

# The development of children's concepts of invisibility

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**Abstract:** The current research aims to identify the concept of invisibility according to the variables of age (4, 5, 7) years and gender (males, females). The significance of differences in children's understanding of the concept of invisibility according to the variables of age (4, 5, 7) years and gender (males, females). The current research sample included (150) boys and girls from kindergartens and government schools in Wasit Governorate, aged (4, 5, 7) years, with (50) boys and girls for each age, equally divided between girls and boys. (Woolley, 2015) The researcher adopted Woolley's tool to measure the concept of concealment. The test consisted of (6) tasks. The first task consisted of (12) elements, each element had (6) questions. The second task was the sponge and rock task, which consisted of two questions. The third task was the apple and candle task, which consisted of two questions. The fourth task was the new entities task, which consisted of two elements, each element had two questions. The fifth task consisted of two questions, and the sixth and final task also consisted of two questions. The total test scores were (84), meaning that the highest score was (84) and the lowest score was (0). The researcher verified the psychometric properties of the test by extracting validity, as the reliability coefficient reached (0.76). The researcher used several statistical methods, and the research concluded that children at the age of (7) years have an understanding of the concept of concealment, and their understanding of the concept of concealment develops with age. There is no effect of gender on their understanding of the concept of concealment.

**Keywords:** development, Concepts of invisibility

## Introduction:

### Research Problem:

This research focuses on how children understand invisibility and how they manage the relationship between visibility and reality. Children do not understand the meaning of invisibility, but they do understand that things are invisible (such as illusions) and that entities exist but are invisible (such as air). Children often experience a mismatch between visibility and reality. Most characters in children's television programs are visible but do not exist in the real world. Germs, a common topic in conversations with children, are real but cannot be seen. Children under 5 years of age do not distinguish between invisible objects and absent humans based on their appearance. That is, children are not fully aware of the existence of an invisible being until age 5. Research by Bering and Parker (2006) indicates that children did not realize until age 7 that invisible beings could have communicative powers. (Bering & Parker, 2006, 253).

Youngsters between the ages of three and seven were told about Princess Alice, an invisible character who would use signals to interact with them during a game. Only the older children (7 years old) recognized the princess's communicative intentions when something unexpected occurred (for instance, a picture of Princess Alice fell from the wall while the kids were playing a game), even though half of the 5-year-olds thought the event was



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caused by the invisible object. Additionally, Bering and Parker found that between the ages of three and five, a child's capacity to define an invisible word coherently rises. (Harris et al., 2006, 76).

Berger examined the conceptions of unobservable (albeit not necessarily invisible) entities, whether actual or imagined, among children aged 4 to 8. Children were shown a variety of imagined (like Santa Claus) and actual (like germs) creatures, and their reality status was questioned. According to their findings, kids realized that while fictional things like monsters don't exist, invisible things like germs do. Harris and colleagues draw the conclusion that children's conceptions are greatly influenced by the kind of testimony they hear about these creatures because the visual evidence for both kinds of entities is the same (i.e., nonexistent). Though this study shows that children's perceptions of real and fictional unobservable things differ, it is still unknown how children perceive invisibility or the relationship between visibility and reality. (Harris et al., 2006, 9)

Youngsters frequently said that they had no idea what germs and oxygen looked like in relation to the actual entities employed in Harris and colleagues' investigation, indicating that they could think they are invisible. (Morison & Gardner, 1978, 48)

Parents do not believe that ghosts, monsters, mermaids, Santa, and the Tooth Fairy are all invisible. Additionally, it appears improbable that kids think they are invisible because only slightly more than half of the kids in the research said they recognized what these things looked like. Children were not expressly questioned about seeing entities, though. To put it briefly, it's unknown if children utilize seeing as a cue to reality. There is at least one important distinction between genuine and illusory unseen things, regardless of the kinds of testimony kids may hear about them: they are invisible for different reasons. There are various physical reasons (e.g., size) that make one unable to see most real, invisible objects with the naked eye. Because of this, through experience, technology, a change in state, or circumstances, one can see these entities. However, by definition, no amount of experience, technology, or change in state can enable one to see truly invisible illusory entities. The current research explores whether children understand these different meanings of invisibility. (Woolly, 1997, 68), Based on the above, we see that the problem of the current research is to understand the development of the concept of invisibility in children, given the research variables of gender and age, as well as the age at which children begin to recognize visual entities. Furthermore, there is no Arab or local study addressing this topic. The researcher posed several questions, including: Does the concept of invisibility develop in children, if it exists, with increasing chronological age? Does the concept of invisibility take a developmental path with age? If it does develop with age, does the development take a continuous or gradual form? Is there a difference in the development of this concept between males and females and by age?

#### **Significance of the Research:**

One of the most crucial phases of a person's life, childhood lays the groundwork for subsequent development. The distinction between reality and imagination is a significant and well researched ontological distinction that intersects with the idea of invisibility. Young children could readily mistake the absence of visual evidence for an unreal state because vision is frequently a marker of reality. At the same time, one needs to be able to distinguish between reality and imagination in order to comprehend that something invisible is actually real. Vision and reality are orthogonal from the standpoint of an adult. Youth might, however, have a harder time distinguishing between the two constructions. We don't sure how much youngsters can reason about the existence and visibility of phenomena like germs, mental states, and fairies, despite evidence showing that they have developed notions of these kinds of creatures. Young children struggle to think about two

conflicting ideas, according to research on the difference between fantasy and reality. (Flavell & Green, 1986, 51)

