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ORIGINAL RESEARCH

Identification of functional domains in developmental measures: An ICF-CY analysis of Griffiths developmental scales and Schedule of Growing Skills II

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Abstract

Objective: This study aims to identify functioning categories of the International Classification of Functionality, Disability and Health for Children and Youth covered by the Griffiths developmental scales and the Schedule of Growing Skills II (SGS-II), as well as to analyse levels of agreement between coders when assigning its items to the ICF-CY classification system. *Methods*: Items were linked to the ICF-CY following a content analysis procedure and the published linking rules. Agreement was calculated with Cohen's Kappa Coefficient. *Results*: All SGS items assess mostly Activities and Participation, alike most of the Griffiths' scales except for the Language and Eye-hand coordination scales, which assess mostly Body Functions. Consistently with previous studies, agreement levels between coders vary considerably, thus being highly dependent on the nature of the concept analysed. *Conclusion*: Although necessary from a capacity-driven approach to assessment, information collected with these instruments should be complemented with other assessments in order to cover all aspects of the child's life, in line with a systemic approach.

Keywords

Functioning, Griffiths, ICF-CY, SGS II

History

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The International Classification of Functionality Disability and Health for Children and Youth

The International Classification of Functionality, Disability and Health for Children and Youth (ICF-CY) [1] is part of the 'Family of Classifications' of the World Health Organization (WHO) and it was preceded by an adult version, the ICF [2]. The ICF model is based on the biopsychosocial approach to disability [3, 4]. Prior to the ICF, the most widely used classifications – the Diagnostic and Statistical Manual of Mental Disorders (DSM) [5] and the International Classification of Diseases (ICD) [6] – were based on a medical approach to disability. While the ICD and the DSM provide etiological information on specific diseases, the ICF was designed to classify aspects of functioning within a person's health condition, which may or may not be a specific diagnosis. Therefore, as it has been widely recognized in scientific literature in the field of rehabilitation, the definition of health condition in the scope of the ICF/ICF-CY is a broad one, and concerns all aspects related to well-being, such as education, for instance [1, 2]. This definition is in line with the WHO's perspective on health as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' [7, p. 942]. Well-being is defined as 'the general term encompassing the total universe of human life domains, including physical, mental and social aspects, that make-up what can be called as a ''good life''' [1, p. 227]. Health domains, in turn, comprise the total universe of human life. Thus, the publication of the ICF reflects the shift of paradigm that has been occurring from medically-based models of disability and health to multidimensional, biopsychosocial and systemic approaches. The efforts that have been made in several countries to use the ICF framework and taxonomy as a way to improve service delivery in health and education are very illustrative of this shift [3]. However, the WHO [1, 2] recommends that the two types of classification – the diagnostic manuals and the ICF/ICF-CY, be used together, as the information they provide is complementary [3, 4, 8, 9]. In fact, Simeonsson et al. [10] studied the utility of a hierarchical algorithm incorporating codes from both the ICF-CY and the ICD-10 to classify reasons for eligibility of young children to early intervention and concluded that the two classifications can be jointly used to classify disability characteristics of children.

Multidimensional, biopsychosocial and systemic approaches to disability and the contribution of the ICF-CY to developmental assessment

The 'child is a moving target', and the ongoing developmental process receives influences from both the individual child

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level and features of the settings in which the child is embedded [8, p. 325]. In fact, the first years of a person's life are characterized by rapid changes at physical, psychological and biological levels. These changes are triggered by processes of mutual influence between the individual and the environment(s), which must be accounted for as relevant in determining the developmental path [11]. This transactional nature of developmental processes implies that each child's particular forms of activities, ways of participating and specific environmental constraints are to be addressed. Similarly, disabling processes during childhood have a different nature, intensity and impact on children's lives, when compared to disability processes in adult life. The ICF-CY was designed to support a multilevel approach in documenting dimensions of children and youth's development, using a common language and taxonomy that is able to address developmental idiosyncrasies and changes over time. In this context, it is essential to underline that the ICF/ICF-CY model and taxonomy does not classify people, but rather it describes the current functioning status/profile of an individual person within each functioning component [1, 2].

