Scale of Harmonic Development. A Validation Study

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Título: Escala de Desarrollo Armónico: un estudio de validación.
Resumen: Este trabajo recoge, en primer lugar, el estudio de validación psicométrica de la *Escala de Desarrollo Armónico* (EDA) (Abellán, 2011). Participaron en el trabajo 218 niños de edades comprendidas entre 0 y 12 años. Los análisis factoriales exploratorios mostraron la unidimensionalidad de todas las subescalas y de la escala globalmente; así como la consistencia interna de las medidas y la adecuación de los ítems, desvelando en este momento del proceso su utilidad como un test de screening para la prevención del desarrollo infantil. Se presenta además un primer acercamiento al proceso de validación concurrente de la misma para el que fueron evaluados otros 67 niños de 6 años. La validación concurrente con las escalas *IDB* (*Fundació Catalana per a la Síndrome de Down*, 1989) y *BLOC Screening* (Puyuelo, Renom, Solanas y Wiig, 2002), mediante análisis de correlaciones arrojó datos contradictorios que deberán ser contrastados en próximos estudios con una muestra más amplia.
Palabras clave: Escalas de desarrollo; validación psicométrica; análisis factorial exploratorio; AFE; validación concurrente; desarrollo infantil.

Abstract: This paper gathers firstly, the study of psychometric validation of the *Scale of Harmonic Development* (SHD) (Abellán, 2011). 218 children between the ages of 0-12 years were participated in the study. The exploratory factorial analysis showed the one-dimensional nature of the scale as a whole and all its subscales; as well as the internal consistency of the measurements and the adequacy of the items, revealing the scale's usefulness as a screening test for prevention of children's development. Secondly, a first approach to the scale's validation process is presented in this dissertation, for which another 67 six-year-old children were evaluated. The concurrent validation with the scales *IDB* (*Fundació Catalana per a la Síndrome de Down*, 1998) and *BLOC Screening* (Puyuelo, Renom, Selanas & Wiig, 2002) conducted through analysis of correlations provided contradictory data that will be contrasted in future studies with a broader sample.
Keywords: Development scales; psychometric validation; exploratory factorial analysis; AFE; concurrent validation, children's Development.

Introduction

The evaluation and monitoring of development from an early age is justified insofar as brain plasticity is higher the younger the brain is, being the first years of age when the main part of acquisitions take place (Cuervo & Ávila, 2010). Therefore, early intervention (clinical and educational) on alterations improves the possibility of harmonization of the developmental course in these areas (Millá, 2016).

Since almost a century ago, the assessment and measurement of psychological development thanks to Arnold Gessell's (1925) pioneering contributions, has produced different tools that have been generally designed to evaluate specific periods of infancy or childhood, which makes professionals have to switch tools between each developmental stage, complicating the interpretation and monitoring of intra-individual change and intergroup comparison. This is due to the fact that many scales are based on distinct constructs; evaluate different functions, although related; and present diverse application methods and measurement units.

Taking the study about the quality of tests for the evaluation of development used in Spain made by Prieto & Muñiz as reference, we selected 11 tests (Abellán, 2011) onto which we applied the following analysis criteria: *degree of specialization* (range of ages to which it can be applied without modifying methodology, number of areas evaluated and level of qualification of the user), *degree of specificity* (psychological, pedagogical or biomedical source from which the test items originate, users' profession) and, *other aspects* such as the total number

of items and range of ages to which they are applied; and the medium, correction method and report.

Regarding the age range, 4 out of the 11 tests, *Guía Portage* (Bluma, Shearer, & Hilliard, 1995), *Haizea-Llevant scale of development* (Fernández, 1991), Evaluación Psicomotriz de Denver (Frankenburg, Dodds, Archer, Shapir & Bresnick, 1992) and the Child Development inventory (CDI) (Ireton & Thwing, 1988) cover the range of 0-6 years, while the rest cover diverse ages. Thus the *Kent Scale of Infant Development* (García-Tornel, Ruiz, Reuter, Clow & Reuter, 1997) and the *Uzgiris-Hunt Ordinal Scales of Psychological Development,* confine the first two years of age, while *the Bayley scales of infant development (B*ayley, 1977*)* and the Brunet-Lezine scale of Psychomotor development in early infancy (Josse, 1997) reach the age of 4 years. Only 2 of the reviewed scales cover the wider range of 0-9 years; these being the *McCarthy Scales of children's abilities* (Cordero, Seisdedos, De la Cruz & González, 1996) and the *Battelle developmental Inventory (BDI)* (*Fundació Catalana per a la Síndrome de Down*, 1989). An exception to this limitation would be the *Escala observacional del desarrollo (EOD)* (Secadas, 1992), which reaches the age of 17 years although incorporating a methodological change which we consider significant as it uses self-report since the age of 10.

