Number difficulties in young children

Deficits in core number?

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With some exceptions the diagnosis of developmental dyscalculia (DD) depends on computation test performance, which means in practice that a formal diagnosis is delayed until after the beginning of formal education. Moreover, the fact that a diagnosis is often based on an arbitrary cut-point on a standardised test (e.g., below the 10th percentile) is of concern (Butterworth, 2005a). DSM IV suggests DD prevalence rates of 2%; however, recent estimates suggest prevalence rates of 6.5% or above (Butterworth, 2010). Children with DD have difficulty acquiring number concepts, exhibit confusion over maths symbols, lack a grasp of numbers and have problems learning and remembering number facts. Little is known, however, about the origins of DD or its manifestation in infancy or preschool periods. Some claim that its origins lie in core number deficits (i.e., deficits in non-symbolic approximate magnitude and/or small quantity representations). These abilities are of particular interest diagnostically because they do not depend on formal education and can be assessed relatively early in life. We suggest that a defensible account of DD awaits a better understanding of the significance of core number competences in the early years.

In this chapter we review research on young children’s core number deficits as a possible account of young children’s number difficulties. We begin by describing the core number hypothesis, following which we review contemporary research findings on core number in infancy and preschool children. We then briefly review other neuro-cognitive indices of early number difficulties that might need to be taken into account in the diagnosis of young children with number difficulties.

Core number hypothesis

The abilities to identify, order and compare quantities are considered core aspects of numerical cognition (Berch, 2005; Butterworth, 1999, 2005a, 2005b, 2010; Desoete, Roeyers, & De Clercq, 2004; Gersten, Jordan, & Flojo, 2005; Laski & Siegler, 2007).
Enumerating visual arrays of dots or comparing two quantities/numbers are used to study these abilities. Number/quantity comparison tasks assess the speed and accuracy with which the relative magnitude of two numerical values is identified (e.g., “which quantity/number is larger”). Number/quantities that are closer in magnitude are judged more slowly and less accurately than those that are more distant in magnitude (referred to originally as the symbolic distance effect: Moyer & Landauer, 1967). Performance on number comparison tasks using number symbols (e.g., Arabic digits) or arrays of dots is associated with arithmetic competence (Holloway & Ansari, 2009; Mazzocco, Feigenson & Halberda, 2011). Mazzocco, Feigenson and Halberda (2011), for example, found that accuracy in comparing two arrays of large numbers of dots correlates with measures of school arithmetic in the primary/elementary school years; and Piazza and colleagues (2010) found that children identified as dyscalculics, having a congenital difficulty in learning arithmetic, were significantly less accurate than age-matched controls in comparing magnitudes.

Number comparison abilities have been studied developmentally (Baker et al., 2002; Chard et al., 2005; Clark & Shinn, 2004; Geary, Hoard & Hamson, 1999; Geary, Hamson & Hoard, 2000; Gersten et al., 2005; Jordan, Kaplan, Nabors Olah, & Locuniak, 2006; Locuniak & Jordan, 2008; Mazzocco & Thompson, 2005; Reeve, Reynolds, Humberstone, & Butterworth, 2012; Shalev, Manor, Auerbach, & Goss-Tsur, 1998; Shalev, Manor, & Goss-Tsur, 1997, 2005; Silver, Pennett, Black, Fair, & Balise, 1999). Different number distance effects (different NC slopes) have been observed in children with maths learning deficits (Mussolin, Mejias, & Noël, 2010; Reeve et al., 2012; Rousselle & Noël, 2007), and comorbid visuo-spatial deficits (Bachot, Gevers, Fias, & Roeyers, 2005). Faster and more accurate judgments of numerical magnitudes may thus reflect a growing understanding of cardinal relationships, improvements in transcoding, and automaticity in accessing numerical information (Girelli, Lucangelli, & Butterworth, 2000; Rubinsten, Henik, Berger, & Shahar-Shalev, 2002).

