

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

Children in this age group have difficulty in focusing their attention on completing the rotation of an object.

Designer Tips:

Children tend to just drop the object down on the matching shape and **leave it without completing proper orientation and alignment.**

Children **need verbal feedback** (e.g., do you think the triangle is in the correct orientation?) or **iconic gesture** (e.g., showing what rotation action looks like by drawing on the air)

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION



Designer Checklist:

- Recognize if child did not complete the rotation action on the Embedded Figure
- Encourage the child to complete the rotation action – this might also take several times and different ways.
- Help child recognize when s/he is very close to complete the rotation action.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING

Children in this age group have difficulty in keeping track of information needed for rotation task.

Designer Tips:

Children are usually **unable to see or recognize the missing shape** embedded in a figure with dash type.

Children **need guiding questions** (e.g., where is the mouth of the turtle?) or **some visual clues better than dash type** without pointing the missing shape.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING



Designer Checklist:

- Recognize if the child did not understand where the missing shape is.
- Encourage child to find the missing shape – this might also need to be done several times and in different ways.
- Help child recognize when s/he is very close to find the missing shape.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING

Children in this age group have difficulty in staying on-task for solving problems related to mental rotation.

Designer Tips:

Children usually **involve random actions** and match shapes and objects that first attract their attention other than the solution.

Children **need complementary feedback** to understand there is a problem in the story (e.g., the turtle is really hungry and needs your help.) or some **correction feedback** for staying on-task (e.g., verbal, visual, or haptic clues).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING



Designer Checklist:

- Recognize if the child behaves randomly instead of behaving on-task.
- Invite child to solve a problem given in a story – this might also need to be done several times and in different ways.
- Help child recognize when s/he is very close to solve the problem.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS

Children in this age group better learn if the instructions include information about spatial relations of objects.

Designer Tips:

Storytelling help children better understand mental rotation tasks in **cause-effect relations** (e.g., the wind blown the roof of the house on top of the mountain).

Children need spatial information that explains the **rotation action** (e.g., flip, turn, rotate) or **spatial features of shapes** (e.g., bigger triangle, smaller square, green circle).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS



Designer Checklist:

- Make sure child understands instructions correctly and act accordingly.
- Present instructions as playful and informational as possible – this might be done via visual, verbal, or haptic cues.
- Recognize child's questions or responses in form of pointing or pre-verbal language.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

Children in this age group have difficulty in focusing their attention on listening to the story at first hand.

Designer Tips:

Children pay attention to the story if the content is **familiar**, **funny** and **exciting** for them.

They need **motivational expressions** (e.g., oh look how sweet is the fish!; you love turtles don't you!; oh, how pity it needs your help, let's fix it!) to focus their attention on-task.

Calling the child by her/his name helps too.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION



Designer Checklist:

- Make sure the child listens to the story.
- Make the content familiar, funny and exciting for the child.
- Help child to recognize when s/he is distracted and not pay attention to the task - this might need to be done several times and in different ways.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING

Children in this age group keep track of the story better if the content is familiar and simple enough.

Designer Tips:

Children **need short and simple sentences** with familiar words.

Children might **need to ask some simple smart questions** if they did not understand something in the story (e.g., where?, why?, what is this?)

Children might raise an objection to the content and say it isn't so – **they are rule breakers** 😊

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING



Designer Checklist:

- Create the content with child's familiar vocabulary including spatial words and concepts (e.g. geometrical shapes)
- Respond to child's questions in simple phrases and/or preverbal language.
- Help child recognize if s/he misunderstands something in the content.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING

Children in this age group have difficulty in identifying, recognizing, or locating the shapes.

Designer Tips:

To find the matching shapes children usually need to hear more about the **name and location** of the shape required in the task.

Children **need complementary information** about the shape or figure to understand what it looks like (e.g., geometrical features).

Children **need to repeat the goal of the task** several times – and **might change the rules** 😊

2,5-3

3,5-4



mental rotation



narrative

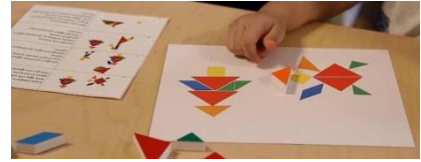


gesture



guided-play

PROBLEM SOLVING



Designer Checklist:

- Recognize if child knows the name of the shape or not – e.g., invite child to show/point which shape looks like the missing shape.
- Help child recognize when s/he is very close to recognize the shape.
- Provide feedback for alternative solutions brought by the child 😊

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS

Children in this age group better learn if the instructions are given in a clue rather than in a didactic manner.

Designer Tips:

Children willing to take instructions if they are presented in the form of **storytelling** and **appealing visuals**.

