DEVELOPMENT AND VALIDATION OF THE AHEMD-SR

(AFFORDANCES IN THE HOME ENVIRONMENT

FOR MOTOR DEVELOPMENT – SELF REPORT)

A Dissertation

by

LUIS PAULO LOPES BRANDÃO AREOSA RODRIGUES

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2005

Major Subject: Kinesiology

DEVELOPMENT AND VALIDATION OF THE AHEMD-SR

(AFFORDANCES IN THE HOME ENVIRONMENT

FOR MOTOR DEVELOPMENT – SELF REPORT)

A Dissertation

by

LUIS PAULO LOPES BRANDÃO AREOSA RODRIGUES

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Approved as to style and content by:

Carl Gabbard (Chair of Committee)	David Wright (Member)
Teresa Wilcox (Member)	Ping Xiang (Member)
Steve Dorman (Head of Department)	

May 2005

Major Subject: Kinesiology

ABSTRACT

Development and Validation of the AHEMD-SR (Affordances in the Home Environment for Motor Development – Self Report). (May 2005)

Luis Paulo Lopes Brandão Areosa Rodrigues, B.A., University of Oporto; M.S., University of Lisbon

Chair of Advisory Committee: Dr Carl Gabbard

A contemporary view of early childhood motor development considers environmental influences as critical factors in optimal growth and behavior, with the home being the primary agent. However, minimal research exists examining the relationship between motor development and the home. The present dissertation addresses this gap with the goal of creating an innovative parental self-report instrument for assessing the quality and quantity of factors (affordances and events) in the home that are conducive to enhancing motor development in children ages 18-to-42 months. In Study 1, following initial face validity determination, expert opinion feedback and selective pilot-testing, construct validity was examined using 381 Portuguese families. Factor analysis techniques were used to (1) compare competing factorial models according to previous theoretical assumptions, and to (2) analyze the fit of the preferred model. Of the five plausible models tested, the 5-factor solution provided the best fit to the data. Reliability was established through the scale reliability coefficient with a value of .85. Study 2 tests for the content validity of the instrument, examining the relationship between the inventory and level of motor development. Fifty-one (51) participants from the original sample were assessed for motor development using the Peabody Developmental Motor Scales II (PDMS2). Comparisons were made between the PDMS2 classifications of the AHEMD-SR quartile groups. Results supported the primary hypothesis, that is, less favorable motor development was associated with less availability of home affordances. Furthermore, the interaction of (factors) Inside Space and Variety of Stimulation was significantly related to both Gross and Total Motor Development scores.

The findings of these two studies suggest that the AHEMD-SR is a valid and reliable instrument for assessing how well home environments afford movement and potentially promote motor development.

This dissertation is dedicated to my wife Beta,
and my children: Malu, Kika, and João Nuno.
I could not have even started without you all.

ACKNOWLEDGMENTS

I would like to express my appreciation for the academic guidance from my committee members that made my passage at Texas A&M so unforgettable. In particular I would like to thank Dr Carl Gabbard for the privilege of collaborating on research and for sharing his experience, wisdom and friendship on a daily basis. I would like also to thank Dr Charles Shea and Dr. John Buchanan for the valuable learning from their classes, seminars, and helpful commentaries.

Many thanks are due to fellow students João Azevedo, Alice Pinto, Mike Tapia, Diala Ammar and Young Uk Ryu, for their friendship and assistance during this important period of my life.

I am also indebted to the Polytechnic Institute of Viana do Castelo and particularly to the College of Education for all the assistance and help they always provided me. Special mention goes to my fellow colleagues at the Kinesiology Department. Linda, César, Pedro and Jorge, I could not have done it without your support and friendship. A very particular debt of gratitude is due to Dr José Portela for the constant encouragement and friendly push in the right direction. To my Texan family, the Docweillers, I want to express my eternal gratitude.

I would also like to acknowledge that the financial support of this work was granted from the European Community and the Portuguese Government, PRODEP III, action 5.3.

Finally I have no way to really thank my family, Beta, Malu, Kika and João Nuno for their endless love and tender support along all this wonderful adventure.

TABLE OF CONTENTS

LIST OF FIGURES

FIGURE Page

LIST OF TABLES

TABLE Page

CHAPTER I

INTRODUCTION

Contemporary research in child development suggests quite convincingly that an optimal level of development occurs with a stimulating environment and strong contextual support (Burton & Davis, 1992; Diamond & Hopson, 1998; Fischer & Rose, 1998; Lerner, 1996, 2002). Furthermore, these factors may have even more impact during the first years of life (Bradley, Burchinal & Casey, 2001; Ramey & Ramey, 1998). Of the various factors comprising the environment, few would disagree that the home (representing the family) is a primary agent for learning and development. For the past 40 years, effort has been devoted to mapping the relations between the home environment and selected aspects of the child's development. Perhaps the most notable attempt in this area - the Home Observation for Measurement of the Environment (HOME) inventory by Caldwell and Bradley (1984) - has been used in numerous studies to examine environmental effects on cognitive and social development. Using the infants and toddlers version of the HOME, Caldwell and Bradley proposed a home structure organized along six different dimensions: 1) responsivity of mother, 2) avoidance of restriction and punishment, 3) organization of the environment, 4) appropriate play materials, 5) maternal involvement, and 6) variety in daily stimulation. Interestingly, although the HOME inventory was not designed to test the relationship to child motor development, one of the most striking and consistent findings has been "availability of

---

This Dissertation follows the style of *Research Quarterly for Exercise and Sport.*

stimulating play materials were more strongly related to child development status than global measures of environmental quality such as SES [socioeconomic status]" (Bradley et al., 1989, p.217).

Although specific home environment and motor development characteristics have been examined (e.g. Abbot & Bartlett, 1999, 2000, Adolph & Avolio, 2000, Bober, Humphry, Carswell & Core, 2001, Goyen & Lui, 2002; Parks & Bradley, 1991), the fact remains that minimal information is available in relation to the multidimensional effects of the home on motor development.

As a part of a study conducted by Poresky and Henderson (1982), the psychomotor development of 27 two-year old infants was related to their home environment and socioeconomic status of the family. Using the Bayley Psychomotor Development Index and the HOME, significant correlations were found for two subscales: Organization of the Physical and Temporal Environment and Learning Materials. A significant correlation also existed between socioeconomic status and psychomotor development. The researchers asserted that Learning Materials and Involvement (which was close to being significant) presented opportunities to learn through experience with the environment and affective support. In a similar study administered by LaVeck and Hammond (1982), children from age 36 to 42 months from an advantaged environment scored higher on the Motor Scale of the McCarthy Scales than those from a less advantaged environment; the HOME Inventory was used to rate the environment.

Botha (1982) used the HOME inventory to investigate “which qualities of the home environment during the child’s early years are most relevant to subsequent gross motor development. ” Dynamic balance, static balance, eye-hand coordination, and gross motor coordination tasks were measured in 120 children ages 36 to 42 months. Stimulation through equipment, toys and experiences was found to have a negative influence on eye-hand coordination, measured by bouncing and catching a 9” ball. Avoidance of restriction and punishment was found to significantly influence dynamic balance as measured by walking on a balance beam and eye-hand coordination. Pride, affection, and thoughtfulness significantly influenced dynamic balance, eye-hand coordination, and gross motor coordination, as measured by a timed 20 yard run. Independence from parental control was shown to have a negative influence on dynamic balance. Gross motor toys significantly influenced eye-hand coordination.

Parks and Bradley (1991) used 6-month-olds to examine the specific interaction of two features of the home environment, availability of toys and amount of maternal involvement. The researchers found that higher locomotor, eye-hand coordination, and general developmental quotients were associated with the additive combination of more optimal play materials and high level of maternal involvement. When examining the independent contribution of the factors, appropriate play materials were associated with more favorable eye-hand coordination.

Similar findings were also reported by Bober, et al. (2001) indicating that persistence in functional play with challenging toys was correlated with the children’s age-equivalent fine motor scores. Hopkins and Westra (1988) observed that mothers who formally handled their child also tended to provide more appropriate toy materials and to be more involved with their child, with these behaviors probable being the cause for a higher gross motor performance found at 6 months of age.

Goyen and Lui (2002) examined motor development at 18 months, 3- and 5-years in a group of 58 “apparently normal” high-risk infants. Their intent was to determine the relation of motor behavior to the quality of the home environment as measured by the HOME inventory. They conclude that the development of gross and fine motor skills appeared to be differently influenced by the home environment. Infants with a lower HOME score consistently scored poorer on Peabody motor scores, however, the difference was only significant for the gross motor skills.

Abbott, Bartlett, Fanning and Kramer (2000) used three subscales of the HOME inventory (maternal responsivity, provision of appropriate learning materials and maternal involvement), and the Alberta Infant Motor Scale (AIMS) to assess 43 homes and their 8-month-old children’s motor development. Results did not show any significant correlation between the HOME and the AIMS scores, but the children in the study scored high both on the AIMS and on the HOME. These results led the authors to conclude that despite the lack of statistically significant support for the hypothesized relation between home environment and motor development, related evidence suggests that more supportive home environment is associated with higher infant motor development. According to them, lack of sensitivity in the HOME inventory (ceiling effect), questionable validity of the HOME inventory to support infant motor development, homogeneity of family aspects (median and high SES) and significantly high motor scores with the AIMS, could have combined to reflect the results. The researchers concluded that although the home environment is surely within the host of subsystems that contribute to infant motor development, little research exists examining this relationship. Furthermore, they strongly emphasized that, “a valid measure reflecting aspects of the home environment that support infant motor development needs to be created” (p. 66). Arguably, such an instrument could have potential for enhancing our understanding of the role of the home on early childhood motor development. In addition, such an instrument could provide useful information in a wide variety of settings, including clinical research with applications to intervention and remediation. For example, medical professionals and social workers could use the instrument to assess the home environment, and then provide resources or recommendations to enhance its potential in maximizing development.

This dissertation describes the efforts in developing such an instrument, tentatively titled Affordances in the Home Environment for Motor Development Self-Report (AHEMD-SR). The starting premise, founded in selected propositions of Ecological (Affordance) theory (Gibson, J.J., 1979; Gibson, E.J., 2002), is that the home environment can provide affordances that can be conducive to stimulating motor development. Affordances are opportunities that offer the individual potential for action, and consequently to learn, and develop a skill or a part of the biological system (Heft, 1997; Hirose, 2002; Stoffregen, 2000). Although the term affordance has been interpreted in several ways, for this study it is one of a more general nature as suggested by Gibson, “The affordances of the environment are what it offers the animal, what it provides or furnishes…"(1979, p.127). In addition to the more obvious set of affordances such as toys, materials, apparatus, and availability of space, stimulation and nurturing by parents (and others) provide the additional component of events. This researcher tends to agree with Stoffregen (2000) and Hirose (2002), in that events are an affordance – events offer the child opportunities for action. Hirose states, "Affordances are opportunities for action that objects, events, or places in the environment provide for the animal," (p. 104). In the present study, the intent or use of the term affordance does not ignore the reciprocity between organism and environment, which is frequently addressed in experimental work. However, since the intent was not to examine the precise perceptual-motor mechanisms involved, reciprocity was not germane.

Bronfenbrenner (1986, 2000) also emphasized the importance of environmental elements for shaping overall human development. Among the settings or environments in which individuals develop, Brofenbrenner describes four distinct systems: (1) Microsystem – family and neighborhood (home, school, peers, play area); (2) Mesosystem – interrelations among various settings; (3) Exosystem – extended family; and (4) Macrosystem – attitudes and ideologies of the culture. Each of these distinct layers contains elements, events and interactions affording opportunities for action. Most crucial for the early ages development are the elements present on the more proximal layer with the home environment being of most relevancy.

More recently, Lerner (1996, 2002) acknowledged in his *Developmental Contextual Theory*, the major importance of the relationship between the changing person and his or her changing environment, with reciprocally influencing each other over time. According to Lerner, the historical period in which the individual develops and inseparability from the environmental contexts should be emphasized. Therefore, the specific configuration or structure of the system at a given point in time could be the "event" affording developmental change; a notion similar to Gibson's idea of an "ecological fit".

With the aforementioned in mind, it was hypothesized that affordances are organized according to a common structure that can be represented by a number of specific stable dimensions of the home environment. This dissertation describes the initial development of the instrument, the testing of its structural validity by comparing alternative models, and finally, the construct validity and reliability of the preferred model, by testing the relationship between the home environment as measured by the AHEMD-SR and motor development. The primary goal was to create an innovative parental self-reporting research instrument to assess the quality and quantity of factors (affordances and events) in the home that are conducive to enhancing motor development for children ages 18-to-42 months.

Statement of the Purpose

This dissertation represents a significant portion of a long-term project (AHEMD project) designed to develop a unique research instrument that can reliably and validly assess the structure of home characteristics that may affect motor development during early childhood. The specific goal was to develop and validate a self-report version of the instrument for the age interval 18-to-42 months.

