

SEMANTIC/PRAGMATIC PROCESSING IN TURKISH PROPOSITIONAL  
ATTITUDE VERBS: THE CASE OF "ZANNET"

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**SEMANTIC/PRAGMATIC PROCESSING IN TURKISH PROPOSITIONAL  
ATTITUDE VERBS: THE CASE OF "ZANNET"**

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**I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.**

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## ABSTRACT

### SEMANTIC/PRAGMATIC PROCESSING IN TURKISH PROPOSITIONAL ATTITUDE VERBS: THE CASE OF "ZANNET"

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This thesis investigated the Theory of Mind (ability to infer mental states) in a verbal medium. In addition to that, some propositional attitude verbs that are used for providing such a medium are investigated semantically and pragmatically. Evaluated verbs were *bil* (know), *düşün* (think), and *zannet* (~falsely-believe). These verbs are used for creating a paradigm where speaker's beliefs are encoded in the utterance, and participants were expected to predict emotional responses to given situations using this information. Their accuracy scores in these experiments were then compared and examined for correlation with their scores on the Autism-Spectrum Quotient questionnaire with which we aimed to measure the ability to process pragmatic inferences.

Keywords: Theory of Mind, Propositional Attitude Verbs, Pragmatic Inferences, Autism Spectrum Disorder, Human Language Processing

## ÖZ

### TÜRKÇE'DE TUTUM FİİLLERİNİN İŞLENİŞİ VE ANLAMBİLİMSEL VE EDİMBİLİMSEL İNCELENMESİ: "ZANNET"

Albayrak, Samet

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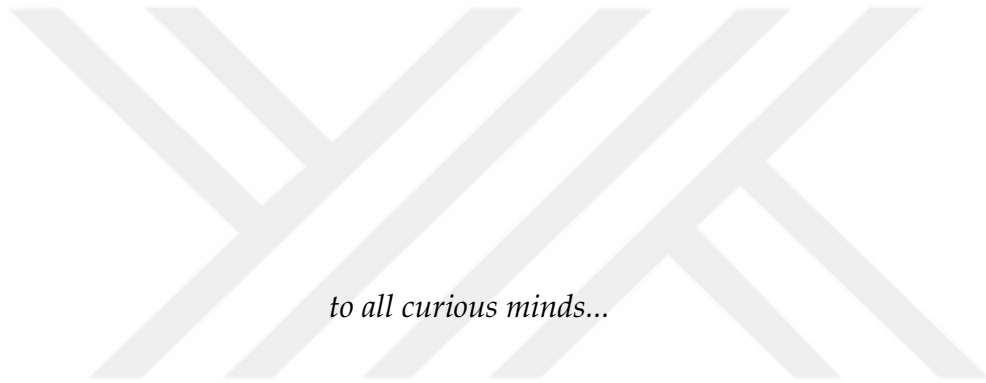
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Bu tez, Zihin Teorisini (zihinsel durum çıkarımı yapabilme becerisi) yazılı ifadelerle oluşturulan bir ortamda araştırmaktadır. Buna ek olarak bahsedilen ortamın oluşturulmasında kullanılan bazı önermesel tutum fiilleri de anlam-bilimsel ve edimbilimsel açıdan incelenmektedir. İncelenen fiiller *bil*, *düşün* ve *zannet*'tir. Bu fiiller cümleleri söyleyen kişinin inanç ve düşüncelerinin cümlelerin içine gizlendiği bir düzenek oluşturmak için kullanılmıştır. Katılımcılardan bu cümlelerde verilen bilgiyi kullanarak anlatılan bir duruma verilebilecek duygusal tepkiyi tahmin etmeleri beklenmiştir. Katılımcıların bu deneylerde verdiği doğru cevap sayıları ile pragmatik çıkarım yapabilme becerilerini ölçmek için eklediğimiz Otizm Spektrum Anketi skorları karşılaştırılıp aralarında korelasyon olup olmadığı incelenmiştir.

Anahtar Kelimeler: Zihin Kuramı, Önermesel Tutum Fiilleri, Pragmatik Çıkarım, Otizm Spektrum Bozukluğu, İnsan Dil İşleme



*to all curious minds...*



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## LIST OF ABBREVIATIONS

ex	example
ToM	Theory of Mind
ASD	Autism Spectrum Disorder
ADHD	Attention Deficit Hyperactivity Disorder
AQ	Autism-Spectrum Quotient
N	Noun
NP	Noun Phrase
V	Verb
VP	Verb Phrase
QUD	Question Under Discussion
SOV	Subject-Object-Verb
SVO	Subject-Verb-Object
a	attitude holder's opinion
e	expectation
p	proposition
r	reaction
s	speaker's opinion
v	propositional attitude verb



# CHAPTER 1

## INTRODUCTION

All social interactions depend on understanding the others' (and one's own) beliefs and desires. This can be done with the help of verbal communication as well as by observing actions and hypothesizing. Where verbal communication falls short or is unavailable, this mechanism heavily relies on hypothesizing. Attributing intentions and observing behavior for constantly updating these attributions is called the Theory of Mind.

Past research indicates that inferring others' mental states is an ability (Theory of Mind) that can be seen even in young children (Wimmer and Perner, 1983; Baron-Cohen et al., 1985; Wellman et al., 2001; Saxe et al., 2004; Baillargeon et al., 2010). For example, if someone aims to get ice and opens the fridge, it is quite straightforward to assume that the person believes the fridge is functioning and there is ice in it. Knowing one's desire and seeing their action allows for deduction of their beliefs. It is also possible to do so without knowing one's aim, provided that there is sufficient information about the actions and the environment. Observing the person's actions step by step allows for updating thoughts about the person's beliefs almost simultaneously.

