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## Identifying Change Blindness Among University Students

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### Abstract

*The present study aims to investigate the level of change blindness among university students. The sample consisted of 400 male and female students from the University of Baghdad across various academic disciplines. A change blindness test was administered to the participants. The results revealed the presence of change blindness among the students, with no statistically significant differences observed between males and females or between students of scientific and humanities disciplines.*

**Keywords:** Change Blindness, Attentional Blink, Inattentional Blindness, Eye Movements, Mud Splashes, Transient State, Veridical Representation.

### Introduction

The phenomenon of *change blindness* was discovered unintentionally while exploring other areas of visual cognition, particularly eye movements. This occurred when Phillips (1950) studied visual memory by asking participants to perform different or similar tasks on a matrix filled with dots, followed by another matrix that was either identical or differed by a single dot. Although individuals exhibited strong memory in recognizing whether a change had occurred, they were notably poor at recalling precise visual details. When presented with a complex visual stimulus, people tend to retain only the general essence of the image rather than its entirety.

Over the past decade, the phenomenon of change blindness has garnered significant scholarly attention. Change blindness refers to the observer's failure to notice substantial alterations in objects or scenes when these changes coincide with a brief visual disruption. Despite becoming a focal topic in visual cognition research in recent years, this phenomenon was actually documented in empirical literature over fifty years ago, with theoretical conclusions aligning with the form of change blindness first identified in 1950.

The concept of change blindness has, in fact, been discussed for decades. For instance, in the 19th century, filmmakers began to observe its occurrence when they introduced cuts and edits in films. Editors noted that background changes often went unnoticed by viewers—an early practical recognition of this intriguing cognitive limitation.

### The Present Study Aimed to:

1. Measure change blindness among university students.
2. Identify statistically significant differences in change blindness according to gender and

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The target population of the present study consists of university students. A random sample was selected from the University of Baghdad, comprising 200 students from humanities majors and 200 students from scientific majors, making a total sample size of 400 students.

To achieve the study's objectives, a *change blindness test* was constructed based on the definition provided by Rensink (2001), drawing on the *coherence theory* and the *snapshot model*. The test consisted of 11 video clips, each showing sequences where a visual change occurred after a one-second interval. Participants were instructed to identify whether a change had occurred between the first and second frame in order to assess the speed of change detection. Additionally, participants were asked to specify the number and type of changes observed. The test was designed after reviewing several experimental studies in the field.

Following the presentation of the 11 videos, *face validity* was established through expert review. The test's *discriminatory power* and *internal consistency* were also assessed. *Reliability* was calculated using both the *split-half method* and the *test-retest method*, yielding a reliability coefficient of 0.73 in both approaches. Upon confirming the validity and reliability of the test, it was administered to the sample of 400 students. The results were as follows:

1. The sample exhibited evidence of change blindness.
2. There were no statistically significant differences in change blindness based on gender (male–female) or academic specialization (scientific–humanities).

### **Chapter One: Research Problem**

When we perceive scenes in real-life environments, we often experience the illusion that we possess rich and detailed visual representations of the external world. However, when stimuli within our visual field change, these changes are typically accompanied by motion cues or other transient events that automatically redirect attention, thereby facilitating the detection of change. Despite this, observers often encounter difficulty in detecting such changes. Humans tend to believe that they see the world in its entirety. Yet, in cases of *change blindness*—which is defined as the failure to detect salient changes from one moment to another—this belief is challenged, revealing discrepancies in memory storage. Objects can undergo significant changes without observers noticing, and this blindness is not due to an inability to see the change, as it becomes clearly visible once identified.

The brain requires time to transfer iconic images from the sensory visual register to long-term storage. If visual cues are not presented rapidly, or if pre-change images are not overlaid, there is ample time for storing these images in working memory. In such cases, change blindness tends to be weaker among individuals.

Through her academic and field work, the researcher noticed that students often fail to attend to sudden changes. This might be due to reduced attention or limited visual perception, and possibly, the presence of change blindness. Therefore, the researcher decided to investigate whether students exhibit change blindness, and whether there are differences in this phenomenon based on gender or academic specialization.

### **Significance of the Study**

Laboratory-based studies on change blindness began in the 1970s when McConkie conducted the first investigations involving textual changes, which were introduced during saccadic eye

movements. Observers often failed to detect these changes. By the late 1980s, compelling experimental evidence demonstrated a considerable failure to detect changes in complex images. For example, *Pashler (1988)* revealed that participants were poor at detecting changes in letter matrices when a brief flicker was introduced between the image sequences.

