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Children's representation of symbolic magnitude: The development of the priming distance effect

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ABSTRACT

The comparison distance effect (CDE), whereby discriminating between two numbers that are far apart is easier than discriminating between two numbers that are close, has been considered as an important indicator of how people represent magnitudes internally. However, the underlying mechanism of this CDE is still unclear. We tried to shed further light on how people represent magnitudes by using priming. Adults have been shown to exhibit a priming distance effect (PDE), whereby numbers are processed faster when they are preceded by a close number than when they are preceded by a more distant number. Surprisingly, there are no studies available that have investigated this effect in children. The current study examined this effect in typically developing first, third, and fifth graders and in adults. Our findings revealed that the PDE already occurs in first graders and remains stable across development. This study also documents the usefulness of number priming in children, making it an interesting tool for future research.

Introduction

How do people process numbers? This question has attracted a lot of interdisciplinary research attention for several years (for reviews, see Ansari, 2008; Kadosh, Lammertyn, & Izard, 2008). One of the most consistent findings in this research area, first described by Moyer and Landauer (1967), is the so-called *comparison distance effect* (CDE), whereby comparing two digits is easier when they

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are numerically further away from each other (e.g., 1–9) than when they are numerically close to each other (e.g., 1–2). A similar effect has been found for comparing nonsymbolic magnitudes such as line lengths and dot collections (for a review, see Kadosh et al., 2008). The existence of a CDE for symbolic and nonsymbolic magnitudes has been interpreted as evidence in favor of the mapping of enculturated symbols for magnitude on an innate representation for magnitude (Feigenson, Dehaene, & Spelke, 2004). Ever since, the CDE has been considered as an important marker for how people internally represent magnitudes.

Although the majority of research has focused on adults, the CDE has also been investigated in children. In a cross-sectional developmental study, Sekuler and Mierkiewicz (1977) showed that the CDE is already present in 5-year-old kindergarteners and that the size of the CDE decreases with increasing age (see also Duncan & McFarland, 1980; Holloway & Ansari, 2008). Most interesting, a recent study by Holloway and Ansari (2009) showed that the size of the symbolic CDE predicts individual differences in mathematical achievement. It has also been suggested that changes in the CDE serve as an important marker for children with impairments in mathematics such as dyscalculia (Butterworth, 2005; Landerl, Bevan, & Butterworth, 2004; Rousselle & Noël, 2007). This makes the study of the CDE of potential interest for the assessment of children's math skills (Holloway & Ansari, 2009) and for the identification of dyscalculia (Butterworth, 2005).

A lot of research has focused on the underlying mechanisms of the CDE. A first explanation has been proposed by Restle (1970), who suggested that the CDE in number comparison is due to an overlap of magnitude representations on a continuum. This representational overlap hypothesis assumes that numbers are represented on a mental number line with, at least in Western cultures, small numbers on the left and large numbers on the right (e.g., Dehaene, Bossini, & Giraux, 1993). A number is represented as a distribution around the true location of that number on the mental number line. Representations of different numbers will overlap, and this overlap is a function of numerical distance between the numbers; the closer the numbers are to each other, the larger the overlap. Discrimination performance between two numbers is, thus, a function of the distributional overlap of their representations. Close numbers have a lot of representational overlap and will be more difficult to discriminate. Two numbers that are far apart have no (or at least less) overlap, making it easier to discriminate between them. In line with this representational overlap hypothesis, the decrease of the CDE throughout development is explained by a more exact representation of magnitudes in older children and adults due to a decrease in representational overlap with increasing age (e.g., Sekuler & Mierkiewicz, 1977). This decrease in representational overlap with increasing age might be explained by an evolution from a logarithmic to a less compressed and more linear mental number line, by a decrease in the variance of the distributions related to a particular representation, or by a combination of both (Noël, Rousselle, & Mussolin, 2005). This representational overlap hypothesis for symbolic magnitudes has also received recent support from brain imaging studies and electrophysiological studies with primates (e.g., Diester & Nieder, 2007; Piazza, Pinel, Le Bihan, & Dehaene, 2007).

