

# AN ATTENTION-VALUE MODEL OF MUSEUM VISITORS

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## INTRODUCTION

In their recently published textbook on cognitive psychology, Ashcraft and Radvansky (2010) described attention as “one of cognitive psychology’s most important topics and one of our oldest puzzles.” Whether we examine human attention in the context of driving an automobile, completing a workplace task, or engaging in educational and recreational activities, the importance of attention processes should not be understated. Talking on a cellular phone or texting while driving an automobile can have a disastrous impact on safe driving. Workplace accidents and errors are often attributed to a lack of focused attention on the task. Failing to pay attention to a lecturer in a school classroom may result in a failing grade. And, in museums, distractions that prevent attending to relevant materials leave the visitor unsatisfied and the goals of the museum unfulfilled.

With a few exceptions, the topic of visitor attention has rarely been examined in a comprehensive manner. Emphasis is often placed upon an inferred outcome of attention such as “learning,” “flow,” “restoration,” or “satisfaction” rather than on the processes that make these outcomes possible. Despite the general lack of concern regarding attention in museums, a number of individuals have contributed to our current knowledge, the most prominent of whom include Edward Robinson, Arthur Melton, Harris Shettel, Chan Screven, John Koran, John Falk, Giana Moscardo, and Jay Rounds.

The attention-value approach described here is relevant to all of informal science education, although the current paper focuses primarily on exhibition environments. Obviously, informal science education cannot occur without engaged attention.

This article is organized in the following way. The remainder of the introduction includes two parts: (1) an identification of five important questions related to visitor attention; and (2) a comprehensive definition of visitor attention. The main body of the article attempts to describe the attention-value model my colleagues and I have developed over the years. The model assumes that attention is a continuum of three stages, each of which is comprised of a unique combination of behavior indicators and factors that influence attention at that stage.

### **Five questions**

Given the importance of this topic, more careful research and reflection are needed if we are to better understand attention phenomena within the context of museum exhibitions. How effectively problems are solved usually depends upon the way questions are asked. With respect

to “visitor attention,” there are five key questions that, if answered adequately, can help to direct us to a better understanding of visitors and ultimately, more effective exhibitions. These questions are:

1. ***What is “visitor attention”?*** What are the possible elements of a comprehensive definition of visitor attention?
2. ***To what do visitors pay attention while viewing exhibitions?*** How do visitors distribute their attention in exhibit environments? What factors are effective in capturing attention?
3. ***Why do visitors attend? What is the motivation for attending?*** What factors contribute to the motivation to attend or not attend to a particular exhibit element?
4. ***How do the processes or mechanisms that explain visitor attention work?*** Processes such as searching or scanning the exhibit environment and making choices about where to focus and engage attention need to be understood if we are to design experiences that adequately manage visitor attention.
5. ***What factors interfere with paying attention to important exhibit elements?*** How do factors such as “fatigue,” “competition,” and “distraction” influence visitor attention. How can these factors be minimized or eliminated?

### **A definition of visitor attention**

Although “visitor attention” is commonly invoked, a comprehensive definition has not surfaced in the literature. References to “attention” are often ambiguous. On the one hand, the term “attention” has been used to refer to a set of cognitive processes (e.g., Koran and Koran, 1986). It has also referred to overt behavior (response measures) – dependent variables such as percent of visitors who stop at an exhibit display or the viewing time once stopped (Melton, 1935; Robinson, 1928; Serrell, 2010). Rarely has a distinction been made between the explanatory processes of attention and the response measures/indicators of this process (e.g., exhibit viewing). In order to develop an adequate model or theory of visitor attention, we need a more comprehensive and precise definition. In this spirit, we offer the following definition:

*Visitor attention is a group of psychological and physiological processes that involve a continuum of three-stages (capture, focus, and engage) with each stage sensitive to a unique combination of independent variables. Actions that result from these processes are motivated by the interaction of personal factors (personal value, interest, past experiences, etc.), psychological-physiological factors (perceptual, cognitive, affective, decision-making, fatigue), and environmental factors (social influence, architectural and exhibit design). The indicators (dependent variables) of attention include approaching an object, stopping, viewing time, reading, talking with others about, thinking about, tests of learning and memory, rating scales, and the like. A different set of responses(indicators) occur at each stage.*

This definition attempts to examine attention in a comprehensive manner by incorporating all aspects of attention. Each component of the definition is expanded below:

**Attention as a continuum.** The definition suggests that the progression from capture to engage is an inter-connected continuum rather than a set of distinct phenomena. Inferred outcomes such as learning are possible only when attention progresses from capture to engagement.

**Unique set of independent variables at each stage.** Visitor reaction at each stage is dependent upon a unique combination of variables that influence attention processes as well as response indicators of attention.

**Interaction among personal, psychological-physiological, and environmental factors.**

The definition recognizes three general factors involved in the visitor experience. Personal, psychological-physiological, and environmental factors are constantly working together within the attention processes. This interacting framework helps to explain the motivations for paying attention. For example, visitors make decisions whether or not to attend based on a combination of personal perceived benefit and cost (personal factors), decision-making processes and physical states (psychological-physiological factors), and design and organization of the exhibition (environmental factors). We infer processes or mechanisms from our observations in order to explain the connection among these interacting factors.

**A different set of dependent variables or response indicators of attention is present at each stage.** Each stage is characterized by a different set of measurable actions or indicators. During the capture stage, actions include looking at, approaching, and stopping during the focus stage, actions involve a narrowing of attention to a single exhibit element to the exclusion of others; and during the engage stage attention is characterized by highly focused examination of the exhibit content, reading text passages, discussing the content with group members, thinking about the implications of the exhibit material, etc.

### AN ATTENTION-VALUE MODEL

In the last decade my colleagues and I have been developing and testing an attention-value model applied to museum visitors (e.g., Bitgood, 2000; Bitgood, 2001; Bitgood, 2006; 2007; 2008; Bitgood, 2009; Bitgood, Burt, & Dukes, 2009; Bitgood, Dukes, & Abby, 2007; Bitgood, New, & White, 2008). This model incorporates what is known from the museum research findings for the last 80 years as well as contemporary research in psychology. Briefly, the model assumes that: (1) attention is a three-level continuum (capture, focus, engage) with a different combination of variables influencing attention at each stage; and (2) the primary motivation for paying attention is perceived value (a ratio of utility/satisfaction divided by costs such as time and effort) of the exhibit element. However, other factors described below are also important, although not at the level of perceived value.

