

Number skills development for infants with Down syndrome (0-5 years)

Learning through play, language and environment at home

Social learning



Figure 3. **Playing together**

Early experience and socially mediated learning at home are important for beginning and continuing to learn about numbers and math.

In families, where numbers are a part of everyday life and where family members play games together, there are frequent opportunities to learn number skills ([Figure 3](#)). Children with Down syndrome enjoy learning in social situations and in games, taking turns with other players.

For example, the idea of 'more' can be introduced from a very young age. Children as young as 18 months may use this sign to obtain more food, drink or repetition of an activity ('again'). This can be developed and elaborated with the questions "how many more?" or "how much more?" as they get older. Children can be included in dice games, counting or moving counters before they understand numbers. It will be easier to learn from adapted dice with smaller numbers.

Games can be adapted with large 'boards' for the floor and large dice to teach the idea of counting as well as the idea of playing a game together, winning and losing. Older children (e.g. 3 and above) can learn how to play board games designed for their age group, and will see numerals and patterns on dice, as well as counting on a board. Quantifying amounts can begin early with noticing "one nose", "two eyes" or "feet", "five fingers", quantities of clothing, food, and number of animals, children or toys during play.

Songs, rote counting, supported counting



Figure 4. **Toys at home for counting**

Children with Down syndrome should be introduced to number games, songs and rote counting activities as early, and in the same way, as other young children. At first, they will benefit from hearing the numbers spoken in order. Later, children learn the number sequence by imitating a parent's counting. Then, parents can count items and omit the final number for the child to say, or pause and say the final number with greater emphasis. These games stress the significance of the final number in a count sequence, this being particularly important as it represents the whole amount (cardinality).

It is easy to underestimate the potential for learning during the early stages of development, even though many children with Down syndrome have little or no speech and delayed motor skills. Number language and skills can be modeled through supported 'pretend' play, and can also be included in speech and language therapy games.



Figure 5. Pictures and finger puppets for making up a number story

Math Environment

Pictures, posters and displays (e.g. on a tray) can be arranged at home as well as at nursery school to provide practice for learning about sorting by features (such as size, shape and color), ordering and counting ([Figure 4](#)). A math rich environment will make it easier for parents and teachers to count daily with their children, with objects or by pointing at items on a picture display. They can use language like "How many can you count today?" (emphasizing the use of "how many" and "count", as this will help children understand cardinality). They can start at different numbers so that counting does not always begin at 1 and different parts of the sequence are practiced. They can find a numeral for the amount counted and place it on a number line with their children. Made-up stories with different numbers of characters, illustrated by pictures, are another way to bring math into everyday language and learning, for example, "Three ladybirds went for a walk. They went to visit..." etc. ([Figure 5](#)).

Play and teaching activities--Teaching methods

Early language skills

- Repeating activities, "more" "again"
- Choosing activities, select, point, name
- "Same" and "different"
- Using "gone" and "no"
- Matching games for size, color and shape
- Category words for size, color and shape
- Color, number, size and shape books
- Introduce written words
- Remembering and combining attributes
- Ordering activities
- Use a range of attribute words

There are many everyday activities where number and other attributes can be introduced, practiced and learned through play in the home and school environment. Structured activities that include 'errorless learning', matching and selecting games can help many children with Down syndrome to learn new ideas. Any materials that children enjoy can be used as part of a teaching and learning game. Structured games are games that have been designed to teach one particular part of a skill that can then be built on in later games, so that every child can learn the whole skill successfully. Children can then progress in small steps, without being overwhelmed by too much new information or too many differing task requirements. Games where too much is presented at once can leave children feeling that they have failed, and they may then not want to play that game again.

Breaking the task into small structured steps usually helps children to do things for themselves; they need less explained to them and can focus on the task, without having to listen and understand spoken information simultaneously. The easier it is for children to 'see' how to succeed, with activities modeled and clear uncluttered, attractive resources, the more likely they will copy and engage in the tasks with enjoyment.

Many number and math skills can be learned through play and teaching games. Targets and activities for learning pre-school and early school skills are described and illustrated below.



Figure 6. Pictures for choosing number songs

Language and activities for learning repetition, comparing and categorizing skills

Repetition

Repeat activities with use of "more" and "again?" for activities that motivate the child, such as bubbles, songs or action games.

Choice

Choosing games requires the child to look for differences between items. Toys, pictures ([Figure 6](#)), food, drink and clothes can be used in choosing activities. If children find it difficult to make a choice, offer both items and when they are looking at one push it forward and praise them, quickly followed by the activity, song or giving them the item. Tell them that they chose the named item. Progress from this stage by prompting and encouraging them to touch to choose, point to choose, sign to choose and speak to choose.



Figure 7. **Picture lotto to teach "same" and "different"**

Similarities and differences

Use the words and signs for "same" and "different", with sets of identical and different items or pictures. Baskets and other neutral containers can help children to match toys to identical toys or photographs of the toys. If children are hesitant push the correct basket closer to them and if they still do not place the identical item point or show them what they should do.

