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The Attentional Blink
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The Attentional Blink

Overview

In order for recognition of a certain stimulus to take place, visual attention needs to be directed towards said stimulus. To the earliest parts of the visual system, objects are not objects, they are collections of visual features—lines, corners, changes in texture, color, and light. Attention is the resource that is necessary for later processing in order to recognize what a given bundle of features adds up to. This makes attention a central focus of research. One especially important set of questions concerns how people sustain attention, that is, the extent to which they can continuously maintain a focus of attention from moment-to-moment. It is now known that sustained attention takes great effort. When attention needs to be focused very rapidly on something that is moving or changing very quickly, the effort involved causes a momentary lapse in attention once it is disengaged. This kind of lapse in attention is called an ‘attentional blink.’ It is like the brain blinks for a moment, shutting down attention for a rest. Stimuli that appear during an attentional blink will not be perceived.

In 1992, a group of researchers devised a paradigm to study the attentional blink, and the paradigm has come to be known by the same name. is a paradigm that It demonstrates some of the challenges to maintaining focused attention. This video demonstrates how to implement the attentional blink paradigm in order to study sustained visual attention.

Procedure

- 1. Equipment
 - 1.1. The experiment requires a computer and experiment implementation software such as E-Prime, or a programming environment such as MATLAB or PsychoPy.
- 2. Stimulus and Experiment Design
 - 2.1. This experiment relies on a general experimental procedure called Rapid Serial Visual Presentation, RSVP for short.
 - 2.1.1. The basics of RSVP involve experimental trials in which a series of images is shown rapidly, one after the other. Images usually remain in a display for less than 200 ms, before being replaced by another image, making extensive processing of the images difficult.
 - 2.2. Start by making a basic RSVP program. Set it to present streams of large black lowercase letters (Helvetica font) in the center of the display, each one lasting only 50 ms. The letters should take up about 2.5 inches vertically and 1.5 inches horizontally. **Figure 1** schematizes an RSVP sequence.

Commented [JS1]: Can you clearly define the phenomenon of attentional blink in the Overview section? Right now, the relationship between attentional engagement and rapidly changing information is unclear (until we get to the Results section)—that we are talking about the brain's eyeblink, rather than studying eyeblink responses.

Commented [JS2]: Please provide a reference to Shapiro and colleagues.

Reference: Raymond, J. E., Shapiro, K. L., & Arnell, K. M. (1992). Temporary suppression of visual processing in an RSVP task: An attentional blink?. *Journal of Experimental Psychology: Human Perception and Performance*, 18(3), 849.

2.3. Now, to make this an attention capture program, do as follows:

- 2.3.1. Make trials that are 30 images long—*i.e.* there will be 30 characters displayed, each for 50 ms, making each trial 1.5 seconds total.
- 2.3.2. 28 of the characters in each trial are lowercase letters as just described, but two are numbers.
- 2.3.3. In each trial, randomly select the two numbers between 1 and 9 to show, but also ensure that the two numbers in a trial are always different.
- 2.3.4. Randomly select the place in which the first number appears within the boundary of the eighth item presented and the twentieth item presented. In other words, in each trial, place one number somewhere between the eighth and twentieth RSVP position.
- 2.3.5. The second number appears anywhere between immediately after the first and six positions after it. Since the position of the second number is defined relative to the first, these are called ‘lag positions’. The second number can have a lag position ranging between 1 and 6. In fact, over the course of the whole experiment there will be an equal number of each of the lag positions between 1 and 6. **Figure 2** schematizes the concept of a lag position.
- 2.3.6. Program the experiment to include 180 trials total, 30 each for each lag position, 1-6.
- 2.3.7. At the end of each trial, the screen should read “First? Second?”, as shown in **Figure 2**, to prompt the observer to report the numbers they saw during the trial.
- 2.3.8. Finally, set up the program to produce an output spreadsheet that reports all the relevant data. Each row in the file corresponds to the contents of a single trial, and should include the following information, as shown in **Figure 3**: the trial number, the position of the first number in the RSVP stream, the lag position of the second number, the true identity of the first number, the true identity of the second number, and the key press made by the participant to identify the first number, and the same for the second.

