

[ PHYSIOTHERAPY 34 ]

2<sup>nd</sup> Year - 2<sup>nd</sup> Term

# Human Development

Summarization # 1 #

Lectures .. " 5 "

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# Cognitive Development

## Piagetion approach

### L 5

## Piagetion approach

- ⌘ Much of what we know about how children think comes from the work of the Swiss theoretician Jean Piaget (1896-1980).
- ⌘ Piaget's cognitive-stage theory was the forerunner of today's "cognitive revolution" with its emphasis on mental processes. Piaget, a biologist and philosopher by training, took an **organismic perspective**

" piagent < كان يعتمد في نظريته ع الـ .. Observe ( الملاحظة ) يشوف أولاده وأولاد عائلته الى أن أجمعت لديه عينة كبيرة وشاف كيف يفكروا وهذه نقطة ضعف لأنو ما يعتمد على التجربة هذه النظرية حصلت في الثمانينات .."

## Piagetion approach

- ⌘ He viewed cognitive development as the product of children's efforts to understand and act on their world.
- ⌘ Piaget's *clinical method* combined observation with flexible questioning.
- ⌘ Piaget suggested that cognitive development begins with an inborn ability to adapt to the environment.

⌘ Piaget described cognitive development as occurring in four universal, qualitatively different Stages:

{ cognitive } = الفهم ، المعرفة ، التفكير ، الإدراك ، فهم المعاني، الانتماء

1) Sensorimotor Stage.

تحدث أول مرحلة في أول سنتين من العمر.

2) Preoperational Stage.

3) Stage of Concrete Operation.

4) Stage of Formal Operation.

⌘ At each stage: cognitive growth occurs through three interrelated processes:

- Organization.

- Adaptation.

- Equilibration

كل مرحلة يحصل فيها ٣ تطورات للعقل:

١ - الطفل المولود عنده القدره على تلقي المعلومات.

٢ - التكيف {assumulation, accumalition}

⌘ **Organization:** is the tendency to create increasingly complex cognitive structures ( systems of knowledge or ways of thinking that incorporate more and more accurate images of reality). These structures, called Schemes ( المعرفة المتزايدة )

⌘ **Schemes** : are organized patterns of behavior that a person uses to think about and act in a situation. ( التفكير بطريقة معينة )

Or

It is Piaget's term for organized patterns of behavior used in particular situations.

يصبح الـ **patern** اعقد وأوسع

⌘ As children acquire more information, their schemes become **more and more complex**. e.g. An infant has a simple scheme for sucking but soon develops varied schemes for how to suck at the breast, a bottle, or a thumb.

" أي معلومة جديدة يأخذها ويخزنها عنده "

⌘ **Adaptation:** is Piaget's term for how children handle new information in light of what they already know.

⌘ Adaptation occurs through **two complementary processes:** ( كيف يتعامل الشخص مع المعلومات الجديده )

(1) **Assimilation:** taking in new information and incorporating it into existing cognitive structures.

( بمعنى لديك خلفية عن معلومة ولاكنك تزيد عليها )

(2) **Accommodation:** adjusting one's cognitive structures to fit the new information. ( معلومة جديده )

⌘ **Equilibration:** a constant striving for a stable balance, or equilibrium, dictates the shift from assimilation to accommodation.

( يوصل لمرحلة أنو يوصفها في مكان معين )

⌘ When children cannot handle new experiences within their existing cognitive structures and thus experience **disequilibrium**, they organize **new mental patterns** that integrate the new experience, thus restoring a more comfortable state of

**equilibrium.**

( وانت مراهق عندك اسئلة ماتعرف فين حلها .. لين توصل للاجابة توصل ساعتها للاتزان )

organization	adaptation	Equilibrium
ان الانسان رديه قابلية للمعرفة ولديه مكان لها..	شبيهه بالمعلومة. < Assuim.. معلومة جديده < Accomo..	ادور للمعلومة في القديم والجديد الين اوصل للحل ي انا لاقى ملف شبيهه او انا احطها في ملف جديد.