However, a second explanation for the CDE has focused more on the role of decisional processes in (numerical) comparison tasks (e.g., Banks, 1977; Verguts, Fias, & Stevens, 2005). Using neural network simulations, Verguts and colleagues (2005) showed that the CDE is due mainly to the differential strength of connections between the magnitude nodes on the number line and the response nodes ("smaller" and "larger"). For example, when target numbers need to be compared with a fixed standard (e.g., 5), the connection weights between the magnitude node and the output node "larger than the standard" will increase linearly with increasing magnitude. Similarly, the connection weights between the magnitude node and the output node "smaller than the standard" will decrease with increasing magnitude. These connection weights will lead to the CDE; when the numerical distance between the target and a fixed standard number increases, the activation of the output node "larger than the standard" or "smaller than the standard" increases, resulting in faster latencies. The observations by Holloway and Ansari (2008) showing similar developmental changes in the CDE for both numerical and nonnumerical magnitude judgments (e.g., luminance judgments) are in line with this explanation.

Recently, the underlying magnitude representation for numbers has also been examined by using the priming paradigm. In this paradigm, two stimuli are presented shortly after each other and the processing time of the second stimulus (the target) is analyzed as a function of the first stimulus (the prime). This paradigm has been frequently used to investigate number processing (e.g., Dehaene et al., 1998; Reynvoet & Brysbaert, 1999). In a typical number priming paradigm, participants need to process a target number that is preceded by a prime number and the distance between the prime and target is varied systematically. Interestingly, studies using this paradigm have reported a so-called *priming distance effect* (PDE); when the numerical distance between prime and target distance is small (e.g., 1–2), the processing of the target occurs faster than when the prime–target distance is large (e.g., 1–9). This effect is explained by assuming the presence of overlap between different numerical representations (Verguts et al., 2005). The PDE is thought to occur because the prime activates the representation not only for the presented number but also for the numbers that are numerically close to it. For example, if the number 8 is presented as a prime, its representation will be activated, but the representations of neighbors 7 and 9 will also be activated, whereas the more distant number 4 will receive much less activation.

The existence of a PDE clearly favors the representational overlap hypothesis and cannot be explained by more general decisional or response selection processes. This makes priming an interesting method to investigate the nature of people's internal representation of numbers. Although the paradigm has been used in adults, no studies with children have been reported.

The current study is, therefore, the first to examine the PDE in typically developing children, aiming to shed new light on the development of number representations during childhood. As mentioned above, studies on the CDE in children showed that the CDE decreases with increasing age, suggesting that number representations become more exact across development. However, given the alternative view that the CDE might reflect a general decision process rather than an underlying representation (Banks, 1977; Verguts et al., 2005), no solid conclusions can be drawn about developmental changes of the magnitude representations. An examination of the PDE in children might reveal new insights on this issue. To achieve this, a priming paradigm was used in the current experiment. We presented two digits, a prime and a target, in close succession. To ensure that the participants processed the prime, we asked them to perform a magnitude judgment task on both the prime and the target. The same stimulus presentation sequence was used by Koechlin, Naccache, Block, and Dehaene (1999), who showed that this method yielded a reliable CDE and PDE in adults. Participants were asked to indicate whether each stimulus (prime or target) was smaller or larger than 5. The numerical distance between prime and target was manipulated systematically.

The following hypotheses were tested. First, in line with the representational overlap hypothesis, we expected that a PDE would be observed in both children and adults; a small distance between prime and target numbers should lead to faster target responses than a large prime–target distance. Second, as participants performed a magnitude judgment on the prime, we expected the emergence of a CDE on the prime. Data from first, third, and fifth graders were collected to examine the developmental changes of both effects. We also collected a sample of adult data to evaluate the validity of the priming paradigm in children. Because one task was used to measure both the CDE and PDE, we were also able to examine the association between the two effects.

Method

Participants

Participants were 55 typically developing primary school children: 20 first graders, 17 third graders, and 18 fifth graders. All children had normal mathematical ability. All first graders had already received instruction in the number domain up to 10. Of the 20 first graders, 4 performed at chance level and were excluded from further analyses. In addition, 1 third grader was excluded because he made substantially more errors (>3*SD*) than the other third graders. In addition to the child participants, 16 first-year psychology students participated in the experiment. Thus, the final sample consisted of 16 first graders (mean age = 6.7 years, 10 males and 6 females), 16 third graders (mean age = 8.8 years, 8 males and 8 females), 18 fifth graders (mean age = 10.6 years, 7 males and 11 females), and 16 first-year psychology students (mean age = 18.9 years, 5 males and 11 females).