From the 1990s to 2000, as computing capabilities advanced, allowing for the presentation of high-resolution and complex images, *McConkie* initiated a research program at the Beckman Institute to explore why the world appears visually stable despite frequent changes in retinal input due to eye movements. This line of research began with *Grimes et al. (1996)*, who used real photographic images to study visual stability. This advancement enabled researchers to investigate change blindness in more realistic settings. Their findings indicated that large changes may go unnoticed when they occur during saccades or brief interruptions. Other studies concluded that changes are more likely to be detected when gaze is fixated on the area of change (*Rensink, O'Regan, & Clark, 1999*). These findings underscored the practical importance of change blindness research and marked the initial steps toward applied implementations of the phenomenon.

Further work by *Rensink, O'Regan, and Clark (1999)* demonstrated that change blindness can persist even when the eyes are fixated on the scene. Their experiments involved presenting an image followed by a blank screen or a masking stimulus, which was then followed by either the original or a modified version of the image. The masking stimulus acted similarly to a blink, contributing critically to change blindness research by proving that even minimal disruptions could obscure noticeable changes.

From 2010 onward, studies have shown that change detection tasks become easier when the stimuli are more meaningful or familiar—such as human faces. Participants tend to identify changes more rapidly when instructed to detect facial feature modifications compared to changes in inanimate objects like houses. Other researchers discovered that mental processing related to change blindness begins even before the change is introduced. Increased brain activity in the occipital and parieto-occipital regions has been recorded prior to the onset of changes in change blindness tasks (*Salunke, 2015, pp. 2–54*).

### **Research Objectives**

The current study aims to investigate the following:

1. The presence of change blindness among university students.
2. Change blindness in relation to gender (male–female) and academic specialization (scientific–humanities).

### **Research Delimitations**

This study is limited to students of the University of Baghdad, including both genders (male and female) and both fields of specialization (scientific and humanities), for the academic year 2024–2025.

### **Definition of Terms**

According to *Ron Rensink (1990)*, change blindness is defined as “the difficulty an individual experiences in detecting that something has changed in a scene or subject” (*Schoenlein, 2017, p. 22*).

## **Chapter Two**

A review of the literature reveals that Simons (2001) proposed five explanations for the phenomenon of change blindness. These are:

### **1. Overwrite Hypothesis:**

One of the most widely accepted and prevalent explanations for change blindness is the overwrite hypothesis. According to this model, the initial visual representation is overwritten by a neutral blank interval or by the subsequent image. Overwrite models have been used to explain visual masking and the poor recognition of scenes. Information not extracted from the initial display is replaced by the new scene representation. When new visual information is presented in succession, it is often easily substituted for the older information, leaving only what was extracted from the initial display. Successful detection of change occurs only for objects to which attention has been directed.

### **2. First Impressions:**

An alternative hypothesis suggests that observers initially encode the features of objects and scenes accurately but subsequently fail to encode the details of the changing scene (often reflecting a current perceptual state). Although this explanation may seem counterintuitive in certain cases, it may be more acceptable than the overwrite hypothesis in the context of change detection tasks. A primary goal of perception is to understand the meaning and relevance of our surroundings. Numerous findings indicate that we can achieve this goal rapidly, and it is one of the first actions we take upon encountering a new scene. If the goal of perception is to extract meaning from a scene, then the details become irrelevant as long as the overall interpretation remains unchanged. If we have encoded the initial features of a scene to grasp its meaning, there may be no need to re-examine those features, particularly if the meaning remains consistent despite the change.

### **3. Nothing Is Stored:**

Simons argued that nothing from the visual world is stored internally, and only the information extracted from sensory input is retained momentarily. If the details of the first image are not represented in visual memory, then detecting any change becomes impossible.

### **4. Everything Is Stored but Not Compared:**

This explanation suggests that individuals may form representations of each image separately without recognizing the differences between them. In other words, the visual-cognitive system may assume that images are consistent unless there is something about the scene's meaning that prompts a comparison. Observers may fail to detect changes even if they have encoded all the relevant details.

### **5. Feature Combination:**

Certain features or objects may be retained from the first view and others from the second (Simons, 2000, pp. 8–10).

## **Models of Change Blindness**

### **1. Single-shot Model:**

Proposed by Ronald Rensink in the late 1990s, this model involves presenting an image briefly,

followed by a short blank screen, then a second display. The observer perceives alternating displays with brief intervals in between. The task is to detect (identify) the change, and performance is measured by the accuracy of the response, i.e., the successful identification of the change.

## 2. **Flicker Paradigm:**

Also developed by Rensink, in this model, a blank screen—typically black—is inserted between two alternating images. After the second (altered) image appears, participants are asked to indicate what changed. Performance is measured by response time.

## 3. **Stage Model by Tovey & Herdman (2014):**

A common critique of studies examining the effect of familiarity on change detection involves overall visual complexity associated with the area of change, which was not controlled across familiar and unfamiliar conditions. The most straightforward manipulation of stimulus familiarity was conducted by Tovey and Herdman in a series of experiments using the flicker paradigm. Participants were tasked with detecting changes in arrays of familiar and unfamiliar letters, where manipulations included size, orientation, and stimulus clarity (clear vs. unclear). Across all experiments, participants were quicker at detecting changes in familiar letters than unfamiliar ones. Stimulus clarity interacted with orientation and size, and size interacted with both change type and familiarity.

## **Theories Explaining Change Blindness**

### **First : Sensorimotor Theory of Vision and Visual Awareness:**

This section focuses on the phenomenon of change blindness—a condition where observers surprisingly fail to notice substantial changes even when actively searching for them. Proponents of the sensorimotor theory argue that change blindness results directly from the claim that the world functions as an external memory store. Much of the early work on change blindness derived from studies on visual integration, especially in the context of reading. For instance, McConkie and Zola demonstrated that observers often failed to notice changing letters on a screen during eye blinks.

Change detection, according to this view, depends on implicit beliefs about one's ability to detect changes, the accuracy of internal representations, or the expectation that significant or rare events will capture attention. However, successful change detection may be largely driven by transient movements that redirect attention toward the environment itself.

Sensorimotor theory posits that internal memory is needed moment-to-moment, as the likelihood of detection depends on the ability to observe environmental changes. If an observer relies solely on the external world for memory, this will likely prevent them from noticing changes that occur during blinks. Accordingly, change blindness aligns with the idea that we lack detailed internal representations. In the absence of such representations, change blindness is inevitable. Still, the existence of change blindness does not logically necessitate the absence of representations—observers might encode both the original and changed scenes but simply fail to compare them directly.

Thus, change blindness does not provide conclusive evidence about the presence or absence of internal representations. Even if such representations exist, they may not be consciously accessed to detect differences. Accepting the idea of the external memory system implies

rejecting other aspects of the theory, such as the claim that sensorimotor contingencies are fundamental to visual awareness.

The central tenet is that perception arises from knowledge of sensorimotor contingencies, with this claim depending on the consistency of the relationship between objects in the world and changes in retinal stimulation. These changes must reveal the persistent features of objects. O'Regan and Noë incorporated attentional blinks—not just eye blinks—into their theory, emphasizing that perception is inherently exploratory and dependent on discovering consistency within change. Learning improves the recognition of these regularities, and temporarily occluded objects can still be "seen" because perception does not depend on internal representations of the world.

### **Second: Representational Theory (Simons & Levin, 1997)**

One of the foundational assumptions underlying this theory is the existence of internal representations of external stimuli. In broader terms, low-level representations are considered near-veridical copies of the world, while higher-level representations become increasingly abstract as greater cognitive processing imparts meaning to the external environment. Simons (1997) proposed that the failure to detect change suggests a scarcity of information retained in visual representations from one view to the next. This perspective was supported by the findings of Levin and Simons (2002), in which participants failed to notice a change in the individual conducting a conversation. Specifically, a participant was directed to approach a person behind a desk to register for a research study. During the interaction, the original person was replaced by another individual. Later, participants were asked whether they noticed any change. Those who did not detect the switch may not have formed complete initial internal representations of either individual, thereby rendering change detection impossible.

Varakin and Levin (2007) extended this idea by suggesting that even if scene representations before and after the change are complete, a failure to sufficiently compare them may result in the inability to detect the change. One significant implication of internal representations is that, once generated, they may be accessible through various cognitive mechanisms. Representations of pre- and post-change images may differ in their efficacy depending on the context. When changes are detected, these representations appear robust. However, when higher levels of processing are required—such as locating the change—the pre-change representation may lack the necessary detail, leading to decreased recognition accuracy. When changes go unnoticed, it is possible that the pre-change representation lacks sufficient information to permit comparison.

Mitroff and Simons found a distinction between change detection and change localization, suggesting that the brain may employ distinct mechanisms for these tasks simultaneously.

### **Third: The Coherence Theory**

This theory posits that certain conditions must converge for an individual to detect changes, and it seeks to achieve this goal by clarifying the roles played by iconic memory, visual short-term memory (VSTM), and attention. The theory also aims to elucidate the neurophysiological processes that mediate these cognitive functions.

To begin explaining the theory, we must first consider the memory systems through which information about the visual world is stored in order to detect changes. Items that are subject to interpretation must be actively stored in the visual short-term memory. If a stimulus is actively maintained in VSTM, it remains accessible for a relatively longer duration, allowing for

comparison between successive views of a scene to determine whether a change has occurred. This active component of VSTM is thus distinct from its fleeting, passive component and from iconic memory. This distinction enables the cognitive system to determine whether a change has taken place over time.

