Türk Çocuklarının Tümce İşleme Süreçleri: Göz İzleme Çalışması

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Öz

Tümceyi kavramak, hem tümceyi oluşturan her bir sözcüğü anlamlandırmayı hem de sözcükler arasındaki hiyerarşik ilişkiyi anlamlandırmaya bağlıdır. Günümüze kadar birçok bilimsani tümcelerin kavranmasını bir çok farklı yöntem kullanarak araştırmıştır. Bu araştırmada, tümce kavranması, herhangi bir dilsel gelişim bozukluğu olmayan okul çağındaki çocuklarda göz izleme yöntemi kullanılarak araştırılmıştır. Veriler on set tümceden oluşan, her setin dört farklı anlamsal durum içerdiği, gerçek anlam, mecazi anlam, yan anlam ve teknik anlam taşıyan tümcelerden oluşmaktadır. Her bir durumda erek sözcük, ilgi alanı belirlenmiş ve toplam 40 tümce kullanılmıştır. Bu çalışmada dört farklı anlamsal durumda bulunan Türkçe tümce kavranmasını inceleyebilmek için göz izleme metriklerinden 'ilk odaklanma süresi', ' toplam odaklanma süresi', 'toplam ziyaret süresi' kullanılmıştır. Çalışmanın sonuçları toplam odaklanma süresi ve toplam ziyaret süresi değişkenlerinde dört anlam kategorisinde anlamsal fark göstermiştir. Toplam odaklanma süresi ve toplam ziyaret süresi değişkenlerinde gerçek ve yan anlam kategorileri arasında, mecazi anlam ve yan anlam kategorileri arasında anlamlı fark vardır. Bunun aksine gerçek anlam ve mecaz anlam, gerçek anlam ve teknik anlam ve mecaz anlam ve teknik anlam kategorileri arasında anlamsal bir fark bulunmamıştır. Çalışmanın sonuçları aynı sözcüğün farklı anlamlarının farklı şekilde işlenebileceğini göstermiştir. Çalışmanın sonuçları yan anlam içeren tümce kavranma gerçek, terim ve mecazi anlam içeren tümcelere göre daha uzun sürede işlendiğini göstermiştir. Çocukların gerçek anlamla yan anlam arasındaki bağı kurmada zorlandıkları düşünülmektedir. Eğitimciler çocukların bilişsel kabiliyetlerini geliştirmeli ve onlara gerçek ve yan anlam arasındaki bağı kurmalarına yardımcı olmalıdırlar. Çalışmanın sonuçları çocukların daha sık karşılaştıkları anlamları daha hızlı işlemlediklerini göstermektedir ve çalışmanın bulguları Giora'nın Graded Salience Hypothesis ile uyumludur.

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Turkish Children's On-Line Sentence Processing: Evidence From Eye Tracking

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Abstract

Sentence comprehension depends on the understanding of both the individual words and their hierarchical relations with other words. So far, researchers have studied sentence processing by using different methods. In this study, sentence comprehension of school-aged children without developmental language disorder were investigated by using eye tracking measure. The data collection consists of ten sets of sentences in four different meaning conditions such as literal, metaphor, idiom and term. In each condition the same target word, area of interest, were identified, which make a total of 40 target sentences. In this study, 'the first fixation duration', 'total fixation duration' and 'total visit duration' are used as the metrics of eye tracking data to analyze the processing of different types of Turkish sentences. The results revealed that in TVD and TFD parameters there was significant difference among all 4 categories of meanings. Furthermore, there was significant difference in TVD and TFD parameter among literal and metaphor meaning categories and idiom and metaphor meaning categories. On the contrary there was no significant difference among literal and idiom, literal and technical and idiom and technical meaning categories. The results of this study indicate that different meanings of the same word can cause different processing procedures. The processing of metaphor takes longer time than processing of literal, idiom and term meaning. The children have difficulty in making connection between the literal meaning and metaphor meaning. Educators should improve children's cognitive abilities and help them to create the connection between the literal and metaphor meaning. The results suggest that salient meaning is more activated than the less frequent meaning. The results of the study are in consistence with Giora's Graded Salience Hypothesis revealing that salient meaning is activated faster than the nonsalient meaning.

