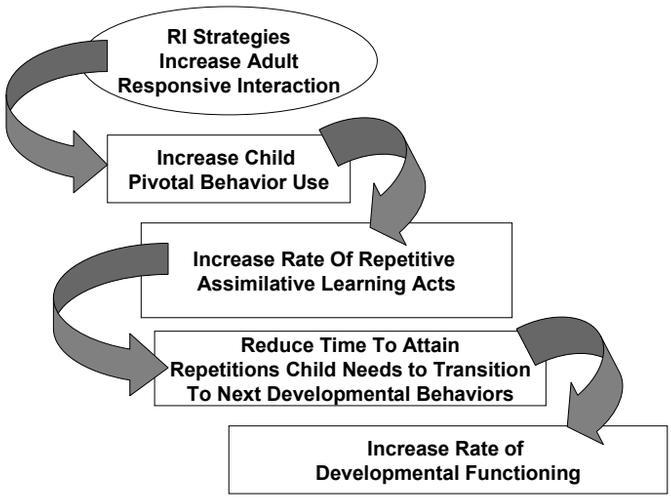

Figure 4 | **RFI conceptual model**

to providing their children information about their immediate activities and interests, parents appear to be encouraging their children to develop the habit of engaging in the repetitive, assimilative leaning processes that are prerequisites for acquiring advanced developmental skills and behaviours.[6]

To illustrate this phenomenon, in a recent evaluation of an RFI called Responsive Teaching, we found that the degree to which responsive interaction strategies successfully encouraged parents to increase their responsiveness with their children was directly related to increases in their children's use of pivotal behaviours during intervention [6] (See FIGURE 3). Children of parents who made substantial increases (e.g., 51%) in their responsiveness made a 46% improvement in their use of pivotal behaviours; children whose parents made moderate increases (17%) in their responsiveness showed a 24% increase in their use of pivotal behaviour; while children of parents who did not increase their level of responsiveness during intervention made only a 4% improvement in their pivotal behaviours. Furthermore, children's increased use of pivotal behaviours was significantly related to the impact that intervention had on their rate of cognitive and communication development. Compared to children who did not improve their use of pivotal behaviours during intervention, on average children who made large pivotal behaviour increases attained 22% higher cognitive development ages and a 45% higher communication development ages[7].

Summary: Putting RFI into a conceptual framework

In this paper we have used Piaget's concepts of assimilation and accommodation to refer to two different types of learning that appear to be involved in child development. Assimilation is related to the spontaneous practice and repetition of children's current thinking, perceiving, and acting; accommodation refers to the acquisition of new perceptions, concepts, and behaviours. We used observations of the play behaviour of children with Down syndrome who were at three different levels of development to illustrate how the majority of the play activities children engage in, at least during the early stages of child development, constitute massive amounts of assimilative learning. We conjectured that the amount of time it takes children to transition from one level of play behaviour to the next is related to the number of repetitions, or assimilative learning experiences, children need before they are ready to acquire the next higher level of perceptions, behaviours, or concepts.

As indicated on FIGURE 4 the notion that assimilative learning is a major component of child development may help to explain how RFI increases children's rate of developmental functioning. As parents use responsive interaction strategies to become more responsive, they focus more on supporting and encouraging the behaviours or activities their children are already capable of doing as opposed to prodding their children to perform higher level behaviours or communications. This is reflected in children's increased use of behaviours that we have called pivotal behaviours, such as attention, initiation, and interest. While these parents continue to model or demonstrate behaviours and communications that reflect higher levels of development, the focus of their interactions is on supporting their children's spontaneous, self initiated behaviours rather than coaxing their children to perform higher level behaviours. Thus by increasing their level of responsiveness, these parents are encouraging their children to engage in higher frequencies of assimilative learning. Insofar as children's development is dependent on the number of assimilative activities they experience, this would shorten the time children need to obtain the repetitive experiences they need to give up their old skills and begin to use higher levels of behaviour, and thereby increase children's rate of development

RFI versus traditional early intervention practices

In the prevailing early intervention model the three children with Down syndrome described in this paper would likely be viewed as lacking the advanced developmental skills exhibited by the children at the next higher chronological age level. As a result, for Meghan early intervention would likely focus on teaching her through some form of direct instruction the types of developmental skills that William exhibited. For William, early intervention would likely focus on teaching him the developmental behaviours that Natalie exhibited. For both children,

the prevailing early intervention model would focus almost exclusively on promoting their accommodative learning by teaching them advanced developmental behaviours that are more in line with their current chronological age.

Based upon previous research regarding the traditional early intervention model as well as our own clinical experience, we could reasonable anticipate that after a few months of this type of instruction both children would successfully learn the advanced developmental behaviours that are being targeted as their intervention objectives. This would be indicated by their ability to perform these behaviours when prompted. Yet it is unlikely that these new developmental skills would transfer to children's unprompted, spontaneous play behaviour much before they attain the developmental age at which typically developing children normally produce these behaviours. This might not occur until several months after these children learned these behaviours in early intervention. Rather, when playing by themselves, these children would likely continue to use the types of play behaviours that are reflective of their current developmental age even though they "know" advanced developmental skills.

Is the delay with which children transfer behaviours they learn through early intervention instruction to their spontaneous behaviour simply attributable to a failure of generalisation as often described, or is it attributable to the failure of early intervention to encourage children's assimilative learning? Might it be that children fail to use these newly learned behaviours because they have not yet had sufficient assimilative learning experiences, especially related to discovering the limitations of their existing behaviours and recognising how other behaviours might help them to function more efficiently, to motivate them to give up their current behaviours and begin to use advanced developmental behaviours?

If developmental learning is the result of massive quantities of repetitive experience as suggested both by our discussions of children's play behaviour and from the results of the motor learning research reported by Adolph and her colleagues, it would appear that both the effects maternal responsiveness has on children's development and the effectiveness of RFI at accelerating children's development result from the impact that RI has on children's assimilative learning. Furthermore, the fact that these developmental effects have been reported with children with Down syndrome suggests that whether children's developmental delays are related to learning inefficiencies or to pivotal behaviour deficits, by engaging in highly responsive interactions, adults can promote children's assimilative learning which can lead to significant improvements in their developmental functioning.

Research questions/future directions

1. Is the commonly observed failure of children with Down syndrome to transfer behaviours that are learned through didactic instructional methods to their spontaneous, self-initiated activity due to a failure of generalisation or to a failure to emphasise assimilative learning?
2. How does children's rate of self-initiated practice or repetition of current behaviours (e.g. assimilative learning) contribute to their developmental learning and remediation?
3. Might language delays of children with Down syndrome be related to deficits in pivotal behaviours such as social initiation, joint activity or joint attention as well as to learning inefficiencies?
4. Are the effects of traditional early intervention methods dependent upon children's level of initiation or their abilities to use other pivotal behaviours?

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