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METAPHOR PROCESSING IN TURKISH: AN EYE-MOVEMENT STUDY

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Abstract: Some studies about processing metaphors, which are accepted to be a natural product of the human cognitive system, focus on the processing where some focus on online processing of metaphors. Online studies where behavioral reactions are measured during silent reading are based on various methods such as self-paced reading, eye-movement and brain imaging techniques. This research will handle processing of prototypical and peripheral concepts and metaphors with varying degrees of familiarity during silent reading. This research aims to test behavioral reactions to prototypical and peripheral concepts and familiar and unfamiliar metaphors during silent reading. In this frame, behavioral reactions during silent reading in Turkish are measured by eye-movement method trying to answer how (a) prototypical concepts are processed, (b) peripheral concepts are processed, (c) metaphors with a high degree of familiarity are processed, (d) metaphors with a low degree of familiarity are processed. To answer these questions two pilot experiments and one main experiment has been carried out with separate subjects. In the research, where the findings of behavioral experiments which

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are applied as preparation to the main experiment with SMI RED 500 Hz eye-movement device are discussed as well, it is found 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.

Key words: *Metaphor, eye-movement, fixation, silent reading, prototypical, peripheral*

TÜRKÇE METAFORLARIN İŞLEMLENMESİ: BİR GÖZ İZLEME ÇALIŞMASI

Özet: İnsanın bilişsel sisteminin doğal bir ürünü olduğu kabul edilen metaforların işlemlenmesine ilişkin çalışmaların bir kısmı, süreç-dışı yöntemlerle, bir kısmı da süreç-içi yöntemlerle metaforların nasıl işlemlendiğine odaklanmaktadır. Sessiz okuma sırasında davranışsal tepkilerin ölçüldüğü süreç-içi araştırmalar, kendi hızında okuma, göz izleme, beyin görüntüleme gibi farklı yöntemleri temel almaktadır. Bu araştırmada, sessiz okuma sırasında öntürsel ve öntürden uzak kavramlarla, farklı bilinirlik düzeylerindeki metaforların işlemlenmesi ele alınacaktır. Araştırmada, sessiz okuma sırasında öntürsel ve öntürden uzak kavramlara ve bilinirlik düzeyi yüksek olan ve olmayan metaforlara yönelik davranışsal tepkilerin sınanması amaçlanmaktadır. Bu çerçevede araştırmada, Türkçede sessiz okuma sırasında (a) öntürü temsil eden kavramların işlemlenmesi, (b) öntürden uzak kavramların işlemlenmesi, (c) bilinirlik düzeyi yüksek olan metaforların işlemlenmesi, (d) bilinirlik düzeyi düşük olan metaforların işlemlenmesi süreçlerinde göz izleme yöntemiyle ölçülen davranışsal tepkilerin neler olduğu sorularına yanıt aranmıştır. Araştırmada farklı katılımcılardan oluşan toplam üç deney gerçekleştirilmiştir. SMI RED 500 Hz göz izleme sistemiyle uygulanan deneylere hazırlayıcı olması amacıyla uygulanan davranışsal deneylerin de bulgularının tartışıldığı bu araştırmada, öntürden uzak kavramların öntürü temsil eden kavramlardan, bilinirlik düzeyi düşük olan metaforların bilinirlik düzeyi yüksek olan metaforlardan daha uzun sürede işlemlendiği sonucuna ulaşılmıştır.

Anahtar sözcükler: *Metafor, göz izleme, sabitleme, sessiz okuma, öntür, öntürden uzak*

1. INTRODUCTION

Metaphors are accepted to be a natural product of the human cognitive system (Gibbs, 1994; Lakoff & Johnson, 1980). In recent years, studies on metaphor processing have become significant, some of these studies focuses on how the metaphors are processed with offline methods (Gibbs & O'Brien, 1990; Gibbs & Colston, 2012), and some focus on how they are processed with online methods (Brisard, Frisson & Sandra, 2001; Blasko & Connie, 1993; Gibbs, 1990; Frisson & Pickering, 1999). These studies directed to measuring behavioral reactions in processing metaphors are based on different experimental methods such as self-paced reading, eye tracking and brain imaging techniques and have various limitations and approaches.