Table 1 provides an overview of our attention-value model and Table 2 provides a list of terms and definitions associated with this model. As indicated by Table 1, the model suggests three levels or stages of attention: capture, focus, and engage. Each stage is distinguished by the qualitative and quantitative type of attention given to exhibit elements and by the combination of psychological and physiological processes at work. The three levels represent a progression from broad, unfocused attention to narrow, deep processing of exhibit information. Each of these stages is assumed to be an important and necessary aspect of the continuum of attention. The “Response Indicators” column contains the unique behaviors that may be observed at each stage. (These are usually called dependent measures in research.) The “Explanatory Mechanisms/Processes” column lists the inferred psychological/physiological explanatory processes that are inferred at each stage. And, the last column, “Factors that influence the experience,” refer to the independent variables or factors that produce the outcome.

At any moment there are multiple alternative objects to which an individual may attend. A powerful stimulus (loud noise, sudden movement, flash of light) may act as a distraction, taking attention away from a target exhibit element. Multiple objects are in constant competition for attention. However, if the element is perceived to be of low potential value, the visitor is likely to search for another element. Once something of potential value is found, visitors narrow or focus their attention. And, if the value is sufficiently high, visitors will engage or become deeply involved with the exhibit element. High perceived value is assumed to be a ratio (i.e., high utility divided by minimal costs).

Why is this approach called an “attention-value” model? The “attention” element should be obvious. The “value” element indicates that a ratio of utility divided by costs is the most powerful motivating force in choosing the object of attention. Several studies have quantified the “value ratio” by using an interest rating to represent utility and a workload indicator (number of words in the text passage) to represent cost. The ratio of interest/number of words was found to be an excellent predictor of how much of a text passage participants actually read in museum simulation studies (Bitgood, Burt, & Dukes, 2009; Bitgood, 2008; Bitgood, Dukes, & Abby, 2007; Bitgood, New, & White, 2008).

How does the visitor attention model proposed here differ from others? It is more comprehensive than others in that it accounts for the attention processes of capture, focus, and engage that are responsible for such outcomes as learning. Second, “attention” is considered the broadest of processes -- it encompasses a number of overt behaviors (approaching viewing, reading, etc.), variables that produce a change in attention, and inferred explanatory processes (searching, finding meaning, memory, learning). Third, the model gives “value” (a ratio of utility divided by costs) the major role in motivating attention. At best, other theories and models have only one or two components of the current model.

### **THE VISITOR ATTENTION CONTINUUM**

The discussion of each stage of the visitor attention continuum is divided as follows: (1) an overview of the stage; (2) the response indicators or behaviors that are associated with the stage; (3) a description of variables that influence attention at that stage; (4) the explanatory processes

or mechanisms that appear to be in play during the stage; and (5) possible design implications for the practitioner. The reader may refer to Table 1 for a summary of these three stages.

### The Capture Stage

**Overview.** During the initial stage, attention is unfocused and the visitor is aware of a very broad number of stimulus inputs. Capturing attention can occur through either orienting or searching. Orienting is an automatic response to a powerful stimulus such as a loud noise. Orienting has obvious survival value to an organism. Stimuli that represent danger or that signal food sources for animals in the wild are most likely to be given attention. In exhibitions, a loud noise, a sudden movement, or a flash of light are automatically given attention, presumably for evolutionary reasons. This type of attention capture has been called “stimulus-driven attention” (e.g., Corbetta & Shulman, 2002). Too often a powerful stimulus, such as a loud, sudden noise, is disruptive because it distracts the visitor from a systematic search of exhibition elements. Once distracted, visitors rarely return their attention to the original target exhibit element. This is similar to “inhibition of return” found in psychological research: once distracted, research respondents are unlikely to return immediately to the original target object (Posner & Cohen, 1984).

Another attention capture process, searching, is more goal-driven (e.g., Corbetta & Shulman, 2002). Searching is the process of scanning the exhibit environment for something of possible utility (something interesting, familiar, etc.). Searching can be either sequential (serial) or simultaneous (parallel). Sequential searches examine one object after another until something of interest is found. Simultaneous searchers scan an entire stimulus complex and look for something to “pop out” such as a large or unusually shaped object. Actions during the search process include looking at an exhibit element, approaching the element, and actually stopping to view.

Corbetta and Shulman (2002) describe the following examples of goal-driven and stimulus-driven attention in an art museum:

“Picture yourself at the Museum El Prado in Madrid while a guide explains the painting *The Garden of Earthly Delights* by the 15<sup>th</sup> century Flemish painter Hieronymous Bosch. Bosch depicts a fantastic, surreal and satirical world, which is in stark contrast to anything else represented until that time. The guide’s words cue us to attend to different aspects of the painting, such as its colour, spatial configuration or meaning. For example, if he notes “a small animal playing a musical instrument,” we can use this information to spot the rabbit playing the horn near a black-and-white dice. Knowledge and expectations allow us to focus on elements, parts or details of a visual scene that we might otherwise have missed. Cognition aids vision by enabling the brain to create, maintain and change a representation of what is important while we scan a visual scene.

At the other extreme, visual perception can be dominated by external events. Initially, our eyes might have been drawn to the more salient objects in the painting, such

as the large wooden musical instrument (a lute in construction) at the center of the scene, rather than to more subtle aspects of the painting that are discussed by the guide. An event might even distract us from the painting altogether. If an alarm system started to ring and flash in a nearby room, everyone's attention would instantly be drawn towards the source of the alarm. Unexpected, novel, salient and potentially dangerous events take high priority in the brain, and are processed at the expense of ongoing behavior and neural activity." Corbetta & Shulman, 2002; p. 201)

**Response indicators.** There are several indicators of attention capture: scanning or glancing, looking at or hearing, approaching, and stopping at an exhibit element. While these responses may appear straight forward, care must be taken to ensure consistent (reliable) measures. For example, we have found considerable difficulty in obtaining inter-observer reliability when trying to measure glances at an exhibit element. If two independent observers cannot agree on what behavior is taking place, we must question the usefulness and accuracy of the data.

**Variables that influence the capture of attention.** There are five major factors that predict whether or not an exhibit element will capture attention:

*Stimulus salience or distinctiveness:*

Powerful stimuli (loud noise, sudden movement, etc.) automatically capture attention as part of the orienting reflex.

Other distinctive stimuli including large objects, isolation from competing objects, objects that have high contrast with background, multi-sensory stimulation, other objects with "landmark" qualities.

*Visual and physical access:* line-of-sight location, or physical nearness because exhibit element is along the circulation pathway and allows efficient movement. Very few "landmark" exhibit elements are attractive enough to warrant moving away from the most efficient pathway in terms of time and effort.

