Cognitive Psychology Background In The Creation Of Popular Science Videos

INTRODUCTION

When creating popular science videos for online publications, content creators, who are called “YouTubers” in the case of YouTube, may want to understand what elements can have effects on their viewer’s watching behaviour. Therefore, it is interesting to look into cognitive psychology areas when studying elements of popular science videos that affect popularity, and thus have an impact on the viewers’ behaviour. Indeed, cognitive psychology focuses on unseen processes of knowledge and the complex relationship between stimulus and response.

Previous literature has explored some applications of cognitive psychology in video making (Ibrahim, 2012), but not focusing on online popular science videos. The aim of this paper is thus to gather the state of the art about cognitive psychology, which will be grouped into four areas, to gather clues on elements to look into when considering the effect of audiovisual elements of popular science videos.

Social learning elements will first be presented, followed by the role of emotions and storytelling in engaging viewers. Afterwards, different types of attention and strategies for capturing it will be presented, as well as the working of memory.

SOCIAL LEARNING

“Monkey see, monkey do”. This well-known expression describes unthinking imitation or mechanically learning or performing something according to the Oxford English Dictionary (2022). Although it does not rigorously represent how humans behave, it illustrates the general idea of social learning theory: “most human behaviour is learned observationally through modelling: from observing others one forms an idea of how new behaviours are performed, and on later occasions, this coded information serves as a guide for action” (Bandura, 1977). How people observe and model what they see determines how and why they learn.

One way of learning this way is through mimicry, which describes the fact that people tend to imitate their interlocutor’s facial expression to “affiliate and [facilitate] an effort to establish rapport with others” according to the American Psychological Association (n.d.). It takes the human brain between 150ms and 180 ms to analyze someone’s facial expression and 500 ms for facial mimicry to be activated (Mangiaracina, 2023). This duration can increase if the facial expression is more

complex than a simple happy or angry face. This is important to know as content creators need to create a feeling of affiliation with the viewer for them to keep watching their video.

The recognition of emotion is also important for the smoothness and effectiveness of interacting socially with someone else. In online videos, there is no synchronous interaction, but the facial expression of the host can help the viewer predict the host's behaviour, thus participating in the decision-making of whether or not to continue the interaction (Marraffa, n.d.), which is watching the video. Therefore, it is important for content creators who appear in their videos to work on their facial expressions to induce their viewers into mimicking and understanding the emotion as rewarding. The reason why the brain aims for rewards is discussed later in this paper.

EMOTION AND STORYTELLING

"Information travels under the guise of idle chatter", as Berger (2016) said. People share information through the means of stories because humans think through narratives. Storytelling often increases the effectiveness of communication because it appeals to emotions, which consequently improves memory and recall the information (Haven, 2007). The way the information is narrated is as important as the information itself. As McLuhan (1964) put it: "the medium is the message". The medium through which information is communicated is as valuable, if not more than the information by appealing to other cues that are not the words of the information itself. This is an important concept to keep in mind when creating content; it is not only essential to think about the words carrying the message but to also care about the support on which this message will be conveyed. One cannot carry on to be popular without the other.

According to Berger (2016), ideas or products that trigger an emotional response are more likely to be shared, and thus become popular, because of the call to action they induce. This applies to videos too; moving images can transmit emotions to the viewer, which can consequently create viewer engagement (León and Bourk, 2018). A distinction needs to be understood between emotions and action or perception when creating a message because only emotionally connoted messages will drive the receiver of this message to act upon it. Actions and perceptions are considered 'neutral' and do not solicit the brain in the same way as emotions (Herbert, 2022). This is due to early posterior negativity (EPN), which is a neurological "indicator of processing emotional valence and arousal of visual images and faces"

(Sarraf-Razavi et al., 2018). Compared to neutral messages, emotional ones trigger this indicator significantly more, which then leads to “bodily activation” or action (Herbert, 2022). Thus, to keep viewers engaged, YouTubers should add emotional levers in their videos.

Some emotions are more effective than others at creating engagement, depending on the arousal they procure. High-arousal emotions, which are awe, excitement, amusement, anger, and anxiety push people to action better than contentment and sadness which are low-arousal emotions (Berger, 2016). This is neurologically explained by the EPN being more highly elicited when facing high-arousal emotion-inducing situations (Mangiaracina, 2023). Therefore, it is important to weigh which emotions content creators wish to transmit to evoke the right, engaging emotions for their videos to be shared.