This study aims to measure the processing characteristics of prototypical and peripheral literal concepts and familiar and less familiar metaphors during silent reading using eye-movement experiments.

Within this framework, answer for the following question will be searched: How are the sentences with (1) prototypical literal concepts, (2) peripheral literal concepts, (3) familiar metaphors, (4) unfamiliar metaphors processed during silent reading in Turkish? In order to answer to these research questions, the theoretical framework will firstly be introduced. Following with the presentation of the method, findings and conclusion within this framework.

Theoretical Discussion

Psycholinguistic studies on figurative language processing focus on whether literal or figurative language is being processed faster. Before we review studies on processing literal and figurative language, we need to define what we understand from these concepts.

Literal and figurative language

It is difficult to make a definition of literal and figurative language since it is difficult to show the difference between these two meaning types. In their study, Gibbs and Colston (2006) try to make a unifying definition of these terms. In traditional terms literal meaning is defined as primary, conventional meaning where figurative meaning is

defined as non-literal secondary products. Figurative meaning has different types such as metaphors, metonymy, idioms, proverbs, irony, sarcasm etc. Another feature what makes defining figurative meaning difficult is that some instances seem more literal whereas some instances such as poetic or novel metaphors seem more non-literal. Parallel to this, there are also different dimensions of literal meaning such as subject matter, conventional, context-free and truth conditional literality (Gibbs, 1994). Thus, it is really difficult to talk about a principled difference between these two terms. Instead literal and figurative meaning can be seen as different ends of a continuum.

Apart from trying to give a definition for these terms, researchers also try to find out how these meaning types are processed. Since there is no agreement on how literal meaning is processed, it is difficult to make an exact assumption on the processing of figurative language. The main question is whether literal or figurative meaning is processed first.

Various models were proposed in order to explain how non-literal meaning is processed. First studies are mainly based on literal first hypothesis, which took its roots from Grice's (1989) theory of conversational implicature. This view, which was called "standard pragmatic", is also known as Indirect Access Model. This model proposes that literal meaning is processed first. In other words, the person processing language begins from literal meaning and processing figurative meaning requires more time. A second view claims that there is not a priority during the processing of literal and figurative meaning. Instead, lexical and contextual information interacts while processing non-literal language (Gibbs, 1994, Glucksberg, 1991; 2003). The supporters of this view, which is called the Direct Access View asserts that given sufficient context people understand non-literal meanings without first analyzing the complete literal meaning of an expression (Gibbs, 2002). In other words, comprehenders do not directly have to process the literal meaning at all. More recent models and theories also aim to describe the role of context on figurative language. For instance according to "Graded Salience Hypothesis" proposed by Giora (2002), context activates figurative meaning. In addition to this as for "Underspecification Model" developed by Frisson and Pickering (2001), in any context, when the reader comes across a figurative expression, the initial

meaning, that is whether it is a literal or figurative usage, is always underspecified. (Gibbs & Colston, 2006). Apart from these, there are studies focusing on different dimensions of figurative language. For example, some researchers defend that grammatical presentation of non-literal linguistic expressions effects processing (Glucksberg & Haught, 2006; Lowder & Gordon, 2013).

These models are proposed in views of offline or online experiments. Offline studies are the ones conducted via behavioral observation techniques. These studies may focus on different kinds of figurative language such as metaphors, idioms, jokes etc. For example in their preliminary study, Gibbs and O'Brien (1990) tried to find out how idioms are comprehended with an offline study in terms of the conceptual metaphors that motivate idioms researched. Iskandar (2014) questions how novel metaphorical linguistic expressions are interpreted. In another study conducted in Turkish, Akcan & Akkök (2016) investigated how metaphorical and metonymical expressions are interpreted through an offline test.

Online studies are the ones such as self-paced reading, eye-movement, brain imaging studies, which try to measure instant processing. The discussions about how figurative language is processed are largely directed by online studies. Some of these studies focus on processing different kinds of figurative language (Blank, 1988; Giora, 2002; Schwoebel et al., 2000). Some point out to the roles of various variables such as the type or familiarity of the metaphor (Onishi & Murphy, 1993; Lemaire & Bianco, 2003; Brissard, Frisson & Sandra, 2001). Some studies investigate metaphor processing in terms of conventionality and familiarity (Gökçesu, 2009; Blasko & Connie, 1993). Some inspect the sentence structure (Lowder & Gordon, 2013) and some types of figurative elements such as idioms, metonymy and metaphor (Frisson & Pickering, 1999); and some focus on the relation between metaphor processing and embodiment (Wilson & Gibbs, 2007).

Here it seems necessary to explain what we mean by the terms metaphor and familiarity. Metaphors are products of an individual's cognitive process. Because of this, the nature of language is metaphorical (Lakoff & Johnson, 1980; Kövecses, 2010). Within cognitive linguistic approach, we all think and act with metaphors.

However not all metaphors have the same familiarity. Metaphors, which are a type of non-literal language, have more literal and more non-literal samples on the literal-non-literal continuum. Likewise, literal language elements have samples closer to the literal end.

This study handles the literal members in the mentioned continuum as prototypical and peripheral, and non-literal members as familiar and unfamiliar metaphors. Two pilot studies have been carried out to prepare the experimental set used in the eye tracking experiment. The experiments and their findings have been explained below.

2. EXPERIMENTS

Two pilot studies were conducted before starting the main experiment. The first pilot study aimed to determine the literal sentences, and the second pilot study was made to determine the metaphorical expressions to be used in the main experiment.

2.1. PILOT STUDY I

Twenty-two native speakers of Turkish participated in the experiment. All participants (12 female, mean age: 35.2; 10 male, mean age: 29.8) were voluntary and included in the statistical analysis processes. The first pilot study aimed to determine prototypical and peripheral members for 30 categories (see Table 1).

Table 1. Categories used in pilot study (I)

Categories				
Tree	Body part	Gun	Crime	Game
Fruit	Medicine	Dessert	Sport	Smell
Insect	Bird	Punishment	Disease	Road
Flower	Place	Structure	Food	Energy
Color	Vehicle	Instrument	Science	Cloth
Artist	Monster	Animal	Mineral	Genius

In order to find out members representing prototypical and peripheral categories, the participants were asked to write down 7 examples for each category as shown in Table 2. The test was an offline pen and paper test with no time limitation.

Table 2. Sample answers for category members in pilot study (I)

KUŞ	*AĞAÇ*	*ORGAN*	*RENK*
1. Serçe (sparrow)	1. Çam (pine tree)	1. Kalp (heart)	1. Mavi (blue)
2. Bülbül (warbler)	2. Palmiye (palm tree)	2. Ciğer (lung)	2. Yeşil (green)
3. Kanarya (canary)	3. Erik (plum)	3. El (hand)	3. Pembe (pink)
4. Muhabbet (conversation)	4. Manolya (magnolia)	4. Mide (stomach)	4. Kırmızı (red)
5. Papağan (parrot)	5. Selvi (cypress tree)	5. Dalak (spleen)	5. Lacivert (navy blue)
6. Leylek (stork)	6. Kavak (poplar tree)	6. Böbrek (kidney)	6. Mor (purple)
7. Güvercin (dove)	7. Ladin (spruce tree)	7. Ayak (foot)	7. Leylak (lilac)

When analyzing the data, prototypical items were selected according to the frequency of the examples written by the participants. Looking at the frequency distributions of the category members, those which are on the first or second place, and have been used by at least half of the participants, have been selected. Conversely, peripheral category members were selected from the least mentioned category members, with the condition that they should be mentioned by at least two or three participants. Some examples of prototypical and peripheral members selected for the main experiment are presented in Table 3.

Table 3. Examples of prototypical and peripheral members

Categories	*Prototypical Member*	*Peripheral Member*
Fruit	Apple (16)	Fig (4)
Flower	Daisy (16)	Dandelion (3)
Colour	Blue (14)	Fuchsia (4)
Bird	Sparrow (13)	Starling (2)
Dessert	Rice Pudding (10)	Turkish Delight (2)
Suç	Robbery (12)	Bribery (3)
Tree	Plane Tree (10)	Fir Tree (3)
Insect	Roach (11)	Turtledove (3)
Artist	Painter (10)	Writer (2)
Organ	Brain (12)	Intestine (2)
Medicine	Aspirin (9)	Penicillin (2)
Place	School (8)	Hostel (2)
Vehicle	Car (14)	Truck (4)

Categories	*Prototypical Member*	*Peripheral Member*
Monster	Dragon (8)	Frankenstein (2)
Weapon	Gun (11)	Rocket (3)
Science	Physics (15)	Genetics (3)
Punishment	Jail (10)	Eunuch (2)
Building	Building (16)	Pyramid (2)
Instrument	Guitar (16)	Harmonica (2)
Animal	Cat (19)	Bull (3)
Sports	Soccer (14)	Fencing (2)
Illness	Cold (11)	Measles (2)
Food	Meat (10)	Gravy (2)
Mine	Gold (15)	Lignite (3)
Game	Hide-and-Seek (10)	Chess (2)
Odour	Perfume (13)	Lavender (2)
Way	Highway (9)	Alley (2)
Energy	Electricity (11)	Wind (3)
Clothing	Pants (12)	Pajamas (3)
Genius	Einstein (15)	Edison (2)

2.2. PILOT STUDY II

Thirty-seven native speakers of Turkish participated in the second pilot study. All participants (20 female, mean age: 38.7; 17 male, mean age: 41.3) were voluntary and included in the statistical analysis processes.

This study aimed to select the familiar and unfamiliar metaphors regarding the 30 categories determined. In this study, six sentences including metaphorical expressions are presented in *"An A is a B"* structure. The participants were asked to rate these metaphorical expressions on a five point scale as shown in Figure 1. Three of these metaphorical expressions included concrete concepts where three included more abstract concepts as in *Arkadaş/ Öğretmen/ Baba/ Yaşam/ Demokrasi/ Mertlik ağaçtır 'A friend/ teacher/ father/ life/ democracy/ bravery is a tree'.*

Figure 1. Scale used for familiarity

The data obtained from the second pilot study was obtained by frequency measurements of the most and the least familiar metaphors. In the light of the two pilot studies, the literal and metaphoric concepts are chosen and the experimental set to be used in the main experiment has been formed in the light of this data.

2.3. EYE-MOVEMENT STUDY

2.3.1. PARTICIPANTS

Forty native Turkish participants without any neurological, hearing or language impairments were included to the eye-movement experiments. Seven of the participants were excluded from the analysis due to their various eye-movements artifacts. 33 participants (22 female, mean age: 24.69, SD= 2.82; 11 male, mean age: 29.54, SD= 12.72) were included to analysis. All participants had normal or corrected-to-normal vision and they voluntarily attended the experiments.

2.3.2. MATERIALS: STIMULUS, APPARATUS AND PROCEDURE

Our eye-movements stimuli consisted of 30 sentences with four experimental conditions as follows in Table 4: Literal prototypical (LP), literal non-prototypical (LN), metaphor familiar (MF), and metaphor unfamiliar (MU) conditions.

Table 4. Sample stimuli of conditions

Conditions	*Stimuli*
LN	Çınar güzel *BİR AĞAÇTIR* ve çoğu zaman sağlam kökleri vardır. '*Sycamore is a beautiful tree and it has usually solid roots*.'
LP	Köknar güzel *BİR AĞAÇTIR* ve çoğu zaman sağlam kökleri vardır. '*Fir is a beautiful tree and it has usually solid roots.*'
MF	Baba güzel *BİR AĞAÇTIR* ve çoğu zaman sağlam kökleri vardır. '*Father is a beautiful tree and it has usually solid roots.*'
MU	Mertlik güzel *BİR AĞAÇTIR* ve çoğu zaman sağlam kökleri vardır. '*Bravery is a beautiful tree and it has usually solid roots.*'

In the study, according to the results of the pilot test, 30 category members chosen for each condition were presented within the initial structure “an A is a B” as below:

*Sycamore/Fir/Farther/Bravery is a nice **tree** and it usually has solid roots.*

Here, to separate the word giving the metaphorical meaning, “tree”, from the words presenting the literal or metaphorical meaning, an adjective was put between them. After the sentence, again, to separate the category member (tree) and the defining phrase, the connective ‘and’ and a time adverb was added.