Several groups have found that difficulty in reporting accurately the number of dots in an array is also a marker of dyscalculia in school children (Koontz & Berch, 1996; Landerl, Bevan, & Butterworth, 2004; Reeve et al., 2012). The apparent failure to label the cardinal value of small numerosities without counting (known as subitising) has been implicated in several cognitive disorders and is associated with dyscalculia. Subitising deficits have mostly been associated with right parietal disruptions, particularly the intraparietal sulcus. These disorders include Turner’s syndrome (TS) (Bruandet, Molko, Cohen, & Dehaene, 2004), cerebral palsy (CP) (Arp & Fagard, 2005; Arp, Taranne, & Fagard, 2006), Velocardiofacial syndrome (VCFS – also known as Chromosome 22q11.2 Deletion syndrome, or DS22q11.2) (De Smedt et al., 2007; Simon, Bearden, McDonald-McGinn, & Zackai, 2005; Simon et al., 2008), Fragile X syndrome (FXS), and Williams (WS) syndrome (Mazzocco & Hanich, 2010; Paterson, Girelli, Butterworth, & Karmiloff-Smith, 2006). Subitising impairments have also been observed in individuals with acquired Gerstmann’s syndrome (Cipolotti, Butterworth, & Denes, 1991; Lemer, Dehaene, Spelke, & Cohen, 2003), who appear to count individual items in arrays of less than four and are poor calculators. Similarly, children who show a constant linear RT increase with no
point of discontinuity when enumerating successive numerosities (i.e., who are not subitising small numerosities), are also very poor at arithmetic (Arp & Fagard, 2005; Arp et al., 2006; Koontz & Berch, 1996; Landerl et al., 2004; Reeve et al., 2012).

We suggest that object enumeration and number comparison may be early markers of number disability in young children which are relatively independent of school-based experiences. In what follows, we review what is known about these two core number abilities in the infancy and preschool period.

**Core number in infancy**

Evidence of numerical processing in preverbal human infants is well documented and provides support for the two core number systems. Infants’ ability to discriminate difference between two non-symbolic quantities (i.e., sets of objects) has been found in several paradigms: habituation (Xu & Spelke, 2000), cross-modal discrimination (Izard, Sann, Spelke, & Streri, 2009), numerical change detection (Starr, Libertus, & Brannon, 2013a, 2013b). Infants’ discrimination abilities are less precise than those of older children, but their precision increases over the first year of life. For instance, Izard and colleagues showed that newborns (49-hour-old neonates) could discriminate between two numerosities presented in different modalities (i.e., visual and auditory) that differed by a ratio of 3:1; and could discriminate between numerosity ratios of 2:1 at 6 months (Xu & Spelke, 2000), and ratios of 3:2 at 10 months old, (Xu & Arriaga, 2007). Moreover, across-modality discrimination suggests infants possess something akin to an abstract representation of quantity, which contradicts the view that infants rely on perceptual features that correlate with number (e.g., surface area) to discriminate between sets on visual properties (Opfer & Siegler, 2012).

Infants can also represent small numbers of objects precisely, with an upper-bound of three items. For instance, findings from manual search and ordinal choice paradigms suggest that infants can precisely represent and keep track of sets of 1, 2, and 3 objects, but not 4 objects or larger (Feigenson & Carey, 2003, 2005; Feigenson, Carey, & Hauser, 2002). Recently, vanMarle (2013) showed that infants (10–12 months) can discriminate between two numerosities presented in different modalities (i.e., visual and auditory) that differed by a ratio of 3:1; and could discriminate between numerosity ratios of 2:1 at 6 months (Xu & Spelke, 2000), and ratios of 3:2 at 10 months old, (Xu & Arriaga, 2007). Moreover, across-modality discrimination suggests infants possess something akin to an abstract representation of quantity, which contradicts the view that infants rely on perceptual features that correlate with number (e.g., surface area) to discriminate between sets on visual properties (Opfer & Siegler, 2012).

Neurological research has also shed light on infants’ numerical processing. For instance, Hyde and Spelke (2011) found the event related potentials (ERPs) in 6–7.5-month-olds as they viewed large sets of dots evoked ratio-dependent responses in the parietal regions, whereas small numbers evoked occipital-temporal responses. Interestingly, these neurological responses are similar to those observed in adults (Ansari, Dhital, & Siong, 2006; Hyde & Spelke, 2009).

There are clear similarities in the core number abilities of infants and older children, which suggests a developmental continuity between earlier and later number
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development. Indeed, Starr et al. (2013b) showed that 6-month-olds’ numerical discrimination abilities predicted their standardised maths score, number word knowledge, and comparison abilities at 3.5 years of age. This is an important finding since it provides direct evidence that infant quantitative competencies are associated with later core number abilities, as well as providing support for the hypothesis that infant quantitative competencies may be associated with later numerical abilities. Nevertheless, in the Starr et al. study, infants’ approximate number acuity accounted for only a small proportion of variance in number abilities at 3.5 years, which suggests that other competencies (e.g., general cognitive competencies, experiences), may also scaffold maths development. As yet though, we know little about the predictive value of infants’ precise small-number representations for later number abilities.