According to current research, children's comprehension of both distinctions significantly improves between the ages of three and seven. However, young children may find it especially difficult to perceive entities that are real but invisible or that are not real but visible because most of their experiences with the world include real and visible entities. According to Harris, Pasquini, Duke, Asher, and Pons (2006), youngsters pick up a lot of knowledge about other intangible scientific and cultural phenomena from other people's testimonies. Even though kids might hear about particular cases of invisibility (e.g., germs or angels) in this way, to fully understand the concept of invisibility, children must be able to separate appearance (or lack thereof) from reality. Without this ability, for instance, it seems incomprehensible why stars and planets persist throughout the day even if they are invisible. Therefore, a fundamental grasp of the difference between appearance and reality may be necessary to comprehend invisible things, Examining this connection is a secondary objective of current research. (Harris et al., 2006, 10)

At this point, researchers have investigated children's understanding of three categories of real, unseen entities: dissolved particles, germs, and mental processes. According to research by Wellman and colleagues, children have a thorough understanding of mental states, including thoughts, emotions, dreams, and imagination, by the time they are three years old. In particular, work by Wellman and Estes (Williamman & Estes, 1986, 57) has demonstrated that although while thoughts cannot be viewed in the same way as physical entities, youngsters are aware that humans have mental states. Others have demonstrated that toddlers can reason about cause and effect by the time they are four or five years old and comprehend the existence of germs and other unseen particles (like sugar dissolved in water). (Sidl & Rollins, 1993, 29), youngsters comprehend, for instance, that viruses can cause illness even if they are invisible and that sugar is still present in sugar water even though it is invisible once dissolved. These earlier research did not address children's conceptions of invisibility, despite the fact that this work offers important insights into children's thought processes. Our goal is to provide light on how kids perceive infections and other invisible things. There is little research on children's views of invisible, non-real entities because actual things are often visible in everyday life and children may expect reality and visibility to coexist. A kid may find it challenging to conceptualize something as both visible and unreal or invisible and real as a result. Therefore, investigating the connection between conceptions of imagination is a secondary goal. (Kalish, 1996, 11) and reality and children's understanding of invisibility.

#### **Research Objectives:**

1- The development of the concept of concealment according to the following variables:

**A- Age (4, 5, 7) years**

**B- Gender (males, females)**

2- The significance of the difference in the development of the concept of concealment according to the following variables:

**A- Age (4, 5, 7) years.**

**B- Gender (males, females).**

### **Research Limits:**

The current research is limited to studying the development of the concept of invisibility for children aged 4, 5, and 7 years old attending nurseries, kindergartens, and public schools in Wasit Governorate, specifically in the city of Kut, for the 2024-2025 academic year.

### **Definition of Terms:**

#### **First: Development**

- Alawneh (2004): It refers to a series of quantitative and qualitative changes, beginning with the formation of the fertilized egg and continuing until full maturation.

#### **Second: The Concept**

Piaget (1920): A mental procedure that is not derived directly from perceptual properties, but rather from actions on or through those objects (Piaget, 1920).

#### **Third: Child**

Zahran (2004): An individual who occupies the stage extending from (3-11) years, consisting of three stages: (3-5) years of early childhood, (6-8) years of middle childhood, and (9-11) years of late childhood (Zahran, 2005, 103).

#### **Fourth: Invisibility:**

The difference between the real and the imaginary, a significant and extensively researched ontological distinction, intersects with the idea of invisibility. Young children can readily mistake the absence of visual evidence for a sign of a fantasy state because visibility is frequently a sign of existence. At the same time, one must be able to distinguish between reality and fiction in order to comprehend that something that is invisible is actually real.

After the researcher reviewed a number of definitions, she found that the definition of Woolly and McInnis 2015 is the appropriate definition of concealment in this research, because it is consistent with the research tool, which is the Woolly and McInnis 2015 tool, and its compatibility with the adopted research theory, which is Piaget's theory (Woolly, McInnis, 2015).

### **Theoretical Framework**

#### **Invisibility:**

The main source of environmental information is visual input. It enables us to determine the color, shape, size, and many other characteristics of an object. Children learn the value of vision as a source of knowledge about the world from a young age. Most significantly, humans frequently utilize eyesight to verify presence. For example, if my child believes she has lost her teddy bear, seeing it under her bed will confirm its location and, more importantly, its existence. In a similar vein, if she claims that there is an alligator beneath her bed, I can disprove her claim by checking beneath her bed and informing her that nothing is there. However, presence is not a direct line of sight, and vision is not a reliable sign of presence. (Williamson et al., 2010)

Youngsters do not comprehend the concept of invisibility, but they do comprehend that certain things, like illusions, are invisible and that there are items that exist but are invisible, like air. Children frequently perceive a discrepancy between reality and vision. In children's television shows, the majority of characters are visible but nonexistent in real life. Although they are invisible, germs are a typical topic of discussion among kids. This study focuses on children's perceptions of invisibility and how they handle the connections between reality and visibility.

From other people's testimonials, children learn a great deal about other unobservable scientific and cultural phenomena. Children must be able to distinguish between reality and fiction in order to properly comprehend the notion of invisibility, even though they may hear about specific examples of invisibility (such germs or angels) in this fashion. Without this capacity, it would be unable to comprehend, for instance, that planets and stars exist throughout the day even though they are invisible at night. Therefore, a fundamental grasp of the difference between reality and fiction may be necessary to comprehend invisible beings.