Apparatus

Stimuli were presented on a 15-in. color screen connected to a computer running the Windows XP operating system. Stimulus presentation and the recording of behavioral data (reaction time and accuracy) were controlled by E-prime (Psychology Software Tools, http://www.pstnet.com).

Stimuli

The prime stimuli were all Arabic digits between 1 and 9, excluding 5. The Arabic digits 1, 4, 6, and 9 were presented as targets. This resulted in 32 (8 primes × 4 targets) possible combinations. In total, five blocks of these 32 trials were presented. The first block served as a practice block. Both prime and target appeared in the middle of the screen as white digits on a black background. They were presented in Arial font measuring 6 to 8 mm in width and 10 mm in height.

Procedure

Participants were tested in a separate room in small groups of 3 or 4 children accompanied by two experimenters in February or March. Instructions were explained thoroughly by one of the experimenters and appeared on the screen at the start of the experiment. The sequence of a trial is displayed in Fig. 1. First, the prime was shown on the screen until a response was detected. After the response, the prime was replaced by a blank screen for 200 ms and then was followed by the target stimulus. The target also remained on the screen until a response was detected. Afterward, a blank screen was shown for 2000 ms, serving as the intertrial interval. Participants were asked to classify each digit as smaller or larger than 5 using a left-hand (*a*) or right-hand (*p*) response button on an AZERTY keyboard. The response buttons were also marked with little colored stickers. If the prime was smaller than 5, participants needed to give a left-hand response; if the prime was larger than 5, a right-hand response was required. All participants used the same response assignment because it is consistent with the association between space and magnitude (left and small vs. right and large) that was observed in previous research (e.g., Dehaene et al., 1993) and because we wanted to eliminate an additional difficulty factor. The experiment took approximately 25 min. Once the experiment was finished, the children received a small reward.

Results

First, we analyzed performance on the prime stimuli as a function of the distance between the prime and the standard 5 for each age group. This allowed us to examine the presence and develop-

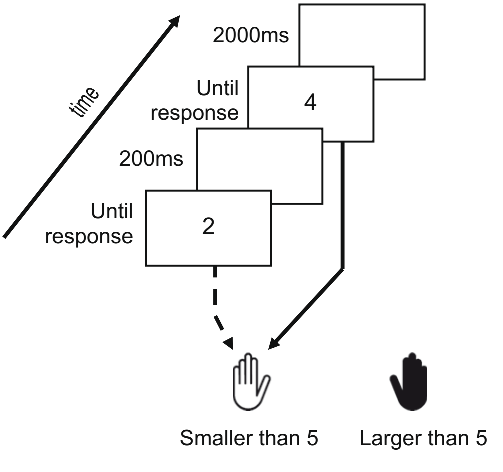

Fig. 1. Example of a trial.

Table 1
Mean percentage error rates and standard deviations as a function of prime value and age group (i.e., the CDE).

	Prime value							
	1	2	3	4	6	7	8	9
Grade 1	8.4 (12.4)	14.8 (16.5)	13.6 (15.1)	25.32 (26.9)	11.6 (14.9)	10.5 (9.9)	6.4 (9.4)	6.1 (7.5)
Grade 3	1.5 (3.5)	5.8 (7.0)	2.3 (4.3)	3.8 (4.8)	5.4 (7.1)	3.4 (4.4)	2.6 (4.9)	3.8 (4.3)
Grade 5	1.3 (3.3)	3.7 (6.1)	3.7 (5.3)	7.2 (9.8)	4.0 (5.6)	6.1 (8.2)	2.4 (6.4)	3.1 (5.7)
Adults	1.5 (2.6)	0.8 (2.0)	0 (0)	1.8 (2.8)	1.8 (2.8)	0.8 (3.0)	0.1 (0.3)	0.4 (1.5)
Average	3.1 (7.2)	6.2 (10.6)	4.8 (9.5)	9.5 (17.3)	5.7 (9.3)	5.2 (7.7)	2.9 (6.5)	3.3 (5.5)