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3. Running the Experiment

- 3.1. For a complete experiment, it is ideal to test between 10-20 participants, but the result of this experiment should be apparent in the data of most individual participants.
- 3.2. To test a participant, seat them in front of the computer monitor so that the back of their chair is about 60 cm away.

3.3. Explain the instructions to them as follows:

3.3.1. “This experiment is designed to investigate the speed of human attention. Each trial will be more or less the same. You will see a screen with the word ‘Ready?’ on it. The screen will remain so until you press the spacebar to initiate a trial. Once a trial is initiated, you will see a series of lowercase letters appear rapidly in the center of the screen over the course of 1.5 seconds. Two numbers will appear embedded between the letters. They will appear in random positions, and not necessarily immediately after one another. Your task is to pay close attention to the sequence of letters, and to try to recognize the two letters that appear. At the end of a trial, you will be prompted to input the numbers that you think appeared, and in the order that you think you saw them, the first one first, followed by the second. There will be 180 trials total, so the experiment should only last 5-10 minutes. It is very important, however, that you do your best. If you are uncertain about the identity of a number in any trial, just guess. Any questions?”

3.4. After answering any questions, start the experiment for the participant, watching as they completes a few trials in case any further questions arise. Then leave the participant to complete the experiment.

4. Analyzing Results

4.1. The first thing to do in order to analyze the results is to add two columns to the now populated data spreadsheet, a column called Accuracy 1, and one called Accuracy 2, meant to indicate whether the participant correctly identified the number in each position in that trial. Compare the actual number that appeared in each trial with the response given, filling the column with a 1 for a correct response, and a 0 for an incorrect response. **Figure 4** shows how the table should look at this point.

4.2. Now compute the overall response accuracy for the participant for the first number. Do this by averaging the numbers in the Accuracy 1 column of the spreadsheet. This should be very high, between 0.90 and 1.

4.3. Finally compute the average response accuracy for each of the six lag positions for the second number.

Representative Result

Graph average response accuracy for the first number, along with response accuracy for the second number as a function of lag position. **Figure 5** shows an example. The graph can be generated for each participant, or averaged across a group of participants. As shown in the figure, the pattern of performance is that participants tend to be very accurate reporting the identity of the first number in each trial. This demonstrates that even though the number appears very

briefly, in an unpredictable location, and embedded between letters, focused attention can support detailed processing and recognition. Immediately following numbers are processed accurately as well, as shown by the relatively high performance for [Lag 1](#) numbers. This is known as [Lag 1](#) sparing. It is thought that as the focused attention remains engaged during this time, the rapid appearance of the next number allows it to be processed. However, at [Lags 2](#) and [3](#), performance is considerably impaired. This is the phenomenon that is known as the attentional blink. The idea is that following the processing of the first number, attention becomes temporarily disengaged—like blinking one’s eyes. Remember, the numbers shown in lags 2 and 3 last for all of 100 ms, not a very long time. They just happen to appear during a brief period in which attention disengages. It quickly re-engages however, to support rapidly improving performance during for [Lags 4](#), [5](#), and [6](#). Taken together these results demonstrate the power and limitations of sustained visual attention. Attention can be sustained to find and identify brief and unpredictably positioned stimuli—numbers. Intensive processing is followed by a brief respite, temporarily limiting the ability to recognize objects.

Applications

Like many other laboratory tasks for studying attention, the attentional blink has become a common tool in studies of brain damage, as well as in studies that use neuroimaging techniques to investigate the brain areas involved in controlling and coordinating attention.

The attentional blink [paradigm](#) has also been used to investigate the kinds of things that may capture attention automatically, and even how anxiety and other mental health problems may cause diverted attention. These studies use the same paradigm just described, only with pictures of real-world images instead of letters. A participant’s task would be to detect any image that is rotated in an unusual position, reporting at the end of the trial whether the rotated image was an indoor or an outdoor scene. **Figure 6A** shows an example of this basic paradigm. **Figure 6B** then shows how the paradigm is used to ask whether something automatically captures attention. There, a spider is shown in the RSVP stream prior to the target. In fact, the target is shown at lag 2 relative to the spider image. The spider is not task relevant, but fear of spiders is common. If the visual system is tuned to automatically detect and process spiders, then the presence of that image in the stream would produce an attentional blink. Indeed, that is what has been found—spiders, snakes, and other threatening images automatically capture attention, producing an emotion-induced attentional blink.