### **Theories Explaining Hiddenness**

#### **Piaget's Theory:**

This theory is one of the first to track the development of knowledge in individuals in an organized manner. It is the theory that has received the most attention from researchers in psychology in general and developmental psychology in particular, due to the comprehensive and profound explanation it provides for the development of human knowledge. Piaget believed that humans develop cognitively through four stages: (the sensorimotor stage, the preoperational stage, the concrete operations stage, and the formal operations stage). The first stage is called the sensorimotor stage because children acquire and develop knowledge through actions associated with their senses. Children think with their eyes, ears, tongue, and hands, and this stage extends from birth to the age of two. The second stage is called the pre-operational stage. At this stage, the child's thinking is inflexible, lacks logical rules, and is restricted to one aspect of the situation they are dealing with. One of the most important determinants of a child's thinking is egocentric or animistic thinking. Egocentricity refers to children's inability to consider more than one point of view when interacting with others. They view events and things from their own perspectives and opinions. Piaget believes that egocentricity is primarily responsible for animistic thinking, as it refers to children's belief that inanimate objects have living properties, such as wishful thinking and feelings. Another determinant of thinking at this stage is the inability to retain, meaning that the physical characteristics of an object remain the same despite changes in its external appearance. Children focus on a single aspect, as their concepts are incomplete. The Operational Stage: This stage extends from 7 to 11 years. This stage is characterized by significant developments in the child's thinking, as they become more logical, organized, and flexible. They are able to distinguish between reality and imagination and provide logical reasons for changes occurring in the events and objects around them. Children at this stage are able to categorize objects into hierarchical categories, such as coins and stamps, and are able to mentally move through a series of steps and then reverse their approach to reach the starting point.

Older children have a good understanding of how objects occupy spaces or differing objects, and how they relate to other objects. By the age of seven, children demonstrate an understanding of perspective and how objects appear in different visual situations. It should be noted that preschool children do not consider variables such as the distance or angle from which they view an object, as their spatial concepts are still limited to a self-centered visual perspective.

## Axis Two: Previous Studies (Woolly and McLannis (2015))

### 1- Woolly and McLannis's study

Preschoolers were the subjects of this investigation. It sought to ascertain the age at which children start to distinguish between visible and invisible items as well as how children perceive disappearance. From a participant database, thirteen three-year-olds (8 females; mean age 42.8 months, range 35-49) seventeen five-year-olds (11 females; mean age 64.4 months, range 58-72 months, standard deviation 4.1 months), seventeen seven-year-olds (11 females; mean age 90. months, range 85-95 months, standard deviation 2.9 months). Eighty-three percent were white, eight percent Hispanic, four percent mixed-race, two percent Asian, and two percent did not identify their race. For a single 15-minute session, each youngster was seen separately. Children who participated in the lab interviews were given a small toy or T-shirt.

Each organization's name was printed on a separate laminated card for the entity tasks; entity photos were not included on the cards. The cards were organized using two cylindrical boxes, One had a "fake" label with a picture of a fish singing into a microphone, while the other had a "real" label with a picture of a cat. The stimuli for the warm-up task were two obviously genuine (such as a dog) or imagined (such as a dancing carrot). The stimuli for the test items varied in terms of reality status (real, unreal) and visibility (seen, unseen). Twelve test items were divided into four categories: visible-unreal (SpongeBob, mermaid, magic wand), invisible-unreal (ghost, imaginary friend, magic spell), invisible-real (germs, air, song), and visible-real (orange juice, teacher, bicycle). Two realistic-looking simulated objects were utilized as stimuli in the fantasy-reality tasks: an apple-shaped candle and a simulated rock composed of a soft, sponge-like substance. For the fantasy-reality job, a little hand puppet served as a warm-up, and questions concerning expertise and technology were answered using a microscope image. Children finished both the regular truth-reality task and the entity task. Kids were informed that they would play a game where they had to decide whether or not specific objects were real. Children were first given a warm-up task in which they could practice giving both answers. The children were asked, "This card says 'Dancing Dog/ Carrot.' Is the dancing dog/carrot real or imaginary?" The youngster was then instructed to put the card in the actual box after the experimenter verified or adjusted their response. Two more clear-cut entities were used in the experiment. The researcher took a card out of a bag for each test item and remarked, "This card says..." The kids were then given two questions concerning each item: one concerning visibility and the other concerning reality. These questions will be described in order. The children were asked, "Is this thing real or imaginary?" The child was then asked to place the card in the real square. These questions were then repeated on all the cards.

A score of 1 was given for a correct answer and 0 for an incorrect answer. That is, 1 was given for visible and real objects, and 0 for invisible and unreal objects.

### Research Methodology:

The current research aims to identify the development of children's concept of disappearance. In addition to identifying the trajectory of this concept, whether it takes a developmental path for the ages covered by it, and whether there is a difference between males and females in this concept. Accordingly, the researcher adopted a descriptive approach. This approach aims to determine the current state of the phenomenon, i.e., it relies on studying the phenomenon as it is in reality, describing objects, events, and incidents, and establishing facts, as it interprets and analyzes them (Hamdan, 1989, 66). (Kadhim et al., 2024).

The methodology of this research is defined as a cross-sectional study among the methods of studying growth, which focuses on studying samples consisting of different age groups in order to reveal the growth that has occurred due to the time factor (Attia, 2010, 173).

## **Second: Procedures**

### **Defining the population:**

The population of this research consists of children aged (4, 5, 7) years who are in kindergartens and first grade in the city of Kut, the center of Wasit Governorate, for the academic year 2024-2025. Their number is (12,113), distributed among (2,403) boys and girls in kindergartens, and (9,710) students in first grade, divided by gender, with (4,985) males and (4,725) females aged (7) years. As for kindergartens, (1,246) boys and (1,157) girls are distributed according to age: (1,193) at the age of (4) years, with (599) males and (594) females, and (1,210) at the age of (5) years, with (647) males and (563) females.

### **1- Selecting the Research Sample:**

The sample was selected from children aged 4, 5, and 7 years from kindergartens and government primary schools (first grade) affiliated with the Wasit Governorate Education Directorate in Kut, comprising 14 kindergartens and 10 primary schools. This was done to obtain sample members who met the research variables of child gender and age. The researcher followed the following procedures:

A- The sample was selected from children using a stratified random sampling method, by referring to the name lists and selecting the individual child's sequence. If the odd numbers did not complete the required number, the researcher returned to the even number sequence until she obtained the required sample size, taking into account the child's gender and age. This was to obtain a sample that included both boys and girls within the age ranges covered.