INTRODUCTION

Children develop the ability to communicate and to express their own feelings in pre-school and in school years. This ability grows and expands as the children grow up. Learning to read gives a major boost to metalinguistic awareness. Reading enhances the understanding that a word is separate from the thing it represents. Metalinguistic awareness helps children to discover the multiple meanings that words have. How do children accomplish this? What enables a child not only to acquire sounds but turn them into words and construct meaningful sentences? Even children with very limited cognitive ability develop complex language systems if they are brought up in environments in which people interact with them. Language represents knowledge that children have acquired through physical interaction with the environment (Lightbown and Spada, 2017). Language acquisition is one of the most impressive and fascinating aspects of human development and it is still in investigation by linguists and psychologists. So far, researchers investigated language acquisition by using many methods. Eye tracking is one of the on-line processing measures that researchers use (Dussias 2010). Because, eye-tracking enables researchers to capture moment-by moment interpretation of the target language. The major benefit of the eye-tracking method is that it can tap into real-time comprehension processes (Roberts and Siyanova-Chanturia, 2013). Furthermore, eye fixations provide a method for tracking on-line cognition and is accepted as a valid indicator of information processing and attention (Tannenhaus et al., 2000; Tannenhaus et al, 1995). In this paper, school-aged children's on-line processing and comprehension of different types of Turkish sentences were investigated by using an eye tracking measure.

Theoretical Background

How children learn words requires to study how arbitrary vocal forms become to represent related referents and concepts in the course of social world and how they are processed in the brain (Blewitt 1982). Linguists argue the role of meaning in language interpretation. How does one infer what speakers imply when they literally say something? There have been many proposals suggested in cognitive science for this question. According to standard pragmatic model listeners first analyze the literal meanings of utterances before applying pragmatic information to understand what speakers implicate. The traditional view of how individuals understand speakers' messages comes from Paul Grice's theory of conversational implicature (Grice 1989). Grice argued that the inferences needed to understand are derived from general principles or maxims of conversation in which participants talk exchange mutually. According to Grice's maxims speakers are to be informative, truthful, relevant, and clear in what they say. When an utterance violates any of the maxims, listeners are expected to derive an appropriate conversational implicature. The standard pragmatic view suggests that figurative language is more difficult to process than literal speech. In figurative language, the intended meanings of the words used do not coincide with their literal meanings (Glucksberg 2001). Speakers mean something other than what they literally say when speaking figuratively (Gibbs and Colston, 2012). Consequently, to understand figurative language an individual must be able to grasp the speaker's intention. It suggests that understanding what speakers literally say requires accessing of semantic information, while understanding what speakers implicate requires pragmatic information (Gibbs 2002). Giora (2002) suggested that the question of whether literal and nonliteral language are equal or different is irrelevant to initial processes. The factor that describes differences occurring early in comprehension is the degree of salience of the instances involved. They suggest that later processes might be governed by a functional principle that might distinguish literal from nonliteral language (Giora 2002).

Psycholinguistic models of sentence comprehension

Language is used for communication after the words are combined into sentences and sentences are combined into texts. Semantics is the study of the meaning of words, phrases and sentences. In semantic analysis, the focus is on the conceptual meaning rather than the intended meaning (Yule, 2010). When language speakers access the lexical entry for a word two kinds of information emerge. One is about the meaning of the word, and the other is about the syntactic category and thematic roles. Lexical access is a simple process as it requires matching the phonological and orthographic features of a word with already established entry in the mental lexicon. On the other hand, processing a sentence requires more complex mechanisms. Every word must be required individually and then whole interpretation of the sentence must be understood by attaching thematic roles. An important level in language development is to learn the thematic relations between the words in a sentence. Sentence comprehension depends on the understanding of both the individual words and their hierarchical relations with other words (Dowty 1991; Cruse, 2011). The structure of a word determines the thematic role assignment in the sentence. In other words, verbs play a major role in parsing. Parsing is the process of computing the syntactic structure of a sentence, during parsing process the syntactic category of each unit in the sentence must be specified and finally by the combining individual words and their combinations whole sentence is processed (Crocker 1999; Harley 2005).

Sentence processing is difficult to specify because phonological, syntactic and semantic information are all involved when sentences are perceived. Two main alternative views have been proposed on language comprehension: serial, syntax-first and interactive, constraint-satisfaction models (Mitchell 1994). These models comprise semantic and syntactic processes but ignore prosodic processes. Serial, syntax first models suggest that the parser initially constructs the simple syntactic structure on the basis of word-category information, independent of lexical-semantic information. The latter information is processed during a second stage that is responsible for thematic-role assignment.

An interactive model that describes processes of auditory comprehension was formulated in 1980 (Marslen-Wilson and Tyler, 1980). In this model syntactic and semantic processes interact from an early stage during auditory language comprehension. Although in both classes of models syntactic and semantic information are integrated during language perception, interaction takes place at different points during processing: interactive, constraint-based models predict early interaction, whereas serial, syntax-first models predict interaction during a later stage of processing. Friederici (2002) suggested that sentence processing is supported by a temporo-frontal network. According to the results of his study, temporal analyses of brain activation within this network support syntax-first models because syntactic structure precedes semantic processes and they interact only during a later stage.