Note. Standard deviations are in parentheses.

ment of the CDE.[2] Furthermore, the presence of the CDE will ascertain that the prime stimulus was processed, which is a necessary prerequisite to obtain a PDE. Second, we analyzed performance on the target stimuli as a function of the distance between prime and target for each age group. This allowed us to examine the presence and development of the PDE. For both CDE and PDE analyses, we examined the error rates and reaction times (RTs). Third, we examined the correlation between the two effects. The correlation between both effects would help to establish the relationship between them.

Comparison distance effect

Error rates

Mean error rates as a function of prime value are displayed in Table 1. Error rates were submitted to an 8 (Prime Value) × 4 (Age Group) repeated measures analysis with prime value as a within-participant factor and age group as a between-participants factor. The analysis revealed a main effect of prime value, $F(7,56) = 5.49$, $p < .001$. In line with previous studies (Duncan & McFarland, 1980; Holloway & Ansari, 2008), more errors were made on digits that were close to the standard 5 than on digits that were further away from the standard. A main effect of age group, $F(3,62) = 11.56$, $p < .001$, was also observed; younger children made more errors than older children and adults. The mean error rates for first, third, and fifth graders and adults were 11, 4, 4, and 1%, respectively. Furthermore, there was a significant interaction between prime value and age group, $F(21,161.35) = 1.67$, $p < .05$. A linear contrast showed that the error rate decreased with increasing distance for first graders, $F(1,15) = 12.83$, $p < .01$, and fifth graders, $F(1,17) = 11.97$, $p < .01$, but not for third graders, $F(1,15) = 1.55$, $p = .23$), or adults, $F < 1$.

Reaction times

Median RTs from correct responses on the primes were submitted to an 8 (Prime Value) × 4 (Age Group) repeated measures analysis. The analysis revealed a main effect of prime value, $F(7,56) = 6.50$, $p < .001$. In line with previous reports (Duncan & McFarland, 1980; Holloway & Ansari, 2008; Sekuler & Mierkiewicz, 1977), a CDE was observed; RTs decreased when the distance between the prime value and the standard increased. There was also a significant main effect of age group, $F(3,62) = 28.80$, $p < .001$, indicating slower responses for younger children. The interaction between age group and prime value was not significant, $F < 1$, indicating that the CDE was similar in all groups (see Fig. 2).

[2] We initially evaluated the development of the CDE by analyzing only the performance on the prime stimuli because performance on prime stimuli is not confounded by prime–target distance and includes RTs on all numbers. To replicate this analysis across prime and target set, we also examined the CDE on the targets as well. A 4 (Target Value) × 4 (Age Group) repeated measures analysis on target error rates and RTs revealed identical results. For the error rates, there was a main effect of age group, $F(3,62) = 15.20$, $p < .001$, with younger children making more errors. Mean error rates on the targets 1, 4, 6, and 9 were 5.9, 10.8, 9.0, and 4.8%, respectively. We also observed a main effect of target value, $F(3,60) = 11.38$, $p < .001$, and an interaction between age group and target value, $F(9,146.17) = 2.12$, $p < .05$); the CDE was much larger in the first grade compared with the other age groups. For the RTs, we observed an effect of age group, $F(3,62) = 16.64$, $p < .001$, and target value, $F(3,60) = 14.77$, $p < .001$. RTs on the targets 1, 4, 6, and 9 were 745, 793, 847, and 760 ms, respectively. No interaction between group and target value was observed, $F < 1$.