Moreover, alike the ICF version, the ICF-CY may be used across disciplines to support the planning of assessment-intervention processes and to promote the documentation of children's functioning across all domains of life. It has had diverse uses, namely as a statistical tool to collect and gather data (e.g. in population surveys), as a research tool to support the measurement of quality of life or environmental outcomes and as a social policy tool, and as an educational tool, specifically in curriculum design and implementation [1, 2, 4, 8].

The ICF-CY provides a functioning profile describing the nature as well as the severity of the limitations of functioning and the environmental factors influencing them [1, 2, 4]. In fact, a number follows each ICF-CY functioning dimension code – the Universal qualifier, ranging from 0 (no problem) to 4 (total problem) to express the magnitude of the difficulty observed in that particular dimension. However, the ICF-CY is not an assessment instrument, but a system for classifying disability, therefore, there is a need for new and extant measurements to be aligned with the ICF-CY classification system, so as to provide evidence for classification [1, 4]. This has been a widely researched application on the ICF-CY, with studies being conducted focusing on the mapping of the ICF-CY with the Carolina Curriculum for Preschoolers with Special Needs [12], the Autism Diagnostic Observation Schedule, the Autism Diagnostic Interview Revised and the Child Autism Rating scale [13], the Vineland Adaptive Behaviour Scales [14] or the Pediatric Evaluation of Disability Inventory [15].

There are two main practical reasons that justify the relevance of mapping the content of developmental measures to the ICF-CY classification system: first, this strand of research enables the identification of functioning dimensions that are being taken into consideration when assessing young children's development with traditional developmental tools; second, it enables the identification of functioning dimensions that are not being addressed in the most commonly used measurements for developmental assessment, thus informing the development of new tools that are based on functioning and on a biopsychosocial approach to development, instead of the traditional approaches to development.

There are also theoretical reasons to conduct this mapping process, which frame the arguments mentioned above. According to Bagnato et al. [16], there are two main approaches for the assessment of young children: a traditional developmental approach, close to what the author designates as conventional testing, and a much more functional approach, which, in turn, is closer to the *authentic assessment* notion [16]. Conventional developmental assessments have been focusing on identifying specific problems within traditional developmental areas, such as cognition, language, motor development or emotional development, providing scores for these different areas [16]. Nevertheless, there is considerable evidence that all developmental areas are interconnected and overlapped, with difficulties in one area reflecting difficulties in other area(s) [17]. In fact, often it is very difficult to ascertain that a particular problematic behaviour is related to one single developmental area, as it is usually related to the dynamic interactions between all developmental aspects. This is in line with contemporary approaches to development, such as the Transactional Theories [11, 16] and the systems theory [18]. Transactional theories propose that development occurs as a result of dynamic interactions between the individual as a whole and the environment over time [11]. In turn, there are several commonalities between the main assumptions of the systems theory and the ICF-CY framework, which have been systematically enumerated by McDougal et al. [18]: (a) the fact that both consider development as a multidimensional process; (b) development is also a holistic process in which often it is very difficult, if not impossible, to isolate the different parts of the system from the bigger picture of the system as a whole; (c) development is non-linear – due to its complexity of sub-systems often there is not a predictable developmental path; (d) the developmental process is characterized by self-organization; (e) development and disability are not permanent, on the contrary, there is permanent change and (f) the developmental process tends to well-being, similar to the concept of systems' equilibrium. Therefore, according to the systems approach to development, which adequately frames the ICF-CY model, the individual child is a sub-system within broader intertwined systems. Similarly, for Bronfenbrenner and Morris, development is the result of the interaction between proximal and distal processes and the individual; proximal processes occur in systems that closely embed the individual, while distal processes occur within systems that are more indirectly related to the individual, but still surrounding him/her [19]. This group of theories is considered within the contextual approaches to development, since they emphasize both the role of the individual and the context in determining developmental outcomes [20]. This justifies the need for assessments providing information on individual developmental domains to be combined with other forms of assessment that cover the transactional nature of development, in order to better and more thoroughly inform educational and developmental interventions with young children, particularly those in need of special support or at risk. The concept of 'functioning' prosed by the WHO may help to overcome the difficulty of apprehending development with consideration for the complexity of domains

involved, since according to the WHO, 'functioning' is the general term that encompasses all domains of life, including environmental influences [1, 2].