*Organization or layout of the exhibit elements:* The conceptual layout or organization of the exhibit elements is critical. If the designer's concept of its organization differs from the visitor's understanding, visitor viewing may be unsatisfactory. We suspect that the most effective design manages attention in a sequential rather than simultaneous searching process since it will increase the chance that each element captures attention.

*Distractions:* while viewing an exhibit element, a highly salient stimulus may divert attention away from the target element and interfere with focused, engaged attention. In addition, non-exhibit related conversations among group members can distract visitors from attending to exhibit content. Excessive mental and/or physical exertion can result in fatigue states in which visitors reduce their level of attention to exhibits. A pre-visit agenda in which only a limited time is available is likely to substantially reduce the number of exhibit elements given attention.

*Perceived value (Potential utility divided by costs):* exhibit content perceived as having high utility (relevance, importance, benefit, satisfaction) is more likely to capture attention in the search process; when the perceived cost in terms of time, effort, and/or money is perceived to be high, visitors are unlikely to pay attention even if utility is perceived as relatively high.

**Explanatory mechanisms/processes.** The following psychological processes are assumed to be important in the capture stage:

*The orienting response:* an evolutionary process; organisms automatically attend to powerful changes in their environment (loud noise, sudden movement, etc.).

*Sequential (serial) and simultaneous (parallel) searches* based on perceptual processes are fundamental to the capture stage. The specific conditions that trigger each of these types of searches are yet to be demonstrated by research. We hypothesize that design factors such as organization or layout of the exhibit objects and information content are key to how the search progresses. An exhibit organization or layout that makes obvious how to sequentially search seems likely to produce more engagement and understanding of the exhibit messages. A simultaneous search may be more likely when the visitor is left to their own devices. Simultaneous searches are likely to experience exhibit elements in a less organized way with spotty focused attention.

*Decision-making:* basic decision-making processes are also involved in the search process. Whether the search is sequential or simultaneous, visitor choice to attend to one exhibit element rather than another is based on predictable, decision-making processes.

*Physical and mental states:* Fatigue and energy level are likely to influence the search process. Lower energy or higher fatigue levels may decrease a visitor's willingness to pay attention.

**Design implications.** Designers/developers of exhibitions must appreciate the psychological processes involved in the capture stage of the attention continuum. Following is a brief list of some of the more important design implications:

There is constant competition among stimuli for attention. That which attracts may also distract from attending to a particular exhibit element. Managing how attention is sequenced through an exhibition requires understanding the mechanisms of orienting and searching.

Designers should clearly plan how visitors are expected to, and how they actually do, divide their attention as they move through exhibition spaces. Are the exhibit elements organized in a way that it is clear to the visitor how to sequence attention from one part of an exhibit element to another? Spatially distributing exhibit elements so that they do not compete with one another for attention

Powerful stimuli that distract visitors from attending to a target exhibit element should be carefully examined and eliminated as much as possible.

Interpretive devices such as those provided in audio tours, when designed effectively, help manage attention by allowing visitors to visually focus on an exhibit element while listening to relevant information. Such techniques remove the need to sequentially shift attention back and forth from text labels to exhibit objects.

Circulation flow should be carefully designed so that intended pathways are clear to visitors in order to ensure that every important exhibit element has an equal chance of capturing attention.

### **The Focus Stage**

**Overview.** Once attention has been captured (for whatever reason), the next stage of the continuum is to narrow attention to a single object or element. Focusing requires paying attention to one thing at a time and ignoring others. Because of the multiple elements and objects competing for attention in most exhibitions, visitors often need some guidance to decide what is considered important. An identifying label may be sought to discover the name or origin of an object or animal. A painting by a familiar artist may capture attention and be the object of focus. This level of attention involves shallow processing and attention can be easily distracted away from the object by sounds, movements, etc. The actions or behavior in this stage are relatively brief (not more than a few seconds) and may involve reading simple identifying information, touching or simple manipulation of exhibit elements without “mind’s on” processing. This level of attention does not involve sustained, involved attention to the exhibit content. However, it must occur before the engagement level is possible.

**Response indicators.** The major indicator of this stage is a narrowing of attention to one exhibit element and away from other possible targets of attention. A visitor’s attention must be visually focused on an exhibit element for at least two or three seconds to consider it focusing. Touching and/or manipulating exhibit elements may occur, but without “minds-on” processing. Attention is easily distracted during this stage.

**Variables that influence the focusing of attention.** Variables that influence focusing include:

*Isolation:* objects isolated from other objects are most likely to receive attention.

*Perceived value (cost and utility):* exhibit elements that are perceived to have high value (utility divided by cost) are more likely to receive focused attention.

*Contrast between object and background:* any object or exhibit element that clearly stands out from the back ground is more likely to be the target of focused attention.

*Focusing device:* Such devices can be either physical or symbolic. Physical devices include spot lighting an object in an exhibit case or raising an object on a platform above other object, or looking through a microscope. Symbolic devices use language, instructing visitor to look for something, or do something. Example: “Notice how the naked mole rat moves backward similar to the ‘moon walk’.”

*Organization or layout of exhibit elements:* when the parts of an exhibit element are laid out so that it is clear to the visitor what to look at first, second, etc. Such organization increases the chance that the exhibit will be viewed in a systematic way similar to the intentions of the designer.

*Distractions:* Attention during the focus stage can be easily disrupted. An orienting stimulus (e.g., loud noise) can capture attention away from the exhibit content. A young child whining can also be distracting. Powerful stimuli from other exhibit elements may distract visitors.

**Explanatory mechanisms/processes.** The main mechanism during the focus stage is the increasing selectivity of attention that occurs during the focusing process (e.g., Bitgood, 2000). Because the capacity to focus on multiple objects is limited, multi-tasking (focusing on more than one task) is difficult if not impossible to do in a competent manner. The focusing process automatically takes away attention from other stimuli in order to focus on the target.

**Design implications.** Designers must consider how attention is going to be focused sequentially as visitors view the exhibition. Exhibit designers have a number of tools that are used to help capture and focus attention. Spot lighting an object makes it more noticeable and suggests that the object is important. Isolating an object is another technique that communicates the importance of an object. Instructions to look at objects or notice an activity (e.g., naked mole rat doing the “moon walk”) also serve a focusing function. Visitor guides or handouts are also effective (Bitgood & Patterson, 1992). The Desert Botanical Garden in Phoenix uses a plastic tube as a focusing device: look through the tube and you can see a bird’s nest in the distant cactus. While most exhibitions tend to use some type(s) of focusing devices, they often fail to control many of the distractions that interfere with focusing. During formative evaluation, techniques that aid focusing attention to elements can be tested to ensure that important exhibit elements are being efficiently viewed. A previous publication (Bitgood, 2000) has summarized many of the design factors that are involved in the focusing stage.

