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A new tool for observing infants' locomotor behaviour: A proposal for professional caregivers

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In recent years, maturationist and cognitivist theories of motor development have undergone considerable change. Ecological approach and dynamic systems approaches interpret in a contextualistic and interactional way motor development and one of its landmarks, independent walking. They stress the perception-action unity and the dynamic interplay between many subsystems cooperating to produce an emergent behaviour, such as walking. Both stress individual variability in motor development.

We present a new tool, called LOCO for evaluating individual differences in independent walking, viewed as a complex goal, involving perceptual, cognitive and contextual variables. The 8 items for observing and the grid for evaluating walking behaviours, in home environment, are described. LOCO has 2 subscales: spontaneous walking, and walking-linked-to-other abilities. Results from 33 infants show that our tool can differentiate infant's locomotor behaviour and that spontaneous walking subscale is not dependent on age.

A new tool for observing infants' locomotor behaviour, a proposal for professional caregivers

This contribution seemingly refers to the level of interplay between child caregivers and researchers which foresees involving nursery teachers as research collaborators offering their "pupils" as research subjects. In fact our aim is really wider. Presenting our observation and evaluation tool we would like to :

- use child caregivers' experience and knowledge, in order to settle this tool;
- develop a new approach to infants' locomotor abilities which are not generally carefully watched by parents and caregivers, because usually these abilities are considered not to be dependent on the surrounding and not relevant to the child's wellbeing.

On the contrary, recent research about motor development shows some new trends:

a) it opposes to both traditional maturationist and the more contemporary neurophysiological and cognitivist explanations of the development of motor patterns and walking;

b) it stresses the crucial contribution of everyday features of the physical and social environment to the development of child motor abilities;

c) it attributes a new "meaning" to variability and to the individual differences in developing motor patterns, particularly to different times and strategies in performing a complex motor behaviour like bipedal locomotion.

About point a): the maturationist interpretation of motor development, still adopted in classical developmental scales like the one of Gesell, assumed that motor development was sequential, rulebased and linear, depending on a single cause, that is structural changes of the C.N.S. This same approach underlies many recent scales, much used in a clinical context, like the Bayley Scales of Infant Development (1969), although the theoretical pattern of this approach is now questioned. Cognitivist approaches stress the existence of computation and internal representation (motor programs) as a basis for performing a desired action (Adams, 1971; Summer, 1992). But, as Thelen frequently remarks "These developmental theories... are imperfect because they essentially prescribe the adult form before it develops. These views take no account of process, of how new forms and functions are realized with time". (Thelen & Smith, 1994, p. XVI).

Two ways of interpreting motor development are now growing and fostering more and more studies: the ecological approach (Gibson, 1991; Reed, 1982; Adolph, 1997) and the dynamic systems approaches (Thelen, 1984; The-

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len, Kelso, & Fogel, 1987) provide an interesting source for ontogenetic innovations in this field.

Both approaches reject the above mentioned maturationist as well as cognitivist approach. Ecological approach stresses on the functional unity of motor and perceptual development: just visual perception offers crucial affordances about surfaces and objects, and lets infants aptly move in their environment. Dynamic systems approaches try to understand the route by which the organism can generate novel behaviours, that is the "how" and the "when" of the attainement of the motor goal: they stress the complex, cooperational, dynamic nature of the seemingly simple goal such as independent walking. For these approaches, gaining a new behaviour depends on many and different, co-operating subsystems or collective variables (neurological, perceptive, biodynamic, contextual, motivational factors, etc.) which work together in a dynamic way permitting to a newly emergent behaviour to raise, as an example, walking.

Cognition and problem solving, for instance in order to get a toy, adopting a specific path, turning around obstacles and so on, are then related to the child's discovery of affordances as well as to the dynamic interaction of multiple subsystems. In the classical piagetian item of discovering a hidden toy, the child can reach different results with regard to his own locomotor experience: infants who had more self-locomoting experience (as crawlers) are more successfull on the A-non B-task (Kermonian & Campos, 1988).