Another theoretical argument that justifies the need to combine traditional developmental assessments with the ICF-CY is the notion of 'capacity' and 'performance'. Capacity refers to the ability of executing a task in a standard environment, while 'performance' is related to what an individual does in his or her environment [1, 2]. While traditional developmental assessments focus on the capacity of the child (what the child is able to do in a standard environment, the laboratory or the psychologist office, for instance), authentic assessment procedures are conducted in natural settings, thus providing information on what the child actually does in her own environment, with the support (or lack of supports) that characterize it. For this reason, a *functional* approach to the assessment of young children is more informative for intervention purposes than an approach based on conventional developmental areas [16, 21]. Figure 1 summarizes the main differences between a conventional approach to developmental assessment and a functional approach, which may be operationalized by the ICF-CY model and classification system.

In line with this particular strand of ICF-CY applications, the purpose of this study is to link two widely used developmental instruments, which are based on a conventional approach to developmental assessment, to the ICF-CY classification system. The two instruments are the Schedule of Growing Skills-II (SGS-II) [22] and the Griffiths Mental Development Scales (GMDS) [23] and they are both focused on developmental areas, norm referenced and clearly assessing capacity of the individual child. Thus, linking the ICF-CY to these conventional assessment tools will enable the identification of additional information, specifically information of functional nature.

Based on this purpose, three research questions were formulated as follows:

(a) What percentage of each ICF-CY component is covered by the SGS-II?
(b) What percentage of each ICF-CY component is covered by the GMDS?
(c) In what way is there agreement between coders when assigning items of the two measurements to the ICF-CY classification system?

The challenges of linking content with the ICF-CY classification system

Linking content with the ICF-CY classification system can be a very challenging process. Specific issues regarding this process have been systematically identified in previous studies with both the ICF and the ICF-CY. Cieza et al. [24] have developed a set of specific rules to link content with the ICF system, widely known as the 'linking rules'. Although extensively applied, these rules do not provide enough detail in terms of how to identify meaningful units in the content being linked and how to reach agreement between coders in the identification of units and their respective coding. Ibragimova et al. [25] have clarified this process by adopting a problem-solving driven approach: first, from the large meaning units to be coded, more narrow small meaning units were identified; second, meaningful concepts that were difficult to link with the ICF-CY were identified and grouped separately and third, the meaningful concepts that could not be linked with the ICF-CY were grouped in the categories 'not-covered' and 'non-definable', previously suggested by Cieza et al. [24]. Similar studies in which the inter-coder agreement level was calculated using the unweighted Cohen's Kappa coefficient have shown that some ICF-CY codes are more likely to endorse agreement between coders, than others; this shows that the agreement level between coders when assigning content to the ICF-CY classification system is very dependent on the nature of the functioning dimension being coded, than on any other variables, such as the training of the coders in using the ICF-CY [13].

Methods

Measurements

As previously mentioned, the measurements analysed in this study were the SGS-II [22] and the GMDS [23]. The SGSs is a measure of child development, from birth to five years of