B- The researcher reviewed the children's records to obtain data and information for each child. If the child's information was not available, the researcher consulted the nursery and school administration or contacted the guardian.

The research sample included (150) children, both boys and girls, with (50) boys and girls aged (4) years, (50) boys and girls aged (5) years, and (50) boys and girls aged (7) years, representing ages (4, 5, and 7).

### **2- Research Tool:**

To achieve the research objective of measuring the concept of concealment, the researcher adopted the Woolley Tool (Woolley and McInnis, 2015). The researcher obtained the tool from Jacqueline Woolley, a specialist in research into the concept of concealment in children, and reviewed the tasks they completed after translating them into Arabic, their scoring methods, and the scoring method.

### **Tool Description:**

The research tool consists of six tasks. The first task is the familiar entities task, which consists of 12 items, each item consisting of six questions.

The second task is the sponge and rock task, which consists of two questions.

The third task is the apple and candle task, which consists of two questions. The fourth task is the new entities task, which consists of two elements, each with two questions.

The fifth task is the box task, which consists of two questions.

The sixth and final task is the bag task, which consists of two questions.

The visibility question received a score of 1 for right responses (i.e., "can be seen" for visible entities and "cannot be seen" for invisible entities) and 0 for incorrect responses.

#### **Answer sheet for the concept of invisibility tool:**

To achieve the research objective, the researcher prepared a sheet for the children's answers, recording the child's date of birth, gender, date of test administration, and time taken to complete the test.

#### **Statistical analysis of the items:**

The process of item analysis is defined as a study to evaluate its effectiveness through students' responses to each item individually (Alam, 1994: 123). (Kadhim et al., 20223)

The process of extracting the psychometric properties of these items aims to calculate their discriminatory power, difficulty level, and validity coefficients. My agencies:

#### **A - Item Difficulty Level:**

The difficulty factor refers to "the ratio of individuals who did not answer the item to the total number of individuals participating in the test" (Raja Abu Alam, 2010: 146).

To calculate the difficulty of the test items, the following steps were followed:

1- The youngest age group, (4 years), was chosen as the lower group, and the oldest age group, (7), was chosen as the upper group. Both groups included (100) boys and girls, with each group comprising (50) boys and girls.

2- The number of children who answered incorrectly in each of the upper and lower groups for each item of the test was extracted.

3- Collect the incorrect answers of the two groups and divide them by the total number of groups, using the equation for the difficulty of the objective questions. I found that the difficulty ranged between (0.16) and (0.5466), as the test items are considered acceptable if their difficulty rate is between (0.20-0.80) (Ayal, 2018: 198). This means that all items are acceptable and valid for application, as Table (1) show it.

**Table 1: Statistical analysis of the items**

| Sequence of paragraphs | Number of answers for the upper group |       | Hold the answers to the lower group |       | Number of correct answers for both groups | Wrong answers for both groups | Ease factor | Difficulty factor | Discrimination coefficient |
|------------------------|---------------------------------------|-------|-------------------------------------|-------|---|-------------------------------|-------------|-------------------|----------------------------|
|                        | The correct one                       | wrong | The correct one                     | wrong |   |                               |             |                   |                            |
| 1                      | 42                                    | 8     | 3                                   | 47    | 45  | 55                            | 0.76667     | 0.23333           | 0.78                       |
| 2                      | 42                                    | 8     | 6                                   | 44    | 48  | 52                            | 0.75333     | 0.24667           | 0.72                       |
| 3                      | 42                                    | 8     | 5                                   | 45    | 47  | 53                            | 0.75333     | 0.24667           | 0.74                       |
| 4                      | 43                                    | 7     | 7                                   | 43    | 50  | 50                            | 0.77333     | 0.22667           | 0.72                       |
| 5                      | 45                                    | 5     | 8                                   | 42    | 53  | 47                            | 0.77333     | 0.22667           | 0.7                        |
| 6                      | 43                                    | 7     | 11                                  | 39    | 54  | 46                            | 0.81333     | 0.28667           | 0.68                       |
| 7                      | 44                                    | 6     | 10                                  | 40    | 54  | 46                            | 0.79333     | 0.20667           | 0.66                       |
| 8                      | 44                                    | 6     | 7                                   | 43    | 51  | 49                            | 0.78        | 0.22              | 0.74                       |
| 9                      | 42                                    | 8     | 8                                   | 42    | 50  | 50                            | 0.80667     | 0.29333           | 0.68                       |
| 10                     | 46                                    | 4     | 4                                   | 46    | 50  | 50                            | 0.76667     | 0.23333           | 0.7                        |
| 11                     | 44                                    | 6     | 9                                   | 41    | 53  | 47                            | 0.78        | 0.22              | 0.76                       |
| 12                     | 45                                    | 5     | 6                                   | 44    | 51  | 49                            | 0.76        | 0.24              | 0.8                        |
| 13                     | 47                                    | 3     | 9                                   | 41    | 56  | 44                            | 0.80667     | 0.29333           | 0.72                       |
| 14                     | 48                                    | 2     | 6                                   | 44    | 54  | 46                            | 0.78        | 0.22              | 0.82                       |
| 15                     | 47                                    | 3     | 8                                   | 42    | 55  | 45                            | 0.82667     | 0.27333           | 0.78                       |
| 16                     | 48                                    | 2     | 4                                   | 46    | 52  | 48                            | 0.8         | 0.2               | 0.82                       |
| 17                     | 47                                    | 3     | 5                                   | 45    | 52  | 48                            | 0.79333     | 0.20667           | 0.76                       |
| 18                     | 46                                    | 4     | 5                                   | 45    | 51  | 49                            | 0.77333     | 0.22667           | 0.86                       |
| 19                     | 48                                    | 2     | 5                                   | 45    | 53  | 47                            | 0.78        | 0.22              | 0.82                       |
| 20                     | 43                                    | 7     | 6                                   | 44    | 49  | 51                            | 0.8         | 0.2               | 0.86                       |
| 21                     | 48                                    | 2     | 4                                   | 46    | 52  | 48                            | 0.76        | 0.24              | 0.76                       |
| 22                     | 46                                    | 4     | 7                                   | 43    | 53  | 47                            | 0.82        | 0.2099            | 0.84                       |
| 23                     | 44                                    | 6     | 8                                   | 42    | 52  | 48                            | 0.78667     | 0.21333           | 0.84                       |
| 24                     | 44                                    | 6     | 11                                  | 39    | 55  | 45                            | 0.76        | 0.24              | 0.74                       |
| 25                     | 43                                    | 7     | 7                                   | 43    | 50  | 50                            | 0.79333     | 0.20667           | 0.72                       |

**B - Discriminatory power of the items:**

The items' discriminatory power is the ability of the items to distinguish between the upper and lower groups, or the individual differences between children who possess the trait or know the answer and those who do not possess the measured trait or do not know the correct answer to each test item. (Ramesh et al., 2022), (Al-Dulaimi and Adnan, 2005: 66).

In order to extract the discrimination coefficient, the current study used the two extreme groups' technique, dividing the number of right answers in each group (higher and lower) by the number in one of the two groups. The range of its value is (+1) to (-1). The discriminating power is positive if the difference is positive and negative if the converse is true. There is no prejudice if the two groups are equal. The paragraph with high positive discrimination is preferred. The discriminating power is inversely related to the difficulty of the paragraph in terms of extremism. The more difficult or easy the paragraphs are, the weaker their discrimination, (Tayyeh et al.,2025), (Awda, 1998: 129). Abel divided the paragraphs according to discrimination as follows:

Using items with a discriminating power larger than (0.30), the researcher used the previously indicated Abel criterion as a reference to get the discrimination coefficient. She determined that each arithmetic test item's discriminating power was between 0.78 and 0.98, indicating that the test items are deemed good and their discrimination coefficient is acceptable. Table (2) show it.

**Table 2: Difficulty coefficients and discriminating power of the test items**

| Paragraph Evaluation   | Discrimination Coefficient |
|--|----------------------------|
| Very Good Paragraph  | or more – 0,40             |
| Good Paragraphs, but may be subject to revision                  | 0,39 – 0,30                |
| Borderline Paragraphs that usually need revision and improvement | 0,29 – 0,20                |
| Weak Paragraphs, to be deleted or improved                       | or less – 0,19             |

**The Relationship of the Item Score to the Total Score of the Deductive Knowledge Comprehension Test:**

This method is one of the most accurate known methods for calculating the internal consistency of items in measuring concepts. It means that each item follows the same path as the test as a whole (Essawi, 1985: 51). The Point-Biserial Correlation Coefficient Formula was then used to calculate the correlation between the total (continuous) test score of (150) boys and girls, and the (discontinuous) binary score for each item. It became clear that all the correlation coefficients were statistically significant when compared to the critical value of (0.161) at a significance level of (0.05) and with a degree of freedom of (148). Table (3) illustrates this.

**Table 3: Correlation Coefficients (Point-Biserial) Between the Item Score and the Total**

| Correlation Coefficient | T  | Correlation Coefficient | T  | Correlation Coefficient | T  | Correlation Coefficient | T  |
|-------------------------|----|-------------------------|----|-------------------------|----|-------------------------|----|
| 0.337                   | 64 | 0.385                   | 43 | 0.437                   | 22 | 0.374                   | 1  |
| 0.337                   | 65 | 0.409                   | 44 | 0.467                   | 23 | 0.441                   | 2  |
| 0.436                   | 66 | 0.395                   | 45 | 0.384                   | 24 | 0.398                   | 3  |
| 0.348                   | 67 | 0.473                   | 46 | 0.501                   | 25 | 0.456                   | 4  |
| 0.412                   | 68 | 0.374                   | 47 | 0.342                   | 26 | 0.439                   | 5  |
| 0.385                   | 69 | 0.441                   | 48 | 0.416                   | 27 | 0.321                   | 6  |
| 0.409                   | 70 | 0.398                   | 49 | 0.337                   | 28 | 0.393                   | 7  |
| 0.395                   | 71 | 0.456                   | 50 | 0.337                   | 29 | 0.415                   | 8  |
| 0.473                   | 72 | 0.415                   | 51 | 0.436                   | 30 | 0.467                   | 9  |
| 0.374                   | 73 | 0.467                   | 52 | 0.348                   | 31 | 0.384                   | 10 |
| 0.441                   | 74 | 0.384                   | 53 | 0.412                   | 32 | 0.501                   | 11 |
| 0.374                   | 75 | 0.501                   | 54 | 0.385                   | 33 | 0.342                   | 12 |
| 0.441                   | 76 | 0.342                   | 55 | 0.409                   | 34 | 0.416                   | 13 |
| 0.398                   | 77 | 0.416                   | 56 | 0.395                   | 35 | 0.337                   | 14 |
| 0.456                   | 78 | 0.337                   | 57 | 0.473                   | 36 | 0.436                   | 15 |
| 0.439                   | 79 | 0.436                   | 58 | 0.374                   | 37 | 0.348                   | 16 |
| 0.321                   | 80 | 0.321                   | 59 | 0.441                   | 38 | 0.412                   | 17 |
| 0.393                   | 81 | 0.393                   | 60 | 0.398                   | 39 | 0.385                   | 18 |
| 0.415                   | 82 | 0.374                   | 61 | 0.456                   | 40 | 0.409                   | 19 |
| 0.467                   | 83 | 0.441                   | 62 | 0.439                   | 42 | 0.395                   | 20 |
| 0.384                   | 84 | 0.473                   | 63 | 0.321                   | 42 | 0.473                   | 21 |

### **Psychometric Properties of the Concept of Invisibility:**

These properties are among the important standard properties of the scale, which scholars have emphasized in terms of validity and reliability. They have been verified as follows:

**Test validity:** That is, the test achieves what it was designed to achieve (Awda, 1998, 335). Those concerned have referred to the various methods for calculating and estimating validity. The researcher extracted validity for the concept of invisibility scale as follows:

1- Apparent validity: What is meant by apparent validity is the test's ability to measure what it was designed to measure. This procedure is carried out by distributing the test to a group of experts in order to determine what the test measures. The researcher distributed the test in the form of a picture to a group of experts (Ayal: 2018, 95), numbering (10) experts in the field of developmental psychology, measurement, and evaluation. To achieve descriptive validity for the test, the researcher relied on the chi-square test for goodness of fit to determine the experts' agreement on the items. All items were significant at the level of (0.05)

2- Hypothetical construct validity: This is one of the most representative types of validity. Anastasi indicated that the correlation coefficient between the score of each item and the total score of the test is an indicator of the validity and construct of the test. It refers to the degree to which the test addresses a specific characteristic or theoretical construct. This validity is achieved through the following:

- By finding the discriminating power and difficulty coefficient of the test items using the upper and lower sets method, which showed that all test items were within the acceptable range of difficulty and discrimination.
- This validity was also achieved by finding the relationship between the score of each item of the test and the total score of the test using a correlation coefficient (point-wise).

### **3- Reliability:**

The test's reliability was calculated using Cronbach's alpha as follows:

The internal consistency method (Cronbach's alpha) was used to calculate the scale's reliability coefficient using internal consistency. The internal consistency sample was (60), a statistical method that demonstrates the correlation between items and measures internal consistency. The reliability coefficient extracted using this method was (0.768), which indicates the test's reliability.

### **Statistical Methods:**

Several statistical methods were used as follows:

#### **First: The SPSS statistical package was used**

- 1- T-test for one sample.
- 2- Two-way analysis of variance with interaction.
- 3- Cronbach's Alpha Method for Reliability

1. Two-way ANOVA with Interaction: Used to identify differences according to the variables (age and gender).

**Second: Microsoft Office Excel 2010 to extract:**

1. Objective Item Difficulty and Ease Coefficient: Used to find the ease and difficulty of the test items.

$$Mg\ S\ A + Mg\ S\ D$$

$$\text{Ease} =$$

$$(H + D)$$

Mg S A = Total Correct Answers in the Upper Group.

Mg S D = Total Correct Answers in the Lower Group.

N = Number of Members in the Upper Group.

D = Number of Members in the Lower Group

2. Difficulty = 1 - Ease Coefficient

3. Objective Item Discrimination Equation: Used to find the discrimination of the test items: Mg S A - Mg S D

$$\text{Discrimination} = \frac{1}{2} (H + D)$$

Mg S A = Total Correct Answers in the Upper Group.

Mg S D = Total Correct Answers in the Lower Group.

N = Number of Members in the Upper Group.

D = number of individuals in the lower group. (Al-Imam et al., 1990, p. 115).

**Third: Point correlation coefficient Beiseraal**

Used to verify the internal consistency of the test, i.e., to calculate the correlation coefficient between the item score and the total test score.

$$\bar{S}_1 - \bar{S}_0$$

$$R_{dD} = \frac{\sum L K}{S C}$$

$$S C$$

Where:-

S1: The arithmetic mean of the individuals' scores for correct answers.

S: The arithmetic mean of the individuals' scores for incorrect answers.

S C: The standard deviation of the scores of all individuals.

L: The percentage of individuals who answered the item correctly.

K: The percentage of individuals who answered the item incorrectly.

(Awda and Al-Khalili, 1998: 154)

**Presentation, Interpretation, and Discussion of Results:**

The findings of the current study are presented in this chapter in compliance with the stated goals. It analyzes and examines them in the context of the researcher's theoretical framework, prior research, and the traits of the contemporary research community. It then formulates a series of suggestions and ideas, which are as follows:

First Objective: To identify the development of the concept of invisibility among children according to the variables of (age and gender).

A-Age (4, 5, 7) years

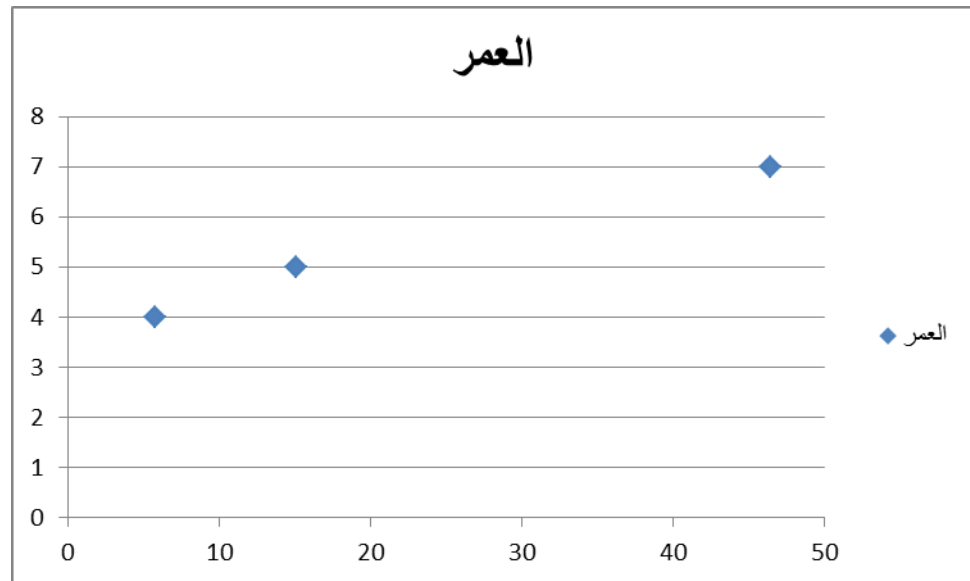
To achieve this objective, the researcher applied the concept of invisibility test, which consisted of (84) items, to the research sample of (150) boys and girls. The arithmetic mean and standard deviation were extracted for each age. When determining the significance of the difference between the arithmetic means and the hypothetical mean, the results were as shown in Table (4) and Figure (1).