ATTENTION

Perception is what allows the human mind to give meaning to sensations; these sensations are gathered through one’s attention, which catalyzes one’s “mental activity on a single object or activity”. This allows the brain to focus on one relevant element to the task at hand (Lieury and Léger, 2020). The other elements are being seen yet discarded if judged non-relevant to said task (Simon, 2010). Facial expressions, emotions and storytelling are essential elements to be aware of when creating content, but understanding how attention works complements these elements to use them efficiently and retain the viewer until the end of the video.

There are four types of attention to be aware of (Chung-Fat-Yim et al., 2022):

- **Sustained attention**, which means concentrating on something for an extended period. After this period, a certain amount of time is needed to be able to focus in such a manner again. This is the kind of attention required to go through an entire popular science video;
- **Selective attention**, which describes the brain’s ability to focus on a particular item in a complex, stimuli-rich environment. This type of attention can lead to communication issues as it may leave important cues out, such as non-verbal communication elements. Having this mind, it is important to not overload the video with information, both visual and auditory, for the viewers to process each element and not miss out on important facts;
- **Alternating attention**, which characterizes the ability to switch one’s focus between two elements, enabling them to ‘multitask’;

- **Divided attention**, that defines one's ability to focus on and process multiple elements at a time. This type of attention is used while driving, for example.

These last two types are less relevant in the context of watching videos as a single activity but are still used if viewers watch videos while doing another activity.

Exposing the mind to multiple relevant stimuli, such as when multitasking, can cause cognitive overload, making some relevant elements invisible to the mind because of the way the attention works (Strayer and Johnston, 2001). This is for example why being on the phone while driving can cause accidents: the brain focused on the call and missed the relevance of seeing a pedestrian starting to cross the road. The same can be applied when watching videos; if there are too many elements said and shown, the brain will automatically filter out some of them, even if they are the most relevant to understand the explained topic. It is thus important to keep important information to a minimum at once in order for the message to come across well.

There are multiple elements that lead to capturing someone's attention (Lieury and Léger, 2020):

- The first ones are the **characteristics of the stimuli** itself, such as its salience in the environment and its sudden emergence in the visual field. Therefore, visually emphasizing an element in a video can help retain the audience longer throughout the video.
- The second element regards **the thoughts, goals, and memory contents**. For example, when waiting at the airport for one's suitcase, that person's thoughts and thus goal will be directed at picking up their suitcase, and by remembering that their suitcase is blue, that person's attention will be focused on blue suitcases. Similarly, when someone clicks on a video expecting to see specific elements, they may stay at least until they saw what they were waiting for.
- The third element regards **the person's emotions**: objects with a negative valence tend to attract more attention than ones with positive valence unless the person is in a positive mood (Wadlinger and Isaacowitz, 2006). Choosing which emotion to play on in a video is thus important to retain the viewer's attention, even though a bet has to be taken on the mood of the viewer.

Another way to improve attention is to induce a vigilance state to the viewer of a video. Vigilance is a mental state preparing someone to answer to a variably intervaled stimulus (Mackworth, 1968). This vigilance will prepare the body and the mind to react in the best way possible (Robson, 2021). Playing on this predictory

feature of the mind can be helpful to retain an audience, combined with the use of doubt in presenting a subject. The human mind does not like uncertainty, therefore doubt engages people to take action to reduce this doubt in order to be able to anticipate consequences (Patino, 2019).

Creating incompleteness also focuses attention. People will feel satisfied when a task is complete, if not, they will keep doing the sequential action in order to complete the task. Social media rely on this method to keep people using them; one is never done scrolling down the timeline, creating this incompleteness (Patino, 2019). This can be applied in the context of video-watching because as long as a video gives new information without fully answering the subject, incompleteness happens. The feeling of completeness will only appear once the video is done. Though series, for example, often leave a cliffhanger at the end of each episode to continue the incompleteness and induce the viewer to stay for the next episode (Wirz *et al.*, 2022). Social media also relies on a random reward system in which each time a specific task is done, the reward—the dopamine release— differs. This goes against the individual's instinct to try and master a mechanism by finding a way that will produce the same rewards every time the related task is performed. This can be seen as another form of incompleteness. Incompleteness can be used to retain an audience, but it is also challenged by the Millenials', 8-second-long attention span, which used to be 33% longer than 20 years ago (McSpadden, 2015). This decrease is caused by overexposure to information and the overstressing of our senses. This shorter attention span is the brain's response to prevent cognitive overloading yet being aware of a maximum of information, switching its focus at shorter intervals (Patino, 2019). Therefore, it is essential for popular science video makers to give the audience a new element to focus on at most every 8 seconds, whether is it a new fact, or a new visual illustration of their speech.