Despite there are many recent studies focusing on modelling Theory of Mind computationally (Baker et al., 2009; Frank et al., 2009; Shafto et al., 2012a,b; Goodman and Stuhlmüller, 2013; Kiley Hamlin et al., 2013; Zaki, 2013; Frank and Goodman, 2014; Kao et al., 2014; Lucas et al., 2014; Baker et al., 2017; Wu et al., 2018), there is still a lot to be learned about how this ability to infer others' mental states work in real life situations. In most of such cases the observed person's intentions are obscure in the beginning. Their reaction to events and to the environment are used for inferring their intentions and knowledge. An answer to question in (1b) can be that he likes what is being cooked and he is happy about the situation. Example (1) presents such a case, where there is no statement regarding Berkay's mental state but his feelings and thoughts can be inferred by observing his actions. On the other hand, there are cases where the intention is known and the action/reaction is predicted as this mechanism works both ways. As shown in example (2), only internal states are reported for Melike and the change that will occur after she gathers new information can easily be inferred. Melike's emotional reaction to this new information would be sad or disappointed (e.g. frowning, sighing etc.) and her next action would probably be directed towards obtaining food

(e.g. taking the banana, ordering food etc.) as she is reported to be hungry.

- (1)
  - a. Berkay enters the kitchen and sees his father preparing dinner. Quickly approaches him and starts smelling for what is cooking. Then he smiles and licks his lips.
  - b. What are Berkay's feelings and thoughts in this scene?
- (2)
  - a. Melike is hungry and wants to eat meatballs and spaghetti. She opens the fridge and sees that it is empty except for a banana.
  - b. How would she react to this situation? What is likely to be her next action?

Propositional attitude verbs are used for reporting mental states. This reporting mechanism can be thought as the linguistic counterpart of the working mechanism of Theory of Mind. But in this case, instead of the observation of one's behavior, a verbal report is used to infer mental states. Example (3) shows various possible reports about mental states of the characters in examples (1) and (2). The relation that is established via Theory of Mind on a cognitive level is established on a linguistic level via propositional attitude verbs.

- (3)
  - a. Berkay believes that his favorite meal is about to be ready.
  - b. Berkay knows that his father is a good cook.
  - c. Melike suspects that Arzu ate the spaghetti and meatballs.
  - d. Melike decides to order sushi.

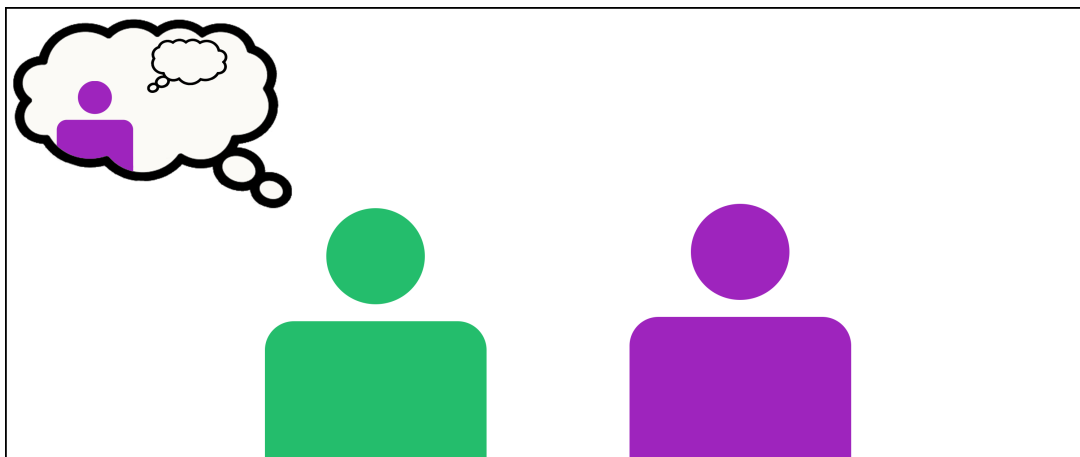


Figure 1.1: Theory of Mind

Figures 1.1 and 1.2 present the parallel between Theory of Mind and propositional attitude verbs visually. In Figure 1.1, observer (green) forms an idea about mental states of the observed (purple). In Figure 1.2 observer (now speaker) (green) is reporting observed's (purple) mental states. Additional verbal step in Figure 1.2 causes the speaker's (green) opinion to leak into the

statement and the hearer's (red) opinion cannot be evaluated independently from it.

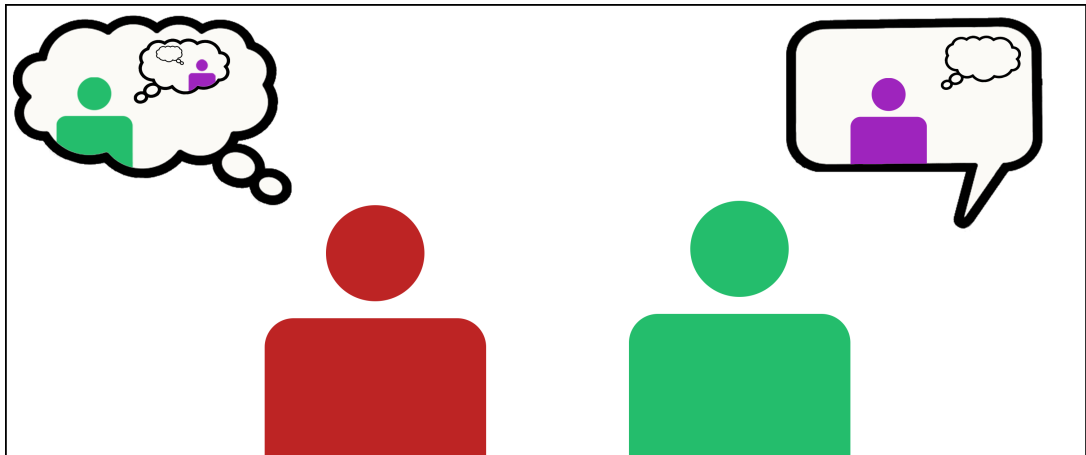


Figure 1.2: Propositional Attitude Verbs

Here in this study, we investigate the hypothesis that through an utterance, which contains a propositional attitude verb, both the situation of environment (through speaker's mental states) and the mental states of the subject of utterance can be inferred varying among the population. We conducted experiments that utilize emotion prediction and pragmatic inference processing mechanisms of propositional attitude verbs that encode the cognitive attitude of a speaker toward a proposition (e.g. know, believe, etc.), as well as questionnaires that aim to test the variation among the population in their social and cognitive patterns that are relevant to ToM related skills.