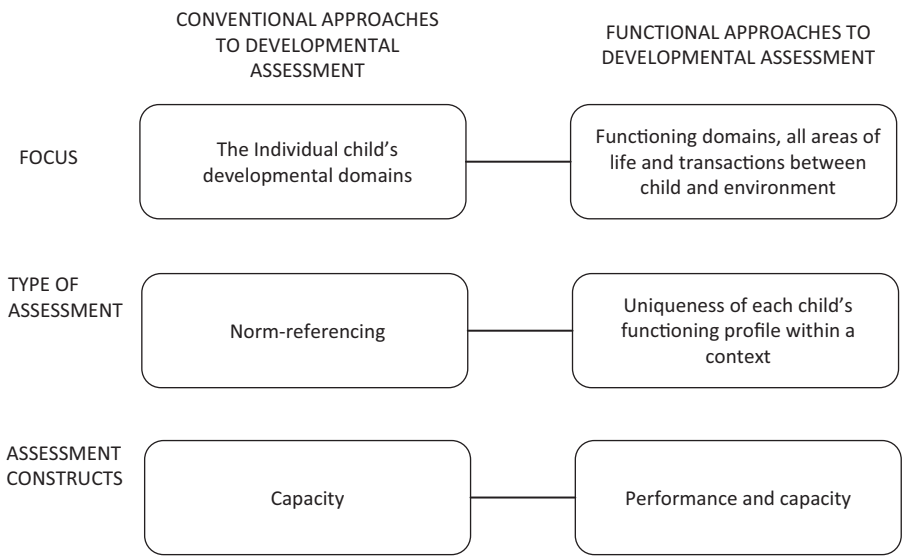

Figure 1. Conventional approaches *vs.* functional approaches to developmental assessment.

age, across nine developmental domains that are based on the Sheridan developmental sequences: passive posture, active posture, locomotor, manipulative, visual, hearing and language, speech and language, interactive social and self-care social. The administration process takes about 20 minutes and implies using a set of supplied toys allowing the child to play with them. Coding is based on the observation of the child's behaviours while playing. The SGS II is a widely used screening tool and it has been validated against the Griffiths' developmental scales [26].

The Griffith's developmental scales measure developmental trends, which are significant for intelligence, or indicative of functional mental growth in babies and young children from birth up to a developmental age of eight years. It provides a profile of children's performance on a standardized situation. There are two sets of scales, one for each age group, 0–2 years and 2–8 years. Within the 0–2 year scales, a profile is obtained from five subscales examining locomotor, personal-social, language, eye-and-hand coordination and performance. In the 2–8 years scales, this profile is expanded to add a practical reasoning subscale. Materials include a number of objects and toys, culturally transferable and attractive to young children. The scales are widely used for both clinical and research purposes. Data collected with Griffiths reveals good levels of reliability (0.95) and validity (0.79–0.81) [23].

Procedure

The process of linking the two measures followed a set of sequential steps. The measurements were linked to the ICF-CY classification system using a deductive content analysis strategy along with an adaptation of the published *Linking Rules* [24]. Therefore, following Graneheim and Lundman's terminology [27], the *Unit of Analysis* is hereby considered as the whole instrument being analysed; the *Content area* is not specifically addressed, as it refers to sections or parts of the instruments, when they exist; the *Meaning Unit* is the item being analysed and the *Meaningful concept* is the minimal idea within the item that should be coded. As a pre-requisite for the mapping process, two independent coders were involved in the process – both coders had solid knowledge and training on the ICF-CY framework and classification system. As a second pre-requisite for the analysis, the two coders had solid knowledge on the measurement being analysed in relation to its scope, structure, purpose and coding method. Before starting the coding process, the coders identified the meaningful concepts within the meaning units (items) to be coded. Independently, the two researchers coded each meaning unit with the ICF-CY codes. The codes that were not possible to link with the ICF-CY were coded with 'non-covered' or 'non-definable' according to definitions provided in the Cieza's linking rules [24]. For each measurement analysed and mapped with the ICF-CY classification system, the coders calculated the probability of agreement computing the unweighted *Cohen's Kappa* coefficient. Introduced in 1960 by Cohen, this coefficient is a reliability index for the proportion of agreement between coders in nominal scales. Kappa values vary between -1 (total disagreement) and 1 (perfect agreement); a value of zero means that the found agreement is due to chance. Kappa values have been classified according to the agreement robustness: $0.01 < \kappa < 0.20$ – slight; $0.21 < \kappa < 0.40$ – reasonable; $0.41 < \kappa < 0.60$ – moderate; $0.61 < \kappa < 0.80$ – substantial; and $0.81 < \kappa < 1.00$ – almost perfect [26]. Kappa was calculated for each ICF-CY code that was assigned to any concept within each analysed item, in each measurement.