Sentence processing requires abilities such as attention, memory and analytic reasoning. Listeners or readers must at the same time interpret linguistic structures in an active mental state and create new structures and combine the sequence of structures and finally create coherent representation of the entire sentence. Fluid reasoning is the ability to recognize novel patterns and sequences of relationships and reason the relations in making a decision (Haavisto and Lehto, 2005). Fluid reasoning and syntactic processing are considered to be similar to some extent because both involve recognizing and interpreting patterns (Andrews, Ogden and Halford, 2017).

Sustained attention abilities may be relevant to sentence comprehension because readers and listeners pay attention to word meaning and switch their attention to the relations between other words. Working memory and long-term memory play an important role in comprehension. Working memory enables individuals to engage in simultaneous information processing and storage. Individuals store linguistic representations while new ones are created. Long-term memory reflects an individual's

permanent knowledge. It resides phonological, morphological, lexical and syntactic representations and help listeners in comprehending the input (Montgomery et al., 2018; Kutas and Federmeier, 2000).

A series of psycholinguistic research has focused on the question how children interpret language. Few studies have investigated metaphor comprehension and none has investigated children's processing different types of meanings of sentence comprehension by eye tracking.

Psycholinguistic studies on figurative language processing discuss whether figurative or literal language is being processed first and faster. Psycholinguistic studies suggest two models, compositional and non-compositional to explain the cognitive processes underlying the comprehension of figurative expressions.

Non-compositional models are the Literal First Hypothesis, the Lexical Representation Hypothesis, and the Direct Access Hypothesis. According to the Literal First Hypothesis idioms are processed literally rather than idiomatically. Bobrow and Bell reported that idioms are processed as lexical items and are listed in memory separately (Bobrow & Bell, 1973). Lexical Representation Hypothesis disagrees that idioms are first interpreted literally. They suggest that both literal and idiomatic meanings are activated in parallel (Swinney & Cutler, 1979). According to the Direct Access Hypothesis, Gibbs stated that idioms are processed faster than literal strings. He supports the priority of figurative processing (Gibbs, 1980).

Compositional models include the Configurational Hypothesis and the Conceptual Metaphor Hypothesis. According to the compositional view, idioms are believed to be semantically analyzable constructions that can be processed compositionally. Cacciari and Tabossi (1988) developed a Configuration Model. They argued that the literal meaning of an idiom is activated during processing. Gibbs and his colleagues (Gibbs & Nayak, 1989) developed the Idiom Decomposition Hypothesis. This hypothesis argues that an idiom's degree of decomposability can be controlled.

The Hybrid Model of Idiom Comprehension (Titone and Connine, 1999) includes aspects from both the traditional and compositional views. It claims that both literal and the figurative are activated during processing. Giora (1997) developed a model called Giora's Graded Salience Model and it suggests processing the salient and non-salient continuums instead of literal and figurative meaning. Giora's Graded Salience Hypothesis suggests that salient meaning is always activated first than the less salient meaning.

Bortfeld & McGlone (2001) reported that their psychological research on metaphor interpretation revealed that the manner in which figurative expressions are interpreted was determined by their linguistic structure. They reported how metaphors are interpreted depend not only on conceptual representations in semantic memory but depend on the processing set. In this paper four different meaning types, words in the literal, idiom, metaphor and term meanings were used.

The literal meaning of a linguistic expression is defined as its conventional, the most obvious, usual meaning. In other words, it is defined as the most basic sense of a word, i.e. dictionary meaning (Aksan 2006; Recanati, 2004; Hani, 1996; Suonuuti 1997). For instance, in a Turkish sentence "Akşam oldu artık perdeleri çekelim." The word 'perde' is used in its literal sense.

Figurative meaning is meaning that is not literal. Figurative meaning of a word implies a different meaning. This meaning is dependent on culture and history. Figurative language refers to speech where speakers mean something other than what they literally say. Idioms, metaphors, conventional ironies, certain indirect speech acts are examples of figurative language (Gibbs & Colston, 2012; Aksan 2006; Lyons, 1995; Pitch& Draskau, 1985). For instance, in a Turkish sentence "Bu kadar suçun üzerine perde çekmek kolay değil." The word 'perde' is used as an idiom.