Concerning the method of application, some are based on indirect observation of spontaneous behavior through responses from informants to the items introduced (*EOD and CDI*), or include items based on this methodology (*Denver, Battelle, Guía Portag*e), while the rest require direct observation of the child's behavior in specific tasks by the assessor during the process of application in all its items (*Bayley or Brunet-Lezine*).

In relation to the areas included, all of them evaluate neurocognitive development, followed by linguistic development and psicomotricity, which are only excluded in the *Huzgiris & Hunt* scale. Due to their specificity, the latter and the *McCarthy*

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scale omit adaptation and socio-affective development. Only the *McCarthy scale* and the *EOD* pay attention to aptitudes, abilities and academic performance. In turn, it has been noticed that the origin of the items included in the different scales is multidisciplinary, which leads us to think that a new scale should take this point into account.

Referring to the level of specialization of the users, we have found that the majority of the scales are of individual application and require a high level of psychological or medical qualification for their use. As a matter of fact, only the *EOD* and the *Guía Portage* can be applied by teachers and other non-specialized professionals.

This analysis proves the procedural challenge faced by professionals involved in evaluation of child development when it comes to carrying out a prolonged monitoring of individual or intergroup change. It is also important to note that the advances in the interpretation of development have not been reflected in traditional tools, whose actualizations have been aimed towards the adaptation of standards to the new generations and a revision of the items at best, remaining attached to the theoretical positions upon which they were built. The difficulties encountered motivated us to devise a new tool for development evaluation which could solve the problems detected and would adapt to the current theoretical frame.

A systemic and dynamical model of development

Bronfrenbrenner's ecological model of development (1979); Sameroff's transactional perspective (1982), or even the Developmental systems model developed by Guralnick (2001) as a result of a long trajectory in the area of early intervention, are, along with Esther Thelen's theory of dynamic systems (1992, 1995), examples of what we could call a new paradigm. This paradigm takes on, on one hand, the systemic and dynamic character of the process of developmental change and, on the other hand, individual variability as key elements (Siegler & Shipley, 1995). We believe that it is necessary to introduce elements responsive to the dynamism of the ontogenetic process, as currently conceived, as the results of an evaluation can be used as a guide for our interventions, and, therefore, ultimately affect the developmental course of the child subject to intervention (DeRobertis, 2011).

In this sense, a proposal in terms of dynamic self-organized systems similar to those developed by Thelen and her collaborators during the last decades (Smith & Thelen, 2003; Spencer & Thelen, 2003; Thelen & Bates, 2003), seems adequate, as well as others, to allow the oscillations and fluctuations that can be observed in the course of individual development (Fo-

gel, Lyra & Valsiner, 2014). Our scale therefore takes on some of the standpoints and key concepts of this approach, such as the dialectic character of development, its interdependence with the context in which it is produced -hence the inclusion of multiple items for the same level of behavioral complexity in each function studied- and the concept of attractor state. A description of the scale is introduced further below in the section of tools. The Scale of Harmonic Development (SHD) (Abellán, 2011) is born as an attempt at renovating the tools for evaluation of development which will bring them closer to this new conception, incorporating measurable parameters of order and control (quotient of development and harmony index respectively) as indicators of the developmental process. The theoretical foundation of the scale was explained in a previous dissertation (Abellán, Calvo-Llena & Rabadán, 2015). We believe a scale built this way will act as a guide for preventive interventions, respecting the individual's development project.

The first objective of this dissertation is to validate the SHD using exploratory factorial analysis, and, secondly, to carry out a first approach at concurrent validity using a general development scale (*IDB*) and a specific test of the language dimension such as the *BLOC Screening* (Puyuelo, Renom, Sonatas & Wiig, 2002). In both cases, the frequency of usage has been a priority selection criteria. For the general scale, we have considered the similarity in application methods with the SHD a relevant point to take into account.

Method

Participants

Two groups were used in order to validate the SHD. The first was used to examine the factorial structure of the scale, it was made up of 218 children with an average age of 3.87 years (3 years, 10 months and 15 days) and a Standard Deviation of 3.54 years (3 years, 6 months and 15 days) whose distributions between the 9 questionnaires which cover all the stages of development is shown on Table 1. The average period of gestation of the children was 37.95 (37 weeks and 28 days) ($SD = 2.61$; 2 weeks and 4 days), the average weight when born was that of 3227.90 grams ($SD = 562.53$), the average Apgar 1 score was 8.97 ($SD = 1.05$) and Apgar 2 was 9.76 ($SD = 0.69$). 92.5% of the children did not require special care at birth and no significant alteration was observed in the remaining 7.5%, although the group included immature babies, with limits under 27 gestations weeks and 920 grams of weight at birth, which did not affect their later development negatively.