Eye-movement experiments were recorded in SMI RED (SensoMotoric Instruments) I View-X eye tracker running at 500 Hz sampling rate. To ensure the stability during the experiments, a chin restraint was used. Stimuli presentation was prepared with the SMI Experimental Suite software. 5-point system was used for eye-gaze calibration. The eye tracker and a 1900 CRT 22-inch wide screen monitor (refresh rate of 140 Hz) were interfaced with a 3-GHz Pentium 4 PC. For each experimental block, recalibration was carried out, before the experiment began. X and Y coordinates were tried to fix at the spatial accuracy rate under of 0.5 degree.

120 sentences were presented in a randomized order in three blocks of three trials. Experiments were recorded in the Linguistics Laboratory of Ankara University Department of Linguistics. Participants were seated in front of the stimuli screen approximately 70 cm from the screen. They were instructed to look at the fixation cross point (+) on the stimuli screen to minimize the eye-movement artifacts. The black-colored fixation cross point appeared in the top-left of the screen. After participants looked at the fixation cross point, they were instructed to read silently the visual stimulus. Then, a question point appeared on the response screen. At that moment, participants judged the linguistic acceptability of the visual stimulus by selecting ‘acceptable’ or ‘non-acceptable’ options (See in Fig.2) via using a button box. There were two resting periods of three experiment blocks up to five minutes. All the experiment procedures were applied in the same order for all experiment blocks. Experiments were completed approximately 30 minutes with resting periods for one subject. All of

the subjects were informed to avoid eye-movements artifacts such as eye blinks during the experiments.

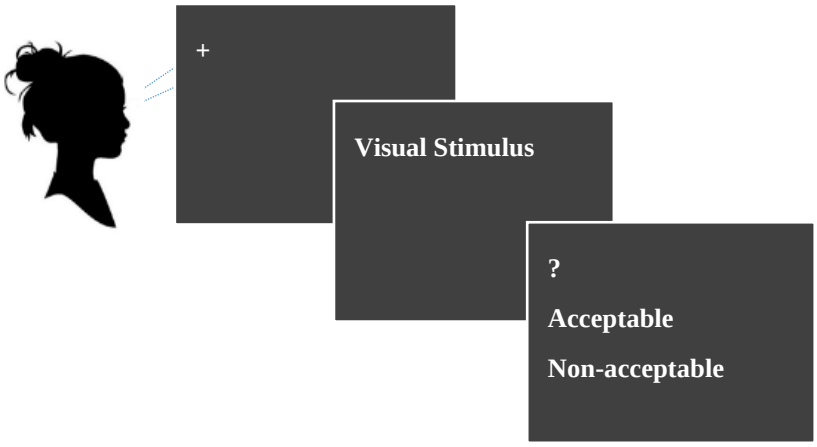

Figure 2. Stimulus design of procedure

2.3.3. DATA ANALYSIS

The lmer4 package were used for statistical data analysis in R programming (R Core Team, 2013) via *lmer()* function for eye-movement data and *glmer()* function (binomial family and logit link function) for behavioral data to fit linear mixed-effects (LME) models, with the fixed factors as *Literal* (prototypical, non-prototypical), *Metaphoric* (familiar, non-familiar). In addition to fixed factors considered in simple linear regressions, LME models account for random variation induced by items and participants. Visual inspection of residual plots did not reveal any obvious deviations from homoscedasticity or normality. P-values were obtained by likelihood ratio tests of the full model with the effect in question against the model without the effect in question. 7 of the 40 participants were discarded from the statistical data analysis due to their eye-movement artifacts.

Our AOIs were the same phrase (‘bir ağaçtır’) in all four conditions. Reading measurements for all the area of interest (AOIs) were analyzed in four eye-movement parameters: (a) First fixation, (b) first-pass duration, (c) second-pass duration, (d) number of regressions out of an AOI.

2.3.4. RESULTS

2.3.4.1. BEHAVIORAL RESULTS

Our results for behavioral data indicates that participants were more successful in literal responses than metaphoric ones. Correct responses were coded as number (1) and incorrect responses as number (0). The R analysis represented a boundary main effect of Literal (β= 0.773 (0.39) z= 1.952, p=0.05), small significancy for Metaphor (β= 0.338 (0.39) z= 1.062, p=0.28). However, there were a significantly important result for the interaction of Literal and Metaphor conditions (β= 3.208 (0.32) z= 9.875, p<0.001). Post hoc multiple comparisons using Bonferroni method on the LME model (*multcomp* package, Hothorn et al., 2008) indicated significant performances between *Literal* and *Metaphor* condition pairs. According to this, the pairwise analysis revealed that participants performed more successful in *Literal* (LN and LP) conditions (β= 0.877 (0.153) z= 5.719, p<0.001), than *Metaphor* (MU and MF) conditions (β= -0.245 (0.102) z= -2.398, p=0.10). While there were a remarkable significancy between LN and LP, there were any significancy between MU and MF condition pairs. Significancy results for acceptability (see in Table 5 and see in Fig.3) presented that the correct responses for Literal conditions pairs were significantly greater than Metaphor conditions pairs.

Table 5. Descriptive overview of the conditions

Conditions	Mean/SE	Standard Deviation
LN	0.844 (0.01)	0.363
LP	0.923 (0.01)	0.265
MF	0.425 (0.02)	0.494
MU	0.379 (0.02)	0.485

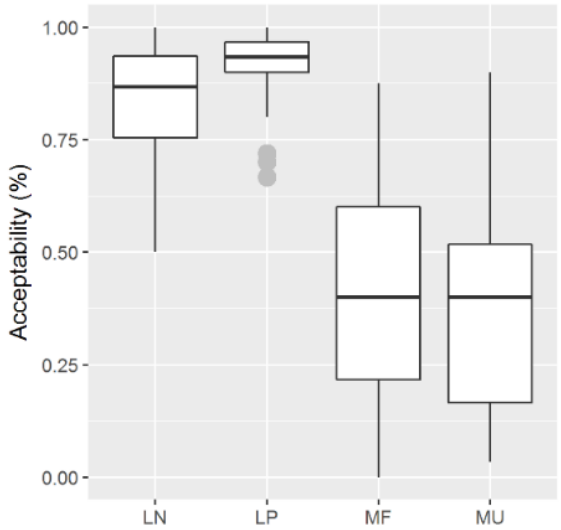

Figure 3. Acceptability rates for behavioral data

2.3.4.1. EYE-MOVEMENT DATA

To examine the effect of Literal and Metaphor on eye-movement measures, we used LME model (*multcomp* package, Hothorn et al., 2008) with post-hoc multiple comparisons tests using Bonferroni method. From this point, we pointed several fixation times on target word in our measurements as *first fixation durations*, *first pass* and *second pass durations*. As well described in Juhasz and Pollatsek (2011), the *first fixation duration* indicates the duration of the first fixation in a target word region. Accordingly, our results for *first fixation duration* on the target word displayed a significantly important finding for the total effects of literal and metaphor as seen in Table 6. Next, the *first pass duration*, which sums up the total time of the first pass processing on the target area, implies an important information for the early linguistic processes. First pass duration might also be an indicator for the initial access to critical word's meaning. As seen in Table 6, the results for first pass duration indicated significancy between condition pairs. Regarding to this, while literal conditions revealed no significancy, metaphoric knowledge indicated high difference for the main effect (β = -0.074 (0.03), t = -2.28) and the total of literal and metaphor (β = -0.125 (0.02), t = -5.92). The pairwise analysis for this significance displayed high importance between the conditions of MU (unfamiliar metaphor)

and LN (non-prototype literal) as (β = 0.130 (0.02), z = 4.694, p < 0.001); the conditions of MF (familiar metaphor) and LP (prototype literal) as (β = 0.119 (0.02), z = 4.235, p < 0.001); and for the conditions of MU and LP as (β = 0.193 (0.02), z = 6.903, p ≤ 0.00). There were also significancy for the pairwise analysis between MU and LP (β = 0.740 (0.02), z = 2.674, p < 0.05).

Table 6. Mean baseline values for first fixation, first pass, second pass and regression out durations on the regions

Measures	
First Fixation	
Literal non-prototype (LN)	168.59 (3.186)
Literal prototype (LP)	160.40 (2.491)
Metaphor familiar (MF)	177.02 (2.952)
Metaphor unfamiliar (MU)	187.44 (3.154)
First Pass	
Literal non-prototype (LN)	234.23 (5.075)
Literal prototype (LP)	220.49 (5.032)
Metaphor familiar (MF)	248.27 (5.457)
Metaphor unfamiliar (MU)	270.67 (5.793)
Second Pass	
Literal non-prototype (LN)	331.47 (25.771)
Literal prototype (LP)	314.30 (42.696)
Metaphor familiar (MF)	274.23 (19.653)
Metaphor unfamiliar (MU)	360.01 (29.270)
Regression Out	
Literal non-prototype (LN)	0.046 (0.008)
Literal prototype (LP)	0.034 (0.006)
Metaphor familiar (MF)	0.048 (0.008)
Metaphor unfamiliar (MU)	0.091 (0.011)

R analysis for the duration of re-fixations as *second pass duration* introduces an amount of the duration, which the participant spends a re-reading process on the target word after first-pass reading. As seen in Table 7, our results for the second pass duration showed significancy only in main effect of metaphor (β = -0.26 (0.11), t = -2.43). The pairwise analysis also supported a high significancy effect between the condition pairs of MU and MF (β = 0.274 (0.08), z = 3.366, p < 0.04).

Table 7. Linear mixed-effects models coefficients, their SEs, and corresponding t-values, for the analyses of first fixation durations, first pass and second pass durations

Measures		
First Fixation	*β* (SE)	*t*
(Intercept)	5.02 (0.03)	173.54
Literal	-0.03 (0.03)	-1.28
Word Length	-0.01 (0.01)	-0.96
(Intercept)	5.11 (0.02)	211.82
Metaphor	-0.05 (0.02)	-2.25
Word Length	0.01 (0.01)	0.47
(Intercept)	5.06 (0.02)	206.52
Literal & Metaphor	-0.09 (0.02)	-4.94
Word Length	-0.004 (0.01)	-0.47
First Pass		
(Intercept)	5.26 (0.04)	136.02
Literal	-0.06 (0.04)	-1.6
Word Length	0.02 (0.02)	1.23
(Intercept)	5.39 (0.03)	164.08
Metaphor	-0.07 (0.03)	-2.28
Word Length	0.03 (0.02)	1.67
(Intercept)	5.33 (0.03)	156.31
Literal & Metaphor	-0.13 (0.02)	-5.92
Word Length	0.03 (0.01)	2.25
Second Pass		
(Intercept)	5.41 (0.09)	62.28
(Intercept)	-0.17 (0.12)	-1.44
Literal	-0.01 (0.06)	-0.23
Word Length	5.45 (0.05)	104.62
(Intercept)	-0.26 (0.11)	-2.43
Metaphor	-0.002 (0.04)	-0.07
Word Length	5.47 (0.05)	105.74
(Intercept)	0.00 (0.07)	-0.04
Literal & Metaphor	-0.01 (0.03)	-0.34

The regressions include the regression time of the participant's first entering and moving out from the target word area. Regression numbers are generally sensitive for semantic integration processes. Our results for regression duration include mainly the analysis of regression out from the target word area. There were significantly important results for the main effect of both literal and metaphor conditions. According to these results, the comparison between the R results for the main effect of literal ($\beta = 0.26$ (0.29), $z = -0.9$, $p < 0.37$)

and metaphor (β = 0.69 (0.0), z = 965, p < 0.001) indicates significantly important differences as seen in Table 8. Even both of the condition pairs displayed significance; there were high difference between their significancy degrees. The pairwise analysis also indicated high significancy between conditions of MU and LN (β = 0.781 (0.19), z = 3.936, p < 0.001), MU and LP (β = -1.051 (0.21), z = 4.902, p < 0.001), MU and MF (β = 0.682 (0.19), z = 0.193, p < 0.001). These results supported the late process of metaphoric knowledge when compared to literal information.