Children need **repeating the story** several times to understand the task given in the story.

Children usually need to hear the name of the figure or shape that is referred in the task several times.

2,5-3

3,5-4



mental rotation



narrative

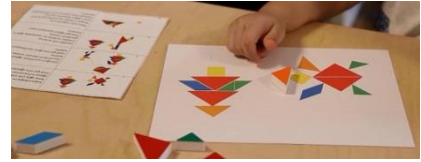


gesture



guided-play

INSTRUCTIONS



Designer Checklist:

- Recognize if child understands what is required in the task.
- Respond child's questions and if necessary present story in different ways to help the child to understand the task.
- Help child recognize when s/he begins to follow the instructions – positive feedback.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

Children in this age group make use of gesture in their communication to focus on a joint activity.



Designer Tips:

Children **need repetitive pointing** to focus their attention on the task (e.g., showing the picture, showing the objects, iconic gestures).

Children sometimes show a figure or an object to **receive a feedback or confirmation**, or only chat about it outside the context 😊.

Children **need complementary gestures** (e.g., repetitive, iconic) for recognizing and keeping track of figures, and shapes in the game.

Designer Checklist:

- Make use of pointing gestures to focus child's attention.
- Recognize and respond if child gestures, points, shows something about the game.
- Invite child to point, show or draw a relevant figure, shape, or object when s/he is distracted.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING



Children in this age group comprehend the content of information better when conveyed with gesture.

Designer Tips:

Gesturing (e.g., pointing, showing) helps children better understand, follow and learn the information presented to them.

Children use pointing, showing things more than they use verbal communication at this age period.

Encouraging child to think with gestures helps his/her spatial learning and understanding.

Designer Checklist:

- Translate gesture information into digital affordances (e.g. visual, audio, tactile)
- Invite child to gesture about shape, figure, orientation, location.
- Recognize and respond to child's gestures (e.g., pointing or showing an object, figure or shape).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING

Children in this age group learn spatial concepts and relations better if they are conveyed through gesture.

Designer Tips:

Showing children **the rotational actions** (e.g., turning, flipping) with gestures help them to solve problems related to mental rotation.

Showing children the shape with **iconic gesture** (drawing the outline framework of a shape with finger) helps to learn shapes.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING



Designer Checklist:

- Recognize if the child is having difficulty in rotating shapes – if so provide him/her gesture input that shows the required rotation action.
- Help child learn shapes through gesture (drawing with finger).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS

Children in this age group benefit gestures to understand or receive the instructions.

Designer Tips:

Children are usually **unable to follow the verbal or visual instructions very well** – gesture helps them focus and follow the information.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS



Designer Checklist:

- Encourage the child to stay on task and not give up on-task behaviors if having difficulty in following instructions
- Provide digital affordances that might replace gesture as a scaffolding tool to help child understand instructions.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

Children at this age group can focus on the guided-play only if they find the aim of the game is very interesting.



Designer Tips:

Children **usually distracted by the objects** and **switch to free play** very easily.

Integrating **riddles / missing shapes / tasks** within the story help to attract their attention.

Visual, verbal, or haptic cues or **immediate feedback** that invites the child to an adventure might help him/her to stay focused.

Designer Checklist:

- Recognize if the child switches to free play and use objects randomly.
- Call the child to this really interesting adventure that worths his/her time playing with the objects.
- Help a child recognize if s/he behaves irrelevant to the aim of the game.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING

Children at this age group might have difficulty in comprehending the task requirement.

Designer Tips:

Embedded Figure Test might be simplified with **basic shapes** and **figure configurations**.

Embedded Figure Test might be integrated into a **visual storytelling** that guide child to solve a problem.

Children might have **difficulty in seeing the missing shape** embedded in a figure.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING



Designer Checklist:

- Simplify Embedded Figure Test by using basic shapes and figure configurations.
- Integrate Embedded Figure Test into a visual storytelling.
- Avoid cognitive load.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING

Children at this age group might have difficulty in finding the missing shape embedded in geometrical figures.

Designer Tips:

Embedded Figure Test is a type of spatial problem developed for preschool children.



2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING



Designer Checklist:

- Provide simplified Embedded Figure Tests with objects to guide the play.
- Provide one simple task at a time.
- Design tasks that might also have and respond to alternative (multiple) solutions.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS

Guided-play is found more beneficial than free play and instructional (didactic play) in learning process.

Designer Tips:

Guided-play is different than free play and didactic play. (e.g., **free play**: «let's play with these objects»; **didactic play**: «we build a house with these objects like this»; and **guided-play**: «let's build a house with these objects».)