Table 1. Number of children, mean and standard deviation of the children in the group used for the strutural validation of the SHD.

Questionnaire	Number of children	*M*	*SD*
A	22	0.25* (3 months)	0.09 (1 month and 3 days)
B	24	0.55 (6 m. and 20 d.)	0.07 (26 days)
C	21	0.85 (10 m. and 10 d.)	0.09 (1 month and 3 days)
D	34	1.47 (1 year and 5 m.)	0.31 (3 m. and 23 d.)
E	34	3.02 (3 y. and 7 d.)	0.50 (6 m.)
F	31	4.84 (4 y. and 10 m.)	0.51 (6 m. and 4 d.)
G	31	7.02 (7 y. and 7 d.)	0.54 (6 m. and 15 d.)
H	24	9.09 (9 y. and 1 m.)	0.51 (6 m. and 4 d.)
I	17	10.88 (10 y. and 10 m.)	0.58 (7 m.)
Total	218	3.87 (3 y. 10 m. and 15 d.)	3.54 (3 y. 6 m. and 15 d.)

* Years, months and days expressed in Decimal Metric System

The average age of the parents was 37.11 years for the fathers (37 years, 1 month and 11 days) (*SD* = 5.98; 5 years, 11 months and 25 days) and 35.07 for the mothers (35 years and 26 days) (*SD* = 5.28; 5 years, 3 months and 12 days). 45.2% of the parents had completed their primary studies (mothers, 42.5%), 11.1 % secondary studies (mothers, 15.5%), 21.1 % vocational training (mothers, 16.9%) and 22.6% of the fathers had completed their university studies (mothers, 25.1%). 3.7% of the fathers self-defined as upper class according to their purchasing power, 88.3% as middle class and 8% lower class.

Regarding their profession, 17.3% of the fathers where high level professionals (mothers, 13.3%), 36.6% were middle level workers (mothers, 23.2%), 43.1% were manual workers (mothers, 17.5%) and 3% were stay-at-home parents (mothers, 46%).

The second group used for the concurrent validity study was integrated by 67 children (*M* = 6.41; 6 years and 5 months, *SD* = .29; 3 months and 15 days), all of them Primary 1 students from different schools in the Region of Murcia. The gender distribution was 36 boys (53.7%) and 31 girls (46.3%). The following were deferral criteria: pregnancy having been high-risk or having been born prematurely (before 37 works of gestation), weighing less than 2.5kg when born, scoring less than 6 in the first minute in the APGAR test or 8 after 5 minutes, having been in the neonatal intensive care unit, not having attended preschool from the age of 3, and having been diagnosed with developmental delay in general or of language in particular.

Furthermore, as a means to guarantee there was no intellectual delay that might provoke a distortion in the results, all the participants must have had reached at least 10% in the *Abstract Reasoning Test* from the *TEA Inicial Battery* (BTI). The values obtained by the selected group where *M* = 20.76 and *DT* = 4.09, very close to those of our standardization *M* = 19.11 and *DT* = 5.87 (García, Arribas & Uriel, 2006).

In this second group, 11.9% of mothers had primary studies (fathers, 20.9%), 25.5% had completed their secondary studies (fathers, 25.4%), 28.4% vocational training (fathers, 22.4%), and 34.3% of the mothers had university studies (fathers, 31.3%). 11.9% of the families self-defined as having a high socio-economic status, 85.1% as middle class and 3% low level. Regarding domicile, 4.5% lived in an iso-

lated rural home, 13.4% in a residential estate, 46.3% in a village and 35.8% in a city.

Procedure

A socio-demographic questionnaire was elaborated to collect the necessary data from the children and their direct relatives anonymously. In addition, from the nine questionnaires, which make up the scale with the different chronological intervals, the questionnaire, which corresponded to the child's age, was used. Each questionnaire was complemented with an appendix, which contained the information concerning the 160 dichotomic items in it, which were answered by the parents. Furthermore, the parent's informed consent to participate in the study was requested.

The evaluator accompanied the parents in the family residence while they were completing the questionnaire in order to make sure they had understood the behavior expresses in the items' statement and, in case of doubt, read the detailed description of the behavior object to observation. If in spite of all this the doubts remained, the answer was left for another day, after the parents had done an appropriate observation of the behavior.

The same socio-demographic questionnaire was used with the second sample although some questions related to school integration and language development were added. Once the fact that the participant had not suffered from any condition, which affected development, was confirmed, they underwent the Abstract Reasoning test. Once their inclusion in the study was decided, they underwent evaluations of their general development with the *IDB* and their linguistic competence with the *BLOC Screening*.