The outline of the thesis is as follows. In the Background chapter (Chapter 2) theoretical concepts which are relevant to this study are explained and some studies with similar experimental approach are discussed. Two main concepts are Theory of Mind and Propositional Attitude Verbs. There are also concepts related to the experimental aspect of this study, namely Emotion Prediction and Autism-spectrum Quotient (Autism Spectrum Disorder) which are also explained in Chapter 2. Experiments chapter (Chapter 3) contains information about how the experiments are constructed, applied and how their results are analysed in chronological order. Conclusion chapter (Chapter 4) consists of the interpretation and discussion of the results in addition to possible future directions for this study.



## CHAPTER 2

### BACKGROUND

Inferring others' mental states is an important ability for social interactions as well as predicting and planning responses and actions of others. It is possible to use the facial expressions, body language, word choices, tone, or contextual information for accessing the information that is not available on the surface. For any event that is without a revealed outcome, it is possible to talk about an intention attribution to those who observe the event. Even though these attributions are not independent from assumptions, it becomes clear what the observers' expectations were by evaluating their reactions once the outcome is revealed. For example, during a trapeze show, it is possible to know if a performer fell just by observing audience's faces and reactions. It is even likely to accurately detect anyone among participants who believe that a performer is going to slip or fall. In other words, not only the events (through reactions) but also the expectations (through the levels of surprisal) are available on the observers' faces. Even young children and some animals are able to do such deductions. This ability to extract information and relate these pieces of information with each other is referred as the Theory of Mind (ToM). An individual with a developed ToM is able to see others not only as what meets the eye but also with their mental states, such as; desires, beliefs, intentions, emotions and so on (Wellman et al., 2001; Wu et al., 2018). This ability is extremely useful for survival for social species considering there is no direct way of observing one's emotions and internal states, it is only possible to infer them by using all the cues and clues available. In this study, we investigate this phenomenon, namely the Theory of Mind, with the help of innate mechanism of emotion prediction in a setting composed with propositional attitude verbs. Since propositional attitude verbs are used for reporting one's own or others' mental states, the representation of these verbs is inevitably related to ToM. And making a prediction about someone's emotions with the help of these verbs should reflect the individual variations regarding ToM related skills among the population. In the remainder of this chapter these concepts and a few other concepts which are related to our experimental approach will be thoroughly explained.

## 2.1 Theory of Mind (ToM)

Theory of Mind (ToM) is the ability to ascribe mental states (emotional or cognitive, such as beliefs, intentions, desires, purposes and presence or absence of knowledge etc.) to oneself and others, and to be aware that these states can be different for others than their own states (Premack and Woodruff, 1978). This understanding also includes realizing that all its subjects are on mental plane and not on physical. The representations are relevant to one's own or others' mental states about the real world and do not correspond directly to the real world (Wellman et al., 2001). Calling this phenomenon the intentional stance, Dennett (2009) defines it as a strategy that is used for behavioral interpretation of an entity (person, animal, object etc.) by considering it being a rational agent capable of making choices and taking actions guided by its beliefs and desires.

Since it is thought to develop in children around 3 years old (Baillargeon et al., 2010), ToM is mostly studied in a developmental aspect. Most well known setup for testing ToM is Wimmer and Perner's (1983) puppet play paradigm (Baron-Cohen et al., 1985), its overview is shown in (1). In Wimmer and Perner's paradigm, there are two puppets, two containers in a room (a basket and a box), and a marble (1a). One of the puppets (puppet A) places the marble in one of the containers (say the box), then leaves the room (1b). Before she returns, the other puppet (puppet B) relocates the marble to the other container (basket) (1c). Children are asked to point out in which container the puppet A will look for the marble when she returns to the room (1d). Children with a developed ToM point to the box as they are aware that the puppet A did not see the relocation of marble, thus will think that marble is where she left it. On the other hand, children without a developed ToM point to the basket as they are not able to make the distinction between their own knowledge and others', thus will not realize that puppet A does not know that the marble is relocated (1e).

- (1) a. Deniz and Leyla are sitting in a room. There is a box and a basket.
- b. Deniz puts the marble in the box and leaves the room.
- c. Leyla takes the marble from the box and puts it in the basket.
- d. Deniz returns to the room.
- e. Where would Deniz look for the marble?
  - (i) Box (Deniz does not know about the relocation)
  - (ii) \*Basket (Deniz knows about the relocation)

The phenomenon tested in Wimmer and Perner's (1983) puppet play paradigm is called the false-belief understanding/attribution. As mentioned in the definition of ToM, one needs to be aware of distinctness of their own and others' knowledge states in order to comprehend others' false beliefs. Testing for false belief understanding is important because it provides a basis for the ability to comprehend what others know and predict their further actions according to their beliefs and intentions (even if the beliefs are not compatible with the real world). (Baillargeon et al., 2010)

Even though the traditional and most well known examples of testing the false belief attribution is done on children and by means of demonstration with puppets or dolls (Wimmer and Perner, 1983; Baron-Cohen et al., 1985; Baillargeon et al., 2010), it is possible to test it in a verbal medium as done in Wu et al. (2018). In their study, Wu et al. (2018) give stories to participants and ask about characters' emotional responses. This study is explained more clearly in Section 2.3.

### **2.1.1 Individual Variations regarding ToM**

Theory of Mind is mainly studied in its developmental aspect as it is seen to develop in healthy or typical children around 3-4 years old (Wimmer and Perner, 1983; Baron-Cohen et al., 1985; Baillargeon et al., 2010). Such studies can provide the rare chance of observing the same individuals before and after they develop a ToM. In addition to these studies, there are others which focus on variations not in a single individual but variations among individuals in population. It is well known that ToM deficits are observed in people with autism spectrum disorders (ASD), attention deficit hyperactivity disorder (ADHD), congenital deafness, developmental language disorders, Alzheimer's disease, schizophrenia, and bipolar disorder (Korkmaz, 2011). ToM requires proper language development in advanced levels such as inferring someone's intentions from a reported behaviour. Thus, it makes sense that people with developmental language disorders and congenital deafness (i.e. deaf children with non-signing parents) to have ToM deficits as their linguistic concepts are not set conventionally. While most of these disorders focus on one aspect of mental variation that can cause a deficit in ToM, ASD is an umbrella term for different types of mental processing variations. For example, people with ADHD show ToM deficits due to their poor emotional processing and focusing abilities which are also seen in people with ASD. Schizophrenia patients have trouble following their internal states and behaviours thus following others' and making the distinction is much more difficult. Even though not through same mechanisms, people with ASD also show a similar symptom of missing their internal stimuli. (Korkmaz, 2011)

Among these variations, the one that is the most studied with ToM is ASD. One of the reasons is that ASD has a wide variety of symptoms that focus on different cognitive abilities, and it is a spectrum of disorders that even typical people show partial symptoms of. We are interested in ASD because we need a scale for measuring ToM related skills of participants. So, in the next section, ASD and its relation to ToM will be explained and the questionnaire named Autism-spectrum Quotient (AQ) will be introduced.

