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## Eye Movement as a Tool of Formative Assessment

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### *Abstract*

Measuring whether students get a particular point in a lesson or no may seem a difficult task for novice teachers. So, assessing students' understanding of the lesson is a crucial step in the teaching process. Despite its increasing importance, few teachers know how to undertake formative assessment and how to exploit its outcome in taking educational decisions. The aim of the present study is to account for psycholinguistic technique of eye movement and to suggest its exploitation in daily assessment. More specifically, it proposes that eye movements' findings can be applicable in helping teachers understand their students' behaviour toward the lesson. In psycholinguistics, long gaze duration, for instance, is a mark of ambiguity and participant's concentration. To examine the adequacy of this technique, the study opts for descriptive approach to provide insights about the effectiveness and the possibility of adopting eye movements in formative assessment process. To that end, the daily assessment and practical educational decision no longer presents a barrier to teachers if they understand and interpret students' eye movement correctly.

**Keywords:** Assessment for learning, eye movement, formative assessment, psycholinguistic technique, saccades.

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## INTRODUCTION

We all worry about the result of what we have done. Teachers, as an illustration, care about the extent to which they succeed to ensure better understanding to their learners and to achieve their learning objectives. In fact, this refers to a step that cannot be neglected in any teaching process which is formative assessment. Hearing so, many teachers may think on the process of assessing learners without grading<sup>1</sup>. Formative assessment, indeed, is not such an easy task. But rather it presents one of the most crucial parts in lesson presentation as its results are the ground based on which the future teaching and learning decisions are built. Put another way, formative assessment is the measurement tool that assesses the students' progress, abilities and needs on presented point, suggesting that remedial work has to be carried out on some unclear elements of lesson<sup>2</sup>. Thought it is so important, formative assessment is missed in many classrooms. From another point, few teachers opt for formative assessment to alter the teaching process. In recent study, Abu Musa and Rafique Islam (2020) discuss the problems faced by teacher in applying such assessment. They stated that insufficient knowledge about formative assessment and the focus on traditional methods are the reasons why teachers avoid the application of this step. A clear understanding of this type of assessment and its purpose can aid teachers know not only how to choose but even to use from different methods the appropriate ones that suit their teaching situation. Here, it is worth noting that there are many methods of formative assessment such as homework, lesson ending activities, asking questions, think pair and share, etc.<sup>3</sup> The ultimate point between all these techniques is the consuming of time and the generalization of its result for all students in classroom. For example, asking question about lesson, teacher may get an answer from at least five students while s/he cannot be sure that the other students have the right answer. One may say here, since students raise their hands, this means that they have the answer but there are a lot of shamed students who do not prefer participation or sharing ideas. So, for all these techniques there is a certain gap that presents an obstacle for teachers in applying it.

It seems clear now why teachers neglect the step of formative assessment but yet, it remains unclear which technique to use. There is a need to investigate for a technique that ensures for teachers a clear result which can be translated to practical decisions. The present study aims to explain the use of eye movements in evaluating students' understanding of lesson. In other words, the study attempts to adopt psycholinguistic technique of eye movement and to exploit its findings in helping teachers carrying out a secure and effective formative assessment. From these objectives, two main research questions can be raised: to what extent can eye movements' findings be adapted in formative assessment? And how can these results be applied?

To find answers to these questions, the study adopts descriptive approach to provide teachers with a guide about what these movement mean and how to react to each. The start was with a selective review of psycholinguistics, its objectives and techniques. Then, an explanation of eye movement technique, its studies and advantages are provided. Based on this ground, some recommendations and pedagogical application are presented under a title of eye movement and formative assessment, concluding with implications of the study.

## I. LITERATURE REVIEW

### I.1. What is psycholinguistics?

Attempting to understand what have been said in a lecture or read on a paper is a pure cognitive process. More clearly, it is the function of human brain to analyze and display the linguistic data received to it. But how does the brain carry out these processes? In fact, it is psycholinguistics that examines the way the mind comprehend language with the help of many techniques<sup>4</sup>. Not only language comprehension but it studies even production and acquisition of language. According to O'Grady, Archibald and Katamba (2011), psycholinguistics is the cognitive science that accounts for language processing mechanisms. That is, the main interest of psycholinguists is to describe the mental process that human beings use to generate, understand and learn language.