Instruments

Scale of Harmonic Development (SHD)

The SHD is based on a two dimensional matrix of 20 rows by 10 columns in which 20 levels of age are listed as well as 10 development functions. The description of infant development is expressed through 4 equivalent items in each one of the 200 intersections of rows by columns, making up a total of 800 items. 40 questions with four answering op-

tions (160 items) and an appendix with a simplified version of the behavior that had to be observed in each item were included in the questionnaires built from the matrix.

Regarding the functions represented in the 10 columns, we chose those those, according to our experience in evaluating child development, would be of more use for the analysis of the processes inscribed in the 4 areas used by most of the scales analyzed. Thereby, the motor area is integrated by three dimensions: *muscular tone* (T: state of tension or relaxation of the muscular layer when prepared to start motor action and while performing it), *general motor coordination* (CO: motor action performed by the big muscles which serve body movement) and *motor precision* (P: motor action of small muscles which coordinate to perform technical gestures such as speaking, looking or manipulating).

The perceptual-cognitive area is integrated by *internal perception* (PI: capacity of representing the internal world from somatic sensations to metacognitive processes), *external perception* (PE: progressive capacity of representing the external world from sensory imput to the acquisition of conceptual universe) and neuropsychological modulation (M: maturation of the CNS informative power due to the stabilization of neurological rhythms and the myelination and cortical hemispheric lateralization processes).

The area of language is made up of *communicative expression* (E: capacity of emission of signals and messages originated in empathic linkage up to acquisition of speech and articulated verbal language) and *communicative comprehension* (CP: capacity for reception of significant messages through the different methods of communication and languages present in the environment: gestural, oral, written, mathematical.)

Lastly, the adaptive area makes a distinction between *identity and personal development* (ID: individual psychological development: awareness of self-identity and gradual acquisition of personal autonomy for resolution of needs) and *social integration* (IT: development as a social subject: from the perception of otherness to the feeling of belonging and participation in the different ecological circles).

Due to the fact that each of the items that make up both questionnaires has been observed and described for a precise chronological age corresponding to each of the 20 levels of development, the final result of the questionnaire is obtained by finding the arithmetic mean of the 40 items chasing as an answer to the questionnaire's questions. From this, the average age of development and, in relation to the chronological age, the average development quotient of each participant assessed with the scale can be found.

Battelle Developmental Inventory (BDI)

The *Battelle Developmental Inventory* (BDI) (Newborg, Stock & Wnek, 1984) was adapted for the Spanish population by the *Fundació Catalana per a la Síndrome de Down* in 1998. The age of application range goes from 0 to 8 years. It assesses the level of development of children with and without disabilities and allows the evaluation of their progress in five dif-

ferent areas: personal/social, adaptive, motor (thick and thin), communicative (receptive and expressive language) and cognitive.

It is made up of 341 items and the direct scores are obtained through observation, structured test situations and interviewing parents or teachers. The items are graded with 0, 1 or 2 points. A basic level (two consecutive items graded 2) and a maximum level (two consecutive items graded 0) are established, thereby obtaining the gross grading for each of the 22 subareas, 5 areas, and the Inventory as a whole. The last count of the scores is taken to the normalized tables, which provide percentages, deviation quotients, T ratings and z ratings (equivalents of a normal curve) and age equivalent.

The reliability indexes to assess the stability of the scores obtained with the IBD were the average standard error of measurement and the test/retest reliability. Regarding the first, the precision of measurement was proven as relatively low values were obtained compared to the corresponding average scores of the group. For example, in the age group used as a sample of our concurrent validation study ($M = 6.41$ years), the average standard error of the scores of the *IBD* (*Fundació Catalana per a la Síndrome de Down*, 1989) was 2.45 ($M = 164.04$) total for the personal/social area; 1.63 ($M = 111.09$) total for the adaptive area; 1.63 ($M = 111.09$) total of the motor area; 1.47 ($M = 111.48$) total for the language area and 2.10 ($M = 103.72$) total for the cognitive area. Regarding test/retest reliability, after a four-week interval from the first application, a correlation of 0.90 was obtained for the total of the *IBD* in the same age group.

Logical and conceptual analysis were carried out for the validation off the original *BDI* test (Newborg et al, 1984) regarding three categories: validity of content, construct and criteria. In order to guarantee the validity of content a thorough process was followed. This included the identification of the areas of general abilities that were to be assessed, the selection or development of items and, subsequently, the verification of results by experts. Construct validity shows up to where the test measures the theoretical constructs that are being evaluated; general theory of development was used by the *BDI* to deduce the predictions that had to be verified. The data obtained proved that this scale is a valid tool for evaluating development, as it makes a distinction between behaviors, which lie within the limits of normality, and those, which characterize clinical problems. Finally, validity of criteria, expressed in correlation coefficients, which indicate the degree of linkage between the test and another chosen as criteria. The studies showed that Spearman correlations between the *BDI* and the *Vineland Scale of Social Maturity* (Doll, 1964), as well as with the *Developmental Activities Screening Inventory* -DASI- (DuBose & Langley, 1977) are high and significant (.94 and .91, respectively).