Instructions of the guided-play can be in the form of simple visual, verbal, or haptic cues that might attract the child's interest and motivate the child to mindfully engage in the play.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS



Designer Checklist:

- Let the child to make mistakes. But make sure s/he also learns from that mistake
- Provide correction feedback for different types of mistakes.
- Present various correction feedbacks as simple as possible (e.g., visual, haptic)

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

Children in this age group can easily focus their attention on completing the rotation of an object.

Designer Tips:

Children are keen on completing the correct orientation by **aligning edges properly** while **matching a 3D object with a 2D shape**.

Children do not need too much verbal feedback or iconic gesture to focus on matching and rotating an object.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION



Designer Checklist:

- Recognize child's ability level and adjust difficulty level.
- Challenge child's expertise in aligning shapes with a more complex shape in Embedded Figure Test.
- Help child recognize when s/he is very close to complete a rotation action.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING

Children in this age group can easily keep track of information needed for a mental rotation task.

Designer Tips:

Children can **recognize, identify, categorize, match basic shapes** according to different size and orientation in a simple task.

Children can easily recognize a **dash type line** refers to a missing shape.

Children sometimes need **guiding questions** to recognize abstract figures created with simple geometrical shapes (e.g., which one do you think is the turtle?).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING



Designer Checklist:

- Challenge child's ability to recognize and match a shape in Embedded Figure Test.
- Embed missing shapes in figures in different ways that challenge expectation except dash type.
- Encourage child to identify an abstract figure configuration created with different geometrical shapes.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING

Children in this age group can easily stay on-task for solving problems related to mental rotation.

Designer Tips:

Children sometimes **shift to random actions** and match shapes and objects that first attract their attention before focusing on the solution.

Children **need complementary feedback** to understand there is a problem in the story (e.g., the turtle is really hungry and needs your help.) or some **correction feedback** for staying on-task (e.g., verbal, visual, or haptic clues).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING



Designer Checklist:

- Recognize if the child behaves randomly instead of involving on-task behavior.
- Invite child to solve the problem given in the story – this might also need to be done several times and in different ways.
- Help child recognize when s/he is very close to solve the problem.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS

Children in this age group better learn if the instructions include information about spatial relations of objects.

Designer Tips:

Storytelling help children better understand mental rotation tasks in **cause-effect relations** (e.g., the wind blown the roof of the house on top of the mountain).

Children need spatial information that explains the **rotation action** (e.g., flip, turn, rotate) or **spatial features** of shapes (e.g., bigger triangle, smaller square, green circle).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS



Designer Checklist:

- Make sure child understands instructions correctly and act accordingly.
- Present instructions as playful and informational as possible – this might be done in different ways.
- Recognize child's questions or responses in form of verbal language.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

Children in this age group can easily focus their attention on listening to the story immediately.

Designer Tips:

Children pay attention to the story easily.

They sometimes need help in associating abstract figures referred in the narrative and **ask questions** (e.g., where is the turtle?) to proceed in the task.

Calling the child by her/his name helps to focus the attention.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION



Designer Checklist:

- Make the content interesting, funny and exciting for the child.
- Help child to realize if s/he is distracted
- Recognize and respond to child's verbal questions.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING

Children in this age group keep track of the story better if the content is familiar and simple enough.

Designer Tips:

Children need **short and simple sentences** with words familiar to them.

Children do not necessarily need to listen to the whole story if the solution of the task is too simple and obvious to them.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING



Designer Checklist:

- Provide spatial words and concepts (e.g. geometrical shapes, orientations, rotation actions) within the narrative
- Challenge child's expectations, avoid being too simple and obvious.
- Help child recognize if s/he misunderstands something in the content.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING

Children in this age group can easily identify, recognize, categorize or locate basic geometrical shapes.

Designer Tips:

To learn **more complex shapes** (e.g., paralleloagram) children need to hear the name of the shape.

Children need **complementary information** about the shape to understand what it consists of (e.g., two triangles can make a square or a paralleloagram).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING



Designer Checklist:

- Recognize if the child knows the name of complex shapes or not.
- Invite child to show/point which shape looks like the rotated complex shape.
- Help child recognize a combination of two basic shapes can make a more complex shape.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS

Children in this age group better learn if the instructions are given in a clue rather than in a didactic manner.

Designer Tips:

Children are willing to take instructions if they are presented in the form of **storytelling** and **appealing visuals**.

Children usually need to hear the name of the figure, and shape that is referred in the task only twice.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS



Designer Checklist:

- Recognize if child understands what is required in the task.
- Respond child's questions and present the story in different ways to help child understand the task.
- Help child recognize when s/he begins to follow the instructions.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

Children in this age group make use of gesture in their communication to focus on a joint activity.