These stages make the tasks increasingly 'errorless', show them what is meant by the "same" and what is expected of them. Early picture lotto's ^[5] will also teach understanding of the "same" and "different" ([Figure 7](#)).

Help your child to notice the similarities and differences with sets of toys by talking with them and describing attributes like color, size, shape and number in clear and simple sentences ([Figure 8](#)).

Using "gone" and "no"



Figure 8. **Toys for talking about "big" and "little" during play**

Show the idea and the word label for absence using "gone", as well as understanding the negative "no". When "gone" has been understood as in "all gone", play games that practice with two ideas and words, for example, "The rabbit's gone", "The car's gone". Put a hat or shoes on and off a doll to demonstrate "no hat", or "no shoes". Play sharing games in which one toy or person gets "none". These concepts will begin to prepare children to understand zero.

Matching games

Use matching games for teaching size, color and shape names. Many types of visual matching games are useful, where the child is helped to place the "same" with the "same" and hears what it is called, by listening to the spoken word and seeing the sign. (Children with Down syndrome are often being taught signs to support their language development.) The stages in matching games are: a matching stage, a selecting stage and a naming stage (see box below). This way of teaching is very effective as it supports the child to learn in an errorless fashion, succeeding at each step, and it can be used to teach a whole range of new concepts throughout childhood. Remember to prompt the child as necessary at each step to ensure that they succeed as they learn.

Teaching new concepts through matching, selecting and naming

1. **Start with matching**

The child is asked to match by putting the object, picture or card with the one that is the same. This is the step in which you are teaching the new concept so it is important to use the appropriate language e.g. "This is a red circle, can you put it with the other red circle". Once the child can match correctly, move on to selecting.

2. **From matching to selecting**

The child is now asked to select each of the items by name e.g. "Can you give me (or show me) the red

circle?" Once the child can demonstrate correct comprehension of the words by selecting the items correctly, move to naming.

3. **From selecting to naming** (using a word or sign). The child is now asked "What color (or shape) is this?" as you point to one of the items. Continue until the child has named each of the items in the set.

Category words

It helps children to learn the concept if you use the category word – for example "these are colors" or "red color" as well as the color word "red", and similarly use category words for shape and size, e.g. "What shape is this? Is it a square or a circle?" "What size is this? Is it big or small?".

Colored bean bags and a large piece of paper with colored rectangles, or circles of color with discs to match to them, make easy matching games in the early stages of color name learning, when identical items are needed ([Figure 9](#), [Figure 10](#) and [Figure 11](#)). In the author's experience, color learning is often helped by giving the color name in print. When you know that the child understands the color name and can demonstrate his or her understanding through selecting games, sort objects or items that share the color feature but differ in other features.



Figure 9. **Bean bags for color matching**

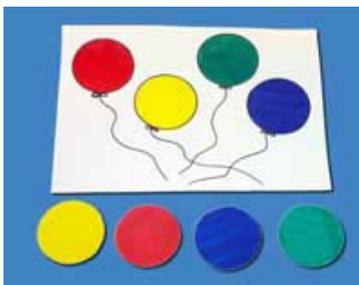


Figure 10. **Child matching colors**



Circles for color matching

Making books

Color books are valuable too, with one color per book, for example a "red color" book, and a "blue color" book. Use pictures of different items in each color book, e.g. a red car, a red ball etc. to teach a new color.

Similarly, number books can be for one number, "a number one" book up to a "number four" book, where the child sees several examples of items for a single number, all in the same book.



Figure 11. **Blocks for teaching attributes**

When children can identify the colors and the numbers from the single concept books, the pages in the books can be mixed, to provide practice with different numbers or different colors in the same book.

Shape books can be created using the same principle, relating shapes to real objects in the environment.

Written words

In books, with pictures and with objects where there will be frequent repetition, the written words for numbers and other math concepts as well as pictures and numerals should be presented on the page or on word cards. Children can see and read single words and also two and three words together, for example "blue car", "red car"; "big yellow hat", "small green hat", paired with the picture.



Figure 12. **Shape work on the computer**

Combining attributes and ordering items

Logic blocks or similar educational materials are available in different shapes, colors and sizes and can be used to teach these concepts. They are also useful for teaching combinations of attributes in a sentence, by asking the child to select on two or three attributes at once (for example, "where's the big, red circle?") (Figure 11). Children may have difficulty remembering a request with three criteria to process, so it will be important to write out or to repeat the sentence while they do the task.

The computer is a valuable aid to learning for children with Down syndrome (Figure 12), and some suitable programs are listed in the references^[6]

Ordering items requires a series of 'comparisons of two' to be made and involves looking, remembering and comparing skills, for example, for ordering in size. The number of items to be ordered can be gradually increased from three upwards. Items can be ordered on many features as well as size and number, such as the loudness of 'noise' the item makes, practicing the vocabulary "loud" or "quiet", or weight, "heavy" and "light".