Table 8. Linear mixed-effects models coefficients, their SEs, and corresponding t-values, for the analyses of regressions

Measures			
Regressions Out	β (SE)	*z*	p
(Intercept)	-3.86 (0.27)	-14.12	<0.001
Literal	-0.26 (0.29)	-0.9	0.37
Word Length	-0.14 (0.15)	-0.96	0.337
(Intercept)	-3.17 (0.0)	-3200	<0.001
Metaphor	0.69 (0.0)	695	<0.001
Word Length	-0.04 (0.0)	42	<0.001
(Intercept)	-3.32 (0.18)	-18.52	<0.001
Literal & Metaphor	-0.61 (0.15)	-4.05	<0.001
Word Length	-0.03 (0.07)	-0.39	0.695

3. DISCUSSION

The aim of our study was to find out differences between cognitive reactions in online processing of literal and metaphoric sentences. In order to test this, we tried to find out whether prototypicality in literal sentences and degree of familiarity in metaphorical sentences effect processing time.

The overall results of the study showed that the effect in processing metaphorical sentences are higher than literal sentences. This result supports the literal first hypothesis, which means the results of the study showed that literal meaning is activated before metaphorical meaning. These results are also compatible to Brissard, Frisson & Sandra's

(2001) study conducted on Dutch literal and metaphorical sentences, which tested reaction times through a self-paced reading study.

If we remember the structure of the sentences used in our study, the Target word (T) shows whether the sentence is metaphorical or literal.

*Çınar/köknar/baba/mertlik güzel bir **ağaçtır** (Target) ve çoğu zaman sağlam kökleri vardır.*
*'Sycamore tree/fir tree/father/bravery is a fine **tree** and it usually has strong roots.'*

As we can see in the example the target word is *ağaç* 'tree' since it shows whether the sentence is metaphorical or not. The results, which show the effect in the study, are fixation duration, pass duration results and regression. Especially the results with respect to the target word show an effect on processing metaphors.

Eye-movement results show that target word in literal sentences have no effect where the target word in metaphorical sentences makes a significant effect. The findings of first fixation duration are considered as an indicator of early processing in metaphorical sentences, which means that metaphors are processed by reference to literal meaning. However, the findings of the first-pass and second-pass durations suggest an impact on both early and late processing of metaphor. The results of regressions numbers support the finding of first fixation durations and first-/second-pass durations results. According to this, the participants make regression when they encounter with metaphorical concepts when compared to literal ones. The significant effect among condition pairs proves this situation. These results indicate that the participants do not make regression out of the target word when the sentence is literal, however they do so when the sentence is metaphorical. Thus, the participants recognize a non-literal usage in the target word and make regressions. For this reason, in regressions results a significant effect is observed in especially unfamiliar sentences.

When we sum up the results in the framework of these parameters; a slight difference between LP and LN, a significant difference between MU-LN, MU-LP and MF ile MU condition pairs are observed. So prototypicality and peripherality in literal sentences don't have a sense

effect as familiarity or unfamiliarity of a metaphor. These results show the following charecteristics in line with the conceptual framework we discussed: The results show that processing slows down as the participants move from the literal end of the literal-figurative continuum to the figurative end of the continuum (See in Fig.4).

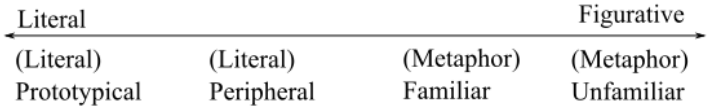

Figure 4. Literal-figurative continuum

Thus prototypical literal sentences are processed more rapidly while peripheral literal sentences are processed a little bit later than the prototypical sentences. It means that whether the sentence was prototypical or peripheral did not make a significant effect. When we analyze the metaphorical sentences, we observe that familiar metaphors are processed more rapidly than the unfamiliar ones. All these results make us think that the literal sentences are processed before metaphorical sentences. However as we discussed in the theoretical background of the study the studies on figurative language may show different results (Glucksberg, 2003; Frisson & Pickering, 2001). This brings up questions about some possible future studies.

These can be summarized in two parts: First, due to the nature of the study, and due to the tested sentence structure, the metaphors used here were novel metaphors. We question if we would obtain similar results without novel metaphors. Secondly, more interesting and easier to determine, we question if we would obtain similar results when we presented an introductory context at the beginning of the metaphorical sentences. Studies (Frisson & Pickering, 2001; Giora, 2002) show context plays an important role in processing. At this point, we are curious about how the results would be if we incorporated the effect of context. We are currently planning to make a second study and test this effect.

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