## The Sensorimotor Stage (birth to approximately age 2).

⌘ The first of Piaget's four stages of cognitive development is **the sensorimotor stage**.

⌘ During this stage, infants learn about themselves and their world through **their developing sensory and motor activity**.

⌘ Babies change from creatures who respond primarily through reflexes and random behavior **into goal-oriented toddlers**.

"احساس حركة"

اول شيء ينمو معرفيا لدى الانسان يكون عن طريق الاحساس

"الطفل في البداية يكون اعتماده على reflex"

⌘ The sensorimotor stage **consists of six substages**, which flow from one to another as a baby's schemes, organized patterns of behavior, become more elaborate.

⌘ During the first five sub-stages, babies learn to coordinate **input from their senses** and organize their activities in relation to their environment. They do this by the processes of *organization, adaptation, and equilibration*, discussed.

⌘ During the sixth (**last sub-stage**), they progress from **trial and error** learning to **the use of symbols and concepts** to solve simple problems.

المرحلة الاولى هذه تعدي على 6 مراحل:

اول 5 مراحل يحاول ويجرب

المرحلة السادسة يكون له هدف يعمل عليه

⌘ Much of this early cognitive growth comes about through **circular reactions**. In which

- An infant learns to **re**produce pleasurable or interesting events originally discovered by chance.
- Initially, an activity produces a sensation so enjoyable that the baby wants to repeat it.
- The repetition again produces pleasure, which, in turn, motivates another repetition.
- The originally chance behavior has been consolidated into a new scheme.

**circular reactions**: هي عمل شيء والاعجاب فيه ثم تكراره

يكرر شيء ع ، اكتشف شيء يسعده بالصدفة

# The sensorimotor six substages:

## The *first substage*:

### Use of reflexes (Birth to 1 month)

المراحل ال ٦ : اول شى يعتمد على الريفلكس .. فى اول شهر

• Infants **exercise their inborn reflexes** and gain some control over them.

• They **do not coordinate** information from their senses.

الشخص البالغ لديه القدرة على الكتابة والمطالعة والاستماع ، اما الطفل فى هذا العمر لا يستطيع الربط بينهم"

• They do **not grasp** an object they are looking at.

"ليس لديه تركيز"

• **e.g** : Baby begins sucking when her mother's breast is in her mouth.

## The *second substage*:

### Primary circular reactions (about 1 to 4 months).

"يبدأ يكتشف جسمه يطالع فى يده . مايهمه البيئه حوله"

• Infants **repeat pleasurable behaviors** that first occur by chance (such as thumb sucking).

• Activities focus **on the infant's body** rather than the effects of the behavior on the environment.

• Infants make first **acquired adaptations**; that is, they suck different objects differently. (ياخذ مصاصه)

• They begin to **coordinate sensory information and grasp objects**.

• **e.g**: when given a bottle, Baby, who is usually breastfed, is able to adjust his sucking to the rubber nipple.

∞ **Circular reactions:** Piaget's term for processes by which an infant learns to reproduce desired occurrences originally discovered by chance.

## The *third substage*:

### Secondary circular reactions (about 4 to 8 months).

∞ It coincides with a new **interest in manipulating** objects and learning about their properties.

∞ Babies **intentionally repeat an action** not merely for its own sake, as in the second substage, but to get results **beyond the infant's own body**.

∞ Infants become more **interested in the environment**; they repeat actions that bring interesting results (such as shaking a rattle) and prolong interesting experiences.

∞ Actions are intentional but **not initially goal directed**.

∞ **e.g**: Baby pushes pieces of dry cereal over the edge of his high chair tray one at a time and watches each piece as it falls to the floor. (يرمى الحبوب ع الأرض وهو مبسوط)

"فى هذه المرحلة يمسك الاشياء ويطالع فيها ويتحمس عشان يحاول يتعرف عليها " هذا لين وهذا قاسى"

"يركز ع الاصوات ، يدور على بيئته من حوله"

## The fourth substage:

### Coordination of secondary schemes (about 8 to 12 months).

- ✂ They have learned to **generalize** from past experience to solve new problems.
- ✂ Behavior is more **deliberate and purposeful** (intentional) as infants coordinate previously learned schemes (such as looking at and grasping a rattle) and use previously learned behaviors to **attain their goals** (such as crawling across the room to get a desired toy).
- ✂ They can **anticipate events**.
- ✂ **e.g:** Baby pushes the button on his musical nursery rhyme book, and "Twinkle, Twinkle, Little Star" plays. She pushes this button over and over again, choosing it instead of the buttons for the other songs

"هذه المرحلة من ٨-١٢  
يكون لديه ذاكرة يفرق بين اللي شافه من قبل واللي شافه اول مره  
يستخدم الحبو للوصول للهدف"

## The fifth substage:

### Tertiary circular reactions (about 12 to 18 months).

- ✂ Babies will **vary an action** to get a similar result.
- ✂ Toddlers show **curiosity** and experimentation; they purposefully **vary their actions to see results** (for example, by shaking different rattles to hear their sounds).
- ✂ They **actively explore** their world to determine what is novel about an object, event, or situation.
- ✂ They try out new activities and **use trial and error** in solving problems.
- ✂ **e.g:** When Baby's big sister holds his favorite board book up to his crib bars, he reaches for it. His first efforts to bring the book into his crib fail because the book is too wide. Soon, baby turns the book sideways and hugs it, delighted with his success.

"من ١٢-١٨ شهر ( من سنه لسنه ونص)  
يكتشف ، عنده فضول ، يجرب ويغلط"

## The sixth substage:

### Mental combinations (about 18 months to 2 years) .

- ✂ It is a **transition** to the preoperational stage of early childhood.
- ✂ They can **pretend**, and their **representational** ability affects the sophistication of their pretending.
- ✂ **Representational ability:** the ability to mentally represent objects and actions in memory, largely through symbols such as words, numbers, and mental pictures, frees children from immediate experience.
- ✂ **Also, Representational ability:** Piaget's term for capacity to store mental images or symbols of objects and events.
- ✂ They can **think about actions** before taking them.

**Representational ability** الطفل لديه خيال ، يعبر تعبيرات مختصره"

- ✂ They **no longer** have to go through laborious **trial and error** to solve **problems**.
- ✂ Since toddlers can mentally represent events, they are **no longer confined to trial and error to solve problems**. Symbolic thought enables toddlers to begin to **think about events** and **anticipate their consequences** without always resorting to action.
- ✂ Toddlers begin to **demonstrate insight**.
- ✂ They can use symbols, such as gestures and words, and can pretend.
- ✂ **e.g:** Baby plays with her shape box, searching carefully for the right hole for each shape before trying and succeeding.

"( يقدر يتعامل مع الألعاب والمربعات والأشكال المختلفة)  
 ما يكون عنده طريقة الخطأ والتجربة وإنما يحاول هو بنفسه يحل المشكله"

### During these six substages, infants develop:

- The abilities to think and remember.
- Knowledge about certain aspects of the physical world, notably, about objects and spatial relationships.

"بدأ يفكر ، يعرف الاشكال"

### Researchers following in Piaget's footsteps

have found that some of these developments conform fairly closely to his observations, but others, including representational ability, may **occur earlier** than Piaget believed possible.

"يقولوا للأسف ان الطفل ممكن يقدر يعمل حاجات قبل العمر اللي حدده "piahet"

### Key Development of the sensorimotor stage.

1

#### Concept or Skill:

Object permanence

#### Piaget's View:

It develops gradually between the third and sixth substage. Infants in the fourth substage (8-12 months) .