Researchers have also used this paradigm to investigate differences between people with severe phobias, and those with just the usual antipathy towards spiders. In this case, the paradigm is reversed. A target is presented and a spider is shown at [Lag 2](#). Is the spider seen, or is it rendered invisible because of the attentional blink? For most people, perception of the spider is blocked by the attentional blink. But for individuals with arachnophobia, the spider is seen, even in lag positions that should suffer from a blink. This suggests that phobia causes certain stimuli to have a very strong pull attention, even when attention would otherwise be disengaged.

Legend

Figure 1. The basics of rapid serial visual presentation (RSVP). A series of images is shown in rapid succession, in this case, lowercase letters each remaining for only 50 ms before becoming replaced by the subsequent letter.

Figure 2. Methods for the attentional blink. A ready screen is followed by an RSVP stream consisting mainly of letters, 30 images in total. Embedded among the letters are two numbers. The first number appears anywhere between the eighth and the twentieth positions in the stream as a whole. The position of the second number is called a ‘lag’ and defined relative to the appearance of the first number such that following the first immediately is called ‘Lag 1,’ the next position Lag 2, and so on. The experiment consists of 30 trials at each of lags 1-6.

Figure 3. Organization of a data output table for an attentional blink experiment. Each row corresponds to a trial of the experiment. The important parameters to record are the position of the first number in the stream (a value between 8 and 20), the lag until the second number (a value between 1 and 6), the identity of the two numbers shown, and the responses given by the participant at the end of the trial.

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Figure 4. Populated data output for an attentional blink experiment. The columns Accuracy 1 and Accuracy 2 report whether the response entered by a participant matched the actual identities of the number presented during each trial. 1 indicates a correct response, and 0 indicates an incorrect response.

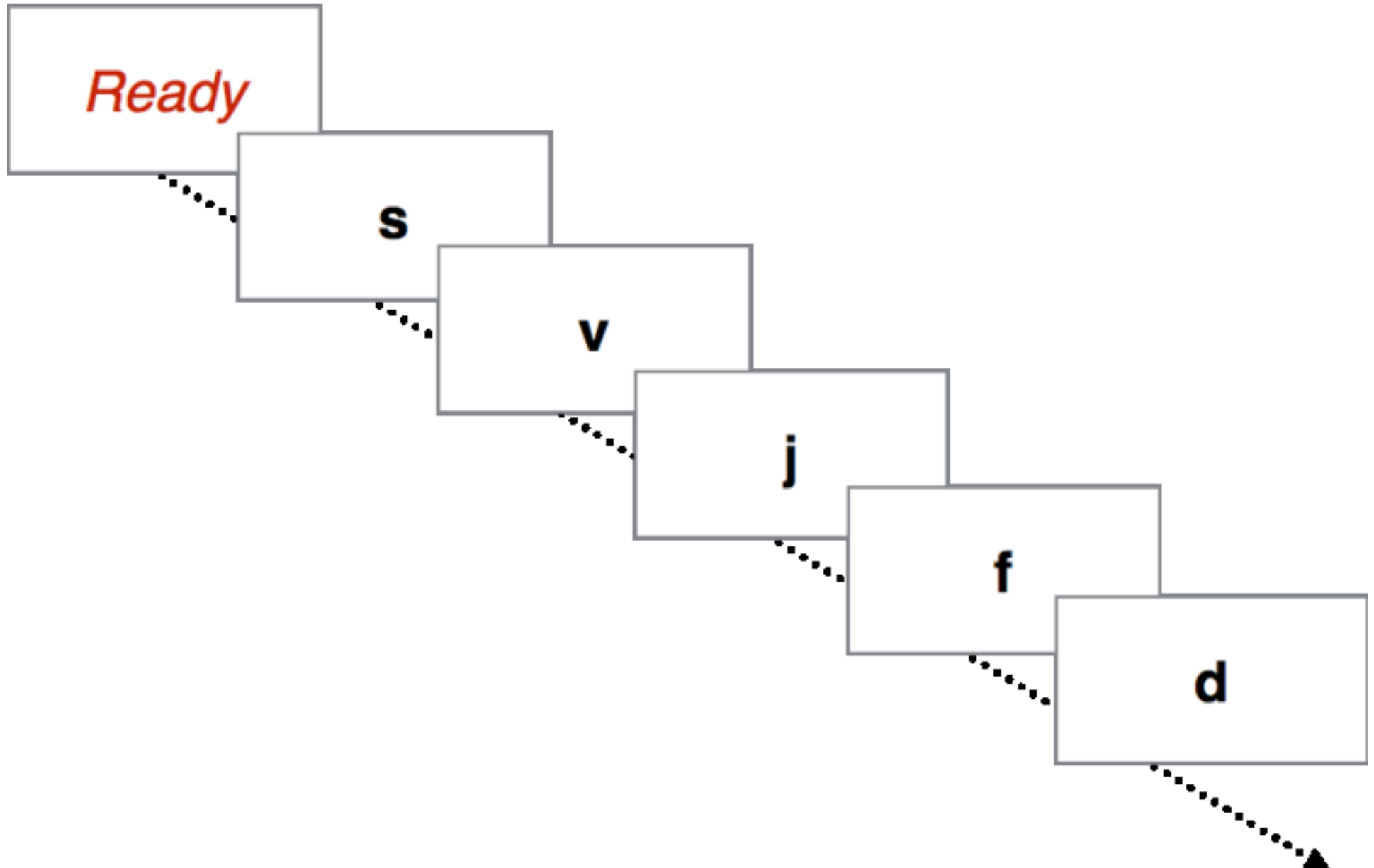
Figure 5. Results of an attentional blink experiment. As shown, participants are generally able to report the first number in a sequence with very high accuracy, here about 0.97. When a second number appears immediately, performance is not as good, but still very high—a phenomenon called lag 1 sparing. In the second and third lag positions, performance tends to be very poor however. This is called the attentional blink, the idea being that attention is mustered to process the first number rapidly, and then becomes momentarily unavailable—like blinking one’s eyes— before it can be engaged again to recognize a second number. The results suggest that heavily focused attention can be sustained, but only with brief interruptions following bouts of intensive processing.

