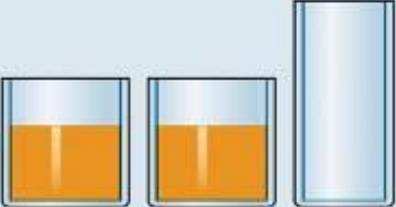
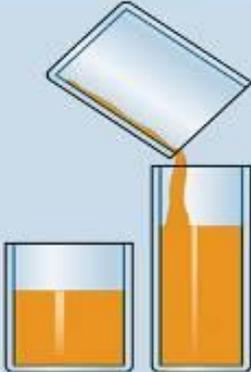
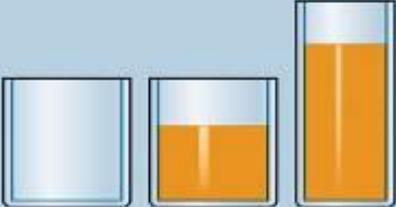
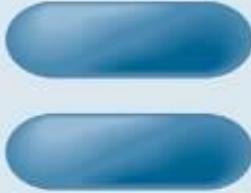


Concrete Operational Stage

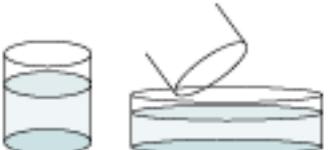
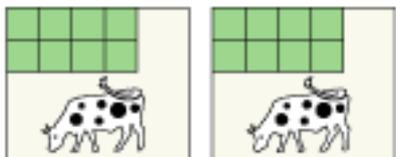
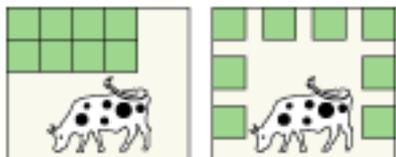
- ▶ **7-11 years old**
- ▶ **Can think logically, use analogies, and perform mathematical transformations ($5+9$ is the same as $9+5$) also known as reversibility.**
- ▶ **Understand analogies** (*My brain is like a computer.*)
- ▶ **Lacks abstract thought**
- ▶ ***Understand concept of conservation.***

Procedures Used to Test Conservation

The idea that merely changing the appearance of objects does not change their key properties

	PHASE 1	PHASE 2	PHASE 3
CONSERVATION OF LIQUID QUANTITY	 <p>"Do they have the same amount of orange drink or a different amount?"</p>	 <p>"Now watch what I do" (pouring contents of one glass).</p>	 <p>"Now, do they have the same amount of orange drink or a different amount?"</p>
CONSERVATION OF SOLID QUANTITY	 <p>"Do they have the same amount of clay or a different amount?"</p>	 <p>"Now watch what I do" (stretching one piece of clay).</p>	 <p>"Now, do they have the same amount of clay or a different amount?"</p>
CONSERVATION OF NUMBER	 <p>"Is there the same number or a different number?"</p>	 <p>"Now watch what I do" (spreading one row).</p>	 <p>"Now, is there the same number or a different number?"</p>

More Conservation Tasks

Type of Conservation	Starting Configuration	Transformation	Final Configuration
Liquid quantity	 <p>Is there the same amount of water in each glass?</p>	Pour water from one glass into a shorter, wider glass.	 <p>Now is there the same amount of water in each glass, or does one have more?</p>
Number	 <p>Are there the same number of pennies in each row?</p>	Stretch out the top row of pennies, push together the bottom row.	 <p>Now are there the same number of pennies in each row, or does one row have more?</p>
Length	 <p>Are these sticks the same length?</p>	Move one stick to the left and the other to the right.	 <p>Now are the sticks the same length, or is one longer?</p>
Mass	 <p>Does each ball have the same amount of clay?</p>	Roll one ball so that it looks like a sausage.	 <p>Now does each piece have the same amount of clay, or does one have more?</p>
Area	 <p>Does each cow have the same amount of grass to eat?</p>	Spread out the squares in one field.	 <p>Now does each cow have the same amount of grass to eat, or does one cow have more?</p>

Concrete Stage: Understanding of conservation – Attained! **LEVEL UP!**



Formal Operational Stage

- ▶ What way do you best learn? (metacognition)
- ▶ What would happen if people stopped having children?
- ▶ If you had a third eye, where would you put it?
- ▶ 11-15 years old
- ▶ Abstract reasoning (algebra)
- ▶ Manipulate objects in our minds without seeing them (no need for "symbols")
- ▶ Hypothesis testing
- ▶ Trial and Error
- ▶ Not every adult gets to this stage

Formal Operational Stage (Age 11 +)

Concrete operations include **analogies** such as “My brain is like a computer.”

Includes arithmetic transformations:
if $4 + 8 = 12$, $12 - 4 = ?$

Formal operations includes **allegorical** thinking such as “People who live in glass houses shouldn’t throw stones” (understanding that this is a comment on hypocrisy).

Includes algebra:
if $x = 3y$ and $x - 2y = 4$,
what is x ?

Concrete v. Formal, deductive reasoning



Jean Piaget's Stages of Cognitive Development

Typical Age Range	Description of Stage	Developmental Phenomena
Birth to nearly 2 years	<i>Sensorimotor</i> Experiencing the world through senses and actions (looking, hearing, touching, mouthing, and grasping)	<ul style="list-style-type: none">• Object permanence• Stranger anxiety
About 2 to about 6 or 7 years	<i>Preoperational</i> Representing things with words and images; using intuitive rather than logical reasoning	<ul style="list-style-type: none">• Pretend play• Egocentrism
About 7 to 11 years	<i>Concrete operational</i> Thinking logically about concrete events; grasping concrete analogies and performing arithmetical operations	<ul style="list-style-type: none">• Conservation• Mathematical transformations
About 12 through adulthood	<i>Formal operational</i> Abstract reasoning	<ul style="list-style-type: none">• Abstract logic• Potential for mature moral reasoning



(a)



(b)



(c)

Figure 4.15 Piaget's stages (a) Sensorimotor stage (b) Preoperational stage (c) Concrete/formal operational stage
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Mnemonics for Piaget's 4 Stages

The best mnemonics are often ones that you create for yourself. Here, however, are some common ones!



Stinkin' Pigs Can't Fly

Sometimes Piaget Can Frustrate

A Constructivist Approach

- ▶ Jean Piaget's theory remains the standard against which all other theories are judged.
 - Often labeled **constructivist** because it depicts children as constructing knowledge for themselves.
- ▶ Children are seen as
 - Active
 - Learning many important lessons on their own
 - Intrinsically motivated to learn

"Little scientists"



Criticisms of Piaget

1. Ages of stages vary quite a bit.
 - Object permanence in 3 month olds
 - Conservation with 4 year olds
2. Piaget believed that children could not think (had no abstract concepts or ideas.)
3. Individuals who have taken science courses (scientific procedures) are always in formal operations
4. Formal operational thinking is not universal
5. Piaget's tasks are culturally biased

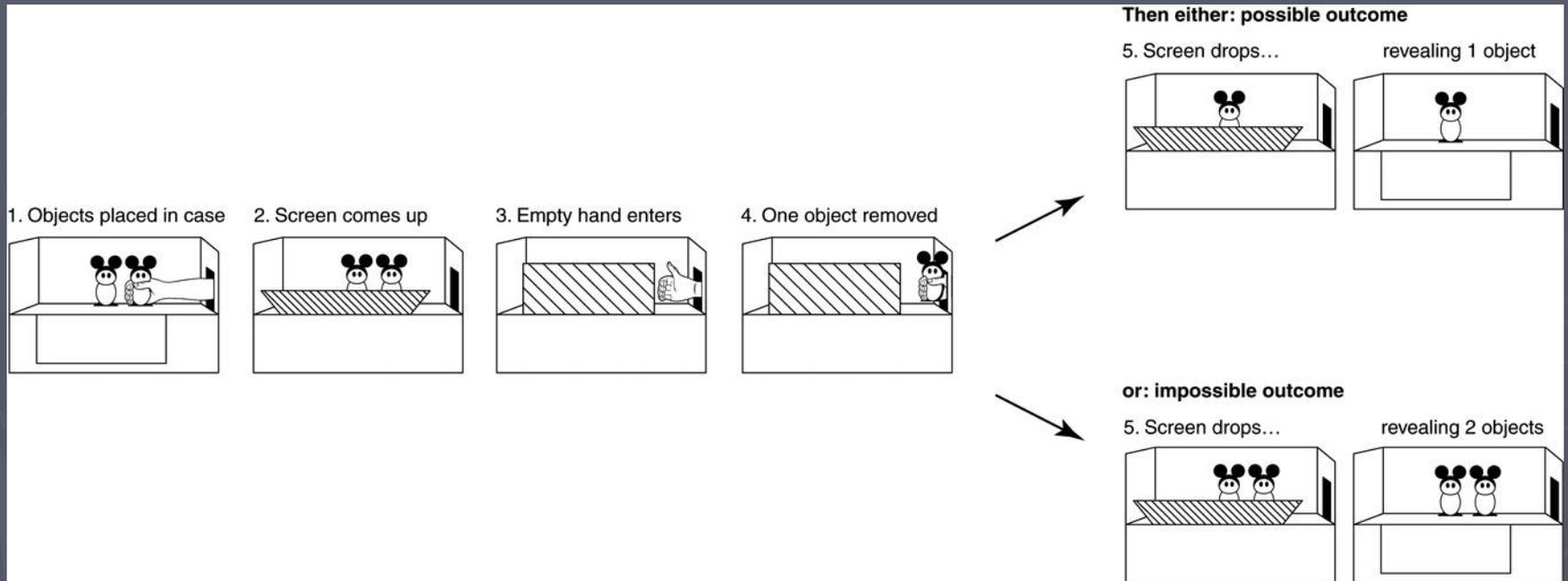


Figure 4.12 Baby math
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LEV VYGOTSKY

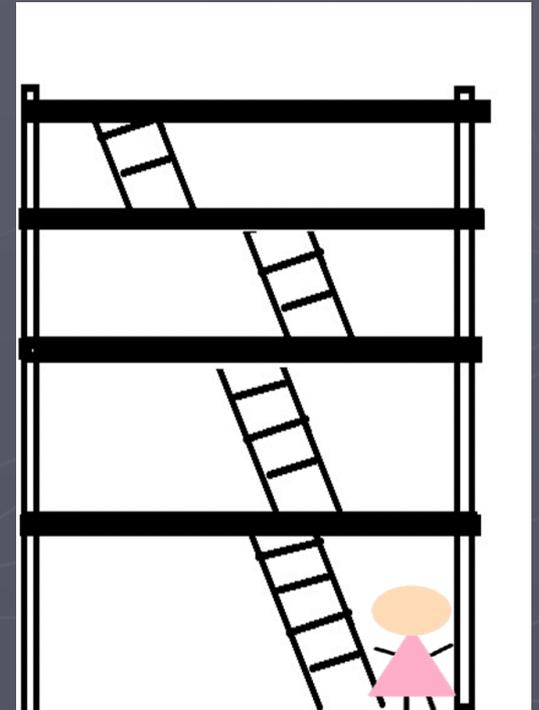
SOCIO-CULTURAL THEORY OF COGNITIVE DEVELOPMENT

- Cognitive development occurs in a sociocultural context that influences the form it takes
- Most of a child's cognitive skills evolve from social interactions with parents, teachers, and other more competent associates

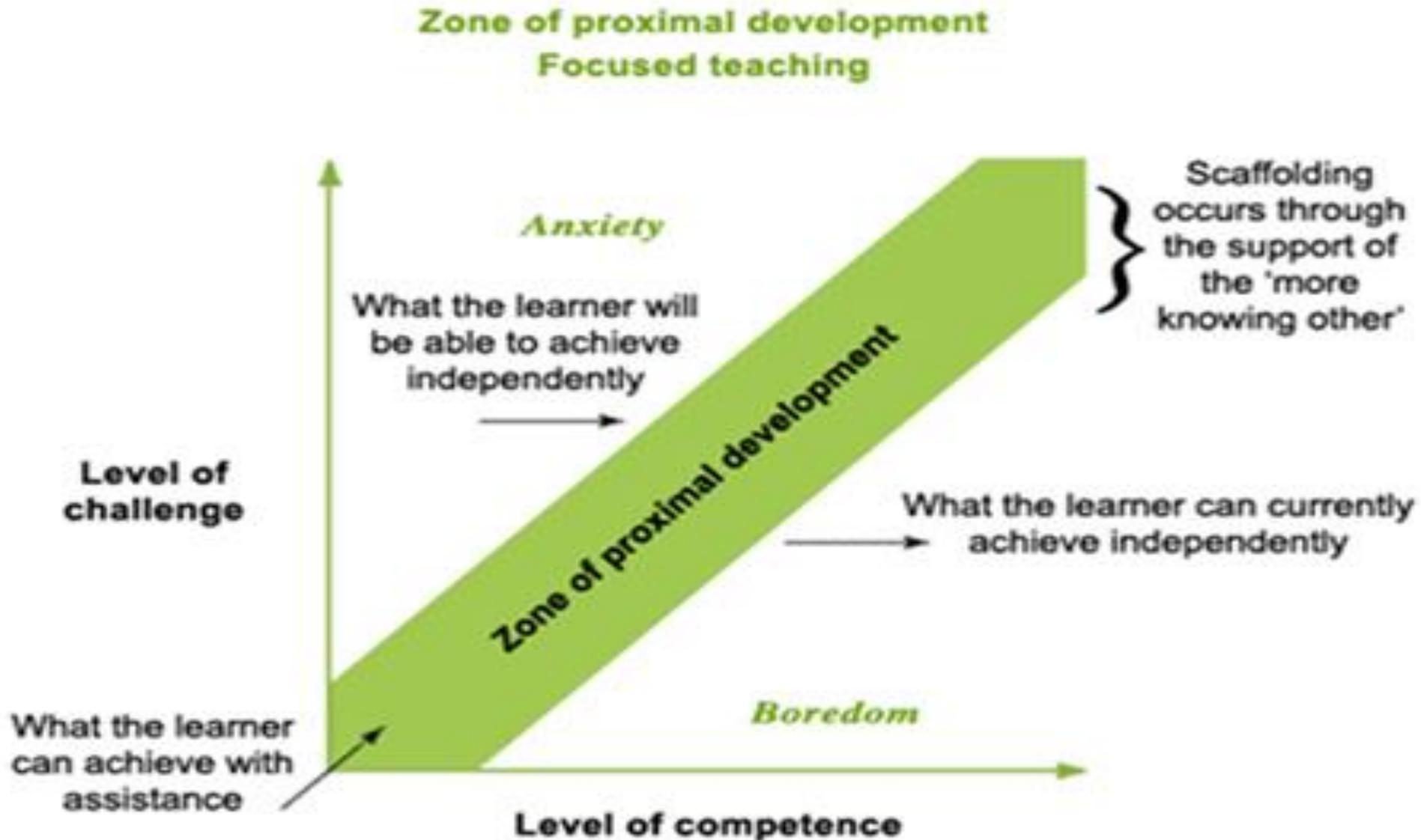
The Social Origins of Early Cognitive Competencies:

► Zone of Proximal Development - range of tasks that are too complex to be mastered alone but can be accomplished with guidance and encouragement from a "more knowing other."

- *Scaffolding*- the expert participant carefully tailors their support to the novice learner to assure their understanding



SCAFFOLDING





CONCEPTUAL DIFFERENCES

BETWEEN

VYGOTSKY

and

PIAGET



1. COGNITIVE DEVELOPMENT IS PRIMARILY A FUNCTION OF

**SOCIO-CULTURAL
INTERACTION**

Adult-child interaction



“More-knowing other”

**INDIVIDUAL
CONSTRUCTION**

Active investigation



The role of language in cognitive development:

- ▶ According to Piaget:
 - Children partake in egocentric speech, utterances neither directed to others nor expressed in ways that the listeners might understand
 - Egocentric speech played a little role in cognitive development
 - Speech tended to become more social as the child matures-less egocentric

The role of language in cognitive development cont'd

► According to Vygotsky:

- Thought and language eventually emerge
- He called a child's *nonsocial utterances* private speech
- Private speech plays a major role in cognitive development by serving as a cognitive self-guidance system, allowing children to become more organized and good problem solvers
- As individuals develop, private speech becomes *inner speech*



CONCEPTUAL DIFFERENCES

BETWEEN

VYGOTSKY

and

PIAGET



2. ROLE OF LANGUAGE AND PRIVATE SPEECH

LANGUAGE CRITICAL -
PRIVATE SPEECH BECOMES
THOUGHT THAT IS SELF-
REGULATING

ONCE LANGUAGE DEVELOPS,
COGNITION *IS* LANGUAGE

COGNITION CRITICAL -
EGOCENTRIC SPEECH
DISAPPEARS AS SOCIAL
SPEECH DEVELOPS

COGNITION MEDIATES
LANGUAGE

Which Viewpoint Should We Endorse?

- ▶ According to contemporary research:
 - Children rely heavily on private speech when facing difficult problems
 - There is a correlation between “self-talk” and *competence*
 - Private speech does eventually become inner speech and facilitates cognitive development

Theories of Cognitive Development: Vygotsky vs. Piaget

Vygotsky's sociocultural theory	Piaget's cognitive developmental theory
Cognitive development varies across cultures	Cognitive development is mostly universal across cultures
Stems from social interactions	Stems from independent explorations
Social processes become individual-physiological processes	Individual (egocentric) processes become social processes
Adults are important as change agents	Peers are important as change agents

Learning drives
development



Lev Vygotsky

One must
develop before
One learns



Jean Piaget

173

LEV
VYGOTSKY



“WHAT A CHILD CAN DO IN
COOPERATION TODAY, HE
CAN DO ALONE TOMORROW”

**ANXIETY
ZONE** CAN'T DO
NOW

**LEARNING
ZONE** CAN DO
WITH HELP

**COMFORT
ZONE** CAN DO
NOW