#### More Recent Findings:

Infants as young as 3,5 months (second substage) seem to show object knowledge, though interpretation of findings is in dispute.

2

#### Concept or Skill:

Spatial knowledge Piaget's View:

Development of object concept and spatial knowledge is linked to self-locomotion and coordination of visual and motor information.

#### More Recent Findings:

Research supports Piaget's timetable and the relationship of spatial judgments to the decline of egocentrism. Link to motor development is less clear.

### 3

#### Concept or Skill:

#### Causality

#### Piaget's View:

It develops slowly between 4-6 months and 1 year, based on an infant's discovery, **first** of effects of own actions and **then** of effects of outside forces.

#### More Recent Findings:

Some evidence suggests early awareness of specific causal events in the physical world, but general understanding of causality may be slower to develop.

### 4

#### Concept or Skill:

#### Number

#### Piaget's View:

It depends on use of symbols, which begins in the sixth substage (18-24 months).

#### More Recent Findings:

Infants as young as 5 months may recognize and mentally manipulate small numbers, but interpretation of findings is in dispute.

### 5

#### Concept or Skill:

#### Categorization

#### Piaget's View:

It depends on representational thinking, which develops during the sixth substage (18-24 months).

#### More Recent Findings:

Infants as young as 3 months seem to recognize perceptual categories, and 7-month-olds categorize by function.

"يعرف هذه طيور وهذا أكل"

### 6

#### Concept or Skill:

#### Imitation

#### Piaget's View:

Invisible imitation develops around 9 months; deferred imitation begins after development of mental representations in the sixth substage (18-24 months).

#### More Recent Findings:

Controversial studies have found invisible imitation of facial expressions in newborns and deferred imitation as early as 6 weeks. Deferred imitation of complex activities seems to exist as early as 6 months.

"يقلد الام والاب والقطة"

⌘ **Invisible imitation** : Imitation with parts of one's body that one cannot see.

⌘ **Visible imitation** : Imitation with parts of one's body that one can see.

⌘ **Deferred imitation** : Piaget's term for reproduction of an observed behavior after the passage of time by calling up a stored symbol of it.

"يتذكر حاجات مرت عليه قبل"

⌘ **Elicited imitation** : Research method in which infants or toddlers are induced to imitate a specific series of actions they have seen but not necessarily don before.

"هو شى ما مر عليه قبل كذا ولكن شبيه له"

مثل الربط بين ملاهى الشلال وملاهى الحجاز!

⌘ **Four factors seem to determine young children's long-term recall:**

(1) the number of times a sequence of events has been experienced,

"الطفل لمن يمر على تجربة للمرة الاولى غير لمن يمر عليها مره ثانيه"

(2) whether the child actively participates or merely observes,

"لو الطفل تبغاه يكتب ما اقلو دا كلب او دا قط ، اروح للحديقته واوريه الحيوانات"

(3) whether the child is given verbal reminders of the experience, and

"اربط الكلام بالصوره"

(4) whether the sequence of events occurs in a logical, causal order (Bauer et al., 2000) .

"اقتعه بالصح والغلط مو اقلو لاتمشى مع فلان وبدون سبب ، اقتعه مثلا بسبب انه يدخن او مايداكل"

## The preoperational stage (2-7 years)

○ Preoperational stage In Piaget's theory, the second major stage of cognitive development, in which children become more sophisticated in their use of symbolic thought but are not yet able to use logic.

○ Jean Piaget called early childhood (the preoperational stage of cognitive development ) because children this age are not yet ready to engage in logical mental operations, as they will be in the stage of concrete operations in middle childhood.

○ However, the preoperational stage, which lasts from approximately ages 2 to 7, is characterized by a great expansion in the use of symbolic thought, or representational ability, which first emerges at the end of the sensorimotor stage

"الفترة هذه بيبدأ يفكر وعنده خطه وتكون عنده عمليات عقلية ، يعرف يجاوب ٧+٥=...