When a word or phrase has multiple meanings, it is called a polyseme. A polyseme is a word which has diverse meanings (Cuyckens, Zawada; 2001; Aksan, 2006; Hazar, 2014). Polysemy is actually

a device of figurative language and it is often referred to as “connotation” as opposed to “denotation” (Karaman, 2017; Sager, 1990). For instance, in a Turkish sentence “Ördeğin ayakları perdelidir.” The word ‘perde’ is used as a metaphor.

The term, as a device of technical language, involves the activity of using special words to describe details of a specific object, phenomenon, or activity. A technical term is a word which has a specific meaning within a specific field or expertise (Aksan, 2006; Hazar, 2014;). For instance, in a Turkish sentence “Tiyatroda ikinci perde başlıyor.” The word ‘perde’ is used in its technical meaning, i.e. as a term.

The sub-types of figurative language are simile, metaphor, irony, hyperbole, alliteration, onomatopoeia, etc. Simile is a figure of speech that directly compares two things. Similes use words such as “like”, “as” or “than”. An example from Turkish language is “Annem melek gibi bir insandır.” Metaphor is a figure of speech which directly refers to one thing by mentioning another. An example from the Turkish language is “Şakaklarıma kar mı yağdı; ne var?” Irony is the expression that normally signifies the opposite, typically for humorous effect (Karaman, 2009; Ungerer & Schmid, 1996). An example of irony in Turkish language is to say someone “Yüzünde güller açıyor” who is not happy. Hyperbole is the use of exaggeration as a figure of speech. An example from Turkish language is “Bir fırın ekmek yedi.” Alliteration is the occurrence of the same letter or sound at the beginning of adjacent words. An example from Turkish language is “Çok çay iç ki çareler çarçur olmasın.” Onomatopoeia is the process of creating a word that includes sounds that are similar to the noises the words refer to (Cruse, 2011). An example from the Turkish language is “Yemek fokur fokur kaynıyordu.”

The sub-types of polysemy are simile, metaphor and metonymy. Metonymy is a figure of speech in which the name of an object or concept is replaced with a word closely related to the original. An example from the Turkish language is “I am studying Shakespeare.”

In this paper the author investigated school-aged children's on-line processing and comprehension of different types of sentence by using an eye tracking. Four different types, literal, metaphor, idiom and term meaning were used. Ten children were tested using an online eye-tracking measure. Moment by moment language processing abilities were evaluated. It is hypothesized that children will process literal meaning faster than other categories. It is also hypothesized that there will be delays in processing idiom and metaphor meaning.

These are the research questions asked in this study.

1. Is there any difference in processing durations of various meanings such as literal, metaphor, idiom and term meaning of words in Turkish in normally developed children?
2. Do the metrics of eye tracking data used in this study (‘the first fixation duration’, ‘total fixation duration’ and ‘total visit duration’) change according to the category (literal, metaphor, idiom and term) of a sentence?

METHODOLOGY

Participants

The data of the study was collected via convenience sampling method. The convenience sampling method is the most commonly used technique as it is prompt, economical and members are readily approachable to be a part of the sample (Büyüköztürk et al., 2018). The data of the study were collected from a group of ten school- aged children without developmental language disorders. Ten third grader, aged nine years old, six female, four male children were tested using an on-line eye-tracking measure. They all were attending to a state school in Western Turkey. They were all native speakers of Turkish, monolingual, right-handed and having no visual deficiency evident. Their parents

were at least primary school graduates. Eight children out of eighteen were excluded from the analysis because of the eye-movements artifacts and their unstable position.

Apparatus

Eye tracking is used in different fields of linguistics such as psycholinguistics, neurolinguistics, psychology such as cognitive psychology, social psychology and neuroscience to gather information about how the brain process the information (Alkan and Cagiltay, 2007; Alptekin and Erçetin, 2015; Dolgunsöz 2016). Also infant and child reserachers use eye tracking to study perceptual, cognitive and social-emotional development from birth through early adulthood.

In this study, eye tracking device was used. Eye movements were recorded with Tobii Pro Glasses 2, with a sampling rate of 100Hz. The device is an eye tracker designed for researchers who want to conduct a study inside and outside a lab with high sampling rate. Participants wore the glass and chinrest during the study. This device provides a detailed analysis of saccades, fixations, pupil size changes and blinks.