## **The Engage Stage**

**Overview.** More has been written about the engagement level of attention than either the capture or focus stage. However, discussions in the literature are usually limited to a particular inferred outcome of engaged attention (e.g., learning, scientific reasoning, inquiry behavior, feeling of immersion, becoming emotionally restored). Rarely have researchers focused on the entire range of outcomes associated with engaged attention. Given the variety

and complexity of engagement outcomes, this should not be surprising. Jan Packer's (2008) study on "experience-benefit analysis" is an encouraging exception.

Engagement involves deep sensory-perceptual, mental and/or affective involvement with exhibit content. It generally requires some type of exertion or concentration as well as a sufficient amount of time to engage (more than a few seconds). Physical interaction with exhibit elements may occur, but this is not essential as long as some time of deep processing is taking place. In addition to and/or part of learning outcomes, the final outcome of attention engagement includes personal interpretation of exhibit content (often called "meaning making"). It may include a series of steps such as in inquiry, critical thinking, and/or scientific reasoning. The outcome may also include a deep, emotional response such as aesthetic appreciation, feeling close to nature, or anger at industries responsible for polluting the air and water. Feeling of being in a specific time and place (immersion) is another type of involved outcome that may result from engaged attention. See Appendix A for a description of many of the outcomes inferred from the processes of attention.

Indicators or actions that show evidence of engagement include a broad range of behaviors: reading of text passages, critical discussion of exhibit content with group members, analysis or synthesis of exhibit content, feelings of being in a particular time and place, verbal expressions of the beauty of nature, etc. Compared to the capture and focus stage, the engage stage of attention is less frequent (although of longer duration) since it is reserved for exhibit elements that have high perceived value (utility/costs) to the visitor.

Engagement of attention is influenced by a number of factors in addition to perceived value. For example, action tendencies (e.g., mental strategies for engaging such as asking questions, visit agendas, learned patterns of behavior such as persistence) help shape how visitors conduct their visit. Still another factors include physical/mental states such as energy level, "museum fatigue," "object satiation," and "depleted attention capacity."

Once attention is focused, the decision (conscious or unconscious) must be made whether the object/element is worthy of engagement. Engagement requires deep processing of content. Deep processing involves mental exertion and is difficult to sustain for long periods of time without fatigue occurring. It is unrealistic to think that all exhibit messages are going to be given engaged attention.

Why do we consider engagement a stage of "attention" rather than simply part of the learning process? It is obviously part of the continuum that starts with the capture of attention and ends with some type of deep, meaningful processing of the experience. Engagement is a collection of processes that leads to the inferred outcomes that we label as learning, attitude change, feelings of being in a particular time and place, etc.

**Response indicators.** Indicators can be divided into direct (or simple) and complex. Direct indicators include reading text labels, talking with group members about exhibit content, answering questions about recognition or recall of exhibit content, etc. Complex indicators

include more detailed measures such as analysis of extended conversations among visitors, or a test of exhibit-content knowledge, or self-reports of reactions to an experience.

**Variables that influence engaged attention.** As indicated by Table 1, we suggest that six major types of factors are involved at this stage:

*Perceived value.* The ratio of utility divided by cost appears to be the most important predictor of engagement or involvement with an exhibit element. A visitor's interests and personal agenda are key to the utility; the perceived time and effort determine the costs.

*Message characteristics.* Both physical factors (e.g., size of font, contrast between letter and background, proximity to object) and symbolic factors (ease of processing or comprehension of text messages) are important and obviously relate to perceived value. Symbolic characteristics involve the syntax, semantics, vocabulary, emotive qualities of the message, etc. (See Screven, 1992 for a more detailed discussion of these factors.)

*Action tendencies.* Action tendencies include complex behavior patterns from past history that shape the way an individual reacts to an experience. These action tendencies include:

Pre-visit agenda: self-report of the visitor groups' plan for the visit including time budgeted, interests in exhibit content, etc. (Briseno-Garzon, Anderson, & Anderson, 2007; Falk, Moussouri, & Coulson, 1998)

Learned persistence: some individuals are more persistent in how they respond to their environment. There is evidence that people can be trained to exert more effort or engage more deeply with exhibit content (Bitgood, White, & New, 2008). This process is similar to Eisenberger's (1985) concept of "learned industriousness."

Exhibit interaction strategies: these are established patterns of exhibit interaction. For example, some visitors try to read all labels; some visitors conduct systematic searches of an exhibit's layout; and others may only read identifying labels.

*Physical and mental states.* Both physical and mental states can influence visitors' degree of involvement in exhibitions. Kaplan's attention restoration theory (Kaplan, 1983; 1995) describes the negative impact on attention that accumulate from the everyday stresses of life. For some visitors, viewing exhibitions appears to restore the ability to engage attention in a task. "Museum fatigue" is another commonly invoked state that is assumed to interfere with visitor attention (Bitgood, 2009a; 2009b, 2009c).

Physical fatigue: decreased attention from prolonged physical exertion

Mental fatigue: decreased attention from prolonged mental exertion/processing

Energy level: feeling of physical and mental energy that fluctuates because of sleep patterns, illness, prolonged stress, etc.

Stress: psychological reaction to feeling overwhelmed by pressures.

Directed attention fatigue: a state of fatigue that results from the everyday stresses of life (Kaplan, 1983).

*Qualities of the exhibit elements.* In addition to affective and intellectual qualities, two other characteristics of exhibit design may evoke visitor reactions:

Response facilitation. For a hands-on, interactive exhibit, effective design includes several important principles: visibility (obvious what response to make); feedback (feedback to know if a response produces a desired action; conceptual model of how the device works must be the same for visitor and designer; etc. (for more on this topic, see Bitgood, 1988; 2002; Kennedy, 1988; Norman, 1980).

Sensory-perceptual facilitation. For immersion experiences, design must incorporate principles that make the visitor feel in a specific time and place (Bitgood, 1990). This is often accomplished by adding key architectural features of an environment or by instructing the visitor to symbolically place themselves in the appropriate time and place.

*Distractions.* At least three types of distractions are common in exhibition settings:

Powerful stimuli: the automatic response of removing attention to one object and instead attending to a more powerful stimulus (movement, flash of light, sound).

Social: the demand for attention from group members or others in the environment or through other, immediate forms of communication (e.g., cell phone).