# Cognitive Advances during early childhood

1-

## Skill:

### Use of symbols

Symbolic function: is the Piaget's term for ability to use mental representations (words, numbers, or images) to which a child has attached meaning.

pretend play: is the Play involving imaginary people and situations; also called *fantasy play*, *dramatic play*, or *imaginative play*.

"يلعب مع اشخاص وهميين"

## Significance:

- Children do not need to be in sensorimotor contact with an object, person, or event in order to think about it.
- Children can imagine that objects or people have properties other than those they actually have.

## Example:

- Child asks his mother about the elephants they saw on their trip to the circus several months earlier.
- Child pretends that a slice of apple is a vacuum cleaner "rooming" across the kitchen table.

"ايش الحاجات الزيادة اللي بدأت تتكون؟"

١ - يستعمل الأرقام والرموز والمعاني"

2-

## Skill:

### Understanding of identities

### Significance:

- Children are aware that superficial alterations do not change the nature of things.

### Example:

- Child knows that his teacher is dressed up as a pirate but is still his teacher underneath the costume.

"الأشياء اللي تتغير في الكل مو شرط في المحتوى.."

يعنى المويه هي نفسها ماتتغير في كوب صغير او كبير

د/ ايهاب لابس ثوب او بدلته يبقى دكتور ايهاب

3-

## Skill:

- Understanding of cause and effect .

### Significance:

- Children realize that events have causes.

### Example:

- Seeing a ball roll from behind a wall, child looks behind the wall for the person who kicked the ball.

"شاف كوره تتدحرج من ورا الجدار ينزل يشوف من دحرجها؟"

4-

**Skill:**

Ability to classify

**Significance:**

- Children organize objects, people, and events into meaningful categories.

**Example:**

- Child sorts the pine cones she collected on a nature walk into two piles according to their size: "big" and "little."

"حيوان - نبات - أكل - سيارات"  
زيادة التصنيفات

5-

**Skill:**

Understand of number

**Significance:**

- Children can count and deal with quantities .

**Example:**

- Child shares some candy with her friends, counting to make sure that each girl gets the same amount.

"يقدر يخش على الرقم ١٠٠ وحسابات اكثر"

6-

**Skill:**

Empathy

**Significance:**

- Children become more able to imagine how others might feel.

**Example:**

- Child tries to comfort his friend when he sees that his friend is upset.

"يعرف الشعور"

7-

**Skill:**

Theory of mind

**Significance:**

- Children become more aware of mental activity and the functioning of the mind.

**Example:**

- Child wants to save some cookies for herself, so she hides them from her brother in a pasta box. She knows her cookies will be safe there because her brother will not look in a place where he doesn't expect to find cookies.

"يعمل خطة عشان تخبي البسكوت"

"التفكير بالعقل"

## Immature Aspects of Preoperational Thought (According to Piaget):

1-

Limitation:

Centration

Description:

- Centration In Piaget's theory, is the tendency of preoperational children to focus on one aspect of a situation and neglect others.
- Decenter In Piaget's terminology, to think simultaneously about several aspects of a situation.
- The inability to decenter , Children focus on one aspect of a situation and neglect others.

Example:

- Child teases his younger sister that he has more juice than she does because his juice box has been poured into a tall, skinny glass, but hers has been poured into a short, wide glass.

"انا العصير حقي اكثر منك، رغم انه نفس الحجم لكن الشكل الزجاجه مختلف"

"ايش الاشياء اللي فيها تصور في هذه الفتره؟"

"نفكر بعدة نواحي: البالغ يكون عنده decenter، اما الطفل يكون عنده centration"

2-

Limitation

Irreversibility

Description:

- Children fail to understand that some operations or actions can be reversed, restoring the original situation.

Example:

- Child does not realize that the juice in each glass can be poured back into the juice box from which it came, contradicting his claim that he has more than his sister.

"الحاجات عنده لايمكن تتغير مثلا المويه لايمكن تكون ثلج"

3-

Limitation

Focus on states rather than transformations.

Description:

- Children fail to understand the significance of the transformation between states.

- **Conservation** : is the Piaget's term for awareness that two objects that are equal according to a certain measure remain equal in the face of perceptual alteration so long as nothing has been added to or taken away from either object.

- **Horizontal decalage** : is the Piaget's term for inability to transfer learning about one type of conservation to other types, which causes a child to master different types of conservation tasks at different

### Example:

- In the conservation task, child does not understand that transforming the shape of a liquid (pouring it from one container into another) does not change the amount.

"يركز ع الشكل اكثر من تحول شي لشي"

## 4-

### Limitation:

Transductive reasoning

### Description:

- **Transduction**: is the Piaget's term for a preoperational child's tendency to mentally link particular phenomena, whether or not there is logically a causal relationship.

- Children do not use deductive or inductive reasoning; instead they jump from one particular to another and see cause where none exists.

### Example:

- A child was mean to his brother. Then his brother got sick. The child concludes that he made her brother sick.

" مثلا زعل اخوه واخوه مرض ، ربط الزعل بالمرض"

" التفكير الإستقرائي المنطقي:

\*خذ الباب وانت ماشي\* لايعرف معناها وليس لديه ربط منطقي.

## 5-

### Limitation

Egocentrism

### Description:

- **Egocentrism**: is the Piaget's term for inability to consider another person's point of view; a characteristic of young children's thought.

- Children assume everyone else thinks, perceives, and feels as they do.

### Example:

- Child doesn't realize that he needs to turn a book around so that his father can see the picture he is asking him to explain to him. Instead, he holds the book directly in front of him, where only he can see it,

" ماعنده قابليه لاستقبال وجهة نظر أخرى"

6-

Limitation

**Animism**

Description:

- Animism :is the Tendency to attribute life to objects that are not alive.
- Children attribute life to objects not alive.

Example:

- Child says that spring is trying to come but winter is saying, "I won't go! I won't go!"

"الشمس قالت لى .. ، القطه قالت لى.."

7-

Limitation:

**Inability to distinguish appearance from reality**

Description:

- Children confuse what is real with outward appearance.

Example:

- Child is confused by a sponge made to look like a rock. He states that it looks like a rock and it really is a rock.

"مايقدر يفرق بين الصوره والحقيقه ، السفنجه مثلا يقول عنها صخره"

## The concrete operational (7-12 years)

✂ According to Piaget, children enter the stage of concrete operations when they can use mental operations, such as reasoning, to solve concrete (actual) problems, such as where to find a missing mitten.

✂ Children at this age can think logically because they are less egocentric than before and can take multiple aspects of a situation into account

"المرحلة الأخيره"

## The concrete operational (7-12 years)

✂ However, their thinking is still limited to real situations in the here and now.

✂ During this stage children develop logical but not abstract thinking.

✂ Cognitive Advances: In the stage of concrete operations, children have a better understanding than pre-operational children of spatial concepts, causality, categorization, inductive and deductive reasoning, conservation, and number

"مايقدر يتخيل ايش اللي حيحصل بالمستقبل.."

"فى البرزح ايش اللي حيحصل .."

"abstract: حب الوطن والحريه"

## Advances in Selected Cognitive Abilities During Middle Childhood:

1-

**Ability:**

*Spatial thinking*

## Example:

- Child can use a map or model to help his search for a hidden object and can give someone else directions for finding the object.
- He can find her way to and from school, can estimate distances, and can judge how long it will take her to go from one place to another.

## Advances in Selected Cognitive Abilities During Middle Childhood:

2-

### Ability:

Cause and effect

### Example:

- child knows which physical attributes of objects on each side of a balance scale will affect the result (i.e., number of objects matters but color does not).
- He does not yet know which spatial factors, such as position and placement of the objects, make a difference.