Multiple stimuli simultaneously fall upon the retina and initially enter iconic memory, which, due to its virtually unlimited capacity, holds a representation of every stimulus reaching the eyes. A subset of these stimuli transitions to the transient part of VSTM. Here, VSTM is defined as a form of short-term memory that bridges iconic memory and the active component of visual short-term memory. It occupies an intermediate position between the two memory structures, possessing less capacity than iconic memory but greater temporal stability and activity than the transient component of VSTM.

Humans possess a mechanism that governs which stimuli are transferred to the active component of VSTM—namely, attention. The theory posits that if an item receives attentional focus, it is transferred to the active portion of VSTM. Accordingly, if the item attended to changes, that change will be detected. However, attention can operate on only a limited number of elements at a time. Given the high volume of elements in most real-world scenes, this attentional process must be temporally regulated.

Information presented as original and modified segments is integrated across interruptions, and this integration is the function of VSTM. This explanation implies that attention alone cannot bind visual features into detailed and enduring long-term representations. The theory posits that focused attention may yield a coherent structure, but only so long as attention remains fixed on the object.

This view forms the basis of the **Coherence Theory**.

- *Pre-attentive stage*: Structures are formed rapidly and in parallel across the visual field. While these initial patterns can be complex, they are only coherent within a limited spatial range. Their coherence is both temporary and spatially constrained, making them susceptible to rapid decay and continuous renewal. As such, any new stimulus appearing at a given retinal location may easily replace them.
- *Focused attention*: Functions metaphorically as a spotlight that governs a select few of these continuously refreshed initial patterns. Once attention is sustained on specific stimuli, they are organized into a distinct and coherent form that remains stable over time. This stability allows the object to retain its identity across brief interruptions, thereby enabling transformation rather than replacement when a new stimulus appears at the same location.

Once focused attention is withdrawn, the object loses its coherence and dissolves, reverting to its initial components. This suggests that visual short-term memory is inherently limited, regardless of the number of items that demand attentional focus.

The distinction between low- and mid-level processing is theoretically valid:

- *Low-level processing* involves retinotopic representations with high visual detail, yet it is highly transient and lasts only for fractions of a second. As a result, unattended objects are in constant flux, forming a continuously reconstructed representation as long as light continues to reach the eyes.
- *Mid-level attentive processing*, by contrast, involves only a small number of stable

structures that persist as long as they remain the focus of attention (Dunijndam, 2010, p.3).

According to the **Coherence Theory**, low-level representations of primitive objects are highly detailed and persist as long as the scene is presented to the eyes. Change blindness does not arise from a lack of detailed representations but rather from the inability to fully integrate a coherent and sufficiently rich set of primitive features to support change perception. Notably, although unattended primitive features may be transient and fade quickly, they are also less accessible for verbal description.

### **Veridical Representation**

This refers to information stored in an accurate and realistic manner, mirroring the actual world with high fidelity. Change blindness demonstrates that observers often fail to integrate information across successive images. As a result, they cannot directly detect differences or identify overlapping items that would occur when information is layered or accumulated. This suggests the absence of a large, detailed store of accumulated visual information.

## **Chapter Three**

### **First: Research Sample**

The current study necessitates the selection of a sample for the purpose of constructing the measurement instrument and extracting the psychometric properties of the research tools. These properties include discriminatory power, the correlation between each item and the total score, the correlation between each domain and the total score, as well as conducting exploratory variance analysis, and assessing reliability through internal consistency and test-retest methods.

The researcher employed a stratified random sampling technique with equal distribution in selecting the research sample. A total of 400 students (male and female) were selected from two colleges at the University of Baghdad: the College of Arts and Ibn Rushd College. These colleges were evenly distributed according to the variables of specialization (scientific vs. humanities) and gender (male vs. female), with 200 male students and 200 female students, and 200 students from scientific specializations and 200 from humanities specializations.

<b>No.</b>	<b>College</b>	<b>Specialization</b>	<b>Males</b>	<b>Females</b>	<b>Total</b>
<b>1</b>	College of Medicine	Scientific	113	166	279
<b>2</b>	Al-Kindy College of Medicine	Scientific	2	24	26
<b>3</b>	College of Dentistry	Scientific	190	251	441
<b>4</b>	College of Pharmacy	Scientific	113	211	324
<b>5</b>	College of Veterinary Medicine	Scientific	178	124	302
<b>6</b>	College of Nursing	Scientific	145	151	296
<b>7</b>	College of Engineering	Scientific	297	352	649
<b>8</b>	Al-Khwarizmi College of Engineering	Scientific	24	49	73
<b>9</b>	College of Agricultural Engineering Sciences	Scientific	133	188	321
<b>10</b>	College of Science	Scientific	215	558	773
<b>11</b>	College of Administration and Economics	Humanities	238	285	523
<b>12</b>	College of Science for Women	Scientific	0	344	344