Figure 6. Methods for the emotion-induced attentional blink. Panel A shows a general RSVP procedure with photographic images. The task is to detect the image in the stream that is rotated (called the ‘target’), and at the end of the trial, to report whether that image was an indoor or an outdoor scene. Panel B shows how these methods are used to produce an emotion-induced attentional blink. Prior to the appearance of the target, an emotional-inducer is shown, here a spider, an object about which many people express fear and anxiety and which tends to grab attention. The target is then shown at lag 2 relative to the emotional-inducer. Although the inducer is task-irrelevant, if it is sufficiently attention-grabbing, it will produce an attentional blink, and participants will have difficulty detecting the rotated target, evidenced by inaccurate indoor/outdoor reports.

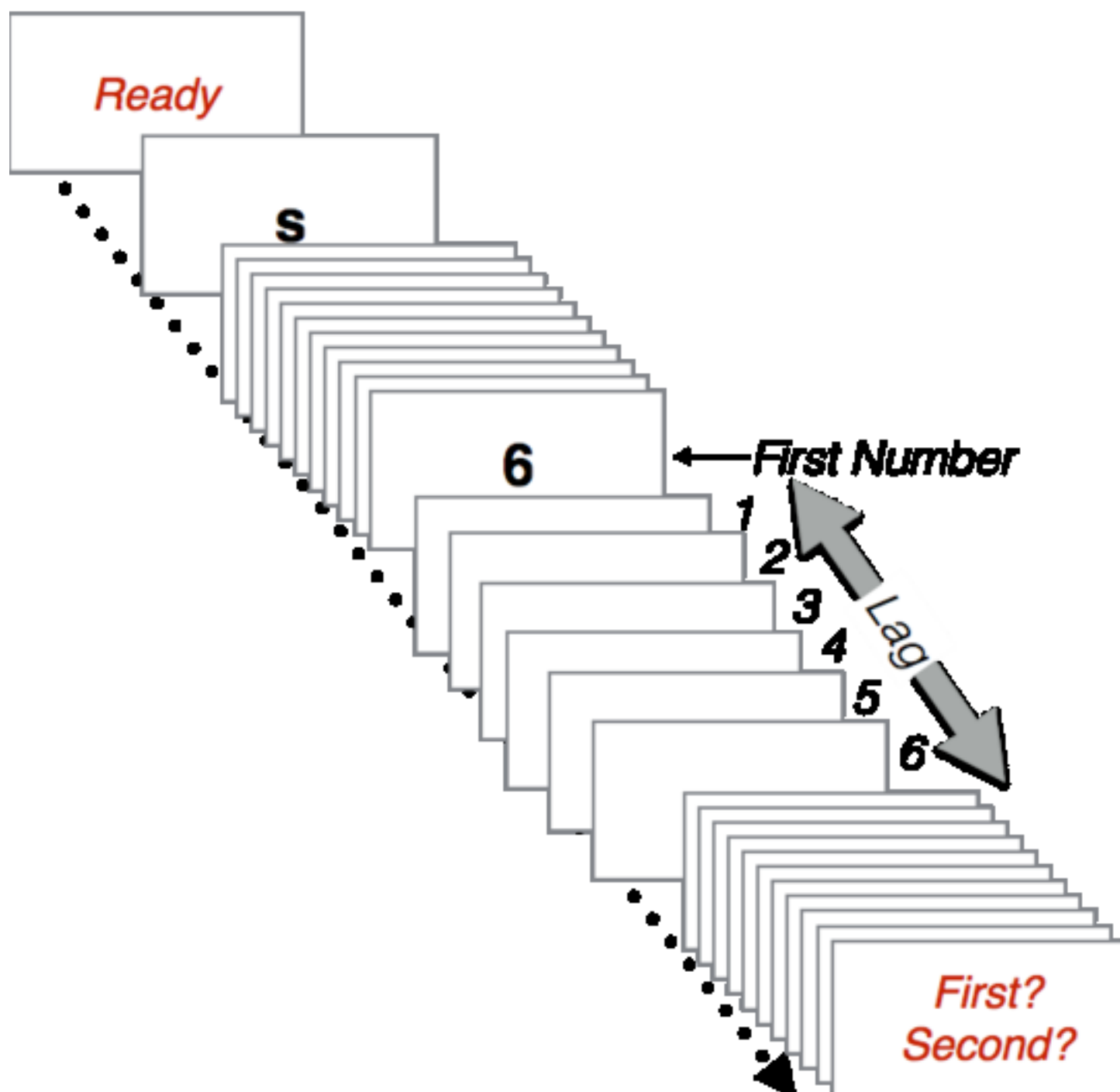
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* Note, all images were obtained from <https://pixabay.com/>, and are available without copyright restrictions.

Rapid Serial Visual Presentation (RSVP)