3-

### Ability:

Categorization

### Example:

- Child can sort objects into categories, such as shape, color or both. She knows that a subclass (roses) has fewer members than the class of which it is a part (flowers).

"التسلسل"

4-

### Ability:

Seriation and transitive Inference

### Example:

- Child can arrange a group of sticks in order, from the shortest to the longest, and can insert an intermediate-size stick into the proper place.
- He knows that if one stick is longer than a second stick, and the second stick is longer than a third, then the first stick is longer than the third.

"يعرف يرتبهم تصاعدي"

5-

### Ability:

Inductive and deductive reasoning

### Example:

- Child can solve both inductive and deductive problems and knows that inductive conclusions (based on particular premises) are less certain

"نوع من أنواع التفكير المنطقي"

- **Seriation:** is the ability to order items along a dimension.
- **Transitive inference:** is the understanding of the relationship between two objects by knowing the relationship of each to a third object.
- **Class inclusion:** is the understanding of the relationship between a whole and its parts.
- **Inductive reasoning :**Type of logical reasoning that moves from particular observations about members of a class to a general conclusion about that class.  
"particular to general"
- **Deductive reasoning :**Type of logical reasoning that moves from a general premise about a class to a conclusion about a particular member or members of the class.  
"general to particular"

6-

**Ability:**

*Conservation*

**Example:**

- Child, at age 7, knows that if a clay ball is rolled into a sausage, it still contains the same amount of clay (conservation of substance). At age 9, he knows that the ball and the sausage weigh the same.
- Not until early adolescence will he understand that they displace the same amount of liquid if dropped in a glass of water.

7-

**Ability:**

*Number and mathematics*

**Example:**

- Child can count in his head, can add by counting up from the smaller number, and can do simple story problems.

## The of Formal Operations (12years-onward)

⌘ According to Piaget, adolescents enter the highest level of cognitive development( formal operations) when they develop the capacity for abstract thought.

⌘ This development, usually around age 11, gives them a new, more flexible way to manipulate information.

⌘ No longer limited to the here and now, they can understand historical time and extraterrestrial space.

"العمليات العقلية الأكثر وضوحا ، يعرف التجربة ويعرف كيف يحققها : المسافة بين مكة والرياض"

"يفهم في الشعر"

"يدرك الأبعاد"

"يعرف الأمثال والاختصارات"

## The of Formal Operations (12years-onward)

- ♋ They can use symbols for symbols (for example, letting the letter X stand for an unknown numeral) and thus can learn algebra and calculus.
- ♋ They can better appreciate metaphor and allegory and thus can find richer meanings in literature.
- ♋ They can think in terms of what might be, not just what is.
- ♋ They can imagine possibilities and can form and test hypotheses.

"الدولة : X، الشخص : Y"

- The ability to think abstractly has emotional implications. Earlier, a child could love a parent or hate a classmate.
- Now "the adolescent can love freedom or hate exploitation. slavery . . . The possible and the ideal captivate both mind and feeling"
- Formal operations Piaget's final stage of cognitive development, characterized by the ability to think abstractly.
- Hypothetical-Deductive reasoning: is the ability, believed by Piaget to accompany the stage of formal operations, to develop, consider, and test hypotheses.

### Hypothetical-Deductive Reasoning :

- ♋ To appreciate the difference formal reasoning makes, let's follow the progress of a typical child in dealing with a classic Piagetian problem, the pendulum problem.
- ♋ The child, Adam, is shown the pendulum (an object hanging from a string) . He is then shown how he can change any of four factors: the length of the string, the weight of the object, the height from which the object is released, and the amount of force he may use to push the object.

### Hypothetical-Deductive Reasoning :

- ♋ He is asked to figure out which factor or combination of factors determines how fast the pendulum swings.
- ♋ Pendulum. The pendulum's string can be shortened or lengthened, and weights of varying sizes can be attached to it.
- ♋ The student must determine what variables affect the speed of the pendulum's swing.