There are many issues that are discussed in psycholinguistics mainly language acquisition, language disorder, lexical processing, syntactic parsing, semantic representation, etc.<sup>5</sup> More specifically, psycholinguistics explains how a person acquires first language and learns second language. It also identifies many problems in learning performance such as aphasia (disorder in producing and understanding spoken language) and dyslexia (disorder in writing and reading)<sup>6</sup>. In this domain, questions like how are lexical words stored and retrieved from the mind? Do we take more time to process semantically abstract words or concrete ones? Do we read texts from beginning to the end? Are the sound systems of language organized mentally into levels of representation using the same symbols we use or no? How do our minds process multi morphonemic words? And many other crucial inquiries are investigated in psycholinguistics<sup>7</sup>. As language users, we can perform many language processes easily and subconsciously but in reality, they involve very complicated mental mechanisms.

Psycholinguistic studies have the goal of testing and clarifying some proposed hypotheses and claims about language processing. It also discovers many mental facts that were ignored. As an illustration, psycholinguistics carried out many experiments to measure the time of syntactic processing. In more details, it aimed to examine the transformational linguistic claim which suggests that sentences with many transformation rules take more time to be produced in mind than other<sup>8</sup>. That is, a speaker may take a long time to generate and comprehend sentences with more transformational rule as s/he should start with deep structure, applies different transformations, then reaches to surface structure. Due to Psycholinguistic studies, this claim has been reformulated providing clear understanding of syntactic parsing and denying the relation between sentence difficulty and time of parsing.

Another aim of Psycholinguistic studies is the amelioration of mental language processing by increasing its speed and efficacy.<sup>9</sup> Clearly, better language comprehension, production and acquisition of the four skills were one of the Psycholinguistic concerns. Based on the assumption that for a better performance, one should understand how something functions. Psycholinguistic studies, basically, have the role of defining how the brain functions in different language operation and what it needs to perform effectively. To make this more concrete, the understanding of language production in general and speaking skill in particular have been improved due to Psycholinguistic data. In past, for instance, speaker behavior such as slips of tongue or semantic substitution were wrongly interpreted

as lack of speaking skills. But, when Psycholinguistics captures the mental complexity of constructing a message, many features of speech production were clarified.<sup>10</sup> One of these features is that at the level of word selection, words with similar semantic meaning to the intended word are all activated<sup>11</sup>. For this, speaker produces a word instead of another. It claims also that these events can be increased because of some external factors such as noise in environment, speakers' interest, motivation, interlocutors' identity, etc. Internal factors in their turns have an effect on the discussed process namely purpose of task, psychological status; angry, fear, etc.<sup>12</sup> Simply, the decrease or elimination of these difficulties can enhance the mental processing and thus speaking performance.

The domain of psycholinguistics does not only enhance the human beings' mental language processing such as language acquisition, language production and comprehension. But it helps even teachers and learners to ameliorate their teaching and learning performance. Taking the previous discussed point into account, teachers who know the complexity of mental processing, would not directly relate their students' failure in oral or written performance to deficiency in their language competence. Instead, they would check the situation in terms of external and internal factors and try to erase the existing barriers. It could be achieved by adopting different strategies such as giving their students choice or time to prepare a topic, creating atmosphere that can decrease their fear, motivating them, etc. On the part of learners, psycholinguistic data loaded learners with very valuable techniques that could help in improving their learning outcome. A case in point, learners with basic psycholinguistic knowledge master how to effectively use rehearsal strategy to save the needed data in their long-term memory. Thanks to psycholinguistic field of research that sets between teachers, learners and even all human beings' hands many strategies that change our mental abilities.