MEMORY

When creating educational content, the functioning of memory is important to understand, as it is what enables someone to remember, and thus learn, information according to the Cambridge Dictionary (n.d.). There are three types of memory (Lieury and Léger, 2020): short-term memory (STM) and working memory (WM), and long-term memory (LTM).

Short-term memory is a type of memory that allows the brain to store multiple pieces of information simultaneously for several seconds (Ferguson, n.d.). According

to Miller (1956), the STM can remember on average a maximum of seven elements. Trying to remember more elements could lead to cognitive overload. Therefore, a popular science video should now aim to have more than seven different, simultaneous elements to understand the given topic. However, grouping information in chunks could help the brain to remember more than seven elements in the short term, involving the working memory (Lieury and Léger, 2020).

Working memory refers to the structure that not only allows the brain to retain information but also processes the information (Colom et al., 2006). It connects STM and LTM in order to perform and memorize elements (Baddeley, 1986). WM has four components that work together in order for information to be processed, as visualized in Figure 1 (Baddeley, 2010):

- The **executive centre** is responsible for the distribution of cognitive resources between the following three components in order to complete a specific task;
- The **episodic buffer** is in charge of linking the WM with the LTM. It will allow the WM to create new connections in the LTM with pre-existing ones, enabling the new information to be stored for a long time;
- The **phonological loop** handles all verbal information by mentally repeating information in order to extend its retention in the short-term memory, so that the visual information associated with it can be recorded and copied into the phonological storage;
- The **visuospatial sketchpad** can be seen as the equivalent of the phonological loop for visual information. It processes this information according to its visual characteristics and spatialization.

The working memory thus relies on both visual and auditory information; the quality of one should not be considered less than the other.

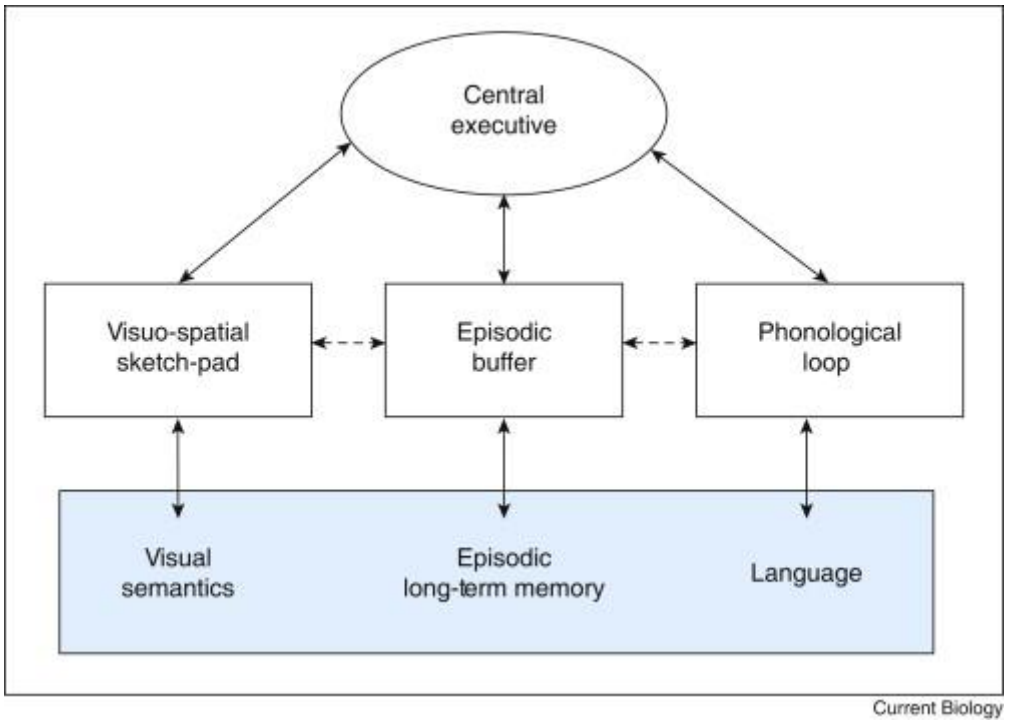

Fig. 1: A later development of the multicomponent model (Baddeley, 2010)