Data Collection

The data consists of totally 40 sentences. (see Appendix for sentence list). First of all, ten key words were manually selected from Turkish Dictionary (Sözlük, T.T. 2011) provided that all key words can be used in four different categories (e.g. literal, metaphor, idiom and technical sense). The Turkish sentences used in this study were made up by two experienced faculty member from Turkish Language Teaching Department. Each key word which is called area of interest is used in four different meaning categories such as literal (denotation), metaphor, idiom and term. Literal meaning is the basic or usual meaning of a word. Idiom meaning is used for words and phrases not with their basic meaning but with a more imaginative meaning, in order to create a special effect. Metaphor is a figure of speech which directly refers to one thing by mentioning another. Metaphor is a figure of speech which directly refers to one thing by mentioning another Technical term is a word that has a specific meaning within a specific field of expertise. For example the word biopsy is a technical word in medicine (Yule 2010; Nöth 1995). In this study all these four categories were used. For instance the word 'göz' is selected as an area of interest and used in different four meaning categories. Sağ gözüm mikrop kaptı (literal), İki gözlü evde kaldık (metaphor), Onun gözü arkada kaldı (idiom) Görmemiz göz yoluyla sağlanır (term). Each condition included four different sentences, which make a total of 40 target sentences. Each of these four sentences in the same condition differs only in terms of meaning.

Procedure

The entire study was conducted by a single researcher. The university Institutional Review Board approval was taken. The researcher read the guideline and informed both the participant and his/her legal guardian about the study and took informed consent from each participant's legal guardian. The data collection design and the sequence of the materials were organized according to the pilot study. Participants were run individually and the experiment took approximately an hour. It was performed in a silent room. The pilot implementation stage was done for every participant to ensure about the process of the study. After the calibration settings were made, the experiment was started. Eye tracking data were recorded during the process. Childrens' eye movements were recorded while they were reading words and sentences silently.

Eye Metrics

The rapid movements that eyes do during reading are called 'saccades. Saccades are different

from fixations. Liversedge and Findlay (2000) stated that new information is encoded during the phase of fixation. The length and the frequency of the fixation increase when there is difficulty in processing. Also the duration of fixations indicate whether the reading was processed easily or not (Garrod 2006). 'First fixation duration' on a particular area of interest was defined as the time the reader spent initially. Total duration of fixations on a particular area of interest was defined as the sum of the durations of all fixations on a word including all saccades. Total Visit duration is the sum of all visits on a particular area of interest. (Rayner and Pollatsek, 2006). In this study, 'the first fixation duration', 'total fixation duration' and 'total visit duration' are used as the metrics of eye tracking data to analyze the processing of different types of Turkish sentences. Each sentence in the study was divided into area of interests (AOIs), a single key word with different meaning types. Each AOI is the same word in the four sentences of a set and fixation data was measured according to these AOIs. Eye metrics (total visit duration, first fixation duration and total fixation duration) of these AOIs were evaluated.

Statistical Evaluation

All data including First Fixation Duration (FFD), Total Fixation Duration (TFD) and Total Visit Duration (TVD), parameters were harvested from the Tobii Lab Pro Software and the data were transferred to Excel 2013. The data filed in Excel was transferred to PASW 18 software for statistical evaluation. Literal, metaphor, idiom and term meaning categories were compared for difference in TVD, FFD and TFD via Kruskal-Wallis test. Post-hoc comparisons were held using pairwise Mann-Whitney U test. Statistical significance was assumed when $p < 0,05$.

RESULTS

The results of the Kruskal-Wallis test revealed that in TVD and TFD parameters there was significant difference among all 4 categories of meaning; at the level of $\chi^2(3)=8,152$, $p=0,043$ for TVD and $\chi^2(3)=8,464$, $p=0,037$ for TFD. On the other hand, there was no significant difference in FFD among the meaning categories, $\chi^2(3)=3,027$, $p=0,388$. (Table-1)

Table-1 Mean ranks and Kruskal-Wallis Test results are shown. There is significant difference between the meaning categories in TVD and TFD. The statistically significant differences are flagged. ($p < 0,05$) TVD: Total Visit Duration, FFD: First Fixation Duration, TFD: Total Fixation Duration.