The Attentional Blink Methods



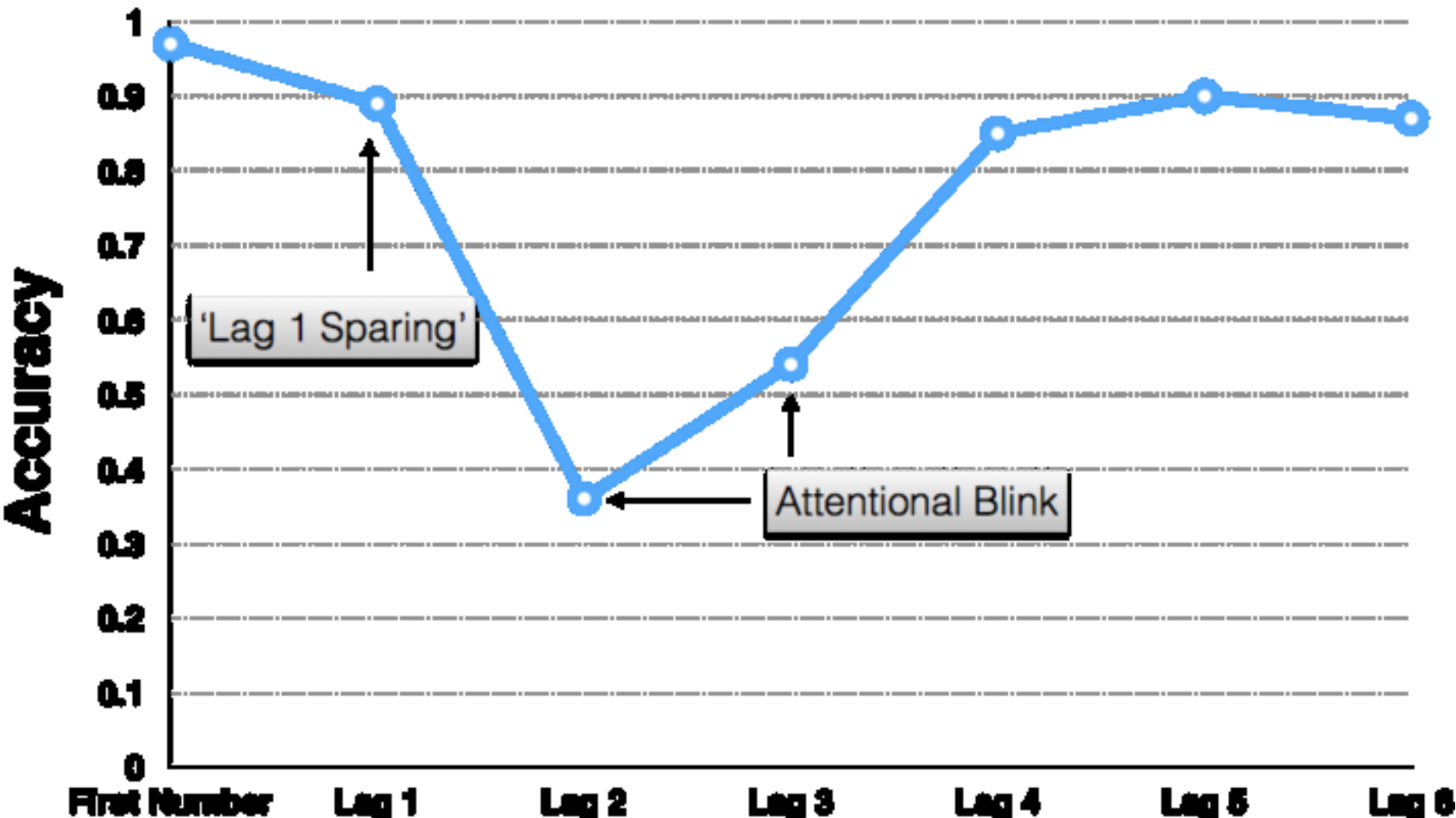
Data Output Table for Attentional Blink

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Populated Data Output for the Attentional Blink

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	A	B	C	D	E	F	G	H	I
1	Trial #	Position First Number	Lag	1st Number ID	2nd Number ID	Response 1	Response 2	Accuracy 1	Accuracy 2
2	1	19	1	1	8	1	8	1	1
3	2	18	6	1	3	1	3	1	1
4	3	10	5	5	9	5	9	1	1
5	4	17	6	6	6	6	6	1	1
6	5	9	2	6	7	6	3	1	0
7	6	14	3	3	7	3	4	1	0
8	7	8	1	2	5	2	5	1	1
9	8	12	6	1	8	1	8	1	1
10	9	14	3	9	5	9	5	1	1
11	10	15	6	6	1	6	1	1	1
12	11	26	3	3	4	3	4	1	1
13	12	8	2	1	7	1	6	1	0
14	13	18	6	1	8	1	8	1	1
15	14	18	3	9	4	9	4	1	1
16	15	17	2	4	8	4	8	1	1
17	16	23	4	8	1	8	1	1	1
18	17	8	3	6	4	6	4	1	1
19	18	11	4	9	9	9	9	1	1
20	19	13	1	6	7	6	7	1	1
21	20	25	2	3	7	3	4	1	0
22	21	15	2	3	7	3	7	1	1
23	22	20	2	5	3	5	3	1	1
24	23	13	1	4	8	4	8	1	1
25	24	22	2	5	4	5	9	1	0
26	25	14	6	1	2	1	2	1	1

Results: The Attentional Blink



The Emotion-Induced Attentional Blink