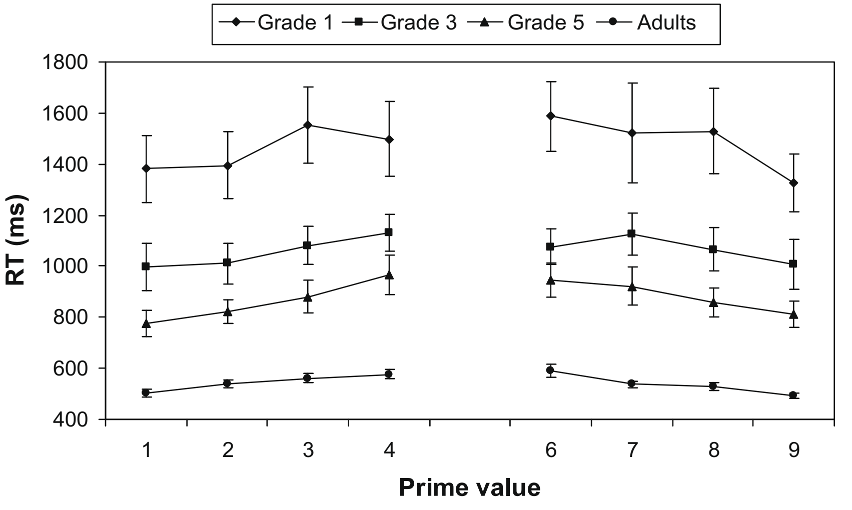

Fig. 2. Mean RTs as a function of prime value and age group (i.e., the CDE) and error bars based on the standard error.

Priming distance effect

To provide a correct evaluation of the PDE, the following types of trials were excluded from these analyses. First, trials on which the prime and target evoked a different response (50%) were excluded. Previous research (e.g., Koechlin et al., 1999; Reynvoet, Caessens, & Brysbaert, 2002) has shown that, in addition to the PDE, a response priming effect can be observed. This response priming effect, situated at the motor level, may obscure the PDE. Second, we excluded trials where prime and target were identical (12.5%) because it has been shown that the repeated presentation of a number can lead to the bypassing of the semantic comparison stage (Dehaene, 1996).[3] Finally, we excluded all trials where an incorrect response was given on the prime stimulus (on average 5.1% of the remaining trials).

Error rates

Mean error rates on targets as a function of prime–target distance are displayed in Table 2. Error rates on the targets were submitted to a 3 (Prime–Target Distance) × 4 (Age Group) repeated measures analysis with prime–target distance as a within-participant factor and age group as a between-participants factor. There was a significant effect of prime–target distance, $F(2,61) = 6.99$, $p < .01$, indicating that more errors were made on trials where the distance between prime and target was 3 than when the distance was 1 or 2. There was also a significant main effect of age group, $F(3,62) = 9.26$, $p < .001$, showing that more errors were made by younger children. The mean error rates were 14, 8, 9, and 3% for first, third, and fifth graders and adults, respectively. Table 2 shows that the PDE was similar in all age groups, leading to a nonsignificant interaction between age group and prime–target distance, $F < 1$.

[3] A 2 (Prime–Target Response: same or different) × 4 (Age Group) repeated measures analysis confirmed that a response priming effect (i.e., slower RTs on trials in which the prime and target evoked a different response) was present, $F(1,62) = 23.17$, $p < .001$. Response priming also interacted with age group, $F(3,62) = 7.46$, $p < .001$. Although the response priming effect was observed in all age groups, first graders exhibited a much larger effect: 198, 29, 36, and 19 ms for first, third, and fifth graders and adults, respectively. An identity priming effect (i.e., faster RTs on trials with identical prime and target) was also observed. In a 2 (Prime–Target Distance: 0 or 1) × 4 (Age Group) repeated measures analysis, trials where prime and target were identical were responded to 100 ms faster than trials where the distance between prime and target was 1, $F(1, 62) = 24.38$, $p < .001$. There was no interaction effect with age group, $F(3,62) = 1.52$, $p = .22$, indicating that this effect was similar in all age groups.

Table 2
Mean percentage error rates and standard deviations as a function of prime–target distance and age group (i.e., the PDE).

	Prime–target distance		
	1	2	3
Grade 1	13.3 (10.9)	11.8 (9.0)	17.6 (14.6)
Grade 3	7.4 (8.8)	5.0 (5.0)	11.8 (11.5)
Grade 5	8.2 (7.7)	6.4 (7.3)	11.3 (9.2)
Adults	2.3 (3.8)	2.6 (3.1)	4.3 (4.9)
Average	7.8 (8.9)	6.5 (7.2)	11.3 (11.4)

Note. Standard deviations are in parentheses.