13	College of Physical Education and Sports Sciences	Humanities	80	26	106
14	College of Education for Pure Sciences / Ibn Al-Haytham	Scientific	0	118	118
15	College of Fine Arts	Humanities	146	244	390
16	College of Law	Humanities	213	208	421
17	College of Political Science	Humanities	95	156	251
18	College of Islamic Sciences	Humanities	49	59	108
19	College of Arts	Humanities	138	189	327
20	College of Languages	Humanities	383	480	863
21	College of Media	Humanities	27	58	85
22	College of Education for Women	Humanities	0	682	682
23	College of Education / Ibn Rushd for Humanities	Humanities	417	544	961

Table (1) Research Community by Gender and Specialization Variables at the University of Baghdad for The Academic Year 2024-2025

**Research Samples:** In order to conduct the current study, it was necessary to utilize several samples. Table (2) illustrates the types of these samples, the number of individuals in each, the purpose for which they were utilized, and the source from which each sample was drawn.

No.	Sample Type	Number of Individuals	Purpose of Utilization	Colleges from which the Sample was Drawn
1	Pilot Sample	30	To ensure the clarity of the scale items and related instructions	College of Arts / Evening Study
2	Construction and Application Sample	400	A. To obtain the research results as indicated in Table () B. To analyze the items of the Change Blindness Test, Anchoring Bias, and Information Avoidance Scales C. To calculate Cronbach's Alpha coefficient for the three scales D. To conduct exploratory factor analysis for the three scales to verify their construct validity indicators	The three scales were applied in two colleges at the University of Baghdad
3	Reliability Sample	50	To calculate the reliability coefficient using the test-retest method for each of the three scales	Ibn Rushd College / University of Baghdad

Table (2) The Sample Used to Prepare the Research Tools

## Second: Research Instruments

To achieve the objectives of the current research, the researcher developed three instruments:

*Change Blindness, Anchoring Bias, and Information Avoidance*. These instruments will be explained in detail as follows:

### First Instrument: Change Blindness

#### 1. Compilation and Identification of Test Items:

The researcher developed the *Change Blindness* test after reviewing previous studies and the theoretical framework proposed by **Rensink (2001)**, which explains the concept of change blindness. Additionally, the researcher obtained and consulted Rensink's book titled *Change Blindness and Visual Memory*. From this source, the experiments conducted by Rensink and his colleagues were translated—these experiments were presented in video format, featuring scenarios indicative of change blindness. These included studies such as the *grocery store*, *marina*, *cartoon character*, *girl in front of the mirror*, and *iron ball* scenarios. The remaining video materials were derived from the studies of Rensink's colleagues.

No.	Video Title	Quantity	Source	Sequence in the Test
1	The Two Opposing Girls	1	Simons & Levin, 1997	Ninth
2	The Door Study	1	Simons & Levin, 1998	Sixth
3	The Gorilla Study	1	Simons & Chabris, 1999	First
4	The Landscape	1	Simons & Ambinder, 2005	Tenth
5	The Girl in the Garden	1	Schoenlein, 2017	Second
6	Grocery Store, Marina, Cartoon Character, Girl in Front of Mirror, Iron Ball, Man in the Office	6	Simons, 2001	Third, Fourth, Fifth, Seventh, Eighth, Eleventh

#### 2. Preparation of the Test Instructions:

The researcher presented the videos to the participants and distributed response sheets for them to complete. Two response options were provided for each video. The first option (A) was selected if the participant did **not** observe any changes, marked with a (√). If the participant **did** observe changes, they would select option (B), also marked with a (√), and provide a written description of the observed changes. The instructions also included essential demographic questions such as academic major and gender. This version of the instrument represents its initial draft.

#### 3. Response Options and Scoring Method:

Scoring was conducted based on participants' responses to each item (video). The total score for each participant was calculated by summing the individual scores across all items. The test consisted of 11 videos, and participants were asked to choose one of two options:

- Option (A): Indicates **no perceived change**, awarded a score of **2**, suggesting that the participant exhibits **change blindness**, as they failed to detect the changes in the video.
- Option (B): Indicates the participant **detected changes** and correctly described them, awarded a score of **1**, suggesting the participant does **not** exhibit change blindness due to accurate identification of the visual changes.

#### 4. Validity of the Change Blindness Test:

According to Ebel (1972), **face validity** is determined through evaluation by a panel of experts in psychology, who assess the appropriateness of the test in measuring the intended phenomenon. The use of multiple reviewers helps estimate the degree of face validity by examining the level of agreement among their evaluations (Awda & Melkawi, 1982, p. 370). Thus, it is essential to subject the items to logical scrutiny by specialists to confirm that the apparent form of the items aligns with the characteristic they aim to measure, before proceeding with empirical analysis.