As to point b), concerning infant's sensitivity to environment, stressed from both ecologists and dynamicists: performing a motor act is a process of continuous interaction among child, environment and task. Moreover, locomotor ability might be related to other dimensions like cognition and affection. Otherwise stated: walking is a finalized behaviour aiming at reaching an object or a person (Gustafson, 1984; Thelen, Ulrich, & Jensen, 1989; E. Gibson, 1991).

As to point c), that is individual variability, a dynamic approach assumes that emergent motor abilities do not differ only in timing but also in strategies and in the sequence. It is clearly noteworthy that some children crawl before walking, while others do not at all. Children follow then different developmental paths and, when they are able to walk they can walk in different ways showing individual *motor styles* (Cioni, et al., 1993). We need to settle new tools for observing and evaluating motor behaviours, taking into account of dynamic and contextual variables surrounding the child.

The aim of this research is to set up a new tool for observing and evaluating infants' locomotor abilities, taking into account of dynamic and contextual variables surrounding child locomotor behavior. We will present the first settlement of this tool, called LOCO, which we hope will be valid and reliable for evaluating individual differences in locomotor ability of newly walking infants. Our hypotheses are as follows:

Hp.1: Our observing situation is able to catch individual differences in the walking patterns of infants.

Hp.2: The walking patterns are independent from age.

Hp.3: A significant relationship can be found between walking patterns and behaviours where the walking ability is aimed to solve perceptual and cognitive items.

METHOD

Procedure

We tested our tool having as subjects newly walking infants. A group of earlier recruited mothers phoned us when their infants were able to walk independently, without any help, for 10 steps. In the span of 7 to 10 days after the call, we visited and videotaped the infants at home: infants were wearing their usual footwear, walking on their different, but ecologically correct floors! Moreover infants were dressed, this is again surely ecologically correct, but does not permit the accurate look to hips position which medical settings guarantee.

Subjects

Some 40 infants were videotaped, but in the final sample 19 of them were given to all the items while 14 more made only the first 3 items (M=17; F=16, mean age=397 days, that is about 13 months, *SD*= 40 days; range = 322-501 days).

The LOCO is a tool which assesses walking and walking connected to other abilities. There are three items evaluating spontaneous independent walking and five items evaluating the infant's behaviour for some tasks that require walking ability. Spontaneous walking is evaluated considering:

Item 1- Walking independently for 10 steps;

Item 2- Rising alone from sitting position;

Item 3- Climbing steps;

- Motor satisfaction.

The final score of the scale evaluating "*spontaneous walking*", called score A, is calculated by the addition of the subscores to the three items and to the qualitative index (motor satisfaction).

There are five other items presenting some tasks to the infants, where the "goal" is always at walking distance from the subject:

Item 4- Taking a toy to ones' mother (the not-dangling toy is picked up from the floor and taken to the mother who asks the child to do so);

Item 5- Reaching a hidden toy (a toy is hidden under a tissue at walking distance from the child);

Item 6- Reaching the same toy as item 5, hidden in a new hiding place (the toy is hidden under the sofa cushion at walking distance from the child);

Item 7- Reaching a toy which is visible, behind an obstacle (the toy is on the floor behind a chair laying on its side);

Item 8- Dragging a toy with wheels (the toy is a dog with wheels and a springing tail, which makes noise if dragged, its movement is showed by the experimenter);

- Motivation for tasks.

The final score of the scale evaluating "*walking connected to other abilities*", called score B, is calculated by the addition of the subscores to the five items and to the qualitative index (motivation for tasks). Evaluation grids of the observed behaviours (see Table 1) were created, with an adequate interjudge reliability (Cohen kappa=.75).

We remember that all those items where the child is spontaneously walking give a final score called A. Now for the evaluation grid for the remaining tasks, which give a second score, called score B, see Table 2.