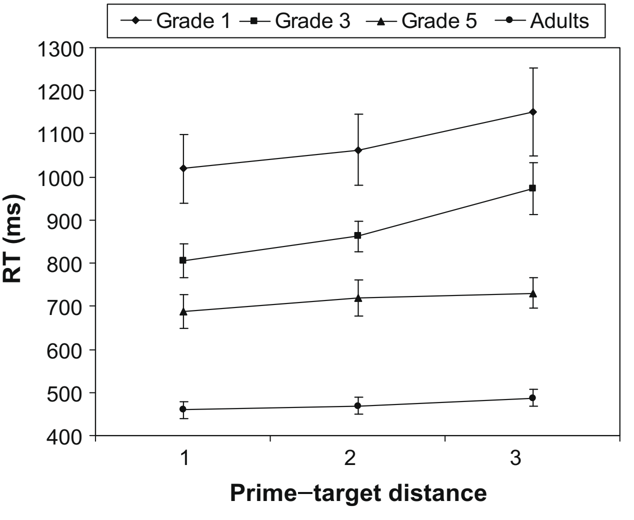

Fig. 3. Mean RTs as a function of prime–target distance and age group (i.e., the PDE) and error bars based on the standard error.

Reaction times

Median RTs from correct responses on the targets were submitted to a 3 (Prime–Target Distance) × 4 (Age Group) repeated measures analysis. The analysis revealed a main effect of prime–target distance, $F(2,61) = 9.54$, $p < .001$; RTs were the fastest when the distance between prime and target was 1 and increased gradually with increasing prime–target distance (Fig. 3). There was a main effect of age group, $F(3,62) = 26.33$, $p < .001$, indicating that RTs decreased with increasing age. Visual inspection of Fig. 3 showed that although the PDE was present in all age groups, it appeared to be stronger in first and third graders. However, the interaction between age group and prime–target distance did not reach significance, $F(6,122) = 1.25$, $p = .29$.

Correlations between CDE and PDE

We also tested whether the sizes of the CDE and PDE were correlated by means of Spearman rank order correlations. The size of the CDE was calculated for each participant separately by subtracting the average RT (or error rate) on trials differing by 3 units from the standard from the average RT (or error rate) on trials differing by only 1 unit from the standard. The resulting RT difference was then divided by the mean RT on trials differing by 3 units from the standard to account for potential individual differences in RT. A similar approach was used for calculating the size of the PDE. The average RT (or error rate) on trials with a numerical prime–target distance of 1 was subtracted from the average RT (or error rate) on trials with a prime–target distance of 3. The RT difference was then divided by the RT on trials with a numerical prime–target distance of 1. There was no association between the size of the individual CDE and PDE for either RTs ($r = .08$, $p = .53$) or error rates ($r = .10$, $p = .42$).

Discussion

The CDE has been considered to be an important marker for how people represent numerical magnitudes internally (for a review, see Kadosh et al., 2008). Historically, two explanations for the CDE have been put forward. Restle (1970) proposed that the CDE is situated at the magnitude level and is caused by overlapping representations for different magnitudes (see also Noël et al., 2005). In contrast, others have suggested that the CDE is situated at the decision level (e.g., Banks, 1977; Verguts et al., 2005).

The CDE has been used to examine developmental changes of children's magnitude representations, and several studies have shown that the CDE decreases with increasing age (Duncan & McFarland, 1980; Sekuler & Mierkiewicz, 1977). This finding has typically been interpreted as a reduction in representational overlap and more precise representations for numbers when age increases. However, the second aforementioned explanation of the CDE suggests that this developmental decrease of the CDE might alternatively be explained by an increasing preference for particular associations between magnitude and response nodes.

The current study aimed to revisit this issue of developmental change in children's magnitude representations by studying the PDE. This PDE refers to the observation of faster responses to targets that are preceded by a numerically close prime. Whereas the necessity for representational overlap for the CDE to occur is debated, the PDE is typically explained by this overlap (Verguts et al., 2005). We investigated the CDE and PDE in typically developing first, third, and fifth graders and adults. Our data showed that the CDE and PDE are observed from first grade onward. Moreover, the sizes of the CDE and PDE of younger children were similar to those of the CDE and PDE found in older children and adults.