To achieve this purpose the following specific research aims were addressed:

1. To determine if there is a common structure underlying characteristics present in the home environment that can be conducive to motor development. A five latent factors model (with possible correlations) grouping items related to Outside Physical Space, Inside Physical Space, Variety of Stimulation, Gross Motor Materials, and Fine Motor Materials, was hypothesized to represent this common structure.
2. To determine if parents using a self-reporting inventory can reliably assess this structure.
3. To determine if there is a relationship between these factors and level of motor development. It was hypothesized that a low AHEMD score complements the likelihood of a low motor development score.

These research questions are illustrated in the proposed research model (Figure 1).

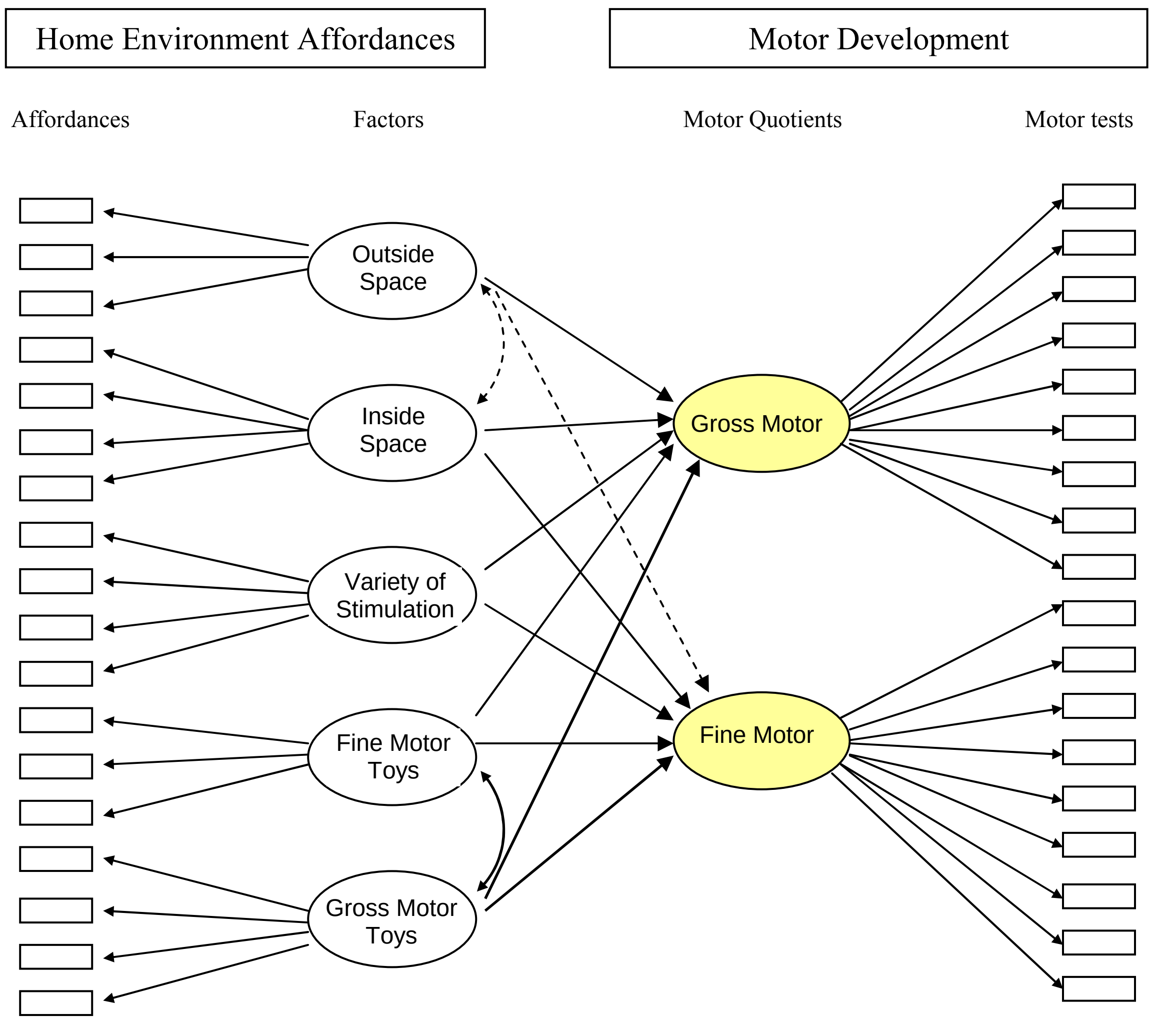


Figure 1. Research model. (Strength of the hypothesized correlations between factors and relations between factors and motor variables are represented by the width of the lines. Number of items and respective factor loadings pretend to be only illustrative.)

Significance of the Study

The outcome of this project has merit in enhancing our basic understanding of the potential of the home environment in optimizing motor development of the child, as supported by Ecological (Affordance) Theory. In addition, it is the expectation that this instrument has promise as a tool for early intervention. For example assessment of the home is followed up with recommendations for home modification and parental education.

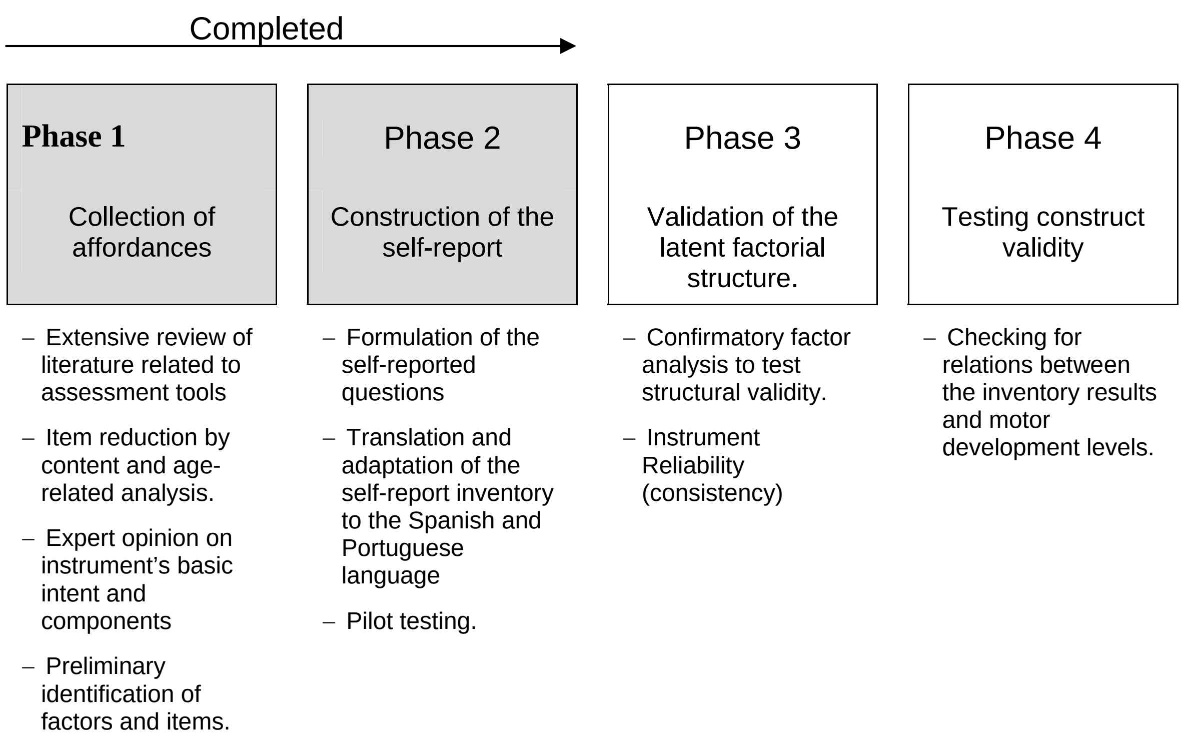


Figure 2. The four phases of the overall research project.

Overview of the Long-Term Project

The overall project was designed in four phases (Figure 2); phases 1 and 2 (completed) form the critical bases for the present dissertation.

Overview of the phases 1 and 2 - initial development of the instrument

In addition to a review of theory associated with affordance (selected references noted earlier), creation of the inventory began with an extensive inspection of contemporary literature related to general assessment tools relevant to this project (e.g., the HOME, Bradley et al., 1989; Bradley, Caldwell, & Corwyn, 2003; Caldwell & Bradley, 1984; Mundfrom, Bradley & Whiteside, 1993), developmentally appropriate play materials (e.g., Goodson & Bronson, 2003; US Consumer Product Safety Commission, 2002), and selected studies of motor development and the home environment (e.g., Abbott & Bartlett, 1999, 2000; Abbott et al., 2000; Bartlett & Fanning, 2003). These initial efforts resulted in a 112-item list of environmental characteristics and family behaviors deemed theoretically indicative of potential opportunities (affordances) for motor development in the home. The list was tentatively grouped into three subscales: Play Materials, Variety of Stimulation and Physical Environment. Items were then grouped according to common content and age related characteristics, leading to the elimination or collapsing of similar items. Following this procedure, the instrument was sent to 15 established specialists (researchers, physical therapists, and occupational therapists) in the fields of infant and early childhood motor development for critical review of the instrument's basic components - categories and items. Their primary task was to comment on the motor affordance “potential” of the listed items and make recommendations for deletion and addition to the list. These individuals were identified (and agreed to participate) from a list generated via recommendations from selected researchers whose published work was judged as related to this project.

With this feedback, which was used to help establish content validity, the resulting draft was then adapted to a parental self-report form. Seventy-five (75) questions addressing home and family characteristics were tentatively written in a neutral manner and using affirmative type questions. That is, questions were structured in an unbiased and affirmative (positive) manner. For example, “My child plays with other children as a usual and ordinary daily event.” as opposed to “My child usually doesn’t play with other children as a daily event.”

Readability was set at an approximate fourth grade reading level, which was established in consultation with an elementary school teacher specializing in language arts. As a general note, parent’s reports have been described to be a sensitive, accurate and reliable source of information in a naturalistic environment (Wilson, Kaplan, Crawford, Campbell & Dewey, 2000). For example, validity for self-reporting the home environment has been established for a version of the HOME inventory (Frankenburg & Coons, 1985).

This first version of the AHEMD-SR was subsequently piloted with 15 US families, representing a variety of ethnic, socioeconomic and education levels. This was a convenient sample drawn from the university and local early childhood school network in the Bryan / College Station, Texas community. Parents were asked to answer the survey questions while pointing out difficulties or making suggestions for corrections (e.g., readability, comprehension, cultural sensitivity). In addition to written feedback, seven parents from the sample volunteered to be interviewed; their remarks were used to clarify the difficulties and / or corrections suggested. In the process, several modifications were made in the vocabulary, syntax, and rating scale. This resulted in the current version of the AHEMD-SR, comprising one section on Child and Family Characteristics (11 items), and three on home environment characteristics and affordances: Physical Space (17 items), Daily Activities (15 items), and Play Materials (28 items). As noted in the example shown in Figure 3, three types of questions: simple dichotomic choice, 4-point Likert-type scale, and description-based queries were used. When appropriate, pictorial examples of the general classification were provided, and noted by parents as quite useful in helping to identify available categories and specific items.

Given the non-existence of instruments measuring a similar construct, we decided to establish the concurrent validity of the self-report using a direct observation measure of the home (Anastasi & Urbina, 1997). That is, an external observer (one member of the research team) assessed 10 homes using the same inventory within one week of the parent's self-report. Pearson's correlations between the self-reported and the observed values for the three sections on the inventory were .98 for the Physical Space (PS) section, .97 for the Daily Activities (DA), and .86 for the Play Materials (PM) items, with a value of .93 for the total scale. These results provided preliminary support for use of the self-report version as a valid instrument for measuring the criterion.

Simple dichotomic question:

	Yes	No
Do you have an outside play area for your child(ren)?	☐	☐

Likert-type scale question

On a typical day, how would you describe the amount of awake time your child spends free to move in any space of the house?

No time ☐ Very little time ☐ Some time ☐ A long time ☐

Description-based question

Play materials used for gross movements with the arm and legs (throwing, catching, kicking, rebounding, striking, etc). Balls of different sizes and colors, Bats, Baseball Gloves, Throwing Targets, etc.

Examples are:

How many of these toys do you have in your house?

None ☐ One ☐ Two ☐ Three ☐ Four ☐ Five ☐ More than 5 ☐

Figure 3. Examples of the three types of questions: simple dichotomic, Likert-type, and description-based.

As noted earlier, one of the prominent long-term goals of the project is to increase its cultural scope; for example, by comparing responses from different nations. In addition to the original English version, used to establish the basic items of the instrument, a Portuguese translation was created. This version presents the focus of the present study. After initial translation by the author (of Portuguese decent), three

Portuguese-speaking specialists in infant development examined the instrument. It is important to note that differences between the original (English) version and the translated version were minimal.