Stimulus competition: the distraction of having multiple objects available at any moment.

**Explanatory mechanisms/processes.** Deep processing of exhibit can be loosely placed into three types: intellectual, emotional, and sensory-perceptual. These types are not mutually exclusive since either two or all three may occur simultaneously. Intellectual involvement is often accompanied by emotional excitement and may be enhanced when physically interaction occurs.

*Cognitive processes.* A large number of cognitive processes are possible once attention is deeply engaged. These include: learning, flow, immersion, attention restoration, meaning making, scientific inquiry, etc. Interested readers should refer to Appendix A for a summary of some of the inferred outcomes and assessment guides to measure engaged attention.

Here, as previously discussed, it is argued that the major cognitive process that motivates visitor to pay attention is decision making based on the perceived value of the experience. Engaged attention to an exhibit element is not likely to occur without a high ratio of utility to cost.

*Affective processes.* Emotional appeals are often used in exhibit design to influence attitude change. An exhibit displaying a plastic beer holder around a bird's necks is designed to make visitors feel bad about carelessly throwing away such trash. Webb (2000) reviewed techniques used in advertising to influence human affect. It is assumed that the affective processes described in cognitive, social, and consumer psychology provide the best account of what happens with visitors in exhibition settings.

**Design implications.** Because of the complexity of engaged attention, it is important to have clear purpose in what you wish to communicate. The measures of attention selected must fit the goals of the communication. Serrell's (1996) "big idea" approach is useful here. For what type of engagement are you looking? What independent variables are most likely to produce such engagement? How are you going to measure the outcome? What design factors will impact on the perceived value to the visitor?

### **Factors that influence all stages of attention**

The combination of variables that are unique to each stage were discussed above. Here we will expand on factors found in all three stages. These include perceived value, physical and mental states, distraction, pre-visit agenda, social influence, and other environmental conditions.

**Perceived value ratio.** Economic value is usually assumed to be the product of the benefits or satisfaction one derives from a commodity per cost. While cost is generally considered to be financial, other resources such as time and effort have been shown to play an important role in how individuals determine value. Value is thus a ratio of utility (satisfaction, benefit) divided by costs (time, effort, money, etc.). Value as a ratio is common in the fields of economics, biology, and psychology. There appears to be a strong tendency for humans (and animals) to engage in a cost-benefit analysis of some type when making choices.

Temporal discounting theory in psychology and economics asserts that a choice among alternatives available depends upon a ratio of amount of reward divided by the immediacy or delay in obtaining the reward (e.g., Critchfield & Kollins, 2001). Thus, receiving \$100 today is of higher value than receiving the same amount with a one-year delay. The value ratio predicts that the longer the delay, the lower the value and consequently, the lower the preference for the alternative.

In biology, optimal foraging theory predicts that the value of a choice (e.g., selection of a prey by a predator) is determined by the ratio of benefit derived from the choice divided by the search and handling time to "consume" the selected alternative. Foraging has also been

applied to information searches by humans (Perelli & Card, 1999). In a thought-provoking article in *Curator*, Rounds (2004) has applied foraging theory to museum visitors. Rounds argues that the curiosity-driven visitor chooses to focus attention on one exhibit element or another based on potential value determined by interest level as well as the time and effort required to search and experience the exhibit component.

Another example of a cost-benefit mechanism of the value concept can be found in the study of aesthetic pleasure (Reber, Schwarz, & Winkelman, 2004). Reber, et al suggest that aesthetic pleasure is determined by the fluency of processing an object (or, to put another way, ease of cognitive effort). Although these authors did not propose an actual value ratio, their review did suggest that variables that influence aesthetic judgments such as figural goodness, figure-ground contrast, stimulus repetition, symmetry, prototypicality must be considered in relationship to cognitive processing effort (cost) in addition to the aesthetic qualities (satisfaction/benefit). If an object requires a considerable amount of cognitive effort to process, despite its other aesthetic characteristics, it is likely to produce a lower level of aesthetic pleasure according to Reber, et al.

With respect to visitors' choice, perceived value (utility/cost) must be high if visitors are to invest their attention to an exhibit element. Utility is the economic term used somewhat equivalently with satisfaction or benefit. Cost includes resources such as financial, time, and/or mental/physical effort. The concept of value implies that satisfaction or benefit alone is insufficient; the perceived cost (e.g., time and effort) is an important part of the decision-making process when attempting to predict attention. In addition to our previous publications (Bitgood, 2000), Screven (1992; 1999) has also noted the importance of the cost of time and effort in processing exhibit content. However, value as a ratio of benefit/cost was not specifically suggested by Screven.

Utility can be increased in at least two ways: (1) by selecting high interest exhibit content; and/or (2) by designing exhibit elements that stimulate curiosity. In both cases, evaluation data is essential. Front-end evaluation is an effective way to identify high interest exhibit content. Formative evaluation is a way to develop content that is effective in stimulating curiosity.

Costs can be reduced by minimizing the time and effort it takes to "consume" exhibit elements. Exhibit organization or layout that makes sense to visitors is one way to minimize cost. Providing short rather than long blocks of text in labels, using bulleted information rather than paragraphs, providing diagrams with conceptual maps are a few ways to minimize costs (e.g., Bitgood, 2000; Screven, 1992).

**Physical and mental states.** Physical and mental states of the individual are assumed to have an important influence on attention. Fatigue, either physical or mental, can obviously decrease attending. Fatigue may be associated with stress, lack of sleep, or prolonged physical and/or mental exertion. Often associated with fatigue is a state of object satiation (boredom associated with monotonous stimulation). For further discussions of fatigue, see Bitgood (2009a; 2009b, 2009c). In addition, energy level may vary from day to day depending upon

the amount of sleep, physical condition, stress, etc. When energy level is low, we are less likely to accept the cost of reading long labels, walking long distances, etc.

**Distraction.** Distractions from attending to a specific exhibit element are often due to the sights and sounds from other sources. However, social distractions are also common during museum visits. Group members may distract a visitor from reading a label or approaching an exhibit element. Of course, distraction away from one exhibit element may result in attraction toward another. Once distracted, visitors are unlikely to return to viewing exhibit elements that preceded the distraction.

**Pre-visit agenda.** Visitor agendas obviously influence visitor attention. However, “agenda” is a tricky concept to define. At the very least, an agenda is a plan for the visit based on a number of factors (time budgeted, group composition, interest in content of exhibitions, etc.). If a visitor group plans to visit a museum for only 30 minutes, only the high spots are likely to receive attention. Clearly, the visitor agenda is subject to modifications as the visit progresses (e.g., Briseno-Garzon, Anderson, & Anderson, 2007). In order to minimize the confusion of considering all the factors that may change the agenda as the visit progresses, we suggest that the term “pre-visit agenda” be used to distinguish the original plan from the ever-changing agenda as the museum visit proceeds. Variables that change the agenda during the course of a visit are included in other factors (e.g., social influence, general environmental conditions).