There is a relationship between logical and statistical analysis of test items. Items that logically conform to the measured construct typically exhibit higher discriminative power and stronger validity coefficients (Al-Kubaisi & Malhim, 2002, p. 120).

The test was reviewed by a group of subject matter experts, who were asked to judge the clarity of the test instructions and assess the test's logical structure, overall validity, and appropriateness for the study sample. The researcher adopted an **80% agreement threshold** as the criterion for item acceptance, and Table ( ) presents the acceptance rates of the items included in the change blindness test.

Items	Number of Items	Number of Approvals	Approval Percentage	Number of Rejections	Decision
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	11	20	100%	0	Valid

**Following the feedback obtained from expert evaluators**, the specialists unanimously approved the validity of the test, its instructions, and its response options, with an agreement rate of 100%.

#### 4. Clarity Sample and Time Estimation

To ensure the clarity of the test and its instructions, and to determine the time required for respondents to complete it, the researcher administered the Change Blindness Test to a randomly selected sample of (30) students from the College of Arts, Evening Studies, University of Baghdad. The results showed that the instructions were clear and the average time taken by the participants to complete the test was approximately (25) minutes.

#### 5. Statistical Analysis of the Change Blindness Test

The purpose of the statistical analysis of the test is to verify the precision of its psychometric properties, which are as crucial as the psychometric characteristics of the instrument as a whole. Although the items were analyzed logically through expert judgment regarding their face validity in measuring the intended construct, statistical analysis is considered more critical, as logical analysis alone may not reveal the actual validity of the measurement tools. In contrast,

statistical analysis of the scores provides a more accurate evaluation of the measurement accuracy (Ebel, 1972, p.402). The statistical analysis process is a fundamental step in constructing measurement tools, and relying on items with strong psychometric characteristics enhances both the validity and reliability of the scale (Anastasi & Urbina, 1997, p.192).

**Discriminatory Power of the Test**

The aim of calculating the discriminatory power is to retain the items that effectively distinguish between high and low-performing individuals, and to eliminate items that do not contribute to such differentiation. Discriminatory power, in this context, refers to the extent to which a video item can distinguish between the upper and lower groups of participants. A high discrimination index indicates that the video effectively differentiates between the two extreme groups in total score, which implies that the video contributes significantly to the test’s ability to detect individual differences (Al-Zubaie et al., 1981, p.37).

To calculate the discriminatory power of the items, the researcher used the following methods:

**A. Extreme Groups Method**

The method of comparing extreme groups and analyzing the relationship between the item score and the total test score is an appropriate approach for item analysis. The researcher followed these steps:

1. A sample of (400) students was selected for the analysis.
2. The Change Blindness Test was administered to the sample, and the total score for each form was determined.
3. The total scores obtained by the students were ranked in descending order (from highest to lowest), and the top and bottom 27% were identified. This percentage was selected to obtain the two groups with the largest possible size and the maximum variance between them (Stanley & Hopkins, 1972, p.268).
4. The two extreme groups (upper and lower) were defined based on a cut-off percentage of (27%) for each group, resulting in (108) individuals per group.
5. The calculated values were obtained using Chi-square ( $\chi^2$ ) and Phi coefficient and compared to the tabulated critical value (3.84) at a significance level of (0.05) and one degree of freedom. The comparison showed that all the calculated values for the test items were statistically significant, as they exceeded the critical value.

No .	Lower Group (1)	Lower Group (2)	Upper Group (1)	Upper Group (2)	Calculated Chi-square ( $\chi^2$ )	Tabulated Value (0.05)	Phi Coefficient ( $\phi$ )	Significance
1	52	56	1	107	65.033	3.84	0.549	Significant Positive
2	45	63	3	105	47.250		0.468	Significant Positive
3	90	18	6	102	6.750		0.177	Significant Positive

4	63	45	3	105	78.545	0.603	Significant Positive
5	99	9	28	80	96.333	0.668	Significant Positive
6	56	52	4	104	62.400	0.537	Significant Positive
7	78	21	5	103	127.313	0.768	Significant Positive
8	29	79	0	108	33.497	0.394	Significant Positive
9	50	58	1	107	61.630	0.534	Significant Positive
10	88	20	1	107	144.643	0.818	Significant Positive
11	82	26	2	106	124.675	0.760	Significant Positive

Table (3)

**b. The Relationship Between Item Score and the Total Test Score (Internal Consistency):**

The correlation between each item's score and the total score of the test is considered an indicator of the validity and homogeneity of the items in measuring the intended phenomenon (Allen & Yen, 1979, p. 124).

The correlation coefficient between performance on each video and performance on the overall test was calculated. The total score represents what the test is genuinely designed to measure. In this context, Anastasi points out that the total score of the scale is the best internal criterion when no external criterion is available (Anastasi, 1976, p. 206).

