

A developmental progression for ordinality

This developmental progression arose as an outcome of a 30-minute presentation at the ECMG meeting on 7 November 2020'

The focus of the presentation was to emphasise the under representation of ordinality in existing professional development materials for early years teachers/practitioners whilst underlining the importance of ordinality in developing a concept of number which will have an impact on later mathematical development.

- Ordinality is taken as the attribute of number indicating position and order.
- Ordinality denotes position in a series.
- Ordinality is concerned with the relationship between positions.
- Ordinal number has an associated direction.
- Ordinality is a way in which we use number.
- Ordinality is essential for developing efficient calculation skills.

“It is important to lay foundations of experience and networks of connections on to which future experiences of number can be built. In this respect the cardinal aspect of number is a very limited view of what numbers are.”

Haylock and Cockburn, Understanding Mathematics for Young Children, 2013

Ordinality Progression; the neglected big idea of early number.

Age / Stage	The child	The adults	The environment
Birth to 12 months	Enjoy and respond with looks and sounds to repeated sequence tactile games. ¹	Play tactile counting in order games – Round and round the garden – one step, two steps...	In a positive and caring relationship.

¹ This includes activities where the adult uses touch and language in a sequence. The activity being often repeated to develop familiarity with the sequence of actions. The child responding with sounds and some body movements. An example would be the game 'Round and round the garden, like a teddy bear. One step, two step, tickle you under there.'

	<p>Pays attention and responds to familiar sequences of events.</p> <p>Linked sounds and numbers through tactile activities which become familiar. The child responds with sounds and gestures (arms and leg movements, face movements, eye movements)</p>		
12 months to 24 months	<p>Makes sounds, some of these respond to number words but may not be in order. Some singing along to much loved rhymes taking place.</p> <p>Anticipates events based on their familiar order.</p>	<p>Develops routines with sequential order. Frequently repeated routines to develop familiarity.</p> <p>Interacts with the child to focus on the repeated sequential activity.</p>	<p>Safe and secure with familiar surroundings. Sequences of events taking place in the same situations and the same environments where possible. Some repeated events taking place in different environments.</p>
24 to 36 months	<p>Arranges objects in an order they choose by for example, lining things up.</p> <p>Knows when number names to five are not said in order.</p> <p>Rearrange jumbled number tiles in order, zero to three.</p>	<p>Represents numbers in order in a variety of ways.</p> <p>Provides representations which can be manipulated as separate objects.</p>	<p>Objects to sort and line up.</p> <p>Tiles with representations of number to five – dot patterns and pictures.</p> <p>Tiles with numerals 0 to 5.</p>
3 to 5 years	<p>Arrange events in order, e.g. cards showing getting up in the morning:</p> <p>Use two finger touch counting to count on from a number less than ten, in track games.²</p> <p>Position numbers (models of numbers or tiles with numbers) in order along a track.</p> <p>Use a number track to find numbers one more and two more than a start number.</p>	<p>Provide stories and rhymes.</p> <p>Read stories involving ordinality. (But check the book images for similar books have the correct orientation.)³</p> <p>Provide jumbled order examples for children to spot and sort out.</p> <p>Give children tasks like jump six places along the track on the floor, starting from 2</p>	<p>Routines events cards to order, for example:</p> <ul style="list-style-type: none"> Have a wash Get out of bed Clean teeth Eat breakfast <p>Number tracks outside</p> <p>Empty number tracks.</p> <p>Number collars for traffic cones outside.</p> <p>Number carpet tiles.</p>

² This is a technique for counting along a track to avoid being one out by the end. Using the index finger of one hand to cover the start number, use the index finger of the other hand to count by putting it on the next square adjacent to the covered start number. For example, if the start number is 4, then this is covered with the index finger of one hand and the index finger of the other hand touches 5 while the counter says, 'one' and counts on from there touching the next square each time until the count is finished.

	<p>Sing counting down and counting up songs and rhymes.</p> <p>Make a given number of jumps along a floor track and say which number you have landed on.</p> <p>Predict where you will land when jumping along a track.</p> <p>Include jumping back as well as forward.</p> <p>Take part in jumps along a track when alternate jumps are missed out. Say where you will and after two jumps, three jumps – both directions.</p> <p>Listen to stories involving ordinality, such as Loo Queue by Nicholas Allan.</p>	<p>then do the number of jumps to match the number you land on.</p> <p>Pose questions about position. (Which is between/next to...)</p> <p>Set challenges to arrange things in order.</p> <p>Check children counting book pages count the sides and not the number of sheets.</p> <p>Ask children to verbally confirm the order of a setting routine such as tidy up time.</p> <p>Match this routine to cards with pictures.</p> <p>Number line 0 to 5 with position markers and cards or other representations (For example, Numicon tiles) to position along once confident with tracks.</p> <p>Stand children in a line. Who is in position 3? Positions 5? And another child(ren) to be the teacher. If you are in position 3, look along the line to see which children you have to stand between to be in position 6.</p> <p>Ask questions about relative position on number tracks.</p> <p>Link cardinal and ordinal for example by putting number cards along the bottom of a staircase of cubes/blocks.</p> <p>Talk about position when in a line such as a queue for lunchtime; what is your position and relate to cardinal by 'How many are in front/behind in the queue'.</p>	<p>Number models to order such as Numicon, Unifix, Cuisenaire, Dice pattern cards, domino tiles.</p> <p>Ordinal number story books.</p> <p>Child level wall number tracks.</p> <p>Number cards to arrange in position using Velcro.</p> <p>Ordered number parking spaces for outside ride-ons with matching numbers on the toys to link with nominal number.</p> <p>Number tracks in correct orientation and include zero.³</p>
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³ Number tracks in correct orientation: horizontal with numbers increasing left to right: vertical with numbers increasing from bottom to top.