**Social influence.** As noted by many writers and researchers, the influence of group members and the presence of other visitors can have a strong impact on how visitors distribute their attention in a museum. Group members may influence the type of exhibit selected for attention, the level of engagement of attention, the type of engagement, and the duration of engagement.

**General environmental conditions.** The architecture of the building, the temperature, sights and sounds, etc. may all influence visitor attention during all stages. Architectural features such as multiple doors within an exhibition may confuse visitors’ ability to circulate through exhibit spaces efficiently (Bitgood, 2006; Melton, 1935). Cold temperatures and dim lights may encourage visitors to move too quickly through the exhibitions.

### **Other considerations**

Visitor circulation and “museum fatigue” are two phenomena related to visitor attention that need to be explicitly discussed since they play an important role in the processes associated with how, when, where, and why visitors pay attention to exhibit elements.

**Attention and visitor circulation.** The relationship between attention and visitor movement through exhibit spaces needs further discussion because of its importance. Previous publications have provided reviews of visitor movement patterns (Bitgood, 1988; 1992; Bitgood, 2006; Bitgood & Dukes, 2006; Bitgood & Lankford, 1995). Attention at all stages

interacts with circulation factors. A few of the most important relationships can be summarized as follows:

“Landmarks” (powerful attention-capturing objects such as a large sculpture) not only attract visitors but pull them toward such objects creating a strong influence on the circulation pathways of visitors.

Visitors are most likely to pay attention to exhibit elements that are within close proximity. Proximity is a function of circulation route through an exhibition. If an exhibit element does not fall in the visitor chosen pathway, it is unlikely to be given attention.

People are reluctant to take the necessary extra steps to explore areas that do not have high perceived value. A remote pathway that does not promise high value because it is unknown what one will find, will receive little exploration.

The value ratio (utility/costs) appears to guide circulation. There must be relatively high promise of an interesting experience coupled with minimal costs (time, effort) for people to circulate or move through different parts of an environment. Long walking distances and a high density of crowding with little promise of satisfying experiences discourage visitors from moving through areas.

**Attention and “museum fatigue.”** Phenomena associated with “museum fatigue” are also important to understand when considering visitor attention (Bitgood, 2009a; 2009b; 2009c). These phenomena include: (1) physical exhaustion/tiredness; (2) mental exhaustion/tiredness; (3) object satiation; (4) decision-making processes that occur as “museum fatigue” processes develop.

*Physical exhaustion or tiredness* is likely to occur after long periods of physical exertion (walking long distances, especially when viewing exhibits because of the bending and unnatural postures required). If a visitor suffers from insufficient sleep or illness, the onset of physical fatigue may be rapid. Physical fatigue is probably less common than other types of “museum fatigue.” Visitors whose agenda involves seeing the Smithsonian Institution museums in one day are likely to suffer from physical fatigue.

*Mental exhaustion or tiredness* may be a more common problem in museums, especially for the conscientious visitor who tries to read all or most of the labels and attempts to comprehend most of what he/she experiences.

*Object satiation* appears to be common in exhibitions that contain highly repetitious objects of similar character. For example, one is likely to become satiated after viewing extensive, homogenous exhibit content such as a large number of snake exhibits, sea shells, rocks, or artworks with little variation in exhibit design. Variation in viewing experiences and taking breaks are likely to minimize satiation.

*Decision-making* appears to change gradually as an individual slowly experiences fatigue or satiation. Visitors become more selective in the object of their attention as they tire or become bored. Thus, visitors stop at fewer exhibit elements, change exhibition halls more frequently, and are more likely to leave the museum entirely as the fatigue-like processes develop.

## SUMMARY AND CONCLUSIONS

While space limitations prevent a detailed account and justification for the attention-value model, we hope that this paper provides at least minimal understanding. A more detailed account is in preparation. It will include a review of other theories/models, an examination of empirical research, and a detailed checklist for applying the model. For the moment, we return to the original questions at the beginning of this article.

### Answers to key questions about visitor attention

- 1. *What is “visitor attention”?*** Our definition of visitor attention includes four elements: (1) a continuum of stages of attention from capture to focus to engage; (2) a unique set of variables that operate during each stage; (3) a number of attention processes that emerge from the interaction among personal, psychological, and environmental factors; and (4) a distinct set or combination of indicators (responses, actions) that occur at each stage of attention. We believe that this definition is comprehensive and incorporates ideas from the various theories or models of attention found in the visitor and psychological literature.
- 2. *To what do visitors attend?*** The attention-value model assumes that exhibit elements capture attention in one of two ways: by either a stimulus-driven or a goal-driven process. In the stimulus-driven process, a powerful stimulus such as a loud noise involuntarily captures attention. A goal-driven search occurs either by a sequential examination of exhibit elements (systematic search from one element to another) or by a simultaneous searching process in which a salient stimulus “pops out” of a stimulus complex. Visitors search for exhibit elements that have potential personal value, and when found, they narrow their attention to the element and judge (usually unconsciously) whether or not the value (utility/costs) is sufficiently high to invest the time and energy to deeply engage with the exhibit element. The search process is neither random nor necessarily conscious. We are not always aware of why and how our attention is captured, focused, and engaged.
- 3. *Why do visitors attend? What is the motivation?*** Visitors attend to exhibit elements that are perceived as having high personal value (a ratio of utility divided by cost). While value is assumed to be the most important motivator of attention, other factors also play a role. For example, if energy level is low, or if “museum fatigue” occurs, visitors become more selective in their attention. That is, they are likely to select only the highest value elements for attention. Action tendencies (e.g., learned persistence and pre-visit agenda) may also play a role in what is given attention. Some visitors have learned to be more persistent in trying to understand the messages of the exhibit elements. Pre-visit agendas differ depending

upon the amount of time budgeted as well as the make-up and desires of other group members.