The correlation between each video in the test and the total score was calculated using the point-biserial correlation coefficient through the Statistical Package for the Social Sciences (SPSS). All correlation coefficients were statistically significant, as they exceeded the critical table value. The critical value for the point-biserial correlation coefficient at a significance level of 0.05 and 398 degrees of freedom is 0.098.

The correlation coefficients in the Change Blindness Test ranged between **0.509 and 0.519**, indicating a statistically significant and meaningful relationship between each item and the total test score.

No.	Item–Total Correlation Coefficient
1	0.519
2	0.524
3	0.496
4	0.540
5	0.482
6	0.545
7	0.556
8	0.470
9	0.562

10	0.538
11	0.509

Table (4) Presents the Correlation Coefficients Between Each Item and the Overall Test Score.

## 7. Validity Indicators

Validity is considered one of the essential characteristics of a test, as it indicates whether the instrument genuinely measures the intended construct. Validity is broader than reliability, as every valid test is inherently reliable (Oppenheim, 1973, p. 69). The validity of the test was assessed using two approaches, as outlined below:

### A. Face Validity:

An instrument is considered to possess face validity if its appearance suggests that it measures the intended behavior or trait. When the content and items of the instrument align with the characteristic being measured, this indicates a higher degree of validity (Abbas et al., 2009, p. 262). This type of validity was established by presenting the instrument to a panel of expert reviewers and incorporating their feedback regarding the appropriateness of the test items, instructions, and structure. The experts, as previously mentioned (see p. ...), approved all the test videos, response alternatives, instructions, scoring procedures, and the suitability of the instrument for the research population.

### B. Construct Validity Indicators:

One of the key indicators of construct validity is the ability of the test items to differentiate between individuals, particularly when using the extreme group comparison method. This reflects the extent to which the instrument can be said to measure a particular trait or construct. Construct validity was assessed using **Exploratory Factor Analysis (EFA)**, as follows:

#### Exploratory Factor Analysis (EFA):

Exploratory Factor Analysis is a widely used statistical method in psychological research. It aims to uncover a relatively small number of unobserved (latent) variables that adequately represent the interrelationships among a larger set of observed variables. Each latent factor accounts for a shared portion of variance among a group of observed variables or represents the common informational ground among them. This simplifies complex datasets by reducing many observed variables into a few meaningful latent dimensions, enabling researchers to focus on the underlying constructs.

A factor is thus a latent variable, differing from observable variables in that most observable variables can be measured directly, whereas factors are hypothetical constructs derived from analyzing directly measured data. Observed variables refer to the components subjected to factor analysis, which may include questionnaire items, test questions, or subscales—each considered an individual variable.

EFA allows for the extraction of latent variables or factors that reflect the shared structural relationships among a set of original observed variables. While the observed variables represent the data collected by the researcher (such as items or tests), the factors represent shared variance among these variables. This shared structure is referred to as the latent structure (or factor structure), which explains the interrelationships among the observed variables.

The **Principal Components Analysis (PCA)** method was used to extract factors in order of

descending importance, starting with the first factor, which accounts for the largest proportion of variance (i.e., the most information in the dataset). This factor also has the highest eigenvalue and exhibits stronger correlations with test items compared to other factors extracted (Tighza, 2012, p. 26).

For the Change Blindness Test, which includes 11 video-based items, exploratory factor analysis was conducted using the **Varimax rotation** method. After applying orthogonal rotation, the analysis revealed the presence of a single general factor. All items showed factor loadings above the 0.30 threshold based on **Guilford's criterion**, indicating significant saturation. The extracted factor had an **eigenvalue of 3.782**, accounting for **34.382% of the total variance**.

According to **Gorsuch (1983)**, a factor is considered significant in this context if its eigenvalue is equal to or greater than 1, and the factor loadings of the items should not be below 0.30. Any item with a lower loading should be excluded, as a factor with an eigenvalue below 1 contributes minimally to explaining variance in the original variables (Rashwan, 2015, p. 20), as detailed in Table (...).

Results of the Exploratory Factor Analysis Using Varimax Rotation (N = 400) for the Change Blindness Test

### General Factor

Item Number	Factor Loading (General Factor)
1	0.555
2	0.396
3	0.459
4	0.525
5	0.551
6	0.493
7	0.615
8	0.559
9	0.421
10	0.724
11	0.672

**Eigenvalue:** 3.782

**Percentage of Variance Explained:** 34.382%

### 8. Reliability Indicators

Reliability refers to the degree of consistency between the results of two measurements in estimating a particular trait or behavior. It is also an indicator of the accuracy and consistency of the measurement tool in assessing what it is designed to measure, yielding the same or closely similar results when the measurement is repeated on the same individuals (Crocker & Algina, 2009, p. 147). The scores of a measurement tool are considered reliable when they consistently provide an accurate estimate of the trait or characteristic being measured under varying conditions (Allam, 2000, p. 167).