Core number abilities in preschoolers

Several studies show that preschoolers’ magnitude comparison abilities are related to concurrent (Bonny & Lourenco, 2013; Libertus, Feigenson, & Halberda, 2011) and future (Libertus, Feigenson, & Halberda, 2013a, 2013b; Mazzocco et al., 2011) maths achievement (as assessed by standardised maths tests). Preschoolers’ approximate magnitude representations are usually assessed using non-symbolic magnitude comparison tasks, which require them to judge which of two magnitude arrays (e.g., sets of dots, rectangles) is larger. Similar to infants, preschoolers’ magnitude comparison abilities show ratio effects, with magnitude discrimination abilities increasing throughout the preschool years: 3-year-olds are able to discriminate 3:4 ratio arrays, while 5-year-olds can discriminate 5:6 ratios (Halberda & Feigenson, 2008).

Several factors caution against drawing strong conclusions about the uniqueness of preschoolers’ magnitude comparison abilities as an index of their maths ability (De Smedt, Noël, Gilmore, & Ansari, 2013). Findings vary as a function of a number of factors (e.g., age, IQ, response time, vocabulary, attention, memory, inhibition: see Chu, vanMarle, & Geary, 2013; Fuhs & McNeil, 2013; Libertus et al., 2013b; Mazzocco et al., 2011), suggesting that the relationship between preschoolers’ magnitude comparison abilities and maths competence may be only part of the story.

Fuhs and McNeil (2013), for example, found that magnitude comparison abilities no longer explained variance in preschoolers’ (44 to 71 months) maths competence when response inhibition was taken into account. Response inhibition, an executive function, has been shown to be related to young children’s maths (Clark, Sheffield, Wiebe, & Espy, 2012; Espy et al., 2004), and may influence magnitude comparison abilities because successful performance depends on an ability to ignore competing non-numerical features (e.g., size and surface area of stimuli). Fuhs and McNeil propose that inhibitory control may account for the association between magnitude comparison abilities in several studies that did not assess this particular executive function (Bonny & Lourenco, 2013; Libertus et al., 2011, 2013a, 2013b; Mazzocco et al., 2011). Nevertheless, Fuhs and McNeil’s data were obtained with children from low-income homes, who may have few everyday maths activities: indeed, everyday experiences are considered important in facilitating approximate number
development (Butterworth, 2010). Nevertheless, the failure to find a relationship between magnitude comparison and maths abilities, after controlling for executive functions, has been found by Chu et al. (2013) with preschoolers at risk of maths learning difficulties, and by Gilmore et al. (2013) with school-aged children (however, see Lonnemann, Linkersdörfer, Hasselhorn, & Lindberg, 2013). While the findings of Fuhs and McNeil (2013), Chu et al. (2013) and of Gilmore et al. (2013) would appear to contradict a unique core number claim (i.e., core number differences uniquely predict number abilities), it is possible that the approximate number system and executive functions jointly support maths development.

Precise small-number representations in preschoolers are most often assessed using dot enumeration tasks. Small sets (typically \( n \leq 4 \)) are enumerated accurately and rapidly with a relative flat response time slope (known as the subitising range), while larger sets (\( n \geq 4 \)) are enumerated more slowly, and enumeration is more error-prone and characterised by a steeper RT slope (Chi & Klahr, 1975; Reeve et al., 2012; Schleifer & Landerl, 2011). This pattern of performance is similar for preschoolers, older children, and adults, albeit preschoolers display slower response times on average (Chi & Klahr, 1975; Klahr & Wallace, 1976). Dot enumeration signatures may be based on up to four parameters: the subitising range, the RT slope of the subitising range, the \( y \)-intercept of the subitising RT slope, and the RT slope of the counting range (see Reeve et al., 2012). The development of these performance parameters in the preschool years has not been thoroughly investigated; although it is claimed that preschoolers’ subitising range increases from 2–3 dots at 2 years of age to 3–4 dots by age 4 (Starkey & Cooper, 1995).

Similar to research with infants, the relationship between dot enumeration abilities and preschoolers’ maths is less studied than their magnitude comparison abilities, which is surprising given the relationships between dot enumeration abilities and maths in kindergarten (Kroesbergen, Van Luit, Van Lieshout, Van Loosbroek, & Van de Rijt, 2009; Yun, Havard, Farran, & Lipsey, 2011) and school children (Desoete & Grégoire, 2006; Fischer, Gebhardt, & Hartnegg, 2008; Fuchs et al., 2010b; Obersteiner, Reiss, & Ufer, 2013; Penner-Wilger et al., 2007; Reeve et al., 2012; Reigosa-Crespo et al., 2012; Träff, 2013). Nevertheless, individual differences in preschoolers’ subitising signatures (subitising range and RT slope) (Gray & Reeve, 2014; Starkey & Cooper, 1995) are related to maths abilities. Gray and Reeve (2014), for example, found that a poor subitising profile (smaller range, steeper slope, slower RTs) uniquely predicted poorer non-verbal addition performance in preschoolers (42 to 57 months), after working memory, basic response time, and response inhibition had been taken into account. Gray and Reeve found that inhibition contributed to predicting addition ability and subitising, while working memory contributed to subtraction ability. These findings support the claim that both core (in this case, dot enumeration) and general cognitive abilities play a role in early maths abilities.

Several studies have investigated the significance of symbolic magnitude comparison and precise small-number abilities in school children’s computation skills, and have found that both measures predict number abilities (Fuchs et al., 2010a, 2010b; Obersteiner et al., 2013; Reeve et al., 2012; Reigosa-Crespo et al., 2012; Träff,
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Moreover, several studies show that precise small-number ability is the better predictor of school computation (addition and subtraction), compared to symbolic magnitude comparison abilities (Fuchs et al., 2010a; Reeve et al., 2012; Reigosa-Crespo et al., 2012). However, it is possible that the two core abilities might be important for different types of computation skills (see Reigosa-Crespo et al., 2012). It also seems likely that the diagnostic significance of the two core abilities changes across development (Reigosa-Crespo et al., 2012). Nevertheless, it remains to be seen how small precise number and magnitude comparison abilities in combination are associated with maths in preschoolers, and how the relative contributions of the two core abilities change across the preschool years and beyond (Gray & Reeve, submitted).

Standardised measures of maths competence (e.g., TEMA-3; Ginsburg & Baroody, 2003) are frequently used to assess preschoolers’ maths skills (e.g., Fuchs & McNeil, 2013; Libertus et al., 2011, 2013a, 2013b), which make it difficult to determine the specific maths skills associated with the different core number abilities (De Smedt et al., 2013; Lonnenmann et al., 2013; Vanbinst, Ghesquière, & De Smedt, 2012). Standardised tests assess a range of maths skills, some of which are dependent on formal instruction. Aggregating performance measures across a range of different types of problems further makes it difficult to identify specific maths difficulties. Given it is possible that the two core abilities scaffold different maths skills (Reigosa-Crespo et al., 2012), aggregated maths scores may misrepresent the relationship (see Lonnenmann et al., 2013). We suggest that a more specific investigation of the associations between magnitude comparison and dot enumeration skills and specific maths skills would provide insight into the role core abilities play in early maths development.

We also need to better understand the diagnostic significance of non-symbolic and symbolic magnitude comparison tasks. It has been suggested that the non-symbolic approximate number/quantity system provides a structure for children to map number symbols onto pre-existing magnitude representations (Opfer & Siegler, 2012). This mapping provides children with an ability to estimate positions of numbers on number lines, estimate quantities, categorise numbers by size, remember numbers, and to estimate and learn answers to arithmetic problems (Opfer & Siegler, 2012). For instance, when learning arithmetic, young children may rely on approximate number representations to grasp the relative magnitudes of addends, and determine the appropriate magnitude of solutions (Lonnenmann et al., 2013).

Although many researchers suggest that approximate number representations support symbolic development; others suggest that it might support very early symbolic number learning, but that the non-symbolic system becomes less important once number symbols are acquired (Holloway & Ansari, 2009; Lyons & Beilock, 2011). Indeed, Libertus et al. (2013b) showed that preschoolers’ non-symbolic magnitude comparison abilities predicted informal maths abilities (including counting, comparing numerals, arithmetic with objects, and cardinality tasks), but not formal maths abilities (numeral literacy, arithmetic fact retrieval and mental and written calculation). Similarly, Chu et al. (2013) found that preschoolers’ symbolic number skills...
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(e.g., knowledge of Arabic digits and number words and their cardinal meaning) better predicted maths learning abilities than their non-symbolic magnitude comparison abilities. In general, findings suggest that non-symbolic magnitude comparison abilities are associated with very early number skills, but not with more formal maths abilities.

There are several hypotheses about how precise small-number representations scaffold early maths ability. Several studies have shown that young children can subitise, or accurately name small sets, before they can reliably count (Benoit, Lehalle, & Jouen, 2004; Fuson & Hall, 1983; Starkey & Cooper, 1995), which has been regarded as evidence that subitising has developmental precedence over counting, and may in fact support counting development. Subitising allows children to view the whole and the elements of a set simultaneously, and by labelling and counting these sets, children may begin to acquire the cardinal meanings of number words and the purpose of counting (Benoit, Lehalle, & Jouen, 2004; Carey, 2001; Clements, 1999; Klahr & Wallace, 1976; Starkey & Cooper, 1995; Wynn, 1992). Subitising may also be important for learning addition and subtraction concepts, by allowing children to represent the effect of transformations on small sets (Baroody, Lai, Li, & Baroody, 2009; Carey, 2001; Clements, 1999; Gray & Reeve, 2014; Hunting, 2003; Jung, Hartman, Smith, & Wallace, 2013). It is unclear why the ability to subitise remains a diagnostic predictor of arithmetic skill beyond the small numbers (Piazza, 2010).

Nevertheless, there is evidence that subitising abilities predict maths abilities across the primary/elementary school period, and might well be a better diagnostic measure of maths abilities than magnitude comparison abilities (Reeve et al., 2012). Moreover, Gray and Reeve (submitted) found that dot enumeration ability, and subitising in particular, is a better predictor of preschool children’s maths abilities than magnitude comparison abilities. They examined a range of preschool maths abilities, including counting, symbolic number, and arithmetic skills, as well as core number and executive function abilities (working memory and response inhibition) to establish whether different combinations of core number abilities and general cognitive functions contribute to the prediction of different maths abilities. Gray and Reeve show that precise small-number abilities were a strong predictor of most maths abilities assessed, over and above magnitude comparison abilities, and cognitive functions. Their findings also showed that subitising and small-number enumeration efficiency more generally predicted emerging maths abilities. Overall, these findings provide support for the claim that precise small-number abilities are a diagnostic marker of preschoolers’ emerging maths competence.

Magnitudes comparison and precise small-number enumeration abilities are claimed to be markers of early maths competence; however, with some exceptions (see Gray & Reeve, submitted) the relative contributions of these abilities for preschool maths have not been examined. It is of diagnostic importance to determine how these abilities are related to each other and to the development of maths abilities in general. Many questions remain unanswered. Is one measure a better predictor of maths than the other? Do they predict the same or different kinds of maths abilities?
What is the relationship between the two core number abilities and other cognitive abilities? We briefly consider some answers to the latter question next.

**Cognitive functions**

As already noted, some researchers have examined the relative impact of general cognitive functions, over and above contributions of core number abilities, for preschool children’s maths skills. It is probable that general abilities are more important for preschoolers’ maths abilities than they are for school-aged children, since maths tasks may be more cognitively demanding for preschoolers (Clark et al., 2012; Fuhs & McNeil, 2013). This claim is supported by neuroimaging evidence which shows that young children rely more heavily on pre-frontal brain regions, associated with executive functioning, when first learning maths; children do not display specialised maths processing regions until later in development, when number knowledge has been acquired (Houdé, Rossi, Lubin, & Joliot, 2010). Several researchers (Fuchs et al., 2010a, 2010b; Östergren & Träff, 2013; Träff, 2013; von Aster & Shalev, 2007) propose that general cognitive abilities (e.g., working memory) support the learning of new maths concepts by facilitating the integration of core number representations with symbolic number systems. While preschoolers might have a core number platform for acquiring number concepts, general cognitive functions may assist by helping children respond to changing task demands, maintain information in memory (working memory), and inhibit distracting inputs (inhibition) (Clark et al., 2012). We should not discount the possibility that different cognitive functions might be important for different maths skills, and their relative contributions may change across preschool and school periods. Furthermore, the relative contributions of relevant abilities might differ depending on a child’s unique developmental trajectory: recent evidence suggests the relationships between core number abilities, general abilities and maths is non-linear in preschoolers (Bonny & Lourenco, 2013; Gray & Reeve, 2014). The relationship between patterns of core number and general cognitive abilities in maths development is complex and undoubtedly will be the subject of much future research.