4. ***How do the processes or mechanisms of attention work?*** We have described several mechanisms that play a role in attention. These processes include: the orienting reflex; sequential and simultaneous searches; focusing mechanisms; action tendencies (e.g., pre-visit agendas, learned persistence), decision-making mechanisms; physical and mental states (fatigue, satiation, etc.). These processes help tie together the factors that have an impact on attention with the outcome measures or indicators.
5. ***What factors interfere with paying attention to important exhibit elements?*** Distraction, fatigue, satiation, and low energy level all play a significant role in visitor attention. Exhibit design plays an important role in minimizing the negative impact of these factors. For example, poorly organized exhibit elements do not make it clear how to sequence attention from one element to another. Extremely large exhibition halls may exhaust visitors long before reaching the end of the exhibits. Loud noises, sudden movements, and flashes of light may distract visitors from engaging with exhibit material in a meaningful way. Monotonous display of exhibit objects in an “open storage” type of exhibition may lead to rapid object satiation. Both a lack of high interest exhibit content (low perceived utility) and/or a high cost/workload result in low perceived value to attend.

### **Final Word**

Additional research is needed to test and refine the attention-value model. While no theory or model is perfect, I hope the current approach leads to some beneficial research and is of practical use to museum professionals.

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## Appendix A

### EXAMPLES OF INFERRED OUTCOMES ASSOCIATED WITH ENGAGED ATTENTION

The visitor literature contains numerous examples of studying the product of engaged attention. Some of these examples emphasize methods of measuring engaged attention (e.g., Personal Meaning Mapping), while others emphasize design principles that create engaged attention (e.g., exhibit efficiency). Still others propose a psychological construct that is relevant when attention is engaged (e.g., flow, immersion, restoration). All of these examples are tied together by their relationship to engaged attention. The following serves as selected examples rather than an exhaustive review.

**Learning.** Learning has received the most attention as a museum experience outcome for many reasons, not the least of which is that museums include education as a major part of their mission. Given the differences of opinion on what learning is (or is not), it's a wonder that any fruitful discussion occurs on the subject. Perhaps the safest thing to do here is note that learning (whatever it is) is consistently measured by recognition and recall of memory. Of course, new information is assimilated and accommodated with the cognitive structures and knowledge that visitor bring to the museum as so many writers have emphasized.

**Flow.** Csikszentmihalyi (1990) has adapted and further developed Maslow's concept of "peak experience" in his construct of "flow." Flow is assumed to involve completely focused motivation during some activity (thus its connection to the engage stage). Flow is accompanied by energized focus, full involvement, and a feeling of accomplishment or success in performance. Harvey, Loomis, Bell, and Marino (1998) found self-reported flow experiences after renovation of natural history museum exhibition halls.

**Simulated immersion.** Bitgood (1990; 1991) expanded Coe's (1986) concept of landscape immersion into a more general notion of "simulated immersion." Immersion was defined as the illusion of "feeling in a specific time and place." Jon Coe (1986), a zoo designer, is part of a movement of landscape immersion that has come to dominate zoo design. "The visitor leaves the familiar grounds of an urban park called a zoological garden, and actually enters into the simulated habitat of the animals." (p.9, Coe, 1986). A similar movement of immersion can be found in living history museums (e.g., Yellis, 1990). (See Harvey, et al, 1988 and Gyllenhall, 2002 for additional examples.)

**Exhibit efficiency.** Screven's (1999) suggested the concept of "exhibit efficiency" or "the time and effort it takes to process a display's content." Efficiency was hypothesized to be a function of both personal factors (e.g., time limitations, fatigue, attitudes), viewer's interest in learning, and the design characteristics of the exhibit. Exhibit efficiency is somewhat related to the notion of value ratio. Unfortunately, Screven did not offer a workable methodology for assessing exhibit efficiency.

**Attention Restoration Theory.** Kaplan developed the theory of attention restoration (Kaplan, 1983; 1995; Kaplan, Bardwell, & Slakter, 1993; Kaplan & Kaplan, 1989). The stresses of everyday life are assumed to decrease the capacity to direct attention and create directed attention fatigue (Kaplan, 1995; Kaplan & Kaplan, 1989; Kaplan, et al, 1993). According to this theory, restoration of directed fatigue requires four components: being away, extent, fascination, and compatibility.

**Knowledge hierarchy assessment.** Deborah Perry (1993) proposed a knowledge hierarchy assessment technique “based on a careful examination of the exhibition, discussions with exhibit developers and in-depth interviews with visitors.” Such an approach assumes that there is a knowledge structure to an exhibition which is capable of communicating this structure to visitors. The technique is individualized for each exhibition.

**Assessment of family learning.** Minda Borun’s work on family learning with the Philadelphia collaborative (PISEC) project (Borun & Dritsas, 1997; Borun, Chambers, Dritsas, & Johnson, 1997; Borun, Chambers, & Cleghorn, 1996) suggest a methodology to measure different levels of engagement related to informal learning. She and her colleagues used three levels of learning: (1) identifying (describing simple activity, naming or group animals); (2) describing (describing specific animal or plant species, making a general connection to other situations); and (3) interpreting and applying (describing how different species support compete or adapt, mentions system of classification). These three criteria can be considered an analysis of different levels of attention engagement.

**Personal meaning mapping.** Using a constructivist rationale, John Falk has suggested Personal Meaning Mapping (PMM) as a method for assessing attention engaged outcomes in exhibit environments (Adelman, Falk, & James, 2000; Falk, Moussouri, & Coulson, 1990). Participants were asked to write words, ideas, images, phrases, or thoughts that came to mind related to exhibit content. These words formed the basis of an open-ended interview in which visitors are encouraged to explain why they wrote what they did and to expand on their thoughts and ideas. Responses are recorded on the same paper and different colors of ink are used for prompted vs unprompted responses. PMMs from pre-visit are compared with post-visit PMMs. Changes in the following dimensions are examined: (1) quantity of appropriate vocabulary (counting number of relevant words/phrases written down by visitor); (2) breadth of a visitor’s understanding, range of conceptual understanding (change in the quantity of appropriate concepts utilized); (3) depth of visitors’ understanding, how detailed and complex within a conceptual category, descriptions were (e.g., how many different types of gems did visitors list?); (4) according to Falk, et al (1998) the fourth criterion is mastery (the overall facility with which visitors described their understanding, rated on a 1-4 scale, novice to expert). However, Adelman, et al (2000) listed the fourth criterion as “emotional intensity.”

**Russell’s design list.** Bob Russell (2000) provided a provocative list of ten suggestions for designing engaging exhibits: (1) provide advance organizers; (2) design accessible, attractive, inviting involving environments; (3) design accessible and east-to-use exhibits; (4) present real objects/phenomenon; (5) meet visitor expectations; (6) provide entry points to meet

individual visitors' needs; (7) offer visitors choices, control, feedback and success; (8) support direct experiences with labels, staff explainers, and opportunities for cooperative engagement; (9) provide support for follow-up educational experiences; and (10) evaluate. While these suggestions had minimal detail, there is little argument of their importance. One difficulty is that they do not organize design principles into an integrated theory of visitor attention. If the list of these ten points were incorporated into a conceptual system, they might be more useful to practitioners and to researchers to wish to tease out implications of the theory.