CHAPTER II

STUDY 1 – ESTABLISHING CONSTRUCT VALIDITY

Introduction

For the past 40 years, effort has been devoted to mapping the relations between the home environment and selected aspects of the child's development. Although motor items have been included in noted inventories, such as the HOME (Caldwell & Bradley, 1984), the fact remains that minimal information is available in relation to the multidimensional effects of the home on motor development. In addition, we still lack a valid measure reflecting aspects of the home environment that influence early motor development (e.g. Abbot et al., 2000). With the intent to fill this void, this project has been devoted to the creation of an innovative self-reporting research instrument that assesses the quality and quantity of motor development affordances in the home for children 18-to-42 months - the AHEMD-SR. As noted in the introduction, the project was designed to be conducted in four phases – with phases 3 and 4 being described as Study 1 as reported here, and Study 2, to be described in Chapter III.

The aim of Study 1 was to test the structure of the proposed model using confirmatory factor analysis. The hypothesis was that there is a common structure underlying indicators present in the home environment that can be conducive to motor development stimulation (according to face validity). In addition, it was predicted that a five latent factors model (with possible correlations) grouping items related to Outside Physical Space, Inside Physical Space, Variety of Stimulation, Fine Motor Materials, and Gross Motor Materials, can represent this common structure. Furthermore, this structure can be accurately assessed by a self-reporting inventory, answered by parents, and so constituting an easy and practical way to assess the construct.

Methods

Participants

Participants were drawn from local affiliates of Early Childhood Education in Viana do Castelo in the northern region of Portugal. That is, the Director of each facility was asked to send home a survey for voluntary participation. Early Childhood facilities were selected according to the criteria of age and location in an effort to select families representing a wide range of SES. An initial sample of 420 volunteer families with children within the age range 18-to-42 months was asked to complete the *AHEMD-SR*. From this initial pool, 19 families did not return the inventory, and 22 were removed due to incomplete data sets. Thus, the final sample consisted of 381 families representing 30% (116) in the 18-to-24 month age group, and 70% (265) in the 24-to-42 month group. Families lived in apartments (46%) or independent houses (54%). In regard to single versus two parent homes, the percentages were 3.4 and 96.6, respectively. More precisely, the question concerned the number of adults living in the home: one or two or more. Another statistic of interest was educational level of the parents; 29% of the fathers completed college or professional school, while 41% of the mothers had done the same. Relative to income, 36% of the families earned € 14.000 or less, while 10% were making more than € 49.000 annually, with everybody else in between these figures.

Procedure

Directors of the early childhood centers gave each family a letter explaining the purpose of the study, asking for their collaboration and providing consent forms. Approximately a week later a package with the *AHEMD-SR* was sent to the home of the volunteer families with instructions to be returned within the same week. A coded number was assigned to each family / child, in order to keep the researchers naive to the results until all the testing procedures were completed. The investigators' university institutional review boards granted approval for this study.

Data analysis

Examination of the structural validity. Given the data's departure from normality, an asymptotic variance-covariance matrix was computed to perform a robust Confirmatory Factor Analysis (CFA) in PRELIS 2.52 and LISREL 8.52 to test each alternative model (Jöreskog, Sörbom, Du Toit, & Du Toit, 1999). When using CFA, the chi-square statistic assesses absolute fit of the model, but it is very sensitive to sample size, so a variety of fit indices were needed to evaluate the fit of the specified model(s) (Jöreskog & Sörbom, 1993; Mueller, 1996). Absolute fit indices used in our study included the Satorra and Bentler scaled chi-square (1994) with correction for non-normality, and adjusted goodness-of-fit index (AGFI). Relative fit indexes included the normed fit index (NFI), the non-normed fit index (NNFI), and the comparative fit index (CFI) to test for the proportionate improvement in fit. For all of these indices, values over .95 and up to 1.0 were deemed indicative of a good fit. The root mean square error of approximation (RMSEA) and respective confidence intervals (CI) were used for evaluating how well the model-implied reproduced the original variance-covariance matrix, keeping in mind that RMSEA values as low as .05 represent a good fit to the model. Finally, modification indices (MI) were interpreted within the theoretical framework for each model and alterations made accordingly. Variables were considered for modification from their initial path to another factor, or for deletion when MI suggested that such procedure resulted in a significant improvement of the model fit.

To access construct validity of the instrument, alternative explanatory models were tested using CFA. Five plausible models were fitted to the data and their results compared: a global one-factor model, a 3-factor model, two 4-factor models, and a 5-factor model. All these alternative models, although entailing different parsimonious views of home affordance provisions, were drawn from a common theoretical perspective and therefore share the same type of path loadings associations. Model specifications were set to accommodate for an expected relationship between latent factors in the multidimensional models and independent measurement errors. The following is a brief description of the five models of fit.

One-factor model. This simplest model assumes a one-dimensional structure, that is, that each home / family globally provides motor opportunities along a single continuum ranging from low to high levels.

3-factor model. This model specifies that families organize their provision of affordances according to three different (although possibly related) dimensions: the physical space characteristics and materials, the variety of stimulation provided to the children, and the type and number of play materials.

4-factor models. Derived from the previous model, these two alternatives allow for the possibility that either the Physical Space or the Play Materials dimensions could be subdivided in two factors. Consequently, the first 4-factor model (4Fa Model) assumed that homes' Physical Spaces characteristics can be distinguished between Inside and Outside Space; while the second one (4Fb Model) accounts for a different organization of Fine Motor and Gross Motor Toys within the home environment.

5-factor model. Representing a complete factorial combination of Models 4a and 4b, this models assumes a different representation of Inside Space, Outside Space, Variety of Stimulation, Fine Motor Toys, and Gross Motor Toys dimensions, that is, when making decisions on providing motor affordances for their children, families tend to stably and coherently organize them according to these 5-factor / groups. This model, considered the more restrictive, was used initially to determine potential modifications to the original model specifications according to the theoretical predictions of this study. From these analyses (fitting the data to the 5-factor model) resulted the alteration of the path loading of one variable (Musical Materials) from Fine Motor Toys to Gross Motor Toys. This resulted in the final specification of the different models as noted in Table 1.

Table 1. Specifications of the path loadings of the five different models.

<table>
<tr><th rowspan="2">Variables</th><th colspan="5">Models</th></tr>
<tr><th>5F Model</th><th>4Fa Model</th><th>4Fb Model</th><th>3F Model</th><th>1F Model</th></tr>
<tr><td>Outside Surfaces (OS)</td><td rowspan="2">Outside Space</td><td rowspan="2">Outside Space</td><td rowspan="6">Physical Space</td><td rowspan="6">Physical Space</td><td rowspan="20">Affordances</td></tr>
<tr><td>Outside Apparatus (OA)</td></tr>
<tr><td>Inside Space (ISp)</td><td rowspan="4">Inside Space</td><td rowspan="4">Inside Space</td></tr>
<tr><td>Inside Apparatus (IA)</td></tr>
<tr><td>Inside Surfaces (ISu)</td></tr>
<tr><td>Inside Play Space (IPS)</td></tr>
<tr><td>Play Stimulation (PSt</td><td rowspan="4">Variety of Stimulation</td><td rowspan="4">Variety of Stimulation</td><td rowspan="4">Variety of Stimulation</td><td rowspan="4">Variety of Stimulation</td></tr>
<tr><td>Freedom of Movements(FM)</td></tr>
<tr><td>Encouragement Stimulation (ES)</td></tr>
<tr><td>Daily Activities (DA)</td></tr>
<tr><td>Replica Toys (RT)</td><td rowspan="5">Fine Motor Toys</td><td rowspan="10">Play Materials</td><td rowspan="5">Fine Motor Toys</td><td rowspan="10">Play Materials</td></tr>
<tr><td>Educational Toys (ET))</td></tr>
<tr><td>Games (GM)</td></tr>
<tr><td>Others Toys (OT)</td></tr>
<tr><td>Construction Toys (CT)</td></tr>
<tr><td>Real Materials (RM)</td><td rowspan="5">Gross Motor Toys</td><td rowspan="5">Gross Motor Toys</td></tr>
<tr><td>Musical Toys (MT)</td></tr>
<tr><td>Gross Manipulative Materials (GMM)</td></tr>
<tr><td>Locomotor Materials (LM)</td></tr>
<tr><td>Body Exploration Materials (BEM)</td></tr>
</table>

Checking for the necessary conditions for the identification of CFA models, the total number of observations (381) were in keeping with Guadagnoli and Velicer’s (1988) recommendations that a sample size of 300 or more should be used in order for a model solution such as the one in question can be interpreted. Due to the outcome that all the models, with the exception of the two 4-factor models, were nested (i.e. each restricted model was a special case of the preceding one, obtained by constraining specific parameters) differences in chi-square according to the reduction in degrees of freedom could be used to judge the statistical significance of changes in fit between models (Jöreskog & Sörbom, 1993). The internal consistency of the instrument was estimated by the scale reliability coefficient (SRC), the magnitude of its standard error

(SE), and corresponding confidence intervals (Raykov, 2001). Briefly, SRC is based on the correlations between the individual items or measurements that make up the scale, relative to the variances of the items.

Initial analysis. The 77 items initially used on the *AHEMD-SR* were grouped according to common content in 20 variables, representing expected markers of the meaningful characteristics of the home environment. Contribution of the original items to the assigned variable was checked for consistency using a correlation (bivariate) matrix. Ten items from the original pool were deleted due to one or more of the following: (1) not being positively correlated with the other items within the variable, (2) having a higher relationship to another variable, (3) showing no discrimination properties, and (4) exhibiting redundancy. The final version of the inventory is presented in Appendix A and the grouping of the items into variables are shown in Table 2.

Results for the preferred model. Results from the preferred solution were used to build a normative classification for the inventory. Norms for each subscale were proposed according to the inter-quartile position, and Total AHEMD scores were calculated adding each subscale classification.

Table 2. Grouping of items into variables

Var	Items
OS	- Outside ground texture (9) - Outside sloped surfaces (10) - Outside stairs (12)
OA	- Outside apparatus to grasp and hang (11) - Outside apparatus to climb and jump (13) - Outside play area (14)
ISp	- Number of rooms (3) - Rooms / Person (3 / [1 + 2]) - Inside amount of space (15) - House space (39)
IA	- Furniture to hang from (18) - Furniture to climb (20) - Furniture to jump from (21)
ISu	- Inside ground texture (16) - Inside material to fall (17) - Inside stairs (19)
IPs	- Inside play room (22) - Special toy's place (23)
PSt	- Daily play with other children (24) - Daily play with other adults (25) - Daily special parent's play time (26) - Number of children in the house (2)
FM	- Freedom to choose activities (27) - Clothing allowing movements (28) - Barefoot in the house (29)
ES	- Encouragement of reaching and grasping (30) - Encouragement of movements (31) - Use of action words (32)
DA	- Carried by adults (33) - Use of seating device (34) - Use of Playpen (35). - Time awake in the bed (36). - Restrained to a specific space (37) - Free to move in any space (38)
RT	- Stuffed toys (40) - Dolls and other play figures (41) - Puppets (42) - House equipment (43) - Vehicles and animals (44) - Familiar play scenes (45)
ET	- Puzzles (46) - Stacking and nesting toys (47) - Lacing boards and beads (48) - Peg boards (49)
GM	- Simple matching and counting toys (50) - Simple games (58)
OT	- Pop-up-toys (51) - Multi apparatus tables (52)
CT	- Small construction blocks (53) - Large construction blocks (54)
RM	- Books (55) - Sand and water toys (56) - Designing and coloring materials (57)
MT	- Musical materials (58) - Music box (59) - Audio equipment (67)
GMM	- Play materials for gross arm and legs movements (61)
LM	- Play materials used with upright locomotion (62) - Ride-on toys (58) - Play materials for locomotor exploration (57)
BEM	- Swings, rocking and twisting toys (59) - Mirror (60)

Note: a) Item number in parenthesis. b) Refer to Table 1 for explanation of abbreviations.

Results

Descriptive values for the measured variables

Tables 3 and 4 show the descriptive values for the 20 measured variables and their correlation matrix. All variables exhibit a wide range of distribution denoting the heterogeneity of the sample and the usefulness of the item's scales. Estimation of the normality assumption indicated a generalized deviation from the normal configuration, suggesting the use of robust techniques to fit the data.