Reliability is typically classified into two types: internal consistency and external consistency. Internal consistency indicates that all items are measuring the same construct. This method relies

on the extent to which items within the scale are correlated with each other, as well as with the total scale. The greater the homogeneity of items in what they measure, the higher the internal consistency, and vice versa (Anastasi, 1976, p. 13).

The reliability of the **Change Blindness Test** was assessed using two methods:

**a. Test-Retest Method:**

To calculate the reliability coefficient using the test-retest method, the researcher administered the test to a sample of 50 students. The sample consisted of 25 students randomly selected from the College of Education, Ibn Rushd / University of Baghdad, and 25 students from the College of Pharmacy / Al-Nahrain University. Two weeks after the initial administration, the same test was reapplied to the same participants. Using Pearson's correlation coefficient, the test-retest reliability was found to be **0.73**, which is considered a good reliability coefficient and acceptable for use, as noted by Foran (1961), who recommended that the reliability coefficient should preferably exceed **0.70** (Foran, 1961, p. 384).

**b. Split-Half Method:**

This method involves dividing the test into two halves—odd-numbered and even-numbered items. The odd-numbered items represent the first half of the test, while the even-numbered items represent the second half. The reliability is then calculated by correlating the scores of the two halves. After obtaining the correlation coefficient using Pearson's formula, the result is adjusted using the **Spearman-Brown Prophecy Formula** to compute the total test reliability, since Pearson's formula only estimates the reliability of half the test. The corresponding reliability values are shown in Table (6).

Table (6)

Variable	Split-Half Correlation Coefficient	Split-Half Reliability (Corrected using Spearman-Brown Formula)
Change Blindness	0.57	0.73

Statistical indicators: The statistical indicators for the change blindness test were obtained through the Statistical Package for the Social Sciences (SPSS) as shown in Table (7).

No.	Indicator	Value
1	Arithmetic Mean	18.8950
2	Median	19.0000
3	Mode	19.00
4	Standard Deviation	2.32393
5	Skewness	0.090
6	Kurtosis	0.045

7	Range	10.00
8	Minimum Score	12.00
9	Maximum Score	22.00

Table (7)

#### Chapter Four:

This chapter presents the results obtained from the current research in accordance with the sequence of its objectives, accompanied by interpretations based on the theoretical framework and previous studies, as follows:

##### First: Identifying Change Blindness Among University Students

The one-sample *t*-test was employed to determine the significance of the difference between the sample mean in change blindness, which was (18.8950) with a standard deviation of (2.32393), and the hypothetical mean (16.5). The calculated *t*-value was (20.532), which is statistically significant at the (0.05) level of significance and (399) degrees of freedom, compared to the critical *t*-value of (1.96).

Sample Size	Mean	Standard Deviation	Hypothetical Mean	Calculated <i>t</i> -Value	Critical <i>t</i> -Value	Statistical Significance
400	18.8950	2.33293	16.5	20.532	1.96	Significant

Table (8)

Arithmetic mean, standard deviation, hypothetical mean, calculated and tabulated value, and statistical significance of change blindness scores

The result indicates that university students exhibit change blindness. This may be attributed to their limited ability to integrate information from successive images, thereby impairing their capacity to directly detect differences or identify overlapping elements that emerge when information becomes stacked or accumulated. This suggests the absence of a substantial storage capacity for the collected visual information.

##### Second: Identifying the Statistical Significance of Differences Among University Students Based on Gender (Male – Female) and Field of Study (Scientific – Humanities)

In order to examine the means and standard deviations of the sample based on the variables of gender and field of study, Table (9) presents the relevant data.

Gender	Field of Study	Sample Size	Mean	Standard Deviation
Male	Scientific	100	19.1300	2.65016
	Humanities	100	19.0500	1.94040
	<b>Total</b>	200	19.0900	2.31705

Female	Scientific	100	18.8100	2.41500
	Humanities	100	18.5900	2.26566
	<b>Total</b>	200	18.7000	2.33823
<b>Total</b>	Scientific	200	18.9700	2.53400
	Humanities	200	18.8200	2.11660
	<b>Overall Total</b>	400	18.8950	2.33293

Table (9)

**The results with respect to the gender variable indicate that there are no statistically significant differences between males and females in change blindness.** This can be attributed to the fact that university students, in general, exhibit change blindness, which may be due to their inability to integrate information from successive images. Consequently, they are unable to directly detect differences or recognize the overlap of elements that occur when information is stacked or accumulated. This suggests a limited capacity in retaining the gathered visual information.

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