We used the *Screening* test from the *BDI* (96 items) as a tool for our study as it can be done in between 10 and 30 minutes, while the complete Inventory takes from 1 to 2 hours. The printed edition is very complete, including inde-

pendent books for both the screening test and each of the five areas. Each of the items in the assessment procedure (structured, observation or information) and the grading criteria is described according to percentages of achievement of conduct. The instructions are clear and complete. Furthermore, the *IDB* includes case studies, which exemplify the whole process, including the interpretation and use of the information to elaborate stimulation programs as well as curricular decision making.

BLOC *Screening (Objective and Criterial Language Battery)*

The first edition of the *BLOC-C* scale dates from 1998 (Puyuelo, Renom, Solanas & Wiig, 2002). It is a test, which detects language problems and informs about altered communication and linguistic conducts both quantitative and qualitatively, enabling the elaboration of intervention plans. It can be applied to an age internal of 5 to 14 years, exploring both expression and comprehension in your aspects of language: morphology, syntax, semantics and pragmatics. The whole battery can be applied, as well as specific modules or even in blocks.

It is made up of a total of 625 items, out of which 45 are examples. Approximately four hours can be invested in the whole application, it consequently is of obvious clinical and educational utility, but too long in those cases in which a wide population has to be assessed of a fast exploration is required. Therefore, Puyuelo et al. (2002) created the screening version (144 items, out of which 26 are examples), accompanied by the BLOC-INFO program, to carry out an indicative exploration of the individual's language level, from which the need for a wider study can be decided.

The items selected form the *BLOC-C* allow for four scores equivalent to the original modules (morphology, syntax, semantics and pragmatics). The selection process determined the best items from a content point of view, as well as its psychometric indicators according to the Rasch model: centered difficulty values, high discrimination parameter and acceptable item characteristic curves. In order to do this, the data from the answers of the first original sample was used (850 scholars between 5 and 14 years of age) which allowed the creation of the *BLOC-C*. Exploratory analysis was used to determine the minimum number of items for each module, which would offer good psychometric indicators in accordance with the original structure. After this task, the scores obtained by the examined in the short version were compared to those obtained in the complete version and as a last verification; the models from the *BLOC-S* underwent another test with a pilot sample of 20 individuals, which were given both versions. The comparison between them confirmed that the evaluation of language carried out which *BLOC-S* is reliable and does not produce distorted results.

This reduced version, *BLOC-S* (Puyuelo et al., 2002), includes a booklet with the images necessary in the four modules and an individual register booklet to reflect the results, which are later transferred to the computerized version. The

items are graded with 1 (correct answer), 0 (incorrect) or N (invalid, for omissions). The exploration is completed in less than an hour and, when the data are introduced; graphic profiles are created automatically by the software, which also calculates the percentage scores for each module separately.

Recoding of the SHD

Due to the fact that every 4 items created natural groupings (testlets) at a development level, it was decided that the dichotomous items would be turned into a single item with a polytomous structure. This way, if the child did not show any of the conducts in the four items of a level it was graded with 0; if they responded to the first item, 1; if they responded to the second one too, 2; if they showed the first three, 3; if they showed all the conducts of the level in the scale it was graded with a 4. Each of the scales with the 20 levels was then turned into a new structure of 2 polytomous items with four dichotomous items which represent the level of development in each level. Under this new polytomous structure, the minimum score was 0, and the maximum was 80.

Statistical analysis

The SHD was validated through an analysis of items in each of the 10 dimensions, which make it up, evaluating the descriptive statistics and the homogeneity index for each of the items. If the correlation item-test lied in the interval between [.3 — .7] the item was considered to show a good homogeneity index (Crocker & Algina, 1986). Furthermore, the internal consistency coefficient (Cronbach alpha) and the L2 Guttman coefficient were obtained in order to asses the reliability of the scores in each of the dimensions of the *SHD*.

Due to the fact that the SHD is in its preliminary phase of application it was chosen to carry out an exploratory factorial analysis in the interest of determining the factorial structure of the 10 dimensions included in the scale. In order to do this, the method of principal axes over polychronous correlation matrices to estimate the factorial charge and a GFI (Goodness of Fit Index) adjustment statistic and a statistic based on residuals (MSR, Mean Square Residual) were applied to decide the number of interpretative factors in each dimension. Although several dimensional solutions were tested (from 1 to 5 dimensions), it was decided that the best was that whose GFI was higher than .95 and the MSR < .08, if the percentage of variance explained by the first factor was higher than 50%. No rotation method was applied as all the solutions were one-dimensional.