Triggers and emotions can facilitate the working memory's work. Triggers can do so by appealing to categories and links previously established in the LTM. These triggers can be linked to any sense (Berger, 2016). For example, seeing someone with a shopping bag may remind an individual that they need to do the groceries today, or a particular smell can bring back memories from a vacation done years ago. Emotions can also help the working memory as humans are more likely to remember elements associated with a strong, highly arousing emotion (Lieury and Léger, 2020; Berger, 2016). When creating a popular science video with the aim of facilitating the remembrance of information for the viewer, YouTubers need to think of every day or topic-related elements that can serve as triggers for the information to be retrieved from the memory later on.

Long-term memory (n.d.) is a "relatively permanent information storage", divided into implicit and declarative memories, that allows individuals to remember and use learned information for a long period, some even for life. Implicit memory can be divided into 3 categories (Camina and Güell, 2017), whose first one is most applicable to the consumption of popular science videos:

- **Associative memory**, in which information is remembered and retrieved by association with previously memorized elements (Camina and Güell, 2017). For

example, when asked to name a yellow flower, the mind will look into the "flower" and "yellow" categories, and retrieve any name associated with both in the memory, such as marigold or narcissus. Information from videos can be stored in this memory through smartly created associations when explaining a new concept, which can act as triggers once the time comes to retrieve this information from the LTM;

- **Procedural memory** (n.d.), where motor skills are stored when they have been learned by doing it. For example, this type of LTM is used when riding a bike, writing, or walking; these are all skills we can do unconsciously or without having to think too much about how to do it;
- **Non-associative memory**, which stores new behaviours learned after being exposed repeatedly to an isolated stimulus. This memory is involved in remembering habits for example (Camina and Güell, 2017);

Declarative memory (n.d.), on the contrary, comes into play when learned information that differs from skills is consciously used when it needs to be verbalized. One part of the declarative memory is the semantic memory (n.d.) where the meaning of words and information is stored. It is used when learning new concepts transmitted through popular science videos. It relies on two principles:

- The **principle of category hierarchy** states that concepts are stored in the semantic memories by category, and each category is hierarchical, just like Russian dolls (Lieury and Léger, 2020). For example, 'marigold' will be stored in the 'flower' category, which is hierarchy under the 'plants' category, and so on. Therefore, categorizing new information in a hierarchical way can help the viewer retain the presented information;
- The **principle of cognitive economy** (2014) states that the brain minimizes processing effort and resources by only categorizing specific semantic traits with a specific concept. For example, the brain will not process every detail of a flower, but will rather take the concept of "petals" only to categorize a flower. When creating a popular science video, it is thus more efficient for the viewer's information memorization to only focus on the most important and salient aspects.

Episodic memory is the other part of the declarative memory. is what enables an individual to "learn, store, and retrieve information about unique personal experiences that occur in daily life" (Dickerson and Eichenbaum, 2010). It is what stores memories about events we encounter in our daily lives.

CONCLUSION

In this paper, five different areas of cognitive psychology were overviewed that can be applied to popular science video watching and thus making. The way individuals learn from each other through mimicry and emotion recognition was overviewed. YouTubers can better communicate through their audience if they play on these aspects. It was also discussed how playing with strong emotions and working on storytelling writing can increase the audience's involvement in the content they are watching. Emotions and storytelling also contribute to the last two areas that were discussed in this paper: attention and memory. It is essential for YouTubers to know how to properly retain their audience's attention for their videos to be watched throughout. Retaining the audience impacts the watch time of their videos, which in turn influences revenue from these videos. Last, for popular science videos to succeed toward their audience, their content needs to be remembered, and memorized. Thus, the memory mechanisms were discussed in order to incorporate good ways of explaining concepts for them to be more easily remembered by the audience members.

Each of these areas could be explored further in future research in order to determine more specific techniques for popular science videos' information understanding and retention to be optimized.

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