In contrast to previous work (Duncan & McFarland, 1980; Holloway & Ansari, 2008; Sekuler & Mierkiewicz, 1977), the size of the CDE did not decrease with age. This might be explained by recourse to differences in task difficulty. The previous studies used a comparison task in which children needed to indicate the largest of two numbers, whereas in the current study children were asked to determine whether a number was smaller or larger than 5. Clearly, the latter task is easier because only one new number needs to be integrated into the decision process. These differences in task difficulty might have led to the disappearance of a developmental change in the CDE.

The observation that the PDE occurred in children from first grade onward is important because this effect cannot be explained without assuming overlap between different magnitude representations. Thus, this observation supports the representational overlap hypothesis; a number is represented as a distribution around the true location of that number on the mental number line and overlaps with the representations of other nearby numbers. Moreover, the PDE found at an early age is very similar to the PDE found in older children and adults, suggesting that internal representations of magnitude for small numbers are rather stable from a developmental perspective.

The analyses also showed that the size of the CDE was not correlated with the size of the PDE for either RTs or error rates. As reviewed above, the PDE can be explained only by representational overlap (Verguts et al., 2005). If the CDE were also due to representational overlap, as originally suggested by Restle (1970), then the CDE and PDE should be correlated, which was not the case. This is in line with the hypothesis of a different origin for both effects and the idea that the CDE is more related to decisional processes than to overlapping internal magnitude representations (Verguts et al., 2005).

The current study also ascertains the usefulness of the priming paradigm for examining number processing in children. Priming paradigms are very popular methods in cognitive science because they offer the possibility to examine underlying representations implicitly. Although this method has been frequently used in adult research, its use in cognitive developmental studies is still limited (for an application in psycholinguistics, see Castles, Davis, Cavalot, & Forster, 2007). To the best of our knowledge, the current study is the first developmental investigation of numerical cognition that has used the priming paradigm to investigate children's internal representations.

A number of issues remain and need to be resolved in future studies. First, the children in the current experiment all were tested in February or March, indicating that the first graders had already received a considerable amount of formal education with digits. It might be worthwhile to test children in kindergarten or at the beginning of the first grade in a follow-up study to see whether similar effects are found for children with little formal education with magnitudes. Testing younger children would also imply that one should use nonsymbolic magnitudes (e.g., dot collections) instead of symbolic magnitudes (e.g., digits) in the experimental design because it is likely that not all kindergarteners will be sufficiently familiar with the symbolic presentations of magnitudes. However, this is not an insurmountable problem given that it has been demonstrated that the presentation of dots also results in a PDE (Koechlin et al., 1999). Second, although age did not affect the CDE or PDE, it could be the case that other variables, such as mathematical competence, are more related to individual differences in one of these effects. A better insight into the relation between the two effects and mathematical competence will also reveal whether individual differences in mathematics are the result of differences in the internal magnitude representation characteristics (i.e., a correlation between the PDE and mathematical ability), differences in decisional mechanisms (i.e., a correlation between the CDE and mathematical ability), or both. Third, it has been suggested that mathematical disabilities or dyscalculia are due to an impaired representation of magnitudes (e.g., Butterworth, 2005). Until now, this has been investigated only by means of the CDE. As argued above, the PDE is unconfounded by decisional strategies and provides a more elegant measure to examine children's representation of magnitude. If impaired magnitude representations are at the core of dyscalculia, then abnormal PDEs should be observed in children with dyscalculia. Fourth, it has been claimed that small numbers are represented more precisely due to their frequent occurrence, whereas the representations of larger numbers are fuzzier (Notebaert & Reynvoet, in press; Verguts et al., 2005). Therefore, it might be interesting to replicate this study using larger magnitudes that are less frequent and perhaps need more time to form a stable representation.

To conclude, we have shown that a priming procedure can be used with children to investigate the development of the magnitude representations. A PDE was observed from first grade onwards, indicating that the implementation of the procedure was successful. Moreover, we obtained similar priming effects in children and adults, indicating developmental stability for participants (children or adults) familiar with small symbolic numbers.

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