To account for different issues of language processing, Psycholinguistics makes use of many techniques. The latter are classified into two categories. The first category relies on observable behaviors like participants' eye movement and slips of tongue. According to O'Grady et al. (2011) these techniques can contribute in testing the units and mechanisms involved in language processing. But, since they are naturally occurring, researchers need to develop more manipulated techniques. The second category is constructed to focus on non-observable mental events. It contains techniques that base more on experimental paradigm<sup>13</sup>. This means that participants are exposed to a stimulus then required to accomplish task. In this context, the examiners have an active role of controlling the participants' behavior. Some of these techniques are: the priming paradigm (lexical decision), sentence processing, bar-pressing time, moving window, self-paced reading/listening, cross modal priming and others<sup>14</sup>. Psycholinguistics creates a branch that devotes many efforts to develop the techniques out of which many pedagogical applications can be proposed.

### **I.2. Eye movement Technique:**

As previously said, eye movement is one of the crucial Psycholinguistic measures that played an important role in the past decades and still provide the field with valuable insights<sup>15</sup>. Unlike the past, psycholinguistics has developed more sophisticated laboratories loaded with non-invasive tools such as light weight eye-tracking visor which studies the movements of eyes profoundly<sup>16</sup>. The technique of eye movement relies heavily on participants' eyes shifting along a written passage

or passed object. In eye movement studies, rapid shift of eyes is called saccades, a pause at certain point is known as fixation while regression refers to back word looking or the looking back at some words and sentences<sup>17</sup>.

It is crucial to note that eye movement studies were mainly used in reading (Morris, 2006). More clearly, many psycholinguistic studies exploit this technique to monitor the reader behavior and mainly to describe the language comprehension process during reading. According to Rayner and Pollatsek (2006), the choice of eye movement technique “is not surprising because eye movements represent one of the best ways to study language comprehension process” (p.613). Recently, eye movement was adopted also in the study of spoken language comprehension process<sup>18</sup>. The visual word eye movement studies aim to answer the same inquires asked in reading studies mainly issues about lexical processing, sentence processing, ambiguity resolution, etc.<sup>19</sup> They also open the gate for new topics to be discussed basically the relation between action and language as well as the language comprehension for infants and young children. The recent aim of psycholinguists is then thinking how to integrate the results from both studies (reading and speaking).

As can be seen eye movement technique has a great attention in psycholinguistics than the other techniques for the clear data it provides<sup>20</sup>. Tanenhaus and Trueswell (2006) postulate reasons why this technique enjoys an increasing interest. For them, the features that make eye movement a unique response measure are summarized below:

In its studies, there is no interruption of language process flow either in reading or speaking as it measures the studied process in very sensitive and implicit way.

Meta linguistic judgment is not required in such tests but only natural tasks.

Eye movements can be appropriate to any kind of population even children.

Eye-tracking can register the relation between language perception and action

It gives the researchers the opportunity to analyze language comprehension and production at the same time.

The human eye movements are ‘goal dependent’. That is, each movement provides clear information about a certain mental process.

Eye movements allow the observation and analysis of many non-amenable issues mainly real time interpretation, message formulation and utterance planning.

### **I.3. Eye movement and Formative Assessment:**

Having reviewed the research base of eye movement now it is time to consider how this research background may be applicable. As a reminder, the purpose of the current paper is to deduce some pedagogical application from eye movement studies, aiming for explaining how these findings can be exploited in facilitating formative assessment. A logical place to start with is to know the normal movements of our eyes. According to Garnhan et al. (2006), eyes do not have smooth movement as it seems to us but rather, they have a series of quick movement (saccades) with pauses where necessary (fixation). In short, movement of eyes is purposeful. With the eyes more is communicated than being said. A common

example is when a teacher asks about responsible for trouble, no verbal answer is received but most students provide a non-verbal answer by gazing at the suspect. Sometimes more evidences are provided especially when the student asks his classmates 'why you are looking at me'. So, this is a simple illustration about the importance of eye movements in classroom. And more can be said about its effectiveness in formative assessment. It is worth noting that this type of assessment is referred to as assessment for learning which describes the goal of this process. That is, formative assessment can be more efficient if it gets the right data that determines the decision has to be taken. This difficult task can be easier with the aid of eye movement.

Cultivating a connection between formative assessment and psycholinguistics, more precisely, eye movement findings, the following pedagogical application have been deduced:

In study about homophones, results show that speaker looks to more frequent sense than to less frequent ones<sup>21</sup>. That is, people always direct their eyes first to what they believe or think. Teachers can exploit this finding in getting answers from shamed students who cannot participate. In question where choices are written on board, instructors can monitor these students' eyes to know their answer.

Increased gaze duration or fixation duration was interpreted in studies about lexical and syntactic ambiguity as the existence of ambiguous words which lead to disruption of system<sup>22</sup>. It highlights also the importance of contextual information. Practically speaking, the increase of students' gaze duration is a mark of losing attention. That is, there is a gap or lack of transition that helps them to relate first point to another. The role of teacher in this case is either to know the wrong idea or concept and make it understandable or to introduce a clear transition between elements of lesson.

The observation of saccadic eye movement both in studies that rely on action-based tasks or passive listening activities indicates that listener is trying to fix the eyes on something<sup>23</sup>. In classroom, saccadic eye movement or initial random fixation mainly in tasks can be a mark of unclear instruction. Clearly, students do not get what is required from them to achieve. For case of silent students, it may imply that they are searching for an answer to their questions.

Tanenhaus and Trueswell (2006) reports that there was a separation between participants' eye fixation and required action. This were explained as a desire to discover new picture or referent for this they called it 'anticipatory eye' movement. Not far from this meaning, lateness in reaction after eye fixation suggests that students are waiting more clarification from teacher about a point. It is also a sign of receiving something new; they do not know it before.

From psycholinguistic perspective, stable eye movement displays the completion of message planning especially in speaking. For teachers, this proposes that students get the point. In case of tasks, stable eyes mean that students complete the task. In spoken task, it can give teacher information about the students' errors. So, when a student has a stable eye means that they think and formulate message but it still contains errors, thus the student ignores these rules.

Regressive eye movement or back ward eye movement is an evidence of difficulty<sup>24</sup>. It requires a repetition of a point from teacher unlike ambiguity that needs more clarification.

#### **I.4. Eye movement and Learning Style:**

As it has been insisted throughout this paper, eye movement is not merely a psycholinguistic tool that accounts for mental processes but rather it could be very successful assessment tool. Scholars skilled in neurolinguistic programming proved that eye movement could be used as a teaching tool, more precisely, as a mark of students' preferred learning style. Before digging deeper, it is crucial to draw attention that knowing and respecting different learning style is one of the teaching skills which plays an important role in the teaching process<sup>25</sup>. Qualified teachers are those who adapt their teaching materials to match different learning styles. Thus, the easiest way to reach to the students' mind is through utilizing their mental code, i.e., their preferred learning style. The matter seems easy but in fact how could a teacher recognize their students' learning preference and how could they design such material that would match all these styles. There is no common tool that could clearly measure them. Eye tracking again could be a good indicator of students' style. And even in a case where a class contains several learning preferences, the flexibility of teachers in reading the style of student who asked a question from his eyes and based on it they provided the required material such as visual in its due time.

To bring more clarity to the point, different learning styles have to be defined. In reference to the sensory classification of learning styles, there are three sub-types: visual, auditory and kinesthetic /tactile.<sup>26</sup> visual learners prefer to obtain information in form of visual means such as diagram and graphs. learners in this style makes use of color cords, pictures, written instruction, note cards, etc. to record and process the information. For the second style, auditory learners are characterized by their preference of verbal discussion and explanation. More clearly, the data are better gained and remembered in this style if it is heard or orally repeated. Anything that is sent through aural channel is very valuable to auditory learners. In the kinesthetic or tactile learning style, learners like to learn with touchable objects and movements. Moreover, learning by doing is the principle that could represent the learners in kinesthetic style.