N=10	TVD	FFD	TFD
	Mean Rank	Mean Rank	Mean Rank
Kruskall Wallis Test	$\chi^2(3)=8,152$, $p=0,043^*$	$\chi^2(3)=3,027$, $p=0,388$	$\chi^2(3)=8,464$, $p=0,037^*$
Literal	18,25	14,95	17,30
Idiom	15,45	22,60	15,80
Term	18,95	22,15	19,35
Metaphor	29,35	22,30	29,55

Post-hoc pairwise Mann-Whitney U tests revealed that, there was significant difference in TVD parameter among literal and metaphor meaning categories, $U=19,500$, $p=0,019$; and idiom and metaphor meaning categories, $U=17,000$, $p=0,011$. On the contrary there was no significant difference among literal and idiom, literal and term and idiom and term meaning categories. (Table-2) (Figure-1)

What is more, the post-hoc pairwise Mann-Whitney U tests revealed that, there was significant difference in TFD parameter among literal and metaphor meaning categories, $U=15,500$, $p=0,007$; and

idiom and metaphor meaning categories, $U=18,500$, $p=0,015$. On the contrary there was no significant difference among literal and idiom, literal and term and idiom and term meaning categories. (Table-2) (Figure-1)

Table-2 The results of the post-hoc pairwise Mann-Whitney U tests of the meaning categories for TFD and TVD parameters. TVD statistics are shown in shaded cells. The statistically significant differences are flagged. $*(p<0,05)$ TVD: Total Visit Duration, TFD: Total Fixation Duration. TVD data are shown in shaded cells.

TFD/TVD	Literal	Idiom	Term	Metaphor
Literal	NA	U=41,500, p=0,529	U=49,500, p=0,971	U=19,500, p=0,019*
Idiom	U=43,500, p=0,631	NA	U=41,000, p=0,529	U=17,000, p=0,011*
Term	U=46,000, p=0,796	U= 41,000, p=0,529	NA	U=25,000, p=0,063
Metaphor	U=15,500, p=0,007*	U=18,500, p=0,015*	U=25,500, p=0,063	NA

Figure-1 The graph illustrates the post-hoc pairwise comparisons of the meaning categories for TVD, FFD and TFD parameters. The statistically significant differences are paired and flagged. $*(p<0,05)$ TVD: Total Visit Duration, FFD: First Fixation Duration, TFD: Total Fixation Duration.

DISCUSSION

Psycholinguistic studies use a wide range of techniques to reveal the language-processing

components. This study analyses the on-line processing of Turkish sentences with different meanings by using eye-tracking measure. The first research question of the study was if there was any difference in processing durations of various meanings such as literal, metaphor, idiom and term meaning of words in Turkish in normally developed children. The results revealed that in Total Visit Duration and Total Fixation Duration parameters there was significant difference among all 4 categories of meaning. The results indicate that different meanings of the same word can cause different processing difficulties. Studies suggest that syntactic knowledge appears to emerge between the age of two and three years (Höhle et al., 2014; Oberecker, Friedrich and Friederici, 2005). Semantic knowledge of words, generalization begin to develop within the first year of life (Bergelson and Swingley, 2012), comprehending the semantic incongruity between words begin at the age of two years old (Holcomb, Coffey and Neville, 1992). This study indicated that although the ages of the participants are nine years old, they still have some delays in comprehension processes of metaphor meaning.

The second research questions of the study was if the metrics of eye tracking data used in this study ('the first fixation duration', 'total fixation duration' and 'total visit duration') changed according to the category (literal, metaphor, idiom and term) of a sentence. The results of the study indicated that there is significant difference between the meaning categories in TVD and TFD. There was significant difference in TVD and TFD parameter among literal and metaphor meaning categories and idiom and metaphor meaning categories but there was no significant difference among literal and idiom, literal and term and idiom and term meaning categories. The results of this study indicate that processing of metaphor meaning takes longer time than processing of literal, idiom and term meaning. This result may be due to the frequency of the category the children encounter. In their daily life and school period they may encounter literal, idiom and term meanings of words more than metaphor meanings. Livesedge and Findlay (2000) stated that in eye tracking measure, new information is encoded during the phase of fixation. The length and the frequency of the fixation increase when there is difficulty in processing. Also the duration of fixations indicate whether the reading was processed easily or not (Garrod, 2006). Alptekin and Erçetin (2015) found that the fewer the number of fixations, the shorter the fixation duration, the less the reader experience difficulty in reading comprehension. When lexical access is easy readers will not need to use fixations and fixation duration will be short. Fixation duration characterizes the time needed to process the information. In this study as Garrod (2006) stated the frequency and length of the fixations increased because participants had difficulty in processing metaphors.

Akkök & Uzun (2018) tested adult individuals' behavioural reactions to prototypical and peripheral concepts and metaphors with varying degrees of familiarity during silent reading. They reported that peripheral concepts are processed in a longer time compared to prototypical concepts, and metaphors with a low level of familiarity are processed in a longer time compared to metaphors with a high degree of familiarity. They reported that their findings support the literal first hypothesis which means that literal meaning is activated before metaphorical meaning. The results of this current study conducted by children are in consistence with Akkök& Uzun (2018) study that processing of metaphors takes longer time than processing of literal, idiom and term meaning. The literal meaning is processed faster than other meaning categories.