Average scores of the invisibility test, their standard deviations, calculated and tabulated t-values, and their significance levels according to age

**Table 4: Presentation, Interpretation, and Discussion of Results**

| Significance Level 0.05            | Second Value |            | Theoretical Mean | Standard Deviation | Arithmetic Mean | Number | Age in Years |
|------------------------------------|--------------|------------|------------------|--------------------|-----------------|--------|--------------|
|                                    | Tabular      | Calculated |                  |                    |                 |        |              |
| Significant in favor of hypothesis | 2,021        | 20.432     | 42               | 2.319904           | 5.77381         | 50     | 4 Years      |
| Not Significant                    | 2,021        | 22.459     | 42               | 1.864108           | 15.08333        | 50     | 5 Years      |
| Significant                        | 2,021        | 22.760     | 42               | 2.240297           | 46.42857        | 50     | 7 Years      |

**Figur 1: Presentation, Interpretation, and Discussion of Results**



**The table and figure above reveal the following:**

1. The research sample, age 4, had a weak understanding of the concept of missingness, as the calculated t-value of 20.432 was statistically significant in favor of the hypothetical mean, being larger than the tabular value of 2.021 at a significance level of 0.05 and a degree of freedom of 49. This means that the sample mean was smaller than the hypothetical mean.
2. The research sample, age 5, had a strong understanding of the concept of missingness, as the calculated t-value of 22.459 was statistically significant, being larger than the tabular value of 2.021 at a significance level of 0.05 and a degree of freedom of 49. This means that the sample mean was close to the hypothetical mean, and there was no statistically significant difference between them.
- 3- The research sample (aged 7) had a high understanding of the concept of disappearance, as the calculated t-value of (12.694) was statistically significant in favor of the sample mean, being greater than the tabular value of (22.760) at a significance level of (0.05) and a degree of freedom of (49). This means that the sample mean was greater than the hypothetical mean.

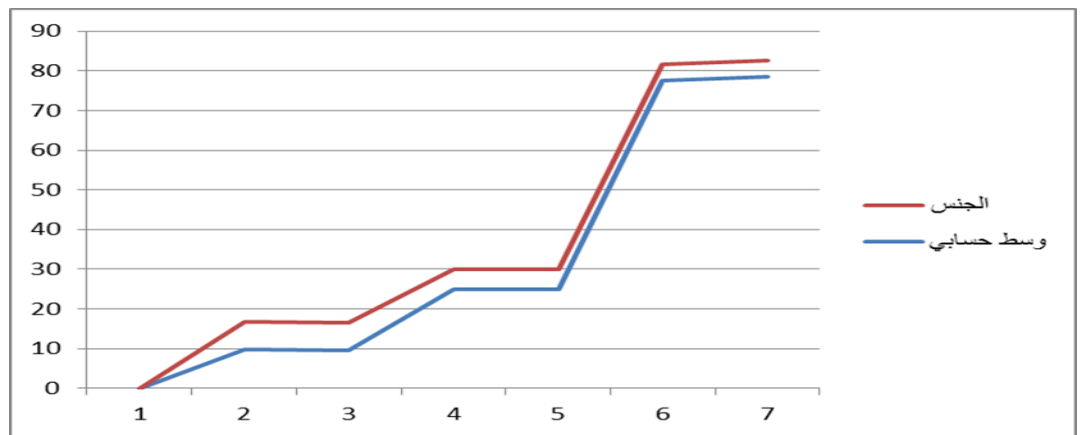
**B - According to gender (males, females)**

After the researcher extracted the results by age, she extracted the arithmetic mean and standard deviation for both males and females and for each age group. When determining the significance of the difference between the arithmetic means and the hypothetical mean for both males and females, the results were as shown in Table (5) and Figure (2).

**Table 5: Average scores for understanding disappearance, their standard deviations, calculated and tabular t-values, and their significance level according to the gender variable**

| Significance Level (0.05)              | T-value |            | Hypothesized mean | Standard deviation | Arithmetic mean | Gender | Number | Age in years |
|--|---------|------------|-------------------|--------------------|-----------------|--------|--------|--------------|
|  | Tabular | Calculated |                   |                    |                 |        |        |              |
| Significant in favor of the hypothesis | 2.064   | 8.450      | 42                | 3.647              | 9.791           | ذكور   | 25     | 4 Years      |
| Significant in favor of the hypothesis | 2.064   | 9.007      | 42                | 3.430              | 9.615           | اناث   | 25     |              |
| Not Significant                        | 2.064   | 0.555      | 42                | 5.965              | 25.8            | ذكور   | 25     | 5 Years      |
| Not Significant                        | 2.064   | 1.616      | 42                | 10.104             | 24.88           | اناث   | 25     |              |
| Significant                            | 2.064   | 5.569      | 42                | 2.518              | 77.52           | ذكور   | 25     | 7 Years      |
| Significant                            | 2.064   | 4.440      | 42                | 2.256841           | 78.48           | اناث   | 25     |              |

**Figur 2: Average scores for understanding disappearance, their standard deviations, calculated and tabular t-values, and their significance level according to the gender variable**



The table and figure above reveal the following:

1. The 4-year-old male and female research sample had a weak understanding of the concept of missingness, as the calculated t-values were statistically significant in favor of the hypothetical mean, being larger than the tabular value of 2,093 at a significance level of 0.05 and a degree of freedom of 24. This means that the mean for males and females was smaller than the hypothetical mean.
2. The 5-year-old male and female research sample had a weak understanding of the concept, as the calculated t-values were not statistically significant, being smaller than the tabular value of 2,093 at a significance level of 0.05 and a degree of freedom of 24. This means that the mean for males and females was close to the hypothetical mean, and there was no statistically significant difference between them.