Designer Tips:

Children rarely **need gestures** to focus their attention on the task (e.g., showing the picture, showing the objects).

Children sometimes show a figure or an object to receive a feedback or confirmation, or to give a comment.

Encouraging children to gesture helps their spatial thinking and understanding.

Designer Checklist:

- Make use of pointing gestures to focus child's attention.
- Recognize and respond if child gestures, points, shows something about the game.
- Invite child to point or show a relevant figure, shape, or objects.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING

Children in this age group comprehend the content of information better when conveyed with gesture.

Designer Tips:

Gesturing (e.g., pointing, showing) helps children better **understand, follow and learn** the information presented to them.

Children need **complementary gestures** (e.g., pointing, showing) for identifying or distinguishing figures, and shapes.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING



Designer Checklist:

- Translate gesture information into digital affordances (e.g. visual, audio, tactile)
- Invite child to think with gesture about shape, figure, orientation, location.
- Recognize and respond to child's gestures (e.g., pointing or showing an object, figure or shape).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING

Children in this age group learn spatial concepts and relations better if they are conveyed through gesture.

Designer Tips:

Showing children the **rotational actions** (e.g., turning, flipping) with gestures help them to solve problems related to mental rotation.

Showing children the shape with **iconic gesture** (drawing the outline framework of a complex shape with finger) helps to learn **complex shapes**.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING



Designer Checklist:

- Recognize if the child is having difficulty in rotating complex shapes – if so provide him/her gesture input that shows the required rotation action.
- Help child learn complex shapes through gesture (drawing with finger).

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS

Children in this age group benefit gestures to understand or receive the instructions.

Designer Tips:

Children might not be able to follow the **verbal or visual instructions** very well – gesture helps them focus and follow the information.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS



Designer Checklist:

- Encourage the child to stay on task and not give up on-task behaviors if having difficulty in following instructions
- Provide digital affordances that might replace gesture as a scaffolding tool to help child understand instructions.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

ATTENTION

Children at this age group can easily focus on the guided-play only if they find the aim of the game.

Designer Tips:

Sometimes children might be distracted by the objects and **switch to free play** unintentionally.

Integrating **riddles / missing shapes / tasks** within the story help to attract their attention.

Visual, verbal, or haptic cues or immediate feedback that **invites the child to an adventure** might help him/her to stay focused.

2,5-3

3,5-4



mental rotation



narrative

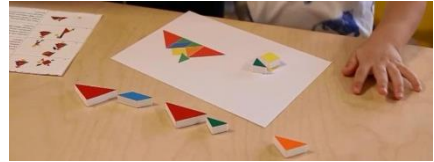


gesture



guided-play

ATTENTION



Designer Checklist:

- Recognize if child switches to free play and use objects randomly.
- Call child to this really interesting adventure that worths his/her time playing with the objects.
- Help a child recognize if s/he behaves inconsistent to the aim of the game.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING

Children at this age group might can easily comprehend the task requirement.

Designer Tips:

Embedded Figure Test might be used with missing **complex shapes combined with basic shapes** and **figure configurations**.

Embedded Figure Test might be integrated into a **visual storytelling** that guide child to solve a problem.

Children might have difficulty **combining the missing shapes** embedded in a figure.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INFORMATION PROCESSING



Designer Checklist:

- Make use of Embedded Figure Test and figure configurations in different ways.
- Integrate Embedded Figure Test into a visual storytelling.
- Avoid cognitive load.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING

Children at this age group might have difficulty in finding complex missing shapes embedded in figures.

Designer Tips:

Embedded Figure Test is a type of spatial problem developed for preschool children.



2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

PROBLEM SOLVING



Designer Checklist:

- Provide Embedded Figure Tests with objects to guide the play.
- Provide one task at a time.
- Design tasks that might also have and respond to alternative (multiple) solutions.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS

Guided-play is found more beneficial than free play and instructional (didactic play) in learning process.

Designer Tips:

Guided-play is different than free play and didactic play. (e.g., **free play**: «let's play with these objects»; **didactic play**: «we build a house with these objects like this»; and **guided-play**: «let's build a house with these objects».)

Instructions of the guided-play can be in the form of simple visual, verbal, or haptic cues that might attract the child's interest and motivate the child to **mindfully engage in the play**.

2,5-3

3,5-4



mental rotation



narrative



gesture



guided-play

INSTRUCTIONS



Designer Checklist:

- Let the child to make mistakes. But make sure s/he also learns from that mistake
- Provide correction feedback for different types of mistakes.
- Present various correction feedback types as simple as possible (e.g., visual, haptic).