Teachers usually discover their learners' learning preference by concentrating on different measurement tools such as the way they take notes or on their interest in a particular kind of teaching material and others. Eye movements equipment could help teachers measure their learners' preferred way of learning. In other terms, learners with different learning styles have different viewing behaviors which translate their learning style. Neurolinguistics claim that visual learners usually sit very straight and follow the teacher with their eyes<sup>27</sup>. Further, they look upward when they process the information. On the other part, the eyes of auditory learners most

of time moves from side to side together with nodding their head in an attempt to grasp the given data. For the case of kinesthetic learners, studies prove that they tend to look at their right and down wards with playing or touching anything with their hands. In sum, teachers are in need to acquire two main skills namely reading students' eye movements and flexibility. so, eye movement is the tool that could provide endless help to teachers in measuring any learners' preferred way of learning based on its findings their flexibility would help them to adopt the teaching materials so as to match those students' learning style.

## II. IMPLICATIONS

What the study has tried to do throughout these pages is to point out at the application of eye movement, as a facilitator of formative assessment process, from our perspective, in the hope that teachers might find them of some use. Experienced teacher can prove that eye movement is of great importance in assessing the teaching process. The study is addressed to novice teachers who do not understand much about their students' eyes. It may seem difficult in the beginning so teachers have to consult as such studies to get better interpretation but with experience their brains translate the students' eyes movements subconsciously and directly to a practical decision. We have presented the possible interpretation of different movements of eyes as persuasively as we could base on different psycholinguistic studies namely Field, 2004; Morris, 2006; Garnhan et al., 2006; Rayner and Pollatsek, 2006; Cowels, 2011; O'Grady et al., 2011 and others but this does not mean that the current study findings are to be accepted without question. The paper constructs the theoretical background about the use of eye movement in formative assessment which can be tested practically with different research tools such as questionnaire, interview, etc. in addition, it explains to teachers the importance of matching between teaching material and learning style which can be deduced also from their students' eyes.

## CONCLUSION

Formative assessment poses a big problem for teachers, ranging from the misunderstanding of its process to the ignorance of its findings' usefulness. Aiming to facilitate this task, the study assumes that psycholinguistic technique of eye movement can yield some practical ideas that enlighten the teachers' comprehension about formative assessment. Different psycholinguistic studies were consulted to ensure that eye movements have a lot to communicate. Moreover, students' eye movement can guide teachers' decision making. It is right interpretation of students' eye movement that help teachers to take immediate practical determination either to explain again, to launch transition, to know their answer, etc. The study concludes that eye movement technique can bridge the gap between lesson presentation and formative assessment. In sum, teachers reading of their students' eyes can be transmitted to immediate decision which saves the teaching and learning process. Thus, teachers have to pay more attention to this technique. Eye movement is an aiding tool which can be more powerful and effective if it combined with other measurement tools like multiple choice question, action-based tasks and others.

- 1-(Cullinane, 2010).
- 2- (Black & William, 1998).
- 3-(Cullinane, 2010; Abu Mussa & Rafique Islam, 2020).
- 4-(Garnham, Garrod & Sanford, 2006).
- 5-(Steinberg & Sciarini, 2006).
- 6-(Steinberg, 1993).
- 7-( O'Grady, Archibald & Katamba., 2011).
- 8-(O'Grady et al., 2011).
- 9-(O'Grady et al., 2011).
- 10- (Griffin & Ferreira, 2006).
- 11-(Griffin & Ferreira, 2006).
- 12-(Demirezen, 2004).
- 13-(Garnhan et al., 2006).
- 14-(Garnhan et al., 2006; O'Grady et al., 2011).
- 15-(Field, 2004; Morris, 2006; Garnhan et al., 2006; Rayner & Pollatsek, 2006; Cowles, 2011; O'Grady et al., 2011).
- 16-(Garnhan et al., 2006).
- 17- (Cowles, 2011).
- 18-(Tanenhaus & Trueswell, 2006).
- 19-(Tanenhaus & Trueswell, 2006).
- 20-(Rayner & Pollatsek, 2006).
- 21-(Tanenhaus & Trueswell, 2006).
- 22-(Field, 2004; Tanenhaus & Trueswell, 2006; Morris, 2006).
- 23-(Tanenhaus & Trueswell, 2006; Rayner & Pollatsek, 2006).
- 24-(Pylkkanen & McELree, 2006).
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