Finally, and following independent coding, the two coders discussed differences in order to obtain consensus on the definition of the final coding. In order to break ties between the two coders regarding the final ICF-CY code(s) to be assigned to each meaningful concept, a third person, highly knowledgeable about the ICF-CY principles and classification system, supported the final decision.

Results

Figure 2 provides an illustration of how the SGS and the Grifiths' sub-scales cover the different ICF-CY components. It is apparent that Activities and Participation are covered

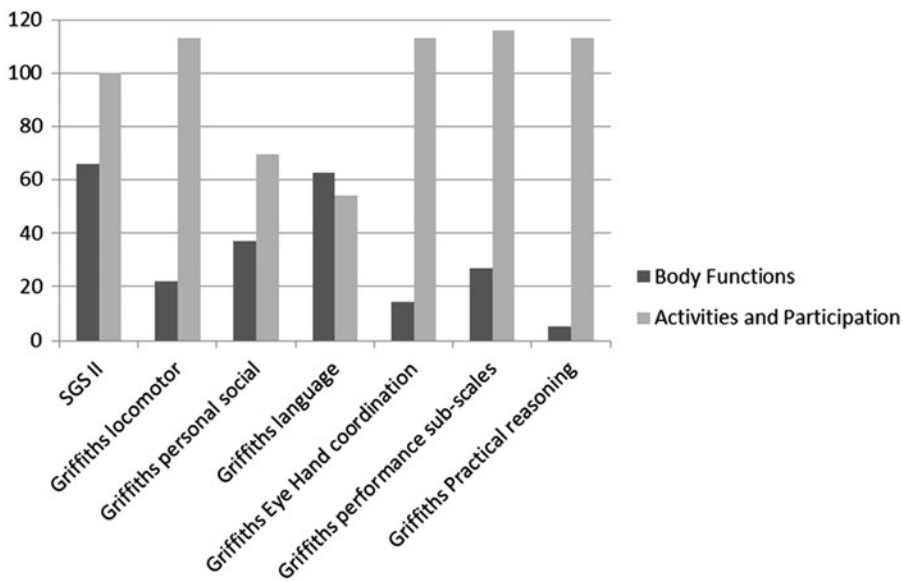

Figure 2. Percentage of ICF-CY components (Activities and Participation, Body Functions and Environmental Factors) in each measure analysed.

much more extensively than Body Functions and that Environmental Factors are not covered at all. However, a more detailed description of the resulting linkage between the tools and the ICF-CY is presented below.

How the SGS-II maps with the ICF-CY

At the component level, the coverage of ICF-CY components by the SGS-II is as follows: 100% of the items cover Activities and Participation dimensions and 66% of the items cover Body Functions, meaning that some of the items overlapped Activities and Participation codes with Body Function codes. Environmental Factors were not assigned to any item of the SGS-II.

The dimensions *Language functions and Muscle tone functions* were the aspects within the Body Functions component that were most frequently assigned to the SGS-II items, 18.9% and 10.1%, respectively. In what concerns the Activity and Participation component, the dimension *Receiving oral messages* was largely the most frequently assigned (24%). Two *nd* (*not definable*) codes were attributed by coders to the items that had an approximate definition in the ICF-CY, but did not show a perfect fit.

How the Griffith's developmental scales map to the ICF-CY

Each sub-scale of the Griffiths Developmental scales was mapped to the ICF-CY components separately. As a whole, 28% of the Griffiths' Mental Development Scales' items were linked to Body Functions dimensions and more than 100% of the items were linked to Activities and Participation dimensions, meaning that many items were assigned more than one Activity and Participation code. A few items were assigned a *nd* code (non-definable) – 2% of the total number of items. No Environmental Factors were linked with any item of the scales. At the component level, the sub-scales cover various aspects of Body Functions and Activities and Participation. None of the Griffiths Sub-scales covers Environmental factors.