Figure 13. **Dolls for ordering games**

The language and ideas for comparing, called comparatives, can be introduced in ordering games, for example "taller than", "smaller than", "heavier than" etc. (Figure 13).

Extending children's understanding of words for qualities or attributes of items (or people, animals or activities) beyond color names, shape names, size ("big", "small") and number will help them to think about the concepts. Children will hear this vocabulary when they reach school if not before, and the more experience children with Down syndrome have, the faster they will learn.

These and other words and concepts will help to give children more elaborate ways of comparing and thinking. They will also help to improve the ways in which they can categories information and improve their memory and language skills.

A range of vocabulary for qualities and attributes

As well as color, shape and size words, use "quick", "slow", "round", "square", "rough", "smooth", "prickly", "shiny", "sparkly", "soft", "hard", "bumpy", "spotty" (dots), "dark", "light", "full", "empty", "hot", "cold", "lots of", "a little", "a drop", "a bit", "a lot", "loads of", "narrow", "wide", "long", "short", "tall", "fat", "thin" and "thick".

Learning about 'one-to-one' correspondence through play

There are many games to play with young children that help them to learn about 'one-to-one' correspondence. This is necessary for learning how to use the number system to count and to share. The foundation for these skills can begin with playing with objects, toys and pictures that can be linked 'one-to-one', e.g. each toy at the party needs one plate and one cup (Figure 15).



Figure 15. Toys for learning about 'one-to-one' correspondence

Games for developing 'one-to-one' correspondence

- Picnic and tea party play – plates for each toy or person, cups, play or real food for each
- Handing out items to members of the family
- Putting hats on toys – one on each
- Puzzles and matching games (or real games), where one thing goes with one thing repeatedly, like matching hats to heads, straws in cups, candles on cakes
- Pairing items together

Early quantity and counting through play

When playing games that use numbers and counting, use the words "how many" and "all" as well as the number in spoken sentences, so that children associate these words with counting and quantity.

In real meal or snack time situations, ask if your child wants "one x", "two x's" or other amounts, showing the choices on offer, or point to other people's plates with the amounts on. Use your fingers to indicate "one" or "two" (or more) of something, and use the sign and word for "lots of" or "a lot of" for numbers over 10. Similarly, when children offer you something (like crisps) quantify your answer, e.g. "Three please" and hold up three fingers.

Early games for learning about quantity and counting

- Discussion while washing or dressing dollies – eyes, ears, hands, feet, socks, legs, arms (all two), nose, hat (one)
- Counting identical items and items similar in category (i.e. dogs, cats, sheep, people) in picture books
- Counting and recognizing quantities in early number books

- Counting stairs, steps or 'jumps', or other activities and characteristics in the child's environment
- Counting to 'time' activities in games – e.g. how long your child can stand on one leg (with help), sit still, pretend to be asleep (sleeping lions), any fun activity – you can show your fingers moving as you count or clap as you count. Make it fun and see how long your child can 'hold' a certain skill for. (These types of games also help children to control and maintain their own behavior in preparation for school)
- Playing 'sorting' and 'giving' games with sets of toys, for example 'families' of toy animals (three ducks, two sheep, four rabbits, small dolls, toy food or real food, colored bricks, beads or pegs)

Beginning to understand money early

Children begin to learn about money by seeing people pay for things by exchanging money for goods – so it is important to take them out shopping and involve them. Play games where money is exchanged, using toy paper or card money to begin with, moving on to real coins or notes when safe to do so in supervised play. Play games of exchange with goods as well as exchange of money in pretend shop games. A pretend shop can be created, with items labeled, or you can give your child a picture (and word) list and shopping bag, for them to find toys or other items at home to place in their bag or basket and then pretend to pay you for them (and the other way around where the child plays shop keeper). Shopping games can help develop memory skills too and offer mobile activity that some children will particularly enjoy . Give children their own purse or purse belt with coins in, or give them enough money for them to pay for real items they like at the shop.

Using a calendar to begin to learn about time

Home-made calendars and timetables, that include written words, pictures or symbols for regularly occurring events, help children with Down syndrome to link ideas about time to the real, meaningful events that they experience. Home-made calendars can include words for days of the week, "morning", "afternoon" and "night" and clock faces showing the times and words for important parts of the day, including "bed-time".

The complexity of the calendar will vary for each child, but you can begin with squares for the days of the week, labeled with the written word and a photograph for each day to separate the weekend activities (or days at home) from nursery or child care days. This may be interesting if made as a 'lift the flap' chart, with the days of the week written on the outer flap. The calendar can be made more complex by having symbols or pictures and words for the separate activities of the days or evenings, when children are familiar with how to use the calendar. A pointer for "today" can be moved along each day, and for older children, "yesterday" and later "tomorrow" pointers can be added. The author suggests that a thick border is used between squares to show a "night time" slot, labeled with words and a symbol or picture of a child sleeping, so night time is visual, not implied. Showing "night time" as a slot becomes particularly helpful for understanding, counting and crossing off how many days, nights or 'sleeps' before a special event, like a birthday or holiday.