Bohrn et al. (2012) evaluated the differences in neural correlates of figurative and literal language processing and to investigate the role of the right hemisphere in figurative language processing. In line with Graded Salience Hypothesis (Giora, 1997) right hemisphere involvement was found for novel metaphors. They concluded that for irony comprehension theory of mind processes are involved whereas more analytic semantic processes are involved in metaphor comprehension. The results of this current study are in consistence with Giora's Graded Salience Hypothesis suggesting that

salient meaning is activated faster than the nonsalient meaning.

İbe & Akkök (2016) revealed the non-literal meaning comprehension with evidence from Turkish. They designed data collection and measuring tool for evaluating the Turkish native speakers' metaphoric, metonymic and humorous expressions comprehension level. The results of their study showed that the participants are successful in interpreting non literal expressions. They revealed that age is an important variable in processing which improves parallel to non-literal interpretation. The results of this current study support the findings of İbe & Akkök (2016) suggesting that nine year old children have difficulties in comprehending metaphors.

Senemoğlu (2007) stated that children have an active role in acquiring process and their view of life is different from adults. For this reason it is worth to study the deep representations of children's thoughts. Cognitive processing plays an important role in children's syntactic comprehension. Most of the researchers believe that multiword chunks are important building blocks for syntactic development and that such chunks are used for comprehension and production (Arnon and Clark, 2011; Arnon, McCauley and Christiansen, 2017; Bannard and Lieven, 2012; McCauley, Isbilen and Christiansen, 2017). The results of this study support the findings that children may learn idioms in chunks and this may be the cause why they do not have delay in processing these kind of utterances.

Trueswell et al. (1999) studied sentence processing in young children and found that five year olds did not take into account pragmatic principles when resolving temporary syntactic ambiguities and showed little or no ability to revise initial parsing commitments whereas adults showed sensitivity to discourse constraints at the earliest stages of processing and also they were capable of revising incorrect parsing commitments. The critical question is how the knowledge of the language affects language processing. Does it have a positive influence on comprehension or not? It is believed that the answer to this question should be investigated.

Lowder & Gordon (2013) investigated whether processing of metonyms depend on sentence structure. The results of their study supported the idea that figurative language processing was regulated by sentence structure. Further studies should be conducted with different sentence structures containing figurative meaning in Turkish.

Glucksberg (2003) wrote a review article about how people understand novel metaphorical categories and suggested that people understand metaphorical meanings as quickly and automatically as literal meanings. However, the findings of this current study suggest that literal meanings are processed faster than other meanings.

Studies in psycholinguistics investigated lexical ambiguity to test models and theories of lexical access and lexical ambiguity processing (Rodd et al., 2002). Most of the studies focused on whether lexical access is an autonomous process or not by manipulating context and interstimulus intervals. The term interstimulus intervals is defined as the delay between the end of primes and the beginning of targets. The results of processing studies suggest that the more salient meaning is more activated than the less frequent meaning (Simpson and Burgess, 1985). This study supports the idea that salient meaning is processed faster and in order to improve children's cognitive abilities and fill the gap between the literal and figurative meaning, reading and role playing activities should be done to create their imaginativity. It is believed that the reason why the children processed idioms faster than metaphors may be due to fact that they acquire idioms in chunks.

Children with developmental language disorders have limitations in cognitive abilities such as phonological short-term memory (Archibald and Gathercole, 2007), verbal complex working memory (Weismer, Evans and Hesketh, 1999), controlled attention (Marton et al., 2014). Montgomery et al. (2018) concluded that working memory as it involves concurrent verbal processing and storage and controlled attention have an influence on sentence comprehension. The studies show that not only frequency or

complexity of meaning affect the processing, there are other factors relating with the child's development.

Psycholinguistic studies have revealed that the interval between prime and target influence the processing of ambiguous words. Time course studies have suggested that short intervals measure immediate activation processes whereas longer intervals reflect later post access selection processes (Laine and Koivisto 1998). The results of this study are in line with Laine and Koivisto's study because children spent more time in processing metaphors.

Bozavlı (2017) found that boys and girls made different phonological, lexical and grammatical linguistic deviations. It is believed that both right and left hemisphere contribute to the comprehension of semantic relations. However left hemisphere is responsible for language processing it is suggested that right hemisphere has also an important role in processing lexically ambiguous structures.