**Empathic dramatic engagement.** Du Toit and Dye (2008) describe “empathic dramatic engagement” in art museums. Visitors construct meaning by “... actively [reaching] out to new knowledge contained within the exhibition and its narratives, and contextualizing significant affective and cognitive percepts through a process of appropriation, assimilation, accommodation, and identification.” (pp. 73-73). According to authors, this process is the product of experience (both previous and in-museum experience), narrative (visitor constructs a “story” related to exhibit content), and play (imaginative association and elaboration of ideas). Measurement of empathic dramatic engagement is accomplished by analysis of post-visit audio recordings of informal conversations (narratives) between the evaluators and the visitors. The discussions are examined in terms of character, plot, dialogue, setting, and suspension of disbelief. Character “refers to the essential nature of a work of art.” Plot refers to the narratives that visitors construct using their memories and imaginations to “fill in the gaps” between what information is given and what makes sense as part of the story. Dialogue “is often the medium through which the plot progresses....[it is] manifest in both explicit language and implicit non-discursive communication.” (p 80). Setting “provides a staged world within which the characters operate.” (p 81). Suspension of disbelief and imaginative elaboration is “the willingness of a person to accept as true the premises of a work of fiction ... and a willingness ... to overlook limitations or shortcomings of the medium.” (p. 81). Incidence of the above dramatic elements reported from this study were: 100% of visitors included dialogue; 90% included suspension of disbelief; 60%, character; 55%, plot; and 25%, setting.

**Experience-benefit analysis.** As we previously noted, engaged attention can result in more than learning outcomes. Jan Packer (2008) examined the experiences (satisfying and restorative) and benefits (psychological well-being, subjective well-being, and restoration) of a museum visit. Visitors were interviewed following their visit. Satisfying experiences were mentioned in 93% of interviews including experiences associated with objects, cognition, introspection, and social interaction. Restorative elements were mentioned in 73% of interviews. For benefits and outcomes, psychological well-being was mentioned in 59%, subjective well-being in 11%, and restoration in 57% of interviews.

**Inquiry behaviors.** Sue Allen and Joshua Gutwill (2009) reported a project at the Exploratorium in which visitors were trained to engage in inquiry behaviors. Inquiry behaviors were defined as a series of steps (observing, asking questions, testing hypotheses, etc.). The study found that training visitor groups to ask a question to drive investigation and

to interpret the results of their investigation at the end improved inquiry behavior at a subsequent exhibit and was rated as enjoyable.

**Table 1**  
**The Attention-Value Model of Visitor Attention**

| <b>STAGE OF ATTENTION</b> | <b>Response Indicators</b>   | <b>Explanatory Processes/Mechanisms</b>   | <b>Factors that influence the experience</b>   |
|---------------------------|--|---|--|
| <b>CAPTURE</b>            | <ul style="list-style-type: none"> <li>- Look at</li> <li>- Feel, touch</li> <li>- Approach</li> <li>- Stop</li> </ul> | <ul style="list-style-type: none"> <li>- Orienting reflex</li> <li>- Searching (sequential or simultaneous)</li> <li>- Decision making</li> <li>- Physical/mental states</li> </ul> | <ul style="list-style-type: none"> <li>- Salience</li> <li>- Visual-physical access or Proximity</li> <li>- Organization/layout of elements</li> <li>- Perceived value</li> <li>- Distractions</li> </ul>                                |
| <b>FOCUS</b>              | <ul style="list-style-type: none"> <li>- View element for few sec</li> <li>- Touch object briefly</li> </ul>           | Narrowing of attention from a broad frame of reference to a single object   | <ul style="list-style-type: none"> <li>- Isolation</li> <li>- Perceived value</li> <li>- Organization-layout</li> <li>-Focusing devices</li> <li>- Contrast with background</li> <li>- Distractions</li> </ul>                           |
| <b>ENGAGE</b>             | <p>Read text labels<br/>Discuss content<br/>Report feelings</p>  | A number of intellectual, perceptual, and affective processes (learning, flow, inquiry, immersion, etc.)  | <ul style="list-style-type: none"> <li>-Perceived value</li> <li>- Message characteristics</li> <li>-Action tendencies</li> <li>- Physical/mental states</li> <li>- Qualities of the exhibit elements</li> <li>- Distractions</li> </ul> |

## Table 2

### Definitions of Terms

**Attention:** a set of cognitive processes involving three stages that may eventually lead to experiences such as learning, flow, inquiry, immersion, etc.

**Attention capture:** the initial stage of attention in which attention to an object or element is broad, unfocused, and lacks deep processing; capture can occur via the orienting reflex or by parallel or serial searching.

**Attention-inferred outcomes:** varied experiences (e.g., learning, immersion, flow, inquiry) that result when engaged attention occurs

**Attention influencing variables (independent variables):** the variables or factors that influence whether or not an individual pays attention

**Attention processes:** the inferred mechanisms that tie the independent variables to the dependent variables

**Costs:** the expenditure of time, effort, and other resources associated with a particular choice

**Decision-making:** the mechanism by which individuals make choices

**Engaged attention:** the most involved stage of attention that is characterized by long duration viewing, concentration of processes, and that results in attention-inferred outcomes (e.g., learning)

**Explanatory process or mechanism:** A process inferred by studying the relationship between the dependent (behavior that is overtly measured) and independent variables (factors that influence the overt behaviors).

**Focused attention:** the second stage of attention in which attention moves from a broad, unfocused manner to a narrow, focused one

**Orienting reflex:** automatic capture of attention to a powerful stimulus such as a loud noise, sudden movement or flash of light; usually a distraction

**Parallel searching:** a search strategy in which attention is broad, taking in the whole Gestalt and the individual waits for something to “pop out” of the stimulus complex

**Response indicators of attention (dependent variables):** the overt behaviors that indicate an individual is paying attention

**Serial searching:** a search strategy in which attention examines each stimulus one at a time in a sequential manner until a stimulus with a high potential value is found

**Utility:** the potential and/or real benefit, reward, or satisfaction an individual obtains from a particular choice

**Value:** a ratio of utility divided by costs; assumes that individuals make choices (often without awareness) based on a combination of utility (benefits) and costs and that this relationship can be expressed quantitatively as a ratio rather than some other mathematical form