**Spatial abilities**

A question of some interest is whether core number representation is maths domain specific or part of a more general spatial magnitude representation system (Lourenco, Bonny, Ferrandez, & Rao, 2012; Walsh, 2003). Associations between numerical magnitude representations and space are commonly invoked, with some researchers proposing numerical magnitudes are represented spatially along a mental number line (e.g., Dehaene, Piazza, Pinel, & Cohen, 2003; Opfer & Siegler, 2012). Precise small-number representations have also been proposed to depend on a visual system that allows individuals to track small numbers of objects in space (e.g., Chesney & Haladjian, 2011; Piazza, 2010). Evidence of an association between numbers and space in older children and adults comes from demonstrations of the
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so-called SNARC effect, in which incongruent spatial cues interfere with numerical processing, and vice versa (see Hubbard, Piazza, Pinel, & Dehaene, 2005). Pinel, Piazza, Le Bihan, and Dehaene (2004) showed that parietal brain regions activated during numerical magnitude comparison overlapped with areas activated when discriminating size and luminance. The joint deficits of space and number commonly observed in patients with Gerstmann’s syndrome, have also been suggested as evidence of a shared underlying mechanism (Henik, Rubinsten, & Ashkenazi, 2011). Moreover, evidence shows spatial processing difficulties are associated with maths abilities in children (de Hevia, Vallar, & Girelli, 2008; Opfer, Thompson, & Furlong, 2010; von Aster & Shalev, 2007), and adults (Lourenco et al., 2012). These findings raise the possibility that spatial ability per se might underlie the association between core number and maths abilities.

It is of course possible that the association between number and spatial processes reflects the anatomical proximity of these systems within the IPS (Butterworth, 2005a; Dehaene et al., 2003; Gracia-Bafalluy & Noël, 2008; Hubbard et al., 2005). The IPS has been implicated in cognitive processes besides number and space, including finger-related skills (grasping and pointing) and attention, which have also been shown to be associated with maths (Chinello, Cattani, Bonfiglioli, Dehaene, & Piazza, 2013). Given their anatomical connections, these processes may mature at the same rate and share developmental trajectories (Chinello et al., 2013), while also sharing impairment in the event of parietal lesions (Hubbard et al., 2005).

It is also possible that the associations between number and space are the product of culture-based training aimed at creating links between these domains; such as instruction on the number line, and using fingers and objects to count and solve problems (see Chinello et al., 2013). It is difficult to disentangle the effects of culture-based training given that most research examining number-space relations focuses on formally educated children and adults (e.g., see de Hevia et al., 2008). Recently, Chinello and colleagues (2013) investigated the relationship between magnitude comparison, visuospatial and finger gnosis abilities in adults and preschoolers. Their findings suggest that number, space and finger skills are related (i.e., they share common developmental trajectories) but are functionally distinct (at least partially) prior to formal education, and segregate further throughout development and into adulthood (Chinello et al., 2013). It is possible that the ability to represent one’s own fingers and use them in maths tasks facilitates the link between number and space in young children, and might even assist mapping symbols onto pre-existing spatial magnitude representations (Fayol & Seron, 2005; Reeve & Humberstone, 2011). Nevertheless, the precise nature of the links between core number, early maths, space and finger representations requires further elucidation (Butterworth, 1999; Noël, 2005).

Final comments

It is evident that we need to more fully understand the factors that scaffold early maths development prior to formal instruction and ipso facto provide a diagnostic framework for assessing young children’s maths abilities. Besides the
core number issues discussed herein, other factors likely support symbolic maths development (e.g., the role of language, everyday maths experiences, and general cognitive functions). Moreover, several researchers have emphasised the importance of assessing children’s ability to attend to number events in their environment (Butterworth & Reeve, 2012; Gelman, 2000, 2009; Gelman & Williams, 1998; Hannula & Lehtinen, 2005; Hannula, Lepola, & Lehtinen, 2010; Hannula, Rasanen, & Lehtinen, 2007), which requires attention. In conclusion, there is little doubt that recent research assessing the role of core number competencies for early maths development shows great promise, especially as a diagnostic measure of children’s maths difficulties. Nevertheless, we must modestly acknowledge that we are at the beginning of a critical research agenda designed to better understand the origins of children’s maths difficulties, and much remains to be done.

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