Table 3. Descriptive values for the measured variables

Variables	Min - Max	M	SD	Skew.	Kurt.
OS	0 - 3	1.3	1.2	0.1	-1.6
OA	0 - 3	0.8	1.0	1.0	0.0
ISp	.7 - 5	2.5	0.5	-0.6	4.0
IA	0 - 3	2.0	0.8	-0.4	-0.4
ISu	0 - 3	2.2	0.7	-0.6	0.3
IPS	0 - 2	1.4	0.6	-0.4	-0.7
PS	1 - 4	2.8	0.9	-0.2	-0.9
FM	0 - 3	2.1	0.6	-0.3	0.5
ES	0 - 3	2.5	0.8	-1.4	1.4
DA	9 - 24	19.7	3.4	-1.1	0.7
RT	5 - 36	22.6	7.2	-0.3	-0.7
ET	0 - 24	9.1	6.0	0.5	-0.5
GM	0 - 12	4.1	3.5	0.7	-0.5
CT	0 - 12	3.2	2.5	0.9	0.3
RM	0 - 18	12.3	5.2	-0.6	-0.7
OT	0 - 12	2.8	3.3	1.3	0.9
MT	0 - 18	8.4	4.3	0.3	-0.3
GMM	0 - 6	3.6	2.1	-0.2	-1.3
LM	0 - 17	5.6	3.3	0.7	0.0
BEM	0 - 12	1.0	1.4	2.9	13.5

Table 4. Variables correlation matrix.

OS	1.0																			
OA	.60	1.0																		
ISp	.13	.08	1.0																	
IA	.29	.26	.29	1.0																
ISu	.01	.12	.18	.15	1.0															
IPS	.15	.17	.35	.18	.11	1.0														
PS	.11	.15	-.10	.10	.01	.03	1.0													
FM	-.14	-.04	.05	.13	.01	.15	.12	1.0												
ES	-.08	-.08	.09	-.03	.16	.05	.21	.13	1.0											
DA	-.05	.01	.10	-.02	.13	.00	.13	.12	.08	1.0										
RT	.02	.05	.19	.09	.19	.34	.19	.19	.19	.24	1.0									
ET	-.00	.03	.26	.15	.21	.32	.20	.18	.19	.19	.65	1.0								
GM	.02	.08	.14	.15	.17	.23	.24	.10	.16	.22	.59	.68	1.0							
OT	.05	.05	.11	.16	.13	.19	.08	.12	.15	.09	.43	.46	.40	1.0						
CT	.05	.06	.22	.19	.13	.29	.18	.08	.06	.19	.56	.67	.58	.43	1.0					
RM	.04	.06	.22	.17	.21	.28	.13	.23	.14	.21	.64	.57	.59	.33	.51	1.0				
MT	.03	.13	.24	.15	.18	.23	.10	.12	.15	.14	.55	.53	.47	.40	.50	.55	1.0			
GMM	.01	.10	.16	.06	.16	.17	.05	.17	.19	.13	.42	.38	.33	.21	.31	.42	.44	1.0		
LM	.18	.22	.21	.16	.17	.23	.15	.17	.15	.16	.52	.51	.48	.41	.47	.48	.53	.40	1.0	
BEM	.10	.21	.09	.12	.17	.13	.06	.08	.14	.05	.23	.30	.23	.26	.32	.22	.34	.17	.38	1.0

Comparison between proposed models

Table 5 presents the chi-square results and measures of fit for the five confirmatory models tested. The 5-factor solution consistently revealed the lowest chi-square values, higher values for all fit indexes, and a RMSEA value of .05; therefore, portraying a good fit to the data for this particular model. Furthermore, when comparing the statistical significance in chi-square reduction for respective degrees of freedom, the 5-factor solution showed an overall significant improvement in fit ($p <. 001$). Therefore, indicating that the data lends support for the selection of a structure underlying five factors: Outside Space (OS), Inside Space (IS), Variety of Stimulation (VS), Fine Motor Toys (FMT), and Gross Motor Toys (GMT).

Table 5. Chi-square statistics, indicators of fit, and nested model comparison for the five models

	Indicators of model fit							Nested models comparison (p-values for difference in X^2 / df)			
	df	X^2	NFI	NNFI	CFI	AGFI	RMSEA	1F	3F	4Fa	4Fb
1F	170	673.4	.88	.90	.91	.82	.085				
3F	167	526.7	.90	.92	.93	.85	.075	<.001			
4Fa	164	380.1	.93	.95	.96	.88	.058	<.001	<.001		
4b	164	468.7	.91	.93	.94	.86	.069	<.001	<.001		
5F	160	322.9	.94	.96	.97	.90	.051	<.001	<.001	<.001	<.001

Note. The two 4-factor models are not nested with each other.

Model-fit assessment of the final solution (5-factor model)

After analyzing the solution that proposes a model of item organization according to the five related sub-structures (Figure 4), we concluded that this model provides a good association to the data structure. All fit indexes were over .90, the RMSEA was 0.05, and all factors were well defined by single path loadings. The standardized factor loadings varied in a range from .34 to .84, but revealing in every case a statistically significant t-ratio (p < .001). The pattern of loading coefficients seemed to suggest that OS, FMT, and GMT emerge as very robust dimensions of the home. The correlation matrix of the latent factors revealed a pattern adequate to the theoretical prediction, that is, significant values for all the combinations between factors IS, VS, FMT, and GMT, and two significant associations of OS with IS and GMT. Furthermore, modification indices and residuals analyses did not suggest any significant alteration to the initial model specification. In essence, these results are indicative of a good fit of this model solution to the sample data, thus providing a very good representation of the underlying structure of motor affordances in the home.

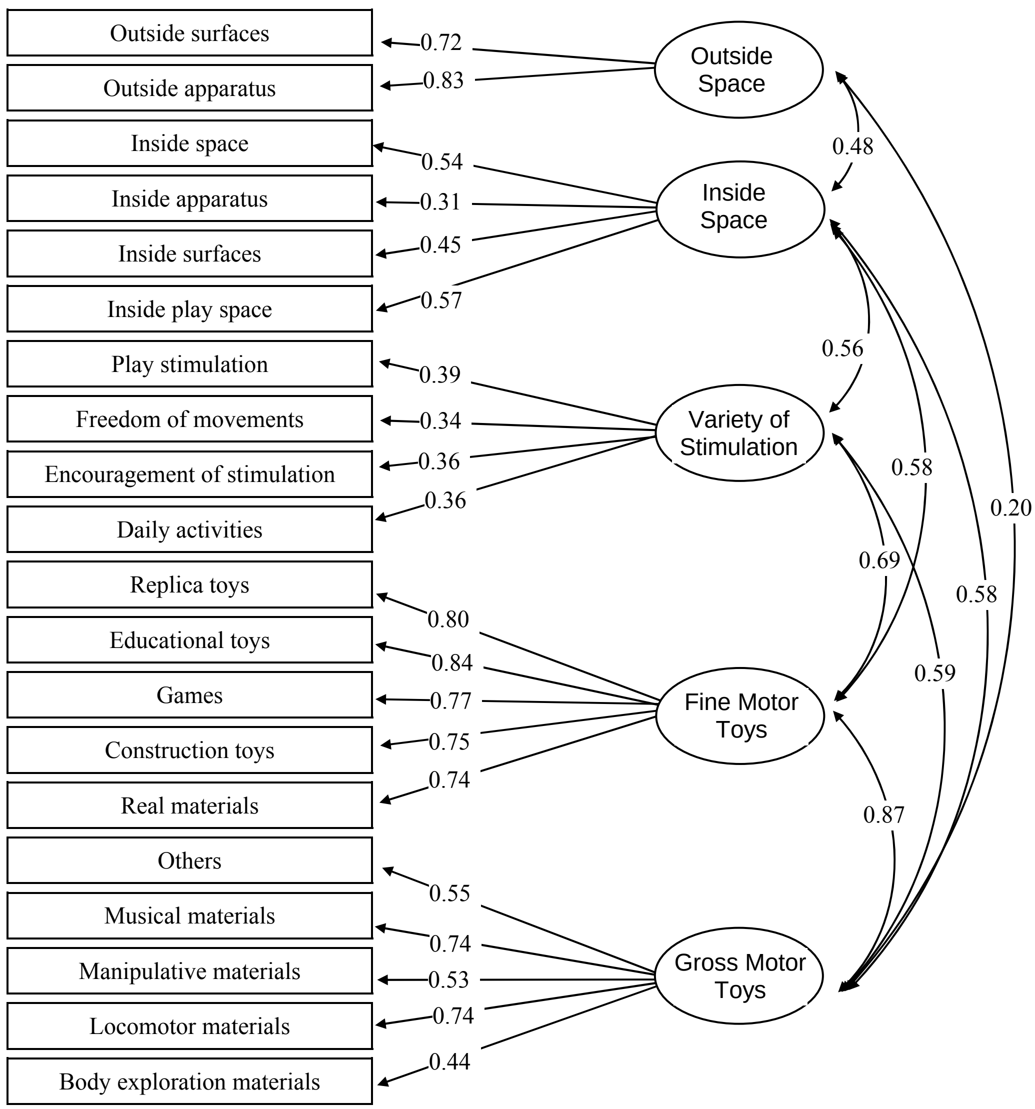


Figure 4. Path diagram of the CFA with the completely standardized values for the five-factor solution (only significant values are shown for factor loadings and correlations between latent factors).

The SRC (reliability coefficient) for the AHEMD had a value of .87, with a SE of 0.023, and a 95% CI ranging from .82 to .91, which indicated a high consistency of the instrument for measuring the construct of interest.

Classification norms for the AHEMD-SR

The mean, standard deviation, and quartiles values for the five AHEMD subscales are presented in Table 6. Given that some scales (OUT and VST) presented a significant departure from normality, inter-quartiles ranges were used to propose the AHEMD subscales classification norms.

Table 6. Mean, standard deviation, range, and quartiles for the five subscales of the AHEMD

Subscales	M	SD	Range	*p*25	*p*50	*p*75
Out Space	2.1	1.9	0 – 6.0	0.0	2.0	4.0
Inside Space	8.0	1.6	2.7 – 11.5	6.8	8.2	9.3
Variety Stimulation	12.2	1.8	6.0 – 16.0	11.0	12.5	13.5
Fine Motor Toys	51.2	20.4	7.0 – 102.0	37.0	51.0	67.0
Gross Motor Toys	21.4	10.4	1.0 – 57.5	14.0	20.0	28.5

Total AHEMD normative scores were then calculated by adding each individual subscale classification. Ranging from 5 to 20, this total score presented a distribution with an average of 12.5 and a SD of 3.5. Since this total score distribution showed a normal configuration, a Mean ± 1 SD interval was used to propose a categorization into Low (less than 9.0), Average (from 9.0 to 16.0) or High AHEMD (more than 16.0).

Discussion

From the results noted, the AHEMD-SR proved its merit in the potential to evaluate and discriminate among different home profiles according to their theoretical driven characteristics for motor development. These data revealed a common structured organization of potential affordances in the home environment comprising five latent factors: Outside Space, Inside Space, Variety of Stimulation, Fine Motor Toys, and Gross Motor Toys. Each of these factors represented a meaningful structure inside the home, possibly resulting from the underlying decisions on how families provide specific environmental stimuli to their children. Although correlation values between factors could imply an overall degree of stability within each home, the better fit of the 5-factor model on portraying home characteristics probably means that parent's decisions are not (or cannot) always be consistent across dimensions. The relevancy for investigating these different profiles of affordances lies in the potential for each child to improve their motor skills.

The findings of Study 1 revealed that the AHEMD-SR is a valid indicator of affordances found in the home environment that have the 'potential' to influence the motor development of young children. As such, this instrument has promise in addressing the statement by Abbott et al. (2000) recommending that "a valid measure reflecting aspects of the home environment that support infant motor development needs to be created" (p. 66).

CHAPTER III

STUDY 2 – TESTING CONSTRUCT VALIDITY

Introduction

After establishing the structural evidence for affordances organization within the home environment, as assessed by the AHEMD-SR, the aim of Study 2 was to test the construct validity of the self-report instrument. That involved testing for the relationship between the AHEMD-SR home evaluation and children's level of motor development. It was hypothesized that a low AHEMD score increases the likelihood of a low motor development score.

Methods

Participants

A sub-sample of 63 families from the 381 of Study 1 was selected for motor assessment. Children were chosen according to the criteria of age (18 to 42 months), absence of disabilities and time spent in Child Care Centers (preferably less than 6 months). In an effort to obtain similar SES, four Child Care Centers divided into Rural (2) and Urban (2) areas were selected. From this initial pool, two families did not return the inventory, three children were excluded due to lack of interest or collaboration during motor testing, two children were not tested because they were sick on scheduled testing days, and permission to perform motor testing was denied by the parents of four children. Thus the final sample consisted of 51 participants (17 girls, 34 boys) with mean age of 36.0 ± 5.2 months, that completed at least one of the PDMS2 components (47 completed the total assessment). Families lived in apartments (47%) or independent houses (53%), with more than one adult present in the house in 98 % of the cases. In regard to parent's education, 19% completed 6th grade, while 41% finished college or professional school. Relative to income, 21% of the children's families had an annual income of less than € 14.000, and 13% earned more than € 49.000 annually, with the rest of the families' income distributed between those two extreme categories.