In the Locomotor sub-scale, 113.1% of the items were assigned to Activities and Participation codes, while 22.1% of the items were assigned to the ICF-CY Body Functions component (namely to the dimensions *Vestibular functions, Muscle power functions* and *Muscle tone functions*), which means that some items were assigned to more than one code. The most frequently assigned Activities and Participation dimensions were *moving around* (47.7% of the items), *walking* (12.8%), *moving objects with lower extremities* (12.8%) and *changing basic body position* (16.3%).

In the Personal Social sub-scale, 69.7% of the items were assigned to codes were assigned to the Activities and Participation component, with the most frequent dimensions being *Fine Hand Use* (9.8%) and *Dressing* (9.8%); 37% of the items were assigned with Body Functions' dimensions, the most frequently being the *Orientation Functions* (9.8%).

In the Language Sub-scale, 54.1% of the items were assigned to the Activities and Participation component, the most frequent being *Pre-talking* (11.8%) and *Listening* (10.6%); 62.5% of the items were assigned to Body Functions' dimensions, and 47.1% of these are concerned with *Language Functions*, as expected. In this subscale, 15.3% of the items were coded as non-definable (*nd*).

In the eye–hand coordination sub-scale, 113.3% of the items were assigned to Activities and Participation dimensions and the most frequent dimensions were *copying* (15.7%), *learning to write* (13.3%)*, acquiring skills* (30.1%) and *fine hand use* (14.5%); 14.4% of the items were assigned to Body Functions codes, the most frequently assigned being the *Seeing Functions* (9.6%); this means that often one item could be assigned to more than one code. Furthermore in this study, researchers coded 4.8% of the items as non-definable (*nd*).

In the Performance sub-scale, regarding the Activities and Participation component, a percentage of 115.8% items were found to be linked to this component, and 26.8% were linked to the Body Functions component; and among these, 23.2% are concerned with *basic cognitive functions*; again, some items have more than one code. 7.3% of items were coded as *nd.*

In the Practical Reasoning sub-scale, 113.2% were linked to the Activities and Participation component and only one Body Function dimension was assigned, representing 5.3% of the items – the *Orientation Functions*.

Reliability when assigning items to the ICF-CY classification system

Table I presents the average levels of Inter-coder agreement, as measured by *Cohen's Kappa* coefficient, when assigning items of the two measures analysed to the ICF-CY classification system. As found in previous studies, some dimensions of functioning had, consistently, very high levels of agreement (e.g. caring for body parts, toileting and dressing), while others had no agreement at all (e.g. intrapersonal dispositions and complex interpersonal interactions). Particularly, it is important to note that Body Functions' categories had much lower levels of agreement when compared to the Activities and Participation's categories, with the exception of Memory Functions, which showed high levels of agreement whenever assigned to the measures. It is also worth to note that all in Activity and Participation Chapters, the two independent coders have reached very good average levels of agreement, except for the interpersonal Interactions chapter, in which *Good* average levels or agreement were obtained.

Discussion

This study identifies the functionality domains that are assessed by extant measurements currently used in the assessment of young children with developmental disabilities, as well as reliability levels, when assigning ICF-CY codes to the content of the items in the analysed measurements.

The results of this study highlight the dichotomy between traditional developmental assessment and the functional approach to assessment described in the introduction section and systematized in Figure 1. In fact, the most interesting aspect to be underlined is that the analysed instruments are child-focused and do not include any aspect related to the assessment of children's proximal environment, not accounting for other levels of the developmental ecology, such as the exossystemic and the macrosystemic levels. It is important to

Table I. Cohen's kappa average values.