		Use picture books with no page numbers and say, 'Which page is the tractor on?', or 'Which page is the duck on?' 'How many pages are there between the tractor and the duck?' 'Where is page 7?' 'Is page 7 nearer to page 5 or page 10?'	
Age 6 to 7 (KS1)	<p>Understand ordinality in different contexts (100 squares, different measuring scales etc)</p> <p>Order odd and even numbers and know there is an odd number between two adjacent even numbers & the corollary to this.</p> <p>Order numbers to 100 using place value to organise the ordering. For example, by finding all the 40s numbers then all the 50s numbers.</p> <p>Identify missing numbers in a counting sequence between 1 and 20, then 1 and 100.</p> <p>Use number structure to count on in 5s from a given 2-digit start number. For example, by identifying patterns on a 100 square.</p> <p>Connect place value with ordinality to know the numbers that are 1 more/less, 10 more/less and 100 more/less than a 3-digit number.</p> <p>Count down in steps of 1, 2, 5 and 10 from a 2-digit start number.</p>	<p>Use questions to develop thinking about the position of numbers in different contexts with an emphasis on L to R and bottom to top.</p> <p>Ask questions about the relative position of numbers in different contexts.</p> <p>Use mathematical models to develop an understanding of the ordinality structure of numbers. For example, Unifix, bead strings and counting sticks.</p> <p>Provide experiences of ordinality in a range of contexts, including 'real-world' contexts.</p>	<p>Number tracks and lines: large outdoor, table-top, wall and individual versions.</p> <p>Suitable mathematical manipulatives.</p> <p>100 squares in different arrangements.</p>

	<p>Find totals in augmentation contexts⁴ using number lines and number tracks. Use a number track 0 to 100, to find differences. Experience multiplication by 2, 5 and 10 as jumps along a number line. Identify points shown on a counting stick Experience arithmetic calculations as steps/jumps on a number line in different contexts, including games.</p>		
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Further Reading:

Numerical predictors of arithmetic success in grades 1–6, Lyons, Price, Vaessen, Blomert and Ansari in *Developmental Science* 17:5 2014

Which preschool mathematics competencies are most predictive of fifth grade achievement? Nguyen, Watts, Duncan, Clements, Sarama, Wolfe and Spitler in *Early Childhood Research Quarterly* 36 (2016)

Early Math Trajectories: Low-Income Children’s Mathematics Knowledge From Ages 4 to 11, Rittle-Johnson, Fyfe, Hofer and Farran, in *Child Development*, Volume 88(5), 2016

Understanding Mathematics for Young Children, Haylock and Cockburn 5th Edition, 2017

Building the Mathematical Brain, Daniel Ansari, The Annual Learnus Lecture, November 2017

https://www.learnus.co.uk/about/videos.html#Learnus_Annual_Lectures

⁴ Augmentation is the increasing of an amount. A form of addition which is distinct conceptually from aggregation. For example, I am three years old now, how old will I be in two years from now, represented as jumps along a number track. This is distinct from aggregation which refers to combining amounts.

The role of numerical and non-numerical ordering abilities in mathematics and reading in middle childhood, Kinga Morsanyi*, Bianca M.C.W. van Bers, Patrick A. O'Connor, Teresa McCormack, *Contemporary Educational Psychology* 62 (2020)

Mastering Early Number, Dr Alf Coles, in Boolean Maths Hub Conference, 2016

https://booleanmathshub.org.uk/files/1914/5614/2366/Alf_Coles_-_Mastering_Early_Number_-_Boolean_Maths_Hub_Conference_30_Jan_2016.pdf

Bruce, C.D., Davis, B., Sinclair, N. *et al.* Understanding gaps in research networks: using “spatial reasoning” as a window into the importance of networked educational research. *Educ Stud Math* **95**, 143–161 (2017). <https://doi.org/10.1007/s10649-016-9743-2>

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John Pearson, December 2020