3. The research sample, aged (7 years), both males and females, had a high understanding of inferential knowledge, as the calculated t-values were statistically significant in favor of the sample mean, being greater than the tabular value of (2.093) at a significance level of (0.05) and a degree of freedom of (24). This means that the mean for males and females was greater than the hypothetical mean.

**Second Objective:** To identify the significance of statistical differences in the concept of disappearance among children according to the variables of age (4-5-7) years and gender (males, females).

After the test was administered in its final form to the research sample, numbering (150) male and female children, and after statistically processing the data, to achieve this objective, the researcher extracted the average scores of the sample members on the test for ages (4-5-7) years, and for gender (males and females). To confirm the differences between the age and gender groups, the researcher used a two-way analysis of variance (ANOVA) test with interaction, and the results were shown in Table (6).

**Table 6: Results of the two-way analysis of variance with interaction to identify statistically significant differences in the disappearance test among the research sample according to the variables (age and gender)**

| Significance ((0.05 | Percentage | Mean Squares | Degrees of Freedom | Sum of Squares | Source of Variance |
|---------------------|------------|--------------|--------------------|----------------|--------------------|
| Significant         | 81.04      | 987549       | 2                  | 3727,883       | Age                |
| Not Significant     | 0,876      | 8,908        | 1                  | 7,210          | Gender             |
| Not Significant     | 0,060      | 0,657        | 4                  | 4,283          | *Age Gender        |
|                     |            | 11,730       | 148                | 5281,500       | Error              |
|                     |            |              | 149                | 7163,509       | Total              |

**The results of the two-way analysis of variance revealed the following data:**

a) Age: The calculated F-value (81.04) was found to be greater than the tabulated F-value (2.21) at a significance level of (0.05) and two degrees of freedom (2,148), indicating the presence of statistically significant differences depending on the age variable. To determine the significance of the differences in favor of any age, the Scheffe test was used for post-hoc comparisons, and the results appeared as shown in Table (7).

**Table 7: Scheffe values for post-hoc comparisons of differences between ages**

| Ages                           | years 4 | years 5 | years 7 |
|--------------------------------|---------|---------|---------|
| years 4                        | –       | –       | –       |
| years 5                        | 3,625   | 1,244   | –       |
| years 7                        | 4,875   | 2,474   | 1,250   |
| Scheffe Critical Value (2.203) |         |         |         |

The table above shows that there are differences based on age, in favor of older people. This means that the understanding of the concept of disappearance continues to evolve with age, as shown in Figure (1).

b) Gender variable: The calculated p-value (0.606) for the gender variable is smaller than the tabular p-value (3.84) at a significance level of (0.05) and two degrees of freedom (1.148), indicating that there are no statistically significant differences based on the gender variable.

c) Age \* Gender: The calculated p-value (0.062) for the interaction between (age \* gender) is smaller than the tabular p-value (2.21) at a significance level of (0.05) and two degrees of freedom (4.148), indicating that there are no statistically significant differences based on the interaction between age and gender. Interpretation and Discussion of Results:

The current research aimed to identify the development of the concept of invisibility in children, with the aim of determining the age at which children understand this phenomenon, the nature of the developmental process, and the impact of gender on this development. The following is an interpretation of the research results according to the established objectives and theoretical framework, and a discussion of them in light of previous studies.

**First Objective:**

The results of the current research showed that children aged (7) years have a good understanding of the concept of invisibility. These results are consistent with the findings of Jacqueline Woolley and Melissa McInnes (2015), who assert that children aged (7) years have a good understanding of the concept of invisibility. These results differ from the study by Bering and Parker (2006), who believe that children aged (3, 5) years can provide a coherent definition of the word "invisible." There are three types of real, invisible entities: mental states, germs, and particles dissolved in water. Seven-year-old children understand a great deal about mental states and invisible entities.

**Second Objective:**

The results of the current research showed that the concept of invisibility takes a continuous developmental trajectory in children, meaning that this variable develops with age. These results are consistent with the Woolley and McInnis model, which suggests that the concept of invisibility develops continuously as the child ages. The results of the current research revealed no statistically significant differences between males and females in the development of the concept of invisibility, as shown in Table (5).

### **Conclusions:**

In light of the findings of this research, the researcher can conclude the following:

1. Children's understanding of the concept of invisibility is an indicator of their ability to distinguish between imagination or invisible objects and reality.
2. Children's understanding of this concept is an indicator of the development of their theory of mind abilities.
3. According to our findings, children's conceptions of invisibility deepen as they become older since presence is not a direct line of sight and sight is not a reliable predictor of presence. In the real world, there are things and occasions that we can feel but cannot see.
- 4- The investigator thinks that this expanding comprehension of the idea of invisibility is probably influenced by early scientific instruction regarding these particular entities.

### **Recommendations:**

- 1- Engage children in games that develop their mental abilities, especially hide-and-seek, to realize that vision is not the basis of existence.
- 2- Develop their reading and writing skills and encourage exploration of new topics.
- 3- Engage them in artistic and sports activities and provide a supportive environment.

### **Suggestions:**

The researcher suggested conducting other studies, such as:

- 1- Dragons and dinosaurs: children's ability to distinguish between reality and reality.
- 2- The development of preschool children's concept of dissolved particles.
- 3- Thinking about imagination: Are children fundamentally different from adults as thinkers?
- 4- The development of preschool children's understanding of germs as invisible mechanisms.

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