		Average Cohen's kappa values for each ICF-CY chapter each instrument analysed						
			Griffith's developmental scales					
Component	ICF-CY component and chapter	SGS-II	Griffith's locomotor	Griffith's personal social	Griffith's language	Griffith's eye hand coordination	Griffith's performance	Griffith's reasoning
Activities and Participation	d2 – general tasks and demands	0	–	0.66	–	0	0	–
	d3 – communication	0.57	–	0.49	0.72	0	–	–
	d4 – mobility	0.78	0.64	0.04	–	0.36	0.39	–
	d5 – self-care	0.85	0	0.76	–	–	–	–
	d6 – domestic life	–	1	–	–	–	–	–
	d7 – interpersonal interactions	0	–	0.59	–	–	–	–
	d8 – major life areas (engagement in play)	0.63	–	0.66	–	–	–	–
Body functions	b1 – mental functions	0.15	–	–	0	–	–	0
	b2 – sensory functions and pain	–	0	0	0	0	–	–
	b3 – voice and speech functions	–	–	–	0	–	–	–
	b5 and b6 – digestive and genito-urinary functions	–	–	0	–	–	–	–
	b7 – neuromusculoskeletal functions	–	0	–	0	0	0	–

note, however, that both of the reviewed instruments provide a comprehensive evaluation of the child's development in several domains of functioning, namely regarding Activities and Participation dimensions as well as Body Functions. Thus, we may posit that functional information obtained through developmental assessment using these two instruments is broad enough to provide a good picture of the children's behaviour. However, the outcomes of the assessment conducted with this instrument are closer to a capacity-driven approach (thus providing a picture of a child's behaviour in a standard environment) than to a performance approach. In order to have a more detailed picture of the child's performance in natural settings, assessment conducted with these instruments would need to be completed with contextual assessment, thus covering all the sub-systems that involve the child in her developmental process and that transactions occurring between them. The ICF-CY analysis of the SGS II and of the Griffiths' scales has shed light into this need. Developmental assessment with these two measures provides a valuable amount of information on Activities that the child executes in standard environments as well as on some Body Functions. However, to be in line with an authentic assessment approach, and consequently, with a functional approach to development and disability, this assessment needs to be complemented with performance assessments, covering all areas of life, as systematized by the ICF-CY classification system. This recognition does not deny the usefulness of standardized instruments, but highlights the advantage of obtaining additional information in natural settings and the need to assess environmental features, which may be influencing children's functioning, in line with the biopsychosocial perspective on human development. These conclusions also emphasize the need for future research to address the development of new measures that encompass an assessment of the individual child's developmental features as well as environmental ones and the transactions operating between the two.

In line with previous research in this area, the level of agreement between coders when assigning measurement items to the ICF-CY dimensions of functioning, as measured by the Kappa coefficient varies widely, depending on the type of ICF-CY dimension that is under consideration. This confirms the assumption presented in the introduction section and discussed in previous studies that the agreement level is probably more dependent on the conceptual nature of each ICF-CY dimension, than on the training that coders have had on the use of the Classification. In fact, all coders had similar training in the use of the Classification, and they all were familiar with the analysed instruments. Functioning dimensions which, by nature, are difficult to define, as they illustrate less concrete concepts (e.g. thinking or intrapersonal dispositions) tend to have lower levels of agreement. The agreement between coders became consistently much higher in functioning dimensions illustrating straight-forward activities (e.g. dressing or toileting or moving around). These results suggest the need to establish very precise definitions for each of the ICF-CY descriptors, so that the agreement levels, when assigning codes to specific content, may improve. This may also contribute to a higher level of accuracy when developing new assessment tools based on the ICF-CY classification system. It is also relevant to highlight that there was no agreement on most of the Body Functions component, while there were several Activities and Participation dimensions in which very high levels of agreement were obtained.

Conclusion

This study has provided an pioneering analysis of two very recognized assessment instruments, the SGS II and the Griffiths' scales, highlighting that: (1) these assessments are child-focused and although they provide a good picture of some of the child's body functions and activities, they do not cover some essential aspects of the developmental process such as the transactions that occur between the child and the environment; these instruments are invaluable from the point of view of a capacity-driven approach, but children's assessment procedures must be complemented with more

context-based tools to provide a good picture of the child's performance and to be in line with an authentic assessment approach; the use of the ICF-CY in the analysis enabled the identification of these specific issues; (2) there are improvements that need to be made in some ICF-CY descriptors, in order to raise the agreement levels of ICF-CY users and improve accuracy of future tools developed based on this system.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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