Table 1

Evaluation grid of the 3 items of *spontaneous walking*

Item 1 Walking independently for 10 steps
Spatial parameters
support base (wide=1; narrow=2)
steps length (short=1; long=2)
Muscle-skeletal parameters
gait (oblique=1; right=2)
foot contact (tiptoe=1; plant=2; heel=3)
foot orientation (twisted=1; right=2)
arms position (hands up=1; "guard position"=2; arms along the body=3)
hips, arms, trunk, (HAT) swinging (strong, not efficient=1; weak, efficient=2)
Centre of gravity parameters
body bent forward (yes=1; no=2)
Item 2 Standing up alone from sitting position
Standing up (no=1; yes=2)
Item 3 Climbing steps
climbing (no=1; yes=2)
climbing way (on the knees=1; standing=2)
speed (slowly=1; quickly=2)
Motor satisfaction
pleasure while walking (static attitude=1; pleasure while walking=2)

Table 2

Evaluation grid of the 5 items of *walking connected to other abilities*

Item 4 Taking up a toy from the floor to ones'mother
taking up the object (1=no; yes=2)
way of catching the object (sits down=1; crawls=2; catch the object from standing position=3)
falls (does not fall because crawling=0; falls=1; does not fall while walking=2)
arms position (hands up=1; folded elbows=2; arms along the body=3)
Item 5 Reaching a hidden toy
finding and picking up the object (no=1; yes=2)
taking out the object (slowly and doubtfully=1; quickly=2)
falls (does not fall because crawling=0; falls=1; does not fall while walking=2)
Item 6 Reaching the same toy as item 5, hidden in a new hiding place
gets the object (no=1; looks around at the place=2; yes=2)
Item 7 Reaching a toy which is visible, behind an obstacle
catching the object (no=1; yes=2)
strategies for reaching the object (moves the heavy obstacle=1; walks around the obstacle leaning on it/ crawls around it=2; walks around the obstacle=3)
falls (does not fall because crawling=0; falls=1; does not fall while walking=2)
Item 8 Dragging a little dog with wheels
dragging the object (no=1, yes=2)
ways of dragging the object (uses the objects like a car, while sitting=1; drags the objects while standing=2; drags the object while walking=3)
falls (does not fall because crawling=0; falls=1; does not fall while walking=2)
Motivation towards tasks
enthusiasm (no=1; yes=2)

All these items evaluate locomotor ability of the child but referring to different components of this ability.

Items 1 to 3 related to "*spontaneous walking*", evaluate only just locomotor ability like: Walking independently for 10 steps, Rising alone from sitting position, and Climbing steps and Motor satisfaction. The items 4 to 8 related to "*walking connected to other abilities*", evaluate other abilities, connected to motor ability, particularly item 4. Taking an object to ones' mother, walking for reaching the mother who is calling the infant, pertains the willingness to have a proximity with the mother or, at least, the willingness to comply with mother; item 5, Reaching an hidden object, and item 6, Reaching the same object hidden in a new hiding place, refer all to cognitive abilities of piagetian tradition.

By item 7, Reaching an object which is partially visible, behind an obstacle, the evaluation of not-traversability affordances is required to the child (as perception-action approach of Gibson's ecological theory stresses). Item 8,

Dragging an object with wheels, requires again an ecological evaluation of using an object. The subscore motivation towards tasks mirrors the "enthusiasm towards tasks" considered by the Bayley scale.

The evaluation grid tries to quantify the qualitative differences of infants' behaviour. In fact, for instance, the foot position on the tiptoes is considered as less effective and less developed than the heel position, therefore tiptoe position is evaluated as 1, while heel position of the feet in walking is evaluated as 3.

RESULTS

We present some results of the first 33 subjects submitted to the LOCO.