Columbus et al. (2015) examined whether individual differences in executive control relate to metaphor processing using eye movements of reading. They found that when metaphors were less familiar, participants read verbs used as metaphors more slowly than verbs used literally. The findings of Columbus et al. (2005) are in line with the current study suggesting that salient meaning is activated first than the less salient meaning.

Frisson & Pickering (1999) investigated the time course of the processing of metonymic expressions comparing with literal ones with eye tracking. They stated that their results are incompatible with figurative language processing models discussing literal sense or figurative sense is processed first, instead they emphasize that both senses can be processed immediately. However, the current study investigated whether there is any difference in processing durations of various meanings such as literal, metaphor, idiom and term meaning of words in Turkish and found that different meanings of the same word can cause different processing difficulties. The results of this current study unlike Frisson & Pickering (1999) study indicate that processing of metaphors takes longer time than processing of literal, idiom and term meaning.

The data of this study provide evidence that children process metaphors with a delay compared to literal meaning. In other words, Turkish sentences with various semantic categories are processed differently.

CONCLUSION

This research follows a psycholinguistic perspective and reflects the on-line language processing of different meaning types of Turkish sentences. The processing of metaphors takes longer time than processing of literal, idiom and term meaning. The results indicate that the children have difficulty in making connection between literal meaning and metaphors. The results reflect the acquisition of linguistic elements for expressing ideas which are present in children's cognitive functioning. Educators should improve children's cognitive abilities and help them to create the connection between the literal and figurative sense. The results of this study are in consistence with Giora's Graded Salience Hypothesis revealing that salient meaning is activated faster than the nonsalient meaning.

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APPENDIX

The forty sentences (literal meaning, polysemous meaning, figurative meaning and technical meaning) used in the study are given below. The sentences are designated according to their word meaning categories. (1) indicates literal meaning (denotation) (2) indicates metaphor, (3) indicates idiom, (4) indicates term.

1. Akşam oldu artık *perdeleri* çekelim (1).
2. Örneğin ayakları *perdelidir* (2).
3. Bu kadar suçun üzerine *perde* çekmek kolay değil (3).
4. Tiyatroda ikinci *perde* başlıyor (4).
5. Soruyu ilk yanıtlayan öğrenciler *ellerini* kaldırdı (1).
6. *Elimde* ne kadar para varsa hepsini size verdim (2).
7. *Eli* geniş adam herkese yardımcı olmaya çalışıyor (3).
8. Pozisyonda *el* olduğunu gören hakem penaltı verdi (4).
9. Arkadaşımın *gözü* mikrop kapmış (1).
10. İki *gözlü* bir evde kalıyorlar (2).
11. Mahalleden ayrıldı fakat *gözü* arkada kaldı (3).
12. *Göz* bir görme organıdır (4).
13. Tavşanın *kulakları* uzundur (1).
14. Arabamın motor *kulağı* arızalandı (2).
15. Anlatılanlara *kulak* verdi (3).
16. Gitarın *kulaklarını* çevirerek akor yapıyordu (4).
17. Aşı olduğum için *kolum* ağrıyor (1).
18. Makinenin *kolu* kırıldı (2).
19. Amcam beni çocuğu gibi sever, her zaman *kol* kanat gererdi (3).
20. Fen bilgisi dersinde vücut organlarımızdan *kolu* işledik (4).
21. Kurak bölgelerde yetişen ağaçların *kökleri* uzundur (1).
22. Ailemizin *kökü* Balkanlar'a dayanır (2).
23. Neredeyse buraya *kök* saldılar (3).
24. Matematik dersinde *kök* konusunu işledik (4).
25. Elim kutuya çarptı ve *taç* kırıldı (1).
26. Gece olunca kulenin *tacını* ışıklandırdılar (2).
27. Bunca yıldır onu baş *tacı* etti (3).
28. Top *taca* çıktı (4).
29. Şuan *ocakta* çay kaynıyor (1).
30. Kömür *ocağında* çok büyük bir patlama yaşandı (2).
31. Bu savaşta çok *ocaklar* söndü (3).
32. *Ocak* ayı yılın ilk ayıdır (4).
33. *Noktaları* birleştirerek bir şekil oluşturalım (1).
34. Uçaktan arabalar *nokta* gibi gözüküyor (2).
35. Artık bu işe bir *nokta* koymanın vakti geldi (3).
36. Tamamlanmış cümlelerin sonuna *nokta* konur (4).
37. Odadaki *ışık* yeterli değil (1).
38. *Işık* gibi bir yüzü vardı (2).

39. Yeni okulu çocuğa **ışık** tuttu (3).
40. **Işık** dönüştürebilir bir enerji türüdür (4).