Procedure

Directors of the four early childhood centers sent each child's family a letter explaining the purpose of the study, asking for their collaboration and providing consent forms. Testing days were scheduled in accordance with the center director. The PDMS2 was administered to each participant by the same researcher according to the Peabody's Instruction Manual and always in the same subtest order: Grasping (GRS), Visual-Motor Integration (VMI), Object Manipulation (OBM), Locomotion (LOC), and Stationary (STT). The PDMS2 (Folio & Fewell, 2000), a revision of the 1983 version, was designed to assess the gross, fine and total motor ability of children from birth through 6 years of age. The assessment of children within the age span of 18 to 42 months consisted of five subtests (Grasping, Visual-motor Integration, Stationary, Locomotion, and Object Manipulation) generating three global indexes of motor performance: the Gross, Fine and Total Motor Quotients. Each Quotient results on a normative, age related classification of the children, based on a normative sample of 2,003 children residing in 47 states of the USA and Canada. The manufacturer claims that psychometrically, this version is an improvement over the original. For example, it has good reliability and validity within a variety of subgroups as well as the general population. According to the manual the test showed high internal consistency (.96 for both gross- and fine-motor scales), test/retest reliability (.89 and .93 for the gross- and fine-motor), and interscorer reliability (.97 and .98 for both scales), and it is a valid assessment of motor development. An outside review of the test's psychometric properties by Palisano et al. (1995) was supportive.

Motor assessments took place in each center facility in a reserved and isolated area. Testing was interrupted whenever a child showed signs of not being attentive or collaborating. If so, consecutive days were used to complete the assessment. All motor assessments were videotaped, reviewed and then destroyed. Within the same week, the AHEMD-SR was completed by the child's family. A coded number was assigned to each family / child, in order to keep the researchers naive to the results until all testing procedures were completed. Two weeks after completion of the initial motor assessment, a random sample of 260 PDMS2 videotaped items were once more assessed by the same observer, resulting in a overall *weighted kappa* for measuring the strength of agreement of .93 (.90 and .96 for the gross- and fine-motor items). The investigators' universities institutional review boards granted approval for this study.

Data analysis

AHEMD results for each subscale were classified according to quartile values for the total sample in Study 1 (see table 6). Total AHEMD scores were calculated adding each subscale classification. PDMS2 values for Fine (FMQ), Gross (GMQ) and Total motor quotients (TMQ) were used as dependent variables to compare groups (Q1 to Q4) for each subscale. Univariate ANOVAs were performed to test for general effect of subscale classification with each dependent variable. LSD multiple comparison test procedures were employed to contrast quartile group developmental levels.

The value from the total AHEMD Mean ± 1 SD from Study 1 (381 subjects) was used to categorize children of the present sub-sample into Low, Average or High AHEMD. The relationship between this allocation and PDMS2 motor quotients was examined using multiple comparison tests and bivariate correlations. Three stepwise regression analyses were implemented to test for the possible linear association between the five AHEMD subscales and their interaction with each of the PDMS2 motor quotients (fine, gross and total). All analyses were performed with the SPSS 11.0 statistical package, maintaining the significance level at .05.

Results

AHEMD results

Descriptive results for each sub-scale are displayed in table 7, along with the percentage of subjects classified according to the AHEMD quartile distribution. Comparing this sample's values with the total sample (Study 1), similar numbers were found for OUT, INS, VST, and GMT; however, a higher mean value was found for FMT (55.8 [Study 1] versus 51.2). No differences were found between the AHEMD classification for these 51 children and the total sample (all *p*-values greater than .1), thus confirming that these families were highly representative of the ones used for the structural validation of the AHEMD.

Table 7. Mean, standard deviation, classification according to the AHEMD quartile classification and comparison with the total AHEMD sample (381 subjects).

			% of subjects by quartile				
	M	SD	Q1	Q2	Q3	Q4	Comparison with total sample
OUT	2.3	2.0	29.4	17.6	23.5	29.4	χ^2 (3, 432)=3.4 p=.32
INS	8.1	1.6	21.6	29.4	21.6	27.5	χ^2 (3, 432)=1.1 p=.75
VST	12.0	2.0	31.4	17.6	27.5	23.5	χ^2 (3, 432)=1.0 p=.79
FMT	55.8	19.0	21.6	13.7	37.3	27.5	χ^2 (3, 432)=6.1 p=.11
GMT	20.7	10.0	23.5	29.4	25.5	21.6	χ^2 (3, 432)= .31 p=.95

Quartile classification of the five subscales was added to find the total AHEMD score. Ranging from 5 to 20, this total score presented a normal distribution with an average of 12.6 and a SD of 3.5.

PDMS2 results

Results of the PDMS2 assessment are shown in Table 8. Children scored better average levels on the fine motor components (GRS = 11.1, VMI = 10.8, and FMQ = 105.7) than on the gross motor component of the assessment (OBM = 10.0, LOC = 9.7, STT = 9.0, and GMQ = 97.2). Classification according to PDMS2 normative groups (right part of table 8) revealed small variation in behavior, with most children classified as *average* on their motor quotients; 67 to 75% of subjects, as opposed to 50% reported in the PDMS2 normative data.

Table 8. Descriptive statistics for PDMS2 standard scores and quotients, and frequency of children located in each category of the PDMS2 classification.

					PDMS2 classification				
	n	*Range*	*M*	*SEM*	Poor	Below Average	Average	Above Average	Superior
Standard Scores									
Grasping	51	7.0 - 15.0	11.1	0.29	0	1	36	10	4
Visual Motor	51	8.0 - 14.0	10.8	0.20	0	0	44	7	0
Manipulative	49	6.0 - 13.0	10.0	0.22	0	4	42	3	0
Locomotion	47	5.0 - 15.0	9.7	0.31	1	7	34	4	1
Postural	47	6.0 - 13.0	9.0	0.26	0	10	36	1	0
Quotients									
Fine Motor	51	91.0 - 127.0	105.8	1.29	0	0	34	13	4
Gross Motor	47	76.0 - 113.0	97.2	1.49	4	6	34	3	0
Total Motor	47	82.0 - 116.0	100.6	1.16	0	6	35	6	0

On the fine motor assessment, only one child was found *below average* on the GRS sub-scale and none were below on FMQ. For the gross motor component, a greater percentage of children were classified as *below average* or *poor* (21%) especially for LOC (17%) and STT sub-scales (21%). Checking the relationship between PDMS2 subtests (Table 9), significant correlations were found between subtests within the same composite score but little or no correlation was revealed between fine and gross motor components.

Table 9. Correlation values between PDMS2 sub-scales and components.

	GRS	VMI	OBM	LOC	STT	FMQ	GMQ	TMQ
GRS	1.0							
VMI	.44**	1.0						
OBM	-.06	.10	1.0					
LOC	-.00	.10	.67**	1.0				
POS	.20	.20	.61**	.51**	1.0			
FMQ	.91**	.77**	.01	.05	.24	1.0		
GMQ	.05	.17	.87**	.87**	.82**	.11	1.0	
TMQ	.48**	.52**	.72**	.73**	.78**	.58**	.87**	1.0

**Correlation is significant at the 0.01 level (2-tailed).

PDMS2 results according to AHEMD subscales classification

Fine motor development. As stated earlier, no child was classified below average for FMQ values for age (table 10). For the most part (67%) children were found to be *average* and *above average* (26%) with a small percentage (8%) classified as *superior*. In regard to the possible association between lower AHEMD and PDMS2 scores (Table 7), children within the first quartile of OUT, INS and VST also exhibited lower mean values of FMQ (respectively 104.0, 102.5 and 103.6). Testing for differences between the FMQ of the lower classified children (Q1) and other groups (Q2. Q3, and Q4), revealed no significant differences.

Table 10. Mean, SEM, and percentage of subjects according to FMQ by AHEMD subscales.

AHEMD Subscale	*Quartile*	*Mean*	*SE*	% of subjects by FMQ classification: Average	Above Average	Superior	ANOVA
OUT	Q1	104.0	2.8	60.0	33.3	6.7	$F_{(3,47)}$= .36 *p*= .77
	Q2	105.0	3.2	88.9	-	11.1	
	Q3	106.5	2.1	66.7	33.0	-	
	Q4	107.4	2.4	60.0	26.7	13.3	
INS	Q1	102.5	2.8	81.8	18.2	-	$F_{(3,47)}$= .94 *p*= .42
	Q2	108.4	2.9	53.3	26.7	20.0	
	Q3	104.6	2.0	72.7	27.3	-	
	Q4	106.4	2.3	64.3	28.6	7.1	
VST	Q1	103.6	2.3	68.8	31.3	-	$F_{(3,47)}$= .68 *p*= .56
	Q2	104.7	1.7	88.9	11.1	-	
	Q3	106.9	2.8	57.1	28.6	14.3	
	Q4	108.3	2.9	58.3	25.0	16.7	
FMT	Q1	106.5	2.5	63.6	36.4	-	$F_{(3,47)}$= .66 *p*= .58
	Q2	107.3	5.0	71.4	-	28.6	
	Q3	106.9	2.3	52.6	36.8	10.5	
	Q4	102.8	1.8	85.7	14.3	-	
GMT	Q1	107.8	2.9	58.3	33.3	8.3	$F_{(3,47)}$= 1.1 *p*= .32
	Q2	102.4	1.8	86.7	13.3	-	
	Q3	108.3	3.2	46.2	30.8	23.1	
	Q4	105.2	2.3	72.7	27.3	-	

Gross motor development. Mean GMQ for the first quartile (Q1) ranged from 91.0 to 97.3 for the five AHEMD subscales, with the percentage of children classified below average (*poor* and *below average*) ranging from 22 to 50 % (table 11). Although Q1 mean values were within normal developmental range, this was the sole quartile group where children rated as *poor* were always present. Gross motor quotient mean values in Q1 were the lowest for INS and VST. Regarding toy provision (FMT and GMT), the first two quartiles had the lowest mean values and shared 100% of the children scoring *poor* in the GMQ. For the OUT subscale, the lowest mean GMQ pertained to the extreme quartiles (Q1 and Q4), but children in the Q1 were more homogeneous than in Q4.

Table 11. Mean, SEM, and percentage of subjects according to GMQ by AHEMD subscales.

AHEMD Subscale	*Quartile*	*Mean*	*SE*	% of subjects by GMQ classification: Poor	Below Average	Average	Above Average	ANOVA
OUT	Q1	95.6	2.8	14.3	14.3	71.4	-	$F_{(3,47)}$= .62 *p*= .60
	Q2	99.4	3.8	-	12.5	75.0	12.5	
	Q3	100.0	2.0	-	-	90.9	9.1	
	Q4	95.4	3.2	14.3	21.4	57.1	7.1	
INS	Q1	91.0	3.5	20.0	30.0	40.0	10.0	$F_{(3,47)}$= 3.36 *p*= .02
	Q2	102.4 *	1.6	-	-	100.0	-	
	Q3	93.8	3.8	20.0	10.0	70.0	-	
	Q4	99.2 *	2.6	-	15.4	69.2	15.4	
VST	Q1	92.5	2.9	18.8	25.0	56.3	-	$F_{(3,47)}$= 2.03 *p*= .12
	Q2	101.6 *	2.7	-	-	75.0	25.0	
	Q3	98.2	2.3	-	16.7	83.3	-	
	Q4	99.9	3.1	9.1	-	81.8	9.1	
FMT	Q1	93.3	4.3	22.2	22.2	55.6	-	$F_{(3,47)}$= 2.25 *p*= .09
	Q2	90.0	5.8	40.0	-	60.0	-	
	Q3	100.9 **	1.9	-	5.3	84.2	10.5	
	Q4	97.3	2.3	-	21.4	71.4	7.1	
GMT	Q1	97.3	3.7	11.1	11.1	77.8	-	$F_{(3,47)}$= .55 *p*= .64
	Q2	94.5	3.3	21.4	7.1	64.3	7.1	
	Q3	98.0	2.3	-	15.4	76.9	7.7	
	Q4	99.7	2.7	-	18.2	72.7	9.1	

* Significantly different from Q1 ($p < .05$)   ** Significantly different from Q2 ($p < .05$)

Examining the significance of the differences between quartile groups within each AHEMD subscale, a significant main effect for INS ($F_{(3,47)}$= 3.36; *p*= .02) was found, with multiple comparison tests indicating that the Q1 mean was significantly lower than Q2 for VST and lower than Q2 and Q3 for INS.

Total motor development. Mean values for TMQ at Q1 ranged from 95.5 to 101.2 for the five AHEMD subscales. In the first three subscales (OUT, INS, and VST), children classified in Q1 also registered the lowest TMQ mean values, although only being statistically significant for Q2 and Q4 groups at INS, and with Q4 children at VST (table 12). On the FMT and GMT subscales there was no difference between mean TMQ values for the four groups, with the two lowest mean values pertaining to Q2 and Q1. Again, INS ($F_{(3,47)}$= 3.28, p= .03) and VST ($F_{(3,47)}$= 2.25, p= .09) classifications accounted for the more evident differences between children's motor levels.

Table 12. Mean, SEM, and percentage of subjects according to TMQ by AHEMD subscales.

				% of subjects by TMQ classification			
AHEMD Subscale	*Quartile*	*Mean*	*SE*	Average	Above Average	Superior	ANOVA
OUT	Q1	99.1	2.3	14.3	64.3	21.4	$F_{(3,47)}$= .42 p= .73
	Q2	100.3	2.8	12.5	75.0	12.5	
	Q3	102.8	1.6	-	90.9	9.1	
	Q4	100.5	2.5	21.4	71.4	7.1	
INS	Q1	95.5	2.6	30.0	60.0	10.0	$F_{(3,47)}$= 3.28 p= .03
	Q2	104.3 *	1.9	-	71.4	28.6	
	Q3	98.2	2.6	20.0	80.0	-	
	Q4	102.4 *	1.8	7.7	84.6	7.7	
VST	Q1	96.5	2.1	25.0	75.0	-	$F_{(3,47)}$= 2.25 p= .09
	Q2	103.3	2.0	-	87.5	12.5	
	Q3	102.2	2.6	16.7	58.3	25.0	
	Q4	102.8 *	1.9	-	81.8	18.2	
FMT	Q1	99.3	2.8	11.1	77.8	11.1	$F_{(3,47)}$= 1.69 p= .18
	Q2	95.4	5.3	40.0	40.0	20.0	
	Q3	103.4 **	1.7	5.3	73.7	21.1	
	Q4	99.5	1.6	14.3	85.7	-	
GMT	Q1	101.2	2.5	-	77.8	22.2	$F_{(3,47)}$= 1.08 p= .36
	Q2	97.4	2.3	21.4	71.4	7.1	
	Q3	102.3	2.4	15.4	69.2	15.4	
	Q4	102.1	2.0	9.1	81.8	9.1	

* Significantly different from Q1 (p< .05) ** Significantly different from Q2 (p< .05)

PDMS2 results according to AHEMD total score

Total AHEMD scores were used to classify children into Average, Low and High AHEMD groups, depending on the total score being within, below or above one *SD* from the Study 1 mean. *Mean* and *SEM* values for FMQ, GMQ, TMQ by AHEMD groups are shown in Figure 5 and Table 13.

Table 13. Descriptive values for motor developmental levels of children classified according to AHEMD and correlation between Total AHEMD and each motor component.

	FMQ				GMQ				TMQ			
AHEMD	n	Mean	SEM	SD	n	Mean	SEM	SD	n	Mean	SEM	SD
Low	9	104.7	3.4	10.0	8	92.9	4.5	12.8	8	97.6	3.3	9.3
Average	35	105.1	1.6	9.3	32	98.1	1.8	9.9	32	100.8	1.4	8.2
High	7	110.3	3.0	7.9	7	98.3	3.3	8.7	7	103.3	1.8	4.8
Total	(r= .10, *p*= .48)				(r= .24, *p*= .11)				(r= .25, *p*= .08)			

Figure 5 shows an increasing average for all three motor quotients from Low to High AHEMD. Complementing this profile, a positive and moderate linear relation between Total AHEMD scores and GMQ (r= .24, *p*= .11), and TMQ (r= .25; *p*= .08) was found. A stepwise regression technique was used to test for the linear association between the five AHEMD factors and their interaction with FMQ, GMQ and TMQ. Interaction between INS and VST was the only significant predictor remaining in the equation for GMQ (standardized coefficient = .369; *p*= .011) and TMQ (standardized coefficient = .416; *p*= .004), explaining respectively 14% and 17 % of the dependent variable variation. There was no significant predictor remaining in the equation for FMQ.

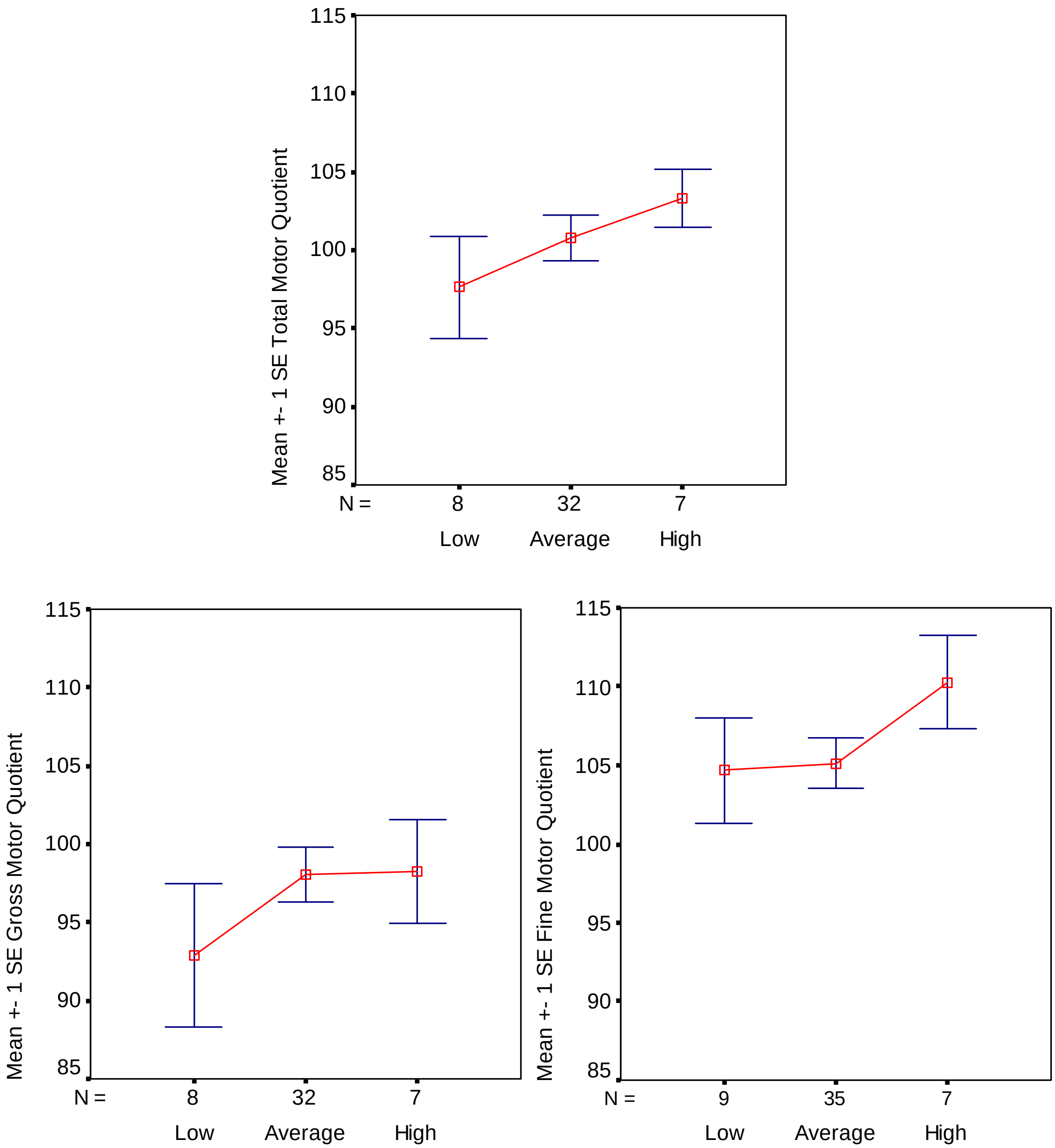


Figure 5. Mean values and SEM of TMQ, GMQ, and FMQ by Low, Average and High AHEMD groups.

Discussion

The initial prediction was that with a low AHEMD score is the likelihood of a lower motor development score. Accordingly, selection of the sample was aimed to collect a range of environmental characteristics (home location, SES and family structure) and motor development behaviors. Final results showed this expectation was met only for the AHEMD. The sample was representative of a wide variety of motor affordances, however, for motor development, the lack of children scoring in the lower range of the PDMS2 scale made it difficult to thoroughly assess the hypothesis. Even so, it was obvious that a general tendency existed for children within the lower quartiles of AHEMD subscales to have lower mean motor development profiles (as shown in tables 7 to 9). This finding was more relevant for *Inside Space* and *Variety of Stimulation* subscales, where Q1 groups had significantly lower gross and total motor quotients ($p < .05$) than children located in the upper quartiles (see table 8 and 9).

Fine motor development showed very small differences between groups scoring in different quartiles of the AHEMD, but since there were no children scoring below average on this motor component, evidence to make a sound conclusion was lacking. It was hypothesized that a reduced number of affordances in the home environment could limit a child from optimal motor development, but its presence certainly could not ensure a good outcome.

Of most importance to this study is the insight obtained from the Total AHEMD scores because they take into account not only the number but also the variety of affordances. For example, an increasing average of all three motor quotients from Low to High AHEMD was found (Figure 3). Complementing this profile, correlation values between AHEMD total scores, composite and total motor scores were always positive and moderate, almost achieving significance despite the limited variation of the motor development outcome. Regression analyses revealed that the interaction between INS and VST was a significant predictor for GMQ and TMQ. This finding suggests that a proper amount of stimulation in the house can multiply the effect of materials and spaces.

Overall, these results show promising evidence for supporting the prediction that with a low AHEMD score is the likelihood of a lower motor development score. Less favorable motor development was associated with less availability of home affordances and the interaction of Inside Space and Variety if Stimulation was significantly related to both Gross and Total motor development. Additional research needs to include samples involving a wider variation of motor development, especially in the lower range.

CHAPTER IV

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

For the past 40 years, effort has been devoted to mapping the relations between the home environment and selected aspects of the child's development. Although motor items have been included in noted inventories, such as the HOME (Caldwell & Bradley, 1984), the fact remains that minimal information is available in relation to the multidimensional effects of the home on motor development. In addition, we still lack a valid measure reflecting aspects of the home environment that influence early motor development (e.g. Abbot et al., 2000). The starting premise of this dissertation, founded in selected propositions of Ecological (Affordance) theory (Gibson, J.J., 1979; Gibson, E.J., 2002), was that the home environment can provide affordances that can be conducive to stimulating motor development. It was further hypothesized that affordances are organized according to a common structure that can be represented by a number of specific stable dimensions of the home environment.

With this in mind, a long-term project (AHEMD project) was designed to develop a unique research instrument that could reliably and validly assess the structure of home characteristics affecting motor development during early childhood. Within this project, the specific goal of this dissertation was to develop and validate a self-report version of the instrument for the age interval 18-to-42 months.

The initial development of the instrument resulted in a tentative version of the AHEMD-SR. Extensive review of the literature, expert panel consultation, readability level checking, and a pilot study, gave initial substance to an instrument that already had potential as a general 'best practice' document. Such a document would also seem to have appeal to educators and parents wishing to optimize the development of normal children.

This first version, comprising one section on Child and Family Characteristics (11 items), and three on home environment characteristics and affordances: Physical Space (17 items), Daily Activities (15 items), and Play Materials (28 items), was tested on its structural validity. A preferred model, entailing five latent dimensions of the home affordances structure was compared with four other possible models in Study 1. The results revealed a significantly better fit for the postulated five factor model, thus leading to the conclusion that a common structured organization of potential affordances in the home environment comprises five latent factors: Outside Space, Inside Space, Variety of Stimulation, Fine Motor Toys, and Gross Motor Toys. Furthermore, the *AHEMD-SR* revealed potential to evaluate and discriminate among different home profiles according to their theoretically driven characteristics for motor development. Each of the dimensions represented a meaningful structure associated with the home, possibly resulting from the underlying decisions on how families provide specific environmental stimuli to their children. The better fit of the 5-factor model and the existence of key significant correlation values, suggests that parent's decisions were not (or could not) always be consistent across dimensions. This assumption complements the notion of individual differences in children that are likely between and within homes.

In addition to finding support for a common structure represented by a number of specific stable dimensions of the home environment, this first study also found that the AHEMD-SR is a valid and reliable instrument for assessing how well the home environment affords movement and potentially promotes motor development. Concurrent validity of the instrument established by direct observation of the home resulted on high correlations (.86 to.98) between the self-reported and the observed values for the three sections of the inventory. The AHEMD-SR showed high consistency for measuring the construct of interest (SRC=.85; SE=.028; 95% CI= .80 to .91)

Study 2 examined the expectation that the AHEMD-SR could validly reflect aspects of the home environment that support infant motor development. In order to establish the construct validity and reliability of the instrument, the relationship between the home environment, as measured by the inventory, and the motor development levels of children (18-to-42 months), as measured by the PDMS2, was tested. The primary prediction was that with a low AHEMD score was the likelihood of a lower motor development score. The sample selection for this study included a range of environmental characteristics (home location, SES and family structure) and motor development behaviors.

The Fine, Gross, and Total motor assessment sections of the PDMS2 was used to compare groups based on subscales (quartiles) and total AHEMD classification (Low, Medium, and High). Results showed a general tendency for children within the lower quartiles of the AHEMD subscales to have lower mean motor development profiles. This finding was more relevant for *Inside Space* and *Variety of Stimulation* subscales, where children in the first quartile groups had significantly lower gross and total motor quotients ($p < .05$) than children located in the upper quartiles. Children scoring in different quartiles of the AHEMD showed no differences on their fine motor proficiency, but this conclusion was limited by the small variance of the sample on this factor. In fact, all the children scored on or above average on the fine motor component. Therefore, a definitive conclusion suggesting that a reduced number of affordances in the home environment would limit a child from optimal motor development was not possible.

In general, the results obtained from the Total AHEMD scores showed a clear increasing average of all three motor quotients (Fine, Gross, and Total) from Low to High AHEMD. This analysis is of utmost importance to this dissertation because the Total AHEMD accounts not only for number but also variety of affordances. Positive and moderate correlation values were always found between AHEMD total scores, and motor scores (total and quotients). This fact is particularly important despite the limited motor development variation registered in the sample because it shows a similar co-variation between the family home affordances and children motor development.

When regression analyses were used to test for the possibility that home affordance dimensions are a significant predictor for children motor development, results revealed that the interaction between INS and VST was a significant predictor for GMQ and TMQ, explaining respectively 14% and 17 % of the variation. This finding is consistent with Bronfenbrenner's (1979, p. 38) assertion that *"in the ecology of human development the principal main effects are likely to be interactions"*, and suggests that a proper amount of stimulation in the home can multiply the effect of materials and spaces.

In summary, the combined results of Study 1 and 2 show promising evidence for the accomplishment of the proposed research goals. A common structure was found that represents the characteristics present in the home environment that can be conducive to motor development. This structure, represented by five latent dimensions (Outside Physical Space, Inside Physical Space, Variety of Stimulation, Gross Motor Materials, and Fine Motor Materials) can be reliably, advantageously and parsimoniously assessed by the parent's answers to the AHEMD-SR. Furthermore, the results found in Study 2 showed support for the prediction that with a low AHEMD score is the likelihood of a lower motor development score. Less favorable motor development was associated with less availability of home affordances and the interaction of Inside Space and Variety of Stimulation was significantly related to both Gross and Total motor development. As so, the AHEMD-SR showed promise in addressing the statement by Abbott et al. (2000) recommending that "a valid measure reflecting aspects of the home environment that support infant motor development needs to be created" (p. 66).

So, what are the implications of this work? The anticipated contributions are found in the instrument's research and clinical applications. The outcome of this project has merit in enhancing our basic understanding of the potential of the home environment in optimizing motor development of the child. Use of the AHEMD-SR has promise in providing insight into the specifics and relations between variety, type and amount of affordances as influencing factors for motor development. For example, perhaps it is not the influence of a few types of affordances or the amount, rather it is the interaction between them; this instrument provides a way to view the home as a multifaceted setting. One of the most apparent applications of the instrument is its use as a research tool. As noted in Chapter 1, studies addressing the relationship between the home environment and infant motor development are sparse – application of the AHEMD-SR may stimulate such inquiry from a number of perspectives. That is, perspectives that stretch beyond an isolated look at motor development. For example, earlier reports using the HOME inventories found that "availability of stimulating play materials were more strongly related to child development status than global measures of environmental quality such as SES [socioeconomic status]" (Bradley et al., 1989, p.217). Use of the AHEMD-SR in some instances provides the collection of more specific data regarding movement affordances (compared to the HOME), which may clarify developmental outcome. As evidenced by one of the more recent studies (Goyen & Lui, 2002), researchers are becoming increasingly interested in the longitudinal effects of the home environment on the motor development of normal and high-risk infants. This interest is prompted in part by the fact that infants born with low birth weight are at risk for motor dysfunction and delay (Case-Smith, 2000; Liebhardt, Sontheimer, & Linderkamp, 2000; Pietz et al., 2004). Furthermore, underlying many studies of this nature is the suggestion that motor development plays an integral role in cognitive and academic outcome (Becker, Grunwald, & Brazy, 1999; Bertenthal & Campos, 1990; Diamond, 2000; Thelen, Schoner, Scheier, & Smith, 2001).

By clarifying the relationship between elements in the home and motor development, the instrument could have clinical significance for early intervention. For example, infants at-risk could have their home assessed (screened) to determine or maximize appropriate intervention strategies. Such strategies may include home modification and parental education. Abbott et al. (2000) suggest that if therapists are to be effective, "an understanding of the physical and social home environment is necessary" (p. 66). Although we have not presented the instrument as such, with some modification, it has potential as a general 'best practice' document, given that most of the items were selected based on expert recommendations. Such a document would also seem to have appeal to educators and parents wishing to optimize the development of normal children.

In regard to possible expansion of this work, additional research needs to include greater sample sizes, involving a wider variation of motor development, especially in the lower range. Complementing this fact is also the need for expanding the age range of the instrument. Given the trend toward early intervention, an AHEMD-SR for ages3- to 18 months and perhaps one for 42- to 72 months (entering the school years) is warranted. Another appropriate question that needs to be addressed is the instrument's stability over time. For example, does change in the home overtime complement change in motor behavior? And, as noted earlier, an avenue of research that is of interest to many early childhood educators is a study of the interrelationships between home affordances that stimulate motor development and later academic performance.

In light of the long-term goal of increasing the cultural scope of the instrument, for further validation in different settings and populations are also in order. There is little doubt that there are differences in infant behavior among cultural groups around the world and subgroups within a country. It would be interesting to determine, for example, which factors and items from the AHEMD-SR remain stable across cultures. Common variables in investigations of this type include relationship to parental expectations, socioeconomic status (SES), child rearing practices, parent education, and space. In this dissertation, although a careful selection was made of a Portuguese sample that was comparable in SES and parent education to the pilot sample in the US, living space and child-rearing differences were probable. For example, Western European families in general are more likely to live in apartments or comparatively smaller single-family homes, compared to US families; consequently, there may be a 'space' affordance issue. However, as one would expect, within any cultural sample is wide range of variability in those factors.

In summary, the findings of this study suggest that the AHEMD-SR is a valid and reliable instrument for assessing how well home environments afford movement and potentially promote motor development. However, although we can make reasonable predictions about developmental outcome, one should keep in mind that the margin of error can vary considerably. The interaction of nature and nurture results in individuality that stresses our ability to measure with a high degree of accuracy - the human condition. Our expectation is that the AHEMD-SR would be a step further in the right direction to open new avenues into understanding the multifaceted dynamics and interaction of the home environment and motor behavior. The present results proved optimistic on this matter, but more data is paramount to better isolate the motor affordance effect within the complex ecology of children's live.

REFERENCES

Abbott, A., & Bartlett, D. (1999). The relationship between the home environment and early motor development. *Physical & Occupational Therapy in Pediatrics*, *19*, 43-57.

Abbott, A., & Bartlett, D. (2000). Infant motor development and equipment use in the home. *Child, Care and Development*, *27*, 295-306.

Abbott, A., Bartlett, D., Fanning, J., & Kramer, J. (2000) Infant motor development and aspects of the home environment. *Pediatric Physical Therapy*, *12*, 62-67.

Adolph, K., & Avolio, A. (2000). Walking infants adapt locomotion to changing body dimensions. *Journal of Experimental Psychology*: *Human Perception and Performance*, *26*, 1148-1166.

Anastasi, A., & Urbina, S. (1997). *Psychological Testing* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Bartlett, D., & Fanning, J. (2003) Relationships of equipment use and play positions to motor development at eight months corrected age of infants born preterm. *Pediatric Physical Therapy*, *15*, 8-15.

Becker, P., Grunwald, P., & Brazy, J. (1999). Motor organization in very low birth weight infants during caregiving: Effects of a developmental intervention. *Developmental and Behavioral Pediatrics, 20* (5), 344-354.

Bertenthal, B. I., & Campos, J.J. (1990). A systems approach to the organizing effects of self-produced locomotion during infancy. In C. Rovee-Collier & L.P. Lipsitt (Eds.),*Advances in infancy research*, (Vol. 6, pp. 1-60). Norwood, NJ: Ablex.

Bober, S., Humphry, R.; Carswell, H., & Core, A. (2001). Toddlers' persistence in the emerging occupations of functional play and self-feeding. *American Journal of Occupational Therapy*, *55*, 369-376.

Botha, M. (1982). The influence of the home environment on the motor performance of preschool children. (Doctoral dissertation, Indiana University,1982). *Dissertation Abstracts International*, *43*, 8-A.

Bradley, R., Burchinal, M., & Casey, P. (2001). Early intervention: the moderating role of the home environment. *Applied Developmental Science, 5*, 2-9.

Bradley, R., Caldwell, B., & Corwyn, R.F. (2003). The child care HOME inventories: assessing the quality of family child care homes. *Early Childhood Research Quarterly, 18*, 294-309.

Bradley, R., Caldwell, B., Rock, S., Ramey, C., Barnard, K., Gray, C., Hammond, M., Mitchell, S., Gottfried, A., Siegel, L., & Johnson, D. (1989). Home environment and cognitive development in the first 3 years of life: A collaborative study involving six sites and three ethnic groups in North America. *Developmental Psychology, 25*, 217-235.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research Perspectives. *Developmental Psychology, 22*, 723-742.

Bronfenbrenner, U. (2000). Ecological Theory. In A. Kazdin (Ed.), *Encyclopedia of Psychology*. Washington, DC and new York: American Psychological Association and Oxford University Press.

Burton, A., & Davis, W. (1992). Optimizing the involvement and performance of children with physical impairments in movement activities. *Pediatric Exercise Science, 4*, 236-248.

Caldwell, B., & Bradley, R. (1984). *Home observation for measurement of the environment*. Little Rock, AR: University of Arkansas at Little Rock.

Case-Smith, J. (2000). Effects of occupational therapy services on fine motor and functional performance in preschool children. *American Journal of Occupational Therapy, 54*, 372-380.

Diamond, A. (2000). Close interrelation of motor development and cognitive development of the cerebellum and prefrontal cortex. *Child Development, 71* (1), 44-56.

Diamond, M., & Hopson, J. (1998). *Magic trees of the mind: How to nurture your child's intelligence, creativity, and healthy emotions from birth through adolescence*. New York: Dutton.

Fischer**,** K**.**, & Rose, S. (1998). Growth cycles of brain and mind. *Educational Leadership*, *56*, 56-62.

Frankenburg, W., & Coons, C. (1985). Home Screening Questionnaire: Its validity in assessing home environment. *The Journal of Pediatrics, 108*, 624-626.

Gibson, E. J. (2002). *Perceiving the affordances: a portrait of two psychologists*. Mahwah, NJ: Erlbaum.

Gibson, J. J. (1979). *An ecological approach to perception*. Boston MA: Houghton Mifflin.

Goodson, B., & Bronson, M. (2003). *Which toy for which child: A consumer's guide for selecting suitable toys, ages birth through five.* Retrieved July 22, 2003 from U. S. Consumer Product Safety Commission Web site: http://www.cpsc.gov/cpscpub/pubs/285.pdf.

Goyen, T., & Lui, K. (2002). Longitudinal motor development of "apparently normal" high-risk infants at 18 months, 4 and 5 years. *Early Human Development, 70*, 03-115.

Guadagnoli, E., & Velicer, W. (1988). Relation to sample size to the stability of component patterns. *Psychological Bulletin, 103*, 265-275.

Heft, H. (1997). The relevance of Gibson's ecological approach to perception for environment-behavior studies. In Gary T. Moore & Robert W. Marans (Eds), *Advances in environment, behavior, and design*, *Vol. 4: Toward the integration of theory, methods, research, and utilization* (pp. 71-108). New York; London : Plenum published in cooperation with the Environmental Design Research Association.

Hirose, N. (2002). An ecological approach to embodiment and cognition. *Cognitive Systems Research, 3*, 289-300.

Hopkins, B. & Westra, T. (1988). Maternal handling and motor development: an intercultural study. *Genetic, Social and General psychology Monographs*, *114* (4), 379-408.

Jöreskog, K., & Sörbom, D. (1993). *LISREL 8: Structural equation modeling with the SIMPLIS command language*. Chicago, Illinois: Scientific Software International, Inc.

Jöreskog, K., Sörbom, D., Du Toit, S., & Du Toit, M. (1999). *LISREL 8: New statistical features*. Chicago, Illinois: Scientific Software International, Inc.

La Veck, B. & Hammond, M. (1982). Performance on the motor scale of the McCarthy scales of children's abilities as related to home environment and neonatal reflexes. *Perceptual and Motor Skills*, *54*, 1265-1266.

Lerner, R. (1996). Relative plasticity, integration, temporality, and diversity in human development: A developmental contextual perspective about theory, process, and method. *Developmental Psychology*, 32 (4), 781-786.

Lerner, R. (2002). *Concepts and Theories of Human Development* (3rd ed). Mahwah, N.J.: L. Erlbaum Associates.

Liebhardt, G., Sontheimer, D., & Linderkamp, O. (2000). Visual-motor function of very low birth weight and full-term children at 3 1/2 to 4 years of age. *Early Human Development, 57* (1), 33-47.

Mueller, R. (1996). *Basic principles of structural equation modeling :an introduction to LISREL and EQS*. New York: Springer.

Mundfrom, D., Bradley, R., & Whiteside, L. (1993). A factor analytic study of the infant-toddler and early childhood versions of the HOME inventory. *Educational and Psychological Measurement. 53*, 479-489.

Palisano, R., Kolobe, T., Haley, S., Lowes, L., & Jones, S. (1995). Validity of the Peabody Developmental Motor Scales as an evaluative measure of infants receiving physical therapy. *Physical Therapy, 75*, 939-948

Parks, P., & Bradley, R. (1991). The interaction of home environment features and their relation to infant competence. *Infant Mental Health*, *12*, 3-16

Pietz, Peter, Graf, Rauterberg-Ruland, Rupp, Sontheimer & Linderkamp (2004). Physical growth and neurodevelopmental outcome of nonhandicapped low-risk children born preterm. *Early Human Development*, *79*, 131-143.

Poresky, R., & Henderson, M. (1982). Infants mental and motor development - effects of home-environment, maternal attitudes, ma rital adjustment, and socio-economic status. *Perceptual and Motor Skills, 54* (3): 695-702.

Ramey, C., & Ramey, S. (1998). Early intervention and early experience. *American Psychologist, 53*, 109-120.

Raykov, T. (2001). Estimation of congeneric scale reliability using covariance structure analysis with nonlinear constraints. *British Journal of Mathematical and Statistical Psychology, 54,* 315-323.

Satorra, A., & Bentler, P. (1994). Corrections to test statistic and standard errors in covariance structure analysis. In A. Van Eye & C. C. Clogg (Eds.), *Analysis of the latent variables in developmental research* (pp. 399-419). Newbury Park, CA: Sage.

Stoffregen, T. A. (2000). Affordances and events. *Ecological Psychology , 12*, 1-28

Thelen, E., Schoner, G., Scheier, C., & Smith, L.B. (2001). The dynamics of embodiment: A field theory of infant perserverative reaching. *Behavioral and Brain Sciences, 24*, 1-86.

US Consumer Product Safety Commission. (2002). *Age determination guidelines: Relating children's ages to toy characteristics and play behavior*. Washington, DC.

Wilson, B., Kaplan, B., Crawford, S., Campbell, A., & Dewey, D. (2000). Reliability and validity of a parent questionnaire on childhood motor skills. *American Journal of Occupational Therapy, 54*, 484-493.

APPENDIX A

AHEMD-SR

AHEMD
affordances in the
home environment
motor development

Self Reporting AHEMD (18-42 months)

Child Characterization

Child's Name: ______________________				**Code:**
				Date:
Male ☐	Female ☐	Birth Date: ____/____/____		Birth Weight: _______ lbs
How long has your child attended childcare?	Never ☐	Less 6 month ☐	6 to 12 months ☐	More 12 months ☐

Ethnicity: White ☐ Black or African-American ☐ Hispanic or Latino ☐ Asian ☐

American Indian or Alaska Native ☐ Native Hawaiian or other Pacific Islander ☐

Family Characterization

1. How many adults live in the family house?	1 ☐	2 ☐	3 ☐	4 ☐	5 or more ☐	
2. How many children live in the family house?	1 ☐	2 ☐	3 ☐	4 ☐	5 or more ☐	
3. How many rooms do you have in your house? *(please do not count the bathrooms)*	1 ☐	2 ☐	3 ☐	4 ☐	5 or more ☐	
4. How long has your child lived at this house?	Less 6 month ☐	6 to 12 months ☐	More 12 months ☐			
5. What's the child's father's education ?	Elementary School ☐	Middle School ☐	High School ☐	College ☐	Master ☐	PhD ☐
6. What's the child's mother's education ?	Elementary School ☐	Middle School ☐	High School ☐	College ☐	Master ☐	PhD ☐
7. What's the annual household income ?	Under $10,000 ☐	$10,000 to $15,000 ☐	$15,000 to 25,000 ☐	$25,000 to $35,000 ☐	$35,000 to $50,000 ☐	$50,000 and over ☐

Physical space in the home

Please read carefully each question and mark the box respective to your answer (Yes or No)

		YES	NO
8	Outside your house (but associated with it) is there ample space for your child to play or move around freely? *(backyard, front yard, garden, etc)*	☐	☐

If you answered YES please proceed with the next question, if you answered NO please go to question number 8

	In the outside space is (are) there:	*YES*	*NO*
9	more than one type of ground texture? *(grass, dirt, concrete, wood, sand, etc).*	☐	☐
10	one or more sloped surfaces? *(varied degrees and types of inclines or gradual slopes and slopes).*	☐	☐
11	any apparatus (man made or natural) that your children can grasp and hang from ?	☐	☐
12	any stairs*? (at least two (2) or more steps)*	☐	☐
13	any apparatus or platform that permits your child to climb on/off and step or jump from*. (It must be about eight-inches or more)*	☐	☐
14	a play area *(playground)* designed for your young children ?	☐	☐

	Inside your house is (are) there:	*YES*	*NO*
15.	enough space for your child to play or move around freely?	☐	☐
16.	more than one type of ground texture? *(carpet, wood, tile, linoleum, etc).*	☐	☐
17.	material for your child to fall safely on*? (carpet with padding, one-inch mat,, etc)*	☐	☐
18.	any furniture or apparatus that your children can grasp and hang from safely?	☐	☐
19.	any stairs*? (at least two (2) or more steps)*	☐	☐
20.	any furniture or apparatus that permits your child to climb on/off and step or fall from? *(Examples are sofas, small tables, chair, etc).*	☐	☐
21.	any furniture or apparatus with a platform eight-inches (8") tall or more, the child can use to jump from?	☐	☐
22.	a playroom? *(room used **only** for kids to play)*	☐	☐
23.	a special place for toys that is accessible to the child so that she/he may choose when and with what to play? *(toy bins, drawers, or shelves)*	☐	☐

Daily activities in the home

During the day (but only referring to the time spent in your house):	YES	NO
24. My child plays with other children as a usual and ordinary every day event.	☐	☐
25. I (or my husband/wife) usually have a daily special time for playing with my child.	☐	☐
26. Other adults, rather than parents, regularly play with my child.	☐	☐
27. When playing, my child is always allowed to choose the toys or physical activities by herself / himself.	☐	☐
28. My child usually wears clothes that allow freedom to move and explore.	☐	☐
29. My child is often barefoot in the house.	☐	☐
30. I (or my husband/wife) usually try to encourage my child to reach and grasp objects.	☐	☐
31. I (or my husband/wife) usually try to engage my child in movements, games or actions in order to teach her/him parts of the body.	☐	☐
32. I (or my husband/wife) regularly try to teach my child movement or action words as “stop”, “run”, “walk”, “crawl”, etc.	☐	☐

On a typical day, how would you describe the amount of awake time your child spends in each of the situations below? *(Read carefully each question and mark the box respective to your answer)*

33. Carried in adult arms, attached to caregiver’s body or in some carrying device.

No time ☐ *Very little time* ☐ *Some time* ☐ *A long time* ☐

34. In a seating device (high chair, stroller, car seat, sofa, or any other type of seating devices)

No time ☐ *Very little time* ☐ *Some time* ☐ *A long time* ☐

35. In a Playpen or some other similar equipment.

No time ☐ *Very little time* ☐ *Some time* ☐ *A long time* ☐

36. On the bed or crib (while awake).

No time ☐ *Very little time* ☐ *Some time* ☐ *A long time* ☐

37. Restrained to a specific space in the floor

No time ☐ *Very little time* ☐ *Some time* ☐ *A long time* ☐

38. Free to move in any space of the house

No time ☐ *Very little time* ☐ *Some time* ☐ *A long time* ☐

39. How do you consider the living space inside your house?

No time ☐ *Very little time* ☐ *Some time* ☐ *A long time* ☐

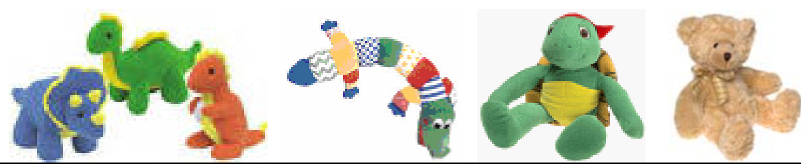
Play materials in the home

On each toy group listed below please check the box for the number of toys you have in your house. Please read carefully each group general descriptions for deciding if you have this type of toy in your house.

Figures are only examples to help you better understand the description. You do not need to have the exact toy represented to count it in the group. ***Similar toys should be counted***

40 Stuffed toys

Examples are:



How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

41 Dolls and other play figures and respective equipment.

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

42 All kind of puppets (small hand puppets)

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

43. House equipment, telephone, cooking play material, play tools, and other play materials that simulate adult home activities.

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

44 Vehicles, animals or other toys to be pushed and rolled

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

45. Familiar play scenes (farm, doll house, airport, garage, etc) with people/animal figures, vehicles, and simple supported material

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

46 Puzzles (4-5 pieces) and Shape sorters

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

47 Stacking (6-12 pieces) and Nesting toys

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

48 Lacing cubes or boards and large colored beads

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

49 Peg boards

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

50. Simple matching toys, Simple number counting toys, Magnetic boards w/ shapes, animals, letters, Color forms.

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

51 Pop-up-toys and Jack-in-the-box toys.

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

52 Multi-activities tables and apparatus.

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

53 Small Blocks, Lego type bricks, small play construction sets.

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

54 Large plastic bricks to put together on construction settings

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

55. Books (picture, stories with repetition, pop-up, hidden pictures, dressing, etc)

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

56. Sand boxes, Sand play toys, Water play toys (floating, funnels, colanders, containers, etc)

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

57. Materials for designing and coloring: Large crayons, Large Paper, Non-toxic paints (finger, tempera) and short handled brushes w/ blunt ends, Clay or dough, Large, sturdy markers, Blunt-end scissors, Large Chalk

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

58. Simple games, Simple matching and lotto material, Color, picture dominoes, Board games based on chance *(only a few large pieces)*

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

59 Musical toys (music box – hand-cranked by child)

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

60. Musical materials, All rhythm instruments (bells, rattles, cymbals, drums, triangle, rhythm stick, xylophones), Horns and whistles

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

61. Play materials used for gross movements with the arm and legs (throwing, catching, kicking, rebounding, striking, etc). Balls of different sizes and colors, Bats, Baseball Gloves, Throwing Targets, etc.

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

62. Play materials used with upright locomotion. Examples are Pull or push toys, Little horses to ride on, Scooters, etc

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

63. Play materials used for gross movement exploration (sliding, creeping, climbing, rolling, etc). Examples are Slides, Stairs, Tunnels, Climbing apparatus, Exercise mattresses, Pools, Parachutes, etc.

Examples are:

How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

64. Auto propelled play materials used for riding on, all types of ride-on toys (propelled by bouncing or pushing) and tricycles.

Examples are:




How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

65 Swings, rocking and twisting toys.

Examples are:






How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

66. Mirror (full-length) that can be used by the children in their motor activities.

Examples are:


How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

67. Audio equipment (CD or tape Players and children's music CD's or Tapes)

Examples are:


How many of these toys do you have in your house?

None ☐ *One* ☐ *Two* ☐ *Three* ☐ *Four* ☐ *Five* ☐ *More than 5* ☐

VITA

LUIS PAULO LOPES BRANDÃO AREOSA RODRIGUES

Departamento de Motricidade Humana
Escola Superior de Educação
Instituto Politécnico de Viana do Castelo
Av. Capitão Gaspar de Castro -Apartado 513
4901-908 Viana do Castelo
lprodrigues@ese.ipvc.pt

Education

PhD	Kinesiology	Texas A&M University	2005
MA	Child Development	University of Lisbon	1995
BS	Physical Education	University of Porto	1986

Professional Experience

Instituto Politécnico Viana do Castelo, Portugal 1988 – present

Published Research

Gabbard, C., Ammar, D., & Rodrigues, L. (in press). Perceived reachability in hemispace. *Brain and Cognition*.

Rodrigues, L., & Gabbard, C. (in press). Development and structural validation of an inventory for assessing affordances in the home environment for motor development. *Research Quarterly for Exercise and Sport.*

Gabbard, C., Ammar, D., & Rodrigues, L. (in press). Motor imagery in reaching: Is there a Left-hemisphere advantage? *International Journal of Neuroscience*.

Rodrigues, L., & Bezerra, P. (2004). Rastreio da deposição de massa adiposa ao longo do crescimento (7-10 anos) na população infanto-juvenil do concelho de Viana do Castelo. *Horizonte*, 19, (113), 15-21.

Gabbard, C., & Rodrigues, L. (2002). Optimizing early brain and motor development through movement. *Early Childhood News*, 14 (3), 32-38.