In order to asses convergent validity, Pearson correlations of each of the dimensions of the SHD with the *IBD* and *BLOC Screening* tests were carried out.

The analysis of items and the calculation of reliability coefficients were done with the CLM-1 program (López-Pina, 2005). The exploratory factorial analysis was carried out with

MicroFACT 2.0 (Waller, 2001) and SPSS v.19.0 was used for the concurrent validity study.

Results

Analysis of items of the SHD dimensions

Table 2 holds the average statistic descriptors and their range, as well as the homogeneity indices and their range for the 20 levels in each one of the dimensions of the SHD.

As shown on the table, the average for right answers on the polytomous items was incremented according to the levels of development in all the dimensions, varying between

the lowest levels around 3.98 (this figure represents that most of the subjects pass the developmentaly lower items) and, the highest levels about .09 (this figure represents that only some subjects pass the developmentaly higher items). The standard deviation also increased in this case in the average development levels, decreasing significantly at the lowest and highest levels of development (this *SD* behavior would be justified by the higher heterogeneity of the individual developmental courses towards the half of the assessed period, corresponding with the ages of 6 and 7. The detailed information for the 10 dimensions can be consulted in Abellán (2011).

Table 2. Descriptive statistics (range) and homogeneity index in the 10 dimensions of the SHD.

Dimension	Mean	Estandar deviation	Homogeneity index
T	2.07 (0.15-3.98)	1.33 (0.21-1.93)	.68 (.17-.89)
CO	2.05 (0.09-3.98)	1.31 (0.25-1.93)	.68 (.18-.89)
P	2.05 (0.09-3.99)	1.31 (0.07-1.91)	.67 (.13-.86)
PI	2.12 (0.13-2.98)	1.35 (0.09-1.96)	.65 (.17-.89)
PE	2.02 (0.16-3.97)	1.36 (0.24-1.91)	.69 (.21-.89)
M	2.07 (0.12-3.98)	1.33 (0.18-1.95)	.69 (.24-.90)
E	2.07 (0.11-3.98)	1.35 (0.17-1.93)	.68 (.19-.89)
CP	2.09 (0.15-3.98)	1.35 (0.19-1.90)	.68 (.18-.88)
ID	2.09 (0.16-3.98)	1.33 (0.17-1.89)	.69 (.21-.89)
IT	2.09 (0.15-3.96)	1.39 (0.32-1.86)	.69 (.24-.88)

T: Tone; CO: Coordination; P: Precision; PI: Internal perception; PE: External perception
M: Modulation; E: Expression; CP: Comprehension; ID: Identity; IT: Integration

All the items, grouped in developmental levels, obtained homogeneity indices in the specified interval, except item 1 in all dimensions, which varied between .13 in the Precision scale and .24 in the Modulation and Integration scales, perhaps due to the effect of the low variability obtained wishing the children used in this study. Nevertheless, these items were kept in the final scale in order to preserve its integrity.

Dimensional structure of the SHD

The factorial analysis carried out show that each dimension formed a one-dimensional scale. Due to the fact that all the GFI were higher than .95 and MSR < .08, the first factor explained in each scale more than 60% of the total variance of the correlations matrix, except in Precision, where it explained approximately 58% (see Table 3).

The inner consistency coefficients were very high in every dimension (α = .95, IC [.93 — .96], except in Coordination and Precision where α = .94. The L2 Guttman reliability coefficients were very high for every dimension (L2 = .97).

Table 3. GFI, MSR, variance percentage explained by the first factor, alpha coefficients (range) and Guttman L2 in the ten dimensions of the SHD.

Dimension	GFI	MSR	% variance explained	Alpha coefficient	L2 coefficient
T	.96	.021	64.46	.95 (.93-.96)	.97
CO	.95	.020	60.38	.94 (.94-.96)	.97
P	.95	.020	57.92	.94 (.93-.95)	.97
PI	.97	.017	64.16	.95 (.94-.96)	.97
PE	.97	.016	68.50	.95 (.94-.96)	.97
M	.97	.015	64.95	.95 (.94-.96)	.97
E	.97	.017	67.60	.95 (.94-.96)	.97
CP	.96	.019	66.33	.95 (.94-.96)	.97
ID	.96	.017	63.50	.95 (.94-.96)	.97
IT	.98	.013	69.41	.95 (.94-.96)	.97

T: Tone; CO: Coordination; P: Precision; PI: Internal perception; PE: External perception
M: Modulation; E: Expression; CP: Comprehension; ID: Identity; IT: Integration

Concurrent validity

We compared the scores obtained by the group of 67 participants in the SHD, the *IDB* and the *BLOC Screening*. The Pearson correlations between the scored obtained in the 10 dimensions of the SHD and the obtained in the areas of the *IDB* and the modules of the *BLOC-S* are shown on Table 4. This correlation was also calculated between the global SHD score and the *IDB* score: .20 (*p* < .09).

The correlation between the dimension Tone of the SHD and the Personal/Social area of the *IDB* was .21 (*p* < .10), and that of the Cognitive are was .21 (*p* < .10); likewise,

the correlation with the syntax module in the *BLOC-S* was .20 (*p* < .10) and .25 (*p* < .05) with the semantics module. The correlation between the Coordination dimension of the SHD and the Thin Motricity of the *IDB* was .27 (*p* < .05); .27 (*p* < .05) with the Expressive Language area; .23 (*p* < .10) with the cognitive are and .21 (*p* < .10) was obtained for the correlation with the total score of the *IDB*. The Precision dimension of the SHD correlated negatively with the Persona/Social area of the *IDB* at -.25 (*p* < .05), which might be showing an inverse relationship between high motor control in precision tasks and social abilities –take for example the high attention to tasks and the meticulousness frequently found in people with autistic spectrum disorder–. Nevertheless, this hypothesis must be empirically contrasted.

The Internal Perception dimension correlated with Thin Motricity from the *IDB*: .21 (*p* < .10); with Expressive Lan-

guage at .32 (*p* < .01); .34 (*p* < .01) with the Cognitive Area and with the total of the *IDB* .30 (*p* < .05). The External Perception dimension had a positive correlation with the Morphology module of the *BLOC-S*, reaching .26 (*p* < .05). The correlation between the Modulation dimension of the SHD and the Morphology module of the *BLOC-S* was .27 (*p* < .05) and .32 (*p* < .01) with the semantic module.

The dimension of Expression correlated with Thin Motricity of the *IDB* .21 (*p* < .10), and with the *BLOC-S* modules: Morphology .22 (*p* < .10), Syntax .21 (*p* < .10) and Pragmatic .22 (*p* < .10). The correlation between the Comprehension dimension of the SHD and the Morphology module of the *BLOC-S* was .26 (*p* < .05) and .29 (*p* < .05) with the Semantic module.

Table 4. Concurrent validity between the 10 dimensions of the SHD, the IDB areas and the BLOC Screening modules.

IDB Screening Dimensions									BLOC Screening			
	P/S	A	MG	MF	LR	LE	AC	Total	MO	SI	SE	PR
T	.21†						.21†			.20†	.25*	
CO				.27*		.23†	.23†	.21†				
P	-.25*											
PI				.21†		.32**	.34**	.30*				
PE									.26*			
M									.27*		.32**	
E				.21†					.22†	.21†		.22†
CP									.26*		.29*	
ID						.23†			.35**		.28*	
IT	-.21†										.21†	

Notes: T: Tone; CO: Coordination; P: Precisin; PI: Internal perception; PE: External Perception; M: Modulation; E: Expression; CP: Comprehension; ID: Identity; IT: Integration; PS: Personal/Social; A: Adaptation; MG: Motricity thick; MF: Motricity thin; LR: receptive language; LE: expressive language;

AC: cognitive area; Total: total score *IDB*; MO: morphology; SI: syntax; SE: semantics; PR: pragmatics; † *p* < .10 (marginally significant); * *p* < .05 y ** *p* < .01 (statistically significant).

The Identity dimension correlated with the Expressive Language are of the *IDB* .23 (*p* < .10); with the modules of the *BLOC-S*, Morphology .35 (*p* < .01) and Semantics .28 (*p* < .05). The last dimension of the SHD, Integration, obtained a negative correlation of -.21 (*p* < .10) with the Personal/Social area of the *IDB*, and positive with the Semantics module of the *BLOC-S* .21 (*p* < .10).

Conclusions

The results prove both the validity of the construct and the internal consistency and reliability of the scores obtained through the scale. Thereby, the results of the factorial analysis (goodness of fit indexes –GFI– greater than .95 and residual quadratic means –MSR– lower than .08) allow us to affirm that the construct *general infant development* is inscribed in the one-dimensional structure of each of the factors, apart from the global structure of the scale as shown by the high interscale correlations, which oscillate between .980 and .993. Similarly, regarding the inner consistency of the scales, the

reliability coefficients obtained (in all cases alpha over .94, and the L2 coefficient is .97 for all the sub scales) widely overcome the criteria (.70) for experimental studies.

In relation to the concurrent validation process, while significant values of concurrence have been obtained for the majority of the dimensions, others do not seem to have a relation to related measurements obtained in the rest of the tests. In the case of the Tone dimension in our scale, the significant correlation between this function and the Personal/Social (.21, *p* < .10) and Cognitive of the *IDB* (.21, *p* < .10), could be understood as far as the tonic aspects of motricity are tightly related to the components of emotional reaction to stimuli, which would be in the bases of construction of del-image in relation to others, on one hand, and with the necessary stability to maintain activation levels compatible with the exploration of the environment and learning, on the other. As they are different areas, the signification of these concurrencies is low. Although the lack of correlation between our Tone dimension and the Motricity measured by the *IDB* may seem surprising, we believe this may be due to

the mainly postural nature of the items we used in contrast with the cinematic character of the motor evaluation in *IDB*, which does have some correlation with the motor Coordination measurement of our scale. The positive correlations found with the Syntax (.20, $p < .10$) and Semantics (.25, $p < .05$) modules of the *BLOC-S*, could be understood as far as the tone sustains the motor aspects implicated in the phonological sequence.

As expected, a positive correlation is found between the Coordination dimension of the SHD and the area of thin Motricity of the *IDB* (.27, $p < .05$), as they are both assessing aspects of the same construct. A correct coordination of the phono-articulatory system is the use of development of the expressive aspects of language, as shown by the positive correlation, marginally significant, when $.05 < p < .10$, obtained with the Expressive Language area of the *IDB* (.23). The correlation obtained between this dimension and both the total score (.21, $p < .10$) and the Cognitive area of the *IDB* (.23, $p < .10$) make sense as coordination is a basic element for any superior order process.

Nevertheless it is the Internal Perception dimension (which directly assess aspects related to cognition) which obtained a greater positive correlation with a good level of significance, both with the total score (.30, $p < .05$) and the Cognitive area of the *IDB* (.34, $p < .01$). In this same sense, the concurrence between our scale's External Perception dimension and the Morphology module of the *BLOC-S* (.26, $p < .05$) can be seen. External perception refers to the progressive conceptualization and management of experience, including aspects such as time and gender, related to this grammatical dimension.

The positive correlation obtained with the Semantics (.32, $p < .01$) and Morphology (.27, $p < .05$) modules of the *BLOC-S* is not surprising insofar as the Modulation dimension is related to the brain spacialization processes and the development of the executive function and behavioral inhibition, as they require these selective attention processes.

It can be observed that the Expression and Comprehension dimensions of the SHD correlate positively with the Morphology (.22, $p < .10$), Syntax (.21, $p < .10$) y Pragmatics (.22, $p < .10$) modules in the first case, and with the Morphology (.26, $p < .05$) and Semantics (.29, $p < .05$) in the second. The expressive aspects of language are more directly related with the organization of discourse and intentions, while the comprehensive function is related to meanings transmitted/received.

The Identity dimension refers to the development of self-concept and autonomy, which might be indirectly influ-

encing both the level of expressive language in the *IDB* (.23, $p < .10$), and the morphological (.35, $p < .01$) and semantic aspects (.28, $p < .05$) of selfreference and differentiation of the interlocutor.

This argument could be extended to the concurrence between Integration and the Semantics module of the *BLOC-S* (.21, $p < .10$) although only providing marginal significance. It is not clear how to interpret the negative and marginal correlation between the Integration dimension of our scale and the Personal/Social area of the *IDB* (-.21, $p < .10$), specially when some of the items in both scales show deep similarities. This result must be revised in future validation studies with a wider sample.

In any case, the possibility of proving correlations as high and significant as those obtained by Newborn and co. (Newborg et al., 1984) for the Spearman coefficient in their criteria validation studies between the *BDI* scores and the *Vineland Scale of Social Maturity* (Doll, 1964), which reached .94 and with the *Developmental Activities Screening Inventory* -DASI- (DuBose & Langley, 1977) which was .91 still remains. At the moment, the Pearson correlation between the total scores of the participants in the *IDB* and the SHD is .20. It is also important to point out the small size of the sample ($n = 67$) with which this first concurrent validation study has been carried out, which must be replicated in more representative future studies and using, at last, the new computer based version of the SHD.

Regarding the validation study of the data shown by the factorial analysis it can be concluded that the Scale of Harmonic Development –*SHD*– (Abellán, 2011), behaves as an integrative tool for the assessment of child development which can be used trustingly and that sticks greatly to the prevalent theories in current Developmental Psychology (Fogel et al. 2014). In this sense, the fact that the homogeneity values found for the fist item of the different scales, which are justified by the size of the sample of this first level (0-1 month and 15 days), do not affect the factoring process must be pointed out. We believe that once the scale is implemented in an informatics application –process already in course–, it can be useful as a screening tool in order to serve developmental prevention.

Regarding the preliminary convergent validation study, we must insist on the fact that the small size of the sample is a burden, which does not allow for any statement to be made. Nevertheless, these first results seem to show the right path and demand for new studies with a wider sample to be carried out.

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