Age The mean age when our subjects were videotaped was13 months (SD=1.10); as the observation happened in the span of a 7-10 days after their first independent steps (mothers' call to the researchers) that means they were generally younger than the Gesell infants (15-18 months), but older than the Bayley's (11.8 months).

Description of spontaneous walking The most frequent behaviours in the scale of *spontaneous walking* (items 1, 2, 3 + motor satisfaction = score A) are as follows (see Table 3).

In order to evaluate the relationship between the walking ability as measured by the *scale of spontaneous walking* (calculated by score A) and infant's age, we checked the Spearman range correlation index (r_s(33)=.096; p=.298; (one-tailed). Infants' age is not related to their spontaneous walking ability, that is the first point, when they appear, independently from age show individual differences (in fact the range of scores A was among 12 and 27) which are not linked to age.

As to the relationship among the scale of *walking connected to other abilities* (calculated by score B) and age, this too is not significant (from a theoretical point of view it would have to be) (r_s(19)=.22; p=.18; (one-tailed)). We believe anyhow that, with a higher number of subjects (only 19 made the complete series of LOCO items) it would be linked to age.

As to the relationship among scores A and B, that is scale of *spontaneous walking* and *walking connected to other abilities*, where walking is a relevant element but other aspects (mother-child relationship, cognition, perception) are involved, the relationship is significant (r_s(19)=.49; p=.01; one-tailed). This result corresponds to our aims when conceiving tasks which ought to tap walking abilities from one side and walking and cognitive, motivational, perceptive abilities from the other.

Table 3

Typical behaviours of first walkers in spontaneous walking

Item. 1 Walking independently for 10 steps
support base: wide
steps length: short
gait: right
foot contact: plant
foot orientation: twisted
arms position: "guard position"
hips, arms trunk (HAT) swinging: modest, efficient
the body is not bent forward
Item 2 Rising alone from sitting position
able to stand up alone
Item 3 Climbing steps
able to climb steps
climbing on the knees
quickly
Motor satisfaction
Pleasure in walking

CONCLUSION

We conclude that:

Hp. 1 Our tasks and the evaluation grid look to discriminate different individual walking patterns as expressed in spontaneous walking.

Hp. 2 Walking patterns and scores are independent from age. The walking ability is reached, at different ages, but it can express itself in more or less efficient ways (higher or lower scores A, the subscale of walking ability, describe only the quality of the behaviour).

Hp. 3 There is a significant relationship between walking ability as measured by score A and solving tasks ability as measured by score B. The tasks which were conceived for tapping walking as related to other abilities are valid measures of this interwoven competencies.

Why then to use LOCO by child caregivers?

We hope that a new look to locomotor experience of infants by caregivers could inspire them to suggest us new and other tasks, not yet proposed by us. The tasks, which can emerge in different contexts like the nursery setting, for instance during play, could help to better identify the individual locomotor competencies.

However, the suggestion to look carefully at the first walking behaviours of the infants is not intended to watch infant's first steps with a clinical diagnostic gaze for precociously identifying motor difficulties, which would be better taken care of by a paediatrician, neither to let the infants

walk earlier. We do not propose an acceleration of the walking development by the management of a helping surrounding. We hope that looking carefully at the first infants' steps would help to know and evaluate the specific, individual styles and walking pattern of each child, considering walking as a relevant part of his behaviour. An attentive look does not request only the management of an environment which favours the spontaneous development of infant's motor competencies (for instance letting infants of even a few months stay freely on the floor, as E. Pikler (1988) recommended) but also the evaluation of the locomotor experiences as central "milestone" for the infants' identity. If, as Jerome Kagan (1998) stresses, one of the main drives in development is the drive to be proud of oneself, is there a better opportunity, to enhance the infant pride, than favouring him while he tries to walk independently and efficiently?

Our results confirm the importance of variability as an essential element in the developmental processes and the complexity of interactions between individual intrinsic dynamics, everyday environmental contexts and task itself.

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