#### **2.1.1.1 Autism-Spectrum Disorder (ASD)**

According to DSM-5, autism-spectrum disorder (ASD) is classified as a neurodevelopmental disorder with a set of psychological symptoms and behav-

ioral variances. These symptoms are widely varied in areas such as imagination, attention, communication, repetitive behaviour, difficulties in planning and so on. ASD may or may not be accompanied by intellectual impairment. While language impairments, that may cause deficits in ToM by themselves, are often seen in people who are diagnosed with autism spectrum disorder, lack of any observable language impairment is also not rare. Language deficits encountered in ASD include but are not limited to total lack of speech, poor comprehension of speech, echoing or parroting, and overly literal or unnatural use of language (American Psychiatric Association, 2013). Mainly, difficulties in planning, overly literal use of language, and decreased ability to form relevance connections and infer others' thoughts cause the inability to process pragmatic language correctly. Implementing the contextual information into the information at hand is harder to do for people with ASD (Loukusa et al., 2018).

Many studies, such as Stewart and Ota (2008), Lewis et al. (2008), Loukusa et al. (2018), have shown the relationship between ASD and understanding of concealed information in a sentence. While Lewis et al. (2008) and Loukusa et al. (2018) studied this relationship in children and adults diagnosed with autism spectrum disorder, Stewart and Ota (2008) focused on the "autistic" traits and studied people without such diagnosis. People who are not diagnosed with autism, or not showing the relevant symptoms and traits on a clinical level are called neurotypicals. Since ASD has a large set of symptoms and is considered a spectrum, many of these traits can be observed in neurotypicals at various levels. Thus, a scale that would measure autistic traits would also suit our needs for a scale that measures ToM related skills.

Lewis et al. (2008) applied tests that measure linguistic and pragmatic ability of adults with and without a diagnosis of ASD, and found that participants with ASD diagnosis were significantly less competent in pragmatic language skills such as understanding inferences and humour. Loukusa et al. (2018) compared children with ASD diagnosis and typically developing children. They applied 5 tests to examine differences in comprehension of contextual inferences with or without the Theory of Mind, relevance, recognition of feelings, and false beliefs. Their results supported their initial hypothesis and showed that children with ASD had trouble answering the questions which required evaluation of pragmatic inferences.

In their study, Stewart and Ota (2008), investigated speech perception abilities of the participants by using words and quite similar sounding pseudo-words. After obtaining a distribution for lexical decision making scores, they applied Autism-Spectrum Quotient (AQ) test of Baron-Cohen et al. (2001) to participants for checking if there is a correlation between these linguistic abilities and the "autistic" traits defined by Baron-Cohen et al. (2001). They considered both overall score and communication score of AQ questionnaire. And for both, they observed that the linguistic abilities decline as the AQ scores increase.



## 2.1.2 Appraisal Theory and Emotion Prediction

Comprehension of one's own and others' mental states can be divided into two categories, cognitive and emotional. While cognitive states are clearer to define and explain verbally, emotional states are more complex and blurry. On the other hand, emotional states, even though emotion is an obscure concept for scientific approach, can be understood, predicted, and perceived more unconsciously/instinctively compared to cognitive states. (Frijda and Scherer, 2009)

Before getting to the linguistic reporting mechanisms for cognitive states that are relevant to this study in the next section, this section is dedicated to explanation of emotion and Appraisal Theory, and how they are related to ToM and to this study.

Despite that there are well defined emotions such as anger, joy, sadness, fear; the concept of emotion does not have a well established definition. This is mainly because emotions are not distinct and specific but continuous and many different combinations of these basic emotions make them more complex to classify. First scientific approach towards emotion is made by Darwin (1872). Even though he followed a functional approach, his work provided a basis for theoretical and experimental studies on and theories about emotions. Nowadays, the main theory that points out the connection between cognition and emotion is Appraisal Theory (first proposed in 1960s, changed and evolved into many different versions since). Its central idea is that emotions are adaptive responses and experiences (instead of states) which are shaped by evaluation of events and/or the environment that is relevant. (Moors et al., 2013)

Appraisal Theory relates emotion to various levels of cognition (appraisal of situation), motivation, physiological and motor reactions, and subjective feeling. The theory's emphasis is on cognition, evaluation (appraisal) of environment and situation (Scherer and Meuleman, 2013).

While it provides a background for scientific investigation of emotions, Appraisal Theory, as most other emotion theories, is interested in how emotions are induced in and experienced by individuals. Despite the theory's focus on appraisal of environment, it is investigated as an internal and subjective manner due to the nature of the concepts emotion and experience. Appraisal Theory does not shed light on how one's emotions are perceived by others.

As Wu et al. (2018) report, literature about Appraisal Theory and ToM is only about the effect of appraisal states' effects on guessing emotions. Nevertheless, this study is on the effect of context and emotional states of others on inferring others' cognitive states and intentions. Detailed explanation of how Wu et al. (2018) utilizes emotion prediction mechanism in their study can be found in Section 2.3.

Prediction of emotion is mostly an instinctive process. Various studies (Harris, 1983; Harris et al., 1985; Lagattuta et al., 1997; Lagattuta and Wellman,

2001) show that even 4-6 years-old children are able to relate past events to current emotional states and predict emotional reactions according to individuals' expectations. For example, knowing a kid's puppy ran away before, children could guess that the kid can get sad seeing another puppy.

Since emotion prediction involves accessing to others' minds, evaluation of context, and deduction of feelings, it is closely related to ToM. And in this thesis, we utilize this innate mechanism for emotion prediction for making a connection between ToM and beliefs, desires, and intentions through appraisals. The focus is on the mechanisms of understanding expectation through a secondary meaning suggested with the help of propositional attitude verbs and coming up with a guess about the emotional response to the outcome.

## 2.2 Propositional Attitude Verbs

Certain verbs that can take clauses as complements, such as *know*, *believe*, *hope*, *suspect*, *decide*, *fear*, *imagine* and so on, relate their subject to a proposition via a cognitive or emotional attitude. These attitudes (sometimes called intentional attitudes referring to ones internal states) usually reside in sentences classified as attitude ascriptions which are structured as "NP V that *x*" where "that *x*" is a finite complement clause (see example (2)). There is a relation declared by attitude ascriptions which take place in between truth-evaluable intentional content and the intention holder. These relations are called propositional attitudes and verbs that can present such a relation are called propositional attitude verbs (Swanson, 2011). As seen in example (2), Anil is the attitude holder and "it is snowing" is the proposition and these two are connected by the propositional attitude verb *think*.

(2) Anil thinks that it is snowing.

There are many different classifications of propositional attitude verbs. Being entailing or not, factivity, and being cognitive or emotive seem to be the main criteria for this classification, especially in the earlier examples in the literature. Even though this study is mainly focused on being entailing or non-entailing for classification and testing of verbs of interest, this thesis will go through the literature and briefly explain the other criteria as well. As Takács (2017) reports, Kiparsky and Kiparsky (1970) made a classification of verbs based on factivity and emotivity (Table 2.1); Givón (1973) took cognitive verbs into consideration and made the classification according to their factivity (Table 2.2); and Klein's (1975) classification is on factives based on whether they are emotive or cognitive (Table 2.3). Some of the contemporary approaches make similar classifications based on the properties of asserted or presupposed entailments (doxastic or veracity entailments) of these verbs, in addition to the verbs' properties like factivity. For example, Swanson (2011) classifies the verbs according to not only their factivity but also whether they are entailing or non-entailing (Table 2.4).

Table 2.1: Kiparsky and Kiparsky's (1970) distinction of attitude verbs

Emotive factives:	suffice, bother, alarm, fascinate, nauseate, exhilarate, regret, resent, deplore, defy, comment, surpass belief
Non-emotive factives:	forget, bear in mind, make clear, take into account, consider
Non-factive emotives:	intend, prefer
Non-factive non-emotives:	turn out, seem, predict, anticipate, foresee, say, suppose, conclude

Table 2.2: Givón's (1973) distinction of attitude verbs

Cognitive factives:	know, remember, forget, see, hear, guess, resent, suspect, understand, be happy, regret, be aware, learn, realize, discover, notice, find out
Cognitive neg-factive:	pretend
Cognitive non-factives:	decide, agree, hope, think, doubt, believe, feel, fear, assume, suppose, dream, imagine

Table 2.3: Klein's (1975) distinction of attitude verbs

Emotive factives:	deplore, resent, regret, alarm, amaze, amuse, annoy, bother, delight, horrify, irritate, preoccupy, shock, surprise
Cognitive factives:	ascertain, comprehend, discover, find out, grasp, know, learn, notice, observe, perceive, realize, recall, recognize, recollect, remember, understand, disclose, reveal

Table 2.4: Swanson's (2011) distinction of verbs

	Entailing	Non-entailing
Factive	Find out, know, remember	Confess, regret, resent
Non-Factive	Discover, establish, prove	Believe, infer, suspect

### 2.2.1 Entailments

An entailment is a relation between two statements' truth values. If a sentence or a statement  $x$  is true whenever another  $y$  is true, then it can be said that  $y$  entails  $x$ . And factivity is about what happens to an entailment under negation. A presupposition is a type of entailment. If an entailment survives the negation of the statement it is nested in, then it is called a presupposition and the propositional attitude verb that establishes this relation is called factive. Presuppositions are such statements when they are not true, their host

sentence would not have a truth value (Frege (1892) and Russell (1905) as cited in Schwarz (2014)).

To illustrate, there is no possible world where (3a) is true, and (3c) is false at the same time for the same Mary. Thus, it can be said that (3a) entails (3c). On the other hand, (3b) (negation of (3a)) does not entail (3c). Sentences (4a) and (4b), entail (4c). Items (a) and (c) in (3) are in an entailment relationship but, there is no such relationship between (b) and (c). Contrarily, (a) and (b) in (4) are both in an entailment relationship with (c). Independent of the truth value or polarity of (4a) (or (4b)), an utterance about baldness of the king of France presupposes the existence of such a king (4c).

- (3) a. Mary ate the cake.
- b. Mary did not eat the cake.
- c. Mary ate something.
  
- (4) a. The king of France is bald.
- b. The king of France is not bald.
- c. There exists a king of France.

Another attempt to define presuppositions can be that they are background information that place the sentence in context for the sentence to be relevant. Despite the lack of a single, agreed on definition for presuppositions, they have two main widely accepted characteristics (Karttunen (1973) and Stalnaker (1973, 1974) as cited in Schwarz (2014)). Firstly, they do not introduce new information but only define the frame or the background. Secondly, they are independent from the polarity or mood of the sentence (i.e. positive, negative, question, and so on). The test to distinguish an entailment from a presupposition is based on this second principle. If the entailment survives the negation of the sentence, it is a presupposition; otherwise an assertion. Negation of (3a) ("Mary did not eat a cake.") no longer entails (3b). However, negation of (4a) ("The king of France is not bald.") continues to entail (4b). There still is no king of France.

For further illustration, take example (5):

- (5) a. Ali quit school.
- b. Ali did not quit school.
- c. If Ali quit school, he should have more free time.
- d. Ali might have quit school.
- e. Did Ali quit school?

The sentences in (5) convey totally different meanings regarding the state of the world, but independent from the sentence's polarity and mood, either positive (5a), negative (5b), conditional (5c), possibility (5d), or question (5e); they all have a common entailment that Ali was attending school at some point in the past. Without this piece of information being true, none of these sentences make sense. Thus, this entailment is distinguished as a presuppo-

sition, not an assertion, that can be inferred from all these sentences.

It is also possible to characterize presuppositions by reference to discourse structure. Singh et al. (2016) uses file cabinet metaphor for dialogue which represents discourse entities as file cards and says: "Each conversational move either adds a new file card or modifies existing ones." And unlike introduction of a discourse referent, which creates a new file card, a presupposition finds and processes (recalls, edits, manipulates, or adds to) the already existing information.

Anand and Hacquard (2014) consider for classification types of entailments that are made by attitude verbs and elaborate on possible reasons for the distributional asymmetry they encountered. As seen in Table 2.5, there is no attitude verb that report private states and are veridical, and none that report mandative communicative acts and veridical or factive. The reason argued by Anand and Hacquard (2014) is that there never was a need for such words because they contradict humans mental states and their representations. Nevertheless, they do not speculate on why this asymmetry is not the same in all languages.

Table 2.5: Anand and Hacquard's (2014) distinction of verbs

Attitude Class	Factivity/Veridicality		
	Neither	Veridical	Factive
<b>Private States</b>			
Doxastic	<i>believe, think, guess</i>	-	<b>cognitive factives:</b> <i>know, discover, realize</i>
Suppositional	<i>imagine, suppose</i>	-	<b>evidential factives:</b> <i>see, hear</i>
Desiderative	<i>want, hope, desire</i>	-	<b>emotive factives:</b> <i>love, regret, be sad</i>
<b>Communicative Acts</b>			
Assertive	<i>say, tell, argue</i>	<i>be right, demonstrate</i>	-
Mandative	<i>ask, request, order</i>	-	-

Veracity and doxastic are two types of entailments. Both can be accommodated in a sentence formed with an attitude verb and an embedded clause. A veracity entailment is about the state of the world as depicted in the embedded proposition and its confirmation via the utterance. A doxastic entailment, on the other hand is about beliefs or internal processes (private states) of the subject of the utterance. For example, both (6a) and (6b) entail "Laura is the murderer.", which is a veracity entailment as it is about the world. And these two sentences make a statement about Esra's beliefs and their relative truth value compared to the world. To see if these entailments are presuppositions or just assertions, negation of the sentences should be taken into consideration. (6c) still entails that Laura is the murderer but changes the statement

about Esra's beliefs on this topic. Thus, we can say that in (6a) the veracity entailment is presupposed, but the doxastic entailment is asserted by *be aware*. Contrarily, (6d) does not entail that Laura is the murderer anymore, but states that Esra thinks she is. So, the veracity entailment is not presupposed but asserted in (6b) through *be right*. This shows that while *be aware* is veridical (presupposes the veracity entailment) and *be right* is doxastic and factive (states the truth of the veracity entailment through the beliefs of the subject).

- (6) a. Esra is aware that Laura is the murderer.
- b. Esra is right that Laura is the murderer.
- c. Esra isn't aware that Laura is the murderer.
- d. Esra isn't right that Laura is the murderer.

At this point it is possible to define factivity as the term to name the cases where the verb has a veracity entailment and that entailment is presupposed.

Another property that can be considered for classification of propositional attitude verbs is polarity. For example, Nairn et al. (2006) classify attitude verbs according to their implications' relative polarity, considering if the sentence agrees or disagrees with the embedded clause's statement.

Polarity is about the direction of an entailment declared by the sentence. If it occurs in a manner such that the statement made by the embedded clause is supported by the attitude verb, then the verb has a positive polarity. If it results in negation of the embedded clause, then the attitude verb has a negative polarity.

- (7) a. Finn forgot that he is on a beach.
- b. Finn pretended that he is on a beach.

For instance, (7a) can be interpreted as Finn, who is on a beach, did not take this fact into consideration while doing or saying something, which matches with the embedded clause: "he (Finn) is on a beach". On the other hand (7b) semantically corresponds to Finn, even though he is not on a beach, acts or speaks as if he is on a beach, which negates the embedded clause: "he (Finn) is on a beach".

### 2.2.2 Context and Question Under Discussion (QUD)

All of the classifications made in the previous section (according to being entailing or not, factivity, veracity, being cognitive or emotive, and polarity) are mainly based on the meanings of verbs, and do not take context into account. As Simons (2007) indicates, attitude verbs can be interpreted as evidentiality markers instead of projectors depending on the context and main point (or QUD: Question Under Discussion).

Question Under Discussion (QUD) is a method (or a tool) which is used to determine the relevance or at-issueness of an utterance. It assumes that every sentence addresses a question by answering it or giving rise to another question which can be used to answer the first. QUD of an utterance is different for each context the utterance can be fit in (Benz and Jasinskaja, 2017). Changing the context and manipulating QUD also affects the implications of the utterance. Thus, context can simply strip an attitude verb from its projectional properties (Simons et al., 2017). An example to this is the use of *discover*, which is classified as a cognitive factive by many (Tables 2.2, 2.3, and 2.5).

- (8) a. [*Lucy is a 6 year-old, who is enthusiastic about dinosaurs and wants to see one*]  
If Lucy discovers that dinosaurs are extinct, she'll be devastated.
- b. [*Speaker comments on that his friend Bill trying to learn whereabouts of his daughter Sally*]  
If Bill discovers that Sally is in New York, he'll be relieved.  
(Simons et al. (2017) refers to Chierchia and McConnell-Ginet (2000) for a variant)
- c. I haven't tried this with wombats though, and if anyone discovers that the method is wombat-proof, I'd really like to know.  
(Simons et al. (2017) refers to Beaver (2010))

In the example (8a), context utilizes *discover* as a factive verb and helps project the statement "dinosaurs are extinct". In this scenario, the main point of the utterance is about whether Lucy will find out this fact or not; or QUD is "Does Lucy know that dinosaurs are extinct?". Contrary to that, in the example (8b) context eliminates the factivity of *discover*, as it states that Sally's location is unknown to the interlocutors. QUD for (8b), in this context, can be "Does Bill know where Sally is?", but not "Does Bill know that Sally is in New York?". For (8c), although a context is not specified, the utterance contains the information that the speaker does not know if the method is wombat-proof or not. Thus, by nullifying the aspect of *discover* that specifies the relation between subjects mental state and the reality (aspect that confirms the two are aligned), with help of the context, speaker uses it as a non-factive attitude verb. So, it is possible to say that presence of an overt statement, either through the utterance or the context, that contradicts with an implication/presupposition can cancel the implied statement (unless the verb is strongly factive and the sentence turns out to be nonsense).

Beaver (2010) reports a sentence processing structure proposed by Gazdar (1979) as starting from pre-established propositions, then adding simple (surface) semantic content, then adding implicatures provided that they are consistent with already processed information, and lastly adding presuppositions that are consistent. Presuppositions can only be accommodated in a sentence if they are not contradicting with any other meaning carried by the utterance. In (8b), presupposition "Sally is in New York" cannot survive this

process because already established information (through context) says that Sally's location is not known. But in (8a), there is no such information that counters the part of the meaning of *discover* which reports that the speaker believes the embedded clause is true.

### 2.2.3 Propositional Attitude Verbs in Turkish

In Turkish, an SOV language, sentences with propositional attitude verbs are structured as "NP *x* V" where *x* is a finite complement clause. But factivity of attitude verbs is dependent on more than semantic correspondence of the verb. Both the verb has to have a factive component and the complement clause must be nominalized. In their study, Ozyildiz (2017) clarifies the difference between two alternate versions of the same sentence with and without nominalization of the complement clause. Parallel to their examples, in (9), the difference called "factivity alternation" is shown. While (9a) indicates that party is postponed and Elif has information about that, (9b) only says what Elif heard about the party and nothing about the truth value of the complement clause "party is postponed". In (9b) proposition *diye* is used for making the complement fit into the sentence and it provides a meaning such as "as she knows"

- (9) a. Elif partinin ertelendiğini biliyor.  
Elif(nom) party(gen) postponed(+nom) knows  
'Elif knows that party is postponed.' (factive)
- b. Elif parti ertelendi diye biliyor.  
Elif(nom) party postponed *diye* knows  
'Elif believes that party is postponed.' (non-factive)

In this study, three Turkish attitude verbs were compared. *bil* (*know*), *düşün* (*think*), and *zannet* (*~falsely think*) are propositional attitude verbs that convey information about subject's thoughts and beliefs. They all are cognitive attitude verbs but their difference is in the sense of factivity and polarity. Even though this study does not focus on factivity of these verbs, in Table 2.6, we classified these verbs of interest according to their entailment patterns and factivities. While *bil* and *zannet* are classified as factives, *bil* is entailing and *zannet* is negatively entailing. On the other hand *düşün* is non-entailing thus, non-factive. It only carries meaning about the subject's thoughts and beliefs. While there are verbs that are entailing and non-factive or negatively-entailing and non-factive, it is not possible to have a lexical item that is non-entailing but factive since factivity, by definition, is a property related to the entailment which does not exist in case of a non-entailing verb.

- (10) a. Gizem Ersin'in uyuduğunu biliyor.  
Gizem(nom) Ersin(gen) sleeping thinks  
'Gizem knows that Ersin is sleeping.'



Table 2.6: Classification of Verbs of Interest

	Entailing	Non-Entailing	Negatively-Entailing
Factive	<i>bil-</i>		<i>zannet-</i>
Non-Factive		<i>düşün-</i>	

believe'(sleep'ersin')gizem'  $\wedge$  believe'(sleep'ersin')speaker'

- b. Gizem Ersin'in uyuduğunu düşünüyor.  
 Gizem(nom) Ersin(gen) sleeping thinks  
 'Gizem thinks that Ersin is sleeping.'  
 believe'(sleep'ersin')gizem'
- c. Gizem Ersin'in uyuduğunu zannediyor.  
 Gizem(nom) Ersin(gen) sleeping falsely-thinks  
 'Gizem falsely-thinks that Ersin is sleeping.'  
 believe'(sleep'ersin')gizem'  $\wedge$  believe'(¬(sleep'ersin'))speaker'

Example (10) contains three different versions of the same sentence, with logical representation of their meanings. They all are reporting Gizem believing that Ersin is sleeping, but different verbs are chosen by the speaker to reflect Gizem's beliefs. Sentence in (10a) is built with *bil* and selection of this lexical alternative shows that the speaker agrees with the statement made by the complement sentence. Oppositely, as in (10c), selection of *zannet* usually means that the speaker wants to declare that the real world does not overlap with the complement, specifically for this example, that Gizem's belief does not match the truth. On the other hand, in (10b) speaker does the reporting without including their own view of the topic.

Comparing *bil* and *zannet* according to their polarities (in a 3rd person, knowable context as given in example (11)) would result in a relation similar to the sentences in example (7) (repeated as (12)). While example (12a) and example (12b) both report relationships between Finn's cognition and his actions related to being on a beach, directions of these relationships are total opposites. Similarly, seen in example (11), while (11a) and (11b) both reporting the same state of mind for Gökçe about the surprise, they are total opposites regarding the surprise being a cake or not.

- (11) a. Gökçe sürprizin pasta olduğunu biliyor.  
 Gökçe(nom) surprise(gen) cake be(nom) knows  
 'Gökçe knows that the surprise is a cake.'
- b. Gökçe sürprizin pasta olduğunu zannediyor.  
 Gökçe(nom) surprise(gen) cake be(nom) falsely-thinks  
 'Gökçe falsely-thinks that the surprise is a cake.'
- (12) a. Finn forgot that he is on a beach.

- b. Finn pretended that he is on a beach.

Another aspect that makes *zannet* interesting is that it does not function the same with 1<sup>st</sup> person subject. The outcome is similar when it is used under an ambiguous condition. Example (13a) works normally according to the meaning assigned to *zannet* in example (10c), but in example (13b), where *zannet* is used with 1<sup>st</sup> person, interpretation of the same meaning causes confusion and contradiction, *zannet* simply becomes *düşün*. Since it is not possible to think something is true while being aware that it is false, the supposedly projected information about the reported thought being wrong cannot survive the dominant meaning of the sentence and is eliminated, as in Gazdar's (1979) idea of processing order. Out of this contradiction it is only possible for one of the meanings to survive and presupposition can never prevail against the surface meaning of its host sentence.

- (13) a. Amcam burada yüzmenin yasaklandığını zannediyor.  
 uncle(poss|1<sup>st</sup>) here swimming be-banned falsely-thinks  
 'My uncle falsely thinks that swimming here is banned.'  
 believe'(banned'swim')uncle'  $\wedge$  believe'(-(banned'swim'))speaker'
- b. Ben burada yüzmenin yasaklandığını zannediyorum.  
 I here swimming be-banned falsely-think  
 ?'I falsely think that swimming here is banned.'  
 (\*)believe'(banned'swim')speaker'  $\wedge$  believe'(-(banned'swim'))speaker'  
 'I falsely think that swimming here is banned.'  
 believe'(banned'swimming')speaker'

Probability or ambiguity about an undisclosed event also prevents the entailment as it is declared by the *main* meaning of the sentence, the outcome is unknown. Negative entailment of *zannet* is absent in this context due to the following explanation. Saying both the outcome is unknown and saying that it is either true or false contradicts with each other and only one survives the cognitive process of elimination of all the possible worlds in order to reach the one that is meant/referred by the speaker. Although probability statements are thought to be a presupposition test (Geurts, 1999), as long as the complement sentence is not invaded by the probabilistic auxiliary such as maybe or perhaps and the said complement is subjected to the probability as a whole the projection is not hindered.

We constructed Table 2.7, which shows the comparison between speaker's and the subject's opinion on the statement according to verbs. Table being half full is due to the fact that the other cells do not have a single lexical item that corresponding to the intended meaning but they can be constructed by other means. This distributional asymmetry is similar to Anand and Hacquard's

(2014) characterization. The reason we adopt this classification is that it is the one that most transparently fits to the manipulations in the experiment we report below.

In English there is also no single lexical item for *zannet*. Even though the mentioned asymmetry is varied among languages, having verbs for *bil* (know) and *düşün* (think) is more common compared to the others as these two are simpler and more direct.

Table 2.7: Classification of Verbs of Interest

	Att. holder +	Att. holder ?	Att. holder -
Speaker +	bil		inkar et
Speaker ?	düşün		reddet
Speaker -	zannet		<i>pretend</i>

### 2.3 Experimental Approach on ToM and Pragmatic Inferences

As Schwarz (2014) points out, especially before the last couple of decades, there were not enough experimental studies on presuppositions and existing work was almost only on English. And experimental studies on pragmatics still mainly focus on implicatures (primarily, scalar implicatures). Nowadays experimental pragmatics studies are more diverse in subject and generally conducted as coupled with other linguistic or cognitive ability measuring methods, such as self-paced reading experiments that measure surprisal effects, guessing emotional response from given texts, N400 studies with help of EEG/MEG, or eye-tracking experiments that investigate the online processing patterns.

One of the studies that investigate the Theory of Mind with the help of emotional prediction is Wu et al. (2018). In their study, Wu et al. (2018) basically give a storyline, including the main characters intentions and expectations, and ask participants to select the character's response to an implied outcome as a facial expression. They propose that even if people's emotions are not observable, facial expressions are good enough for inferring emotional states. The mechanism followed is: Given the knowledge state, intention, and action, participants deduce what outcome the character assumes and what kind of an expectation the character forms. Separately, an outcome to events is implied at the end of the story. Through the character's expectations and participants' interpretation of the outcome, participants are asked to guess the characters reaction from a set of facial expressions, which are varied through sad/happy and surprised/not-surprised. Their experimental setup is extensively explained in Chapter 3.

Similarly Lassiter and Goodman (2015) and Goodman and Stuhlmüller (2013) study the pragmatic inferences related to the speaker's knowledge and intention. Lassiter and Goodman (2015) investigate the reasoning mechanism that lies behind the processing of modal words such as *necessary* and *plausible*.

They compared seven versions of a statement (with *possible, plausible, probable, likely, necessary, certain*, and no modal word) by asking participants if they agree or disagree with the statement. Contrary to previous studies classifying modal words in two categories according to which of the two theories of reasoning, inductive or deductive, they employ, Lassiter and Goodman (2015) conclude, with help of a probabilistic model, that there is not a dual mode of reasoning mechanism but a spectrum which is affected by the word choice. Goodman and Stuhlmüller (2013) study the scalar implicature triggered by *some* under different contextual conditions that effect the speaker's knowledge state. They show that by manipulating how much of the information is available to the speaker, the interpretation of the utterance changes. They give two scenarios where the speaker has information about either the whole set of items or a part of them, and the speaker utters a sentence about items using the quantifier "some", such as "Some of the apples are red". When the speaker can see all the apples, participants interpret the utterance as "some but not all" but when apples are partially exposed to the speaker, participants' interpretation is "at least one, maybe all". Goodman and Stuhlmüller (2013) not only show that speaker's knowledge state and intention are important parts of the context but also state that language is a type of social cognition.

While in the study of Wu et al. (2018) speaker is always neutral and the relation between expectation and outcome is direct, we used different propositional attitude verbs to manipulate the speaker's attitude which makes the obscure outcome accessible depending on the verb. In their study Goodman and Stuhlmüller (2013) do not change the utterance. They only manipulate the knowledge state of the speaker and investigate the various meaning perceived by this contextual element. Lassiter and Goodman (2015) change the modal word and modify the speaker's level of commitment in the given statement, and we change the propositional attitude verb to manipulate the direction of the speakers commitment. In the light of these studies, we constructed several experiments in order to test the acquisition and transfer of ToM relevant information from speaker to the audience. The next chapter describes these experiments.

## 2.4 Research Question

To repeat our research question hypothesis from Chapter 1 a bit more elaborately; we investigate the hypothesis that through a propositional attitude ascription, both the situation of environment (through speaker's mental states) and the mental states of the subject of utterance can be inferred. Our research question is formed considering that making such an inference may include some variation, as the Theory of Mind also varies among the population. We conducted experiments that utilize emotion prediction and pragmatic inference processing mechanisms of propositional attitude verbs that encode the cognitive attitude of a speaker and the character (= subject of the propositional attitude ascription) toward a proposition (e.g. *bil* (*know*), *düşün* (*think*), and *zannet* (*falsely-think*)), as well as a questionnaire (Autism-Spectrum Quo-

tient (AQ)) that aims to test the variation among the population in their social and cognitive patterns that may be relevant to ToM related skills.





## CHAPTER 3

### EXPERIMENTS

This study contains three experiments. In this chapter, the aims, methods, and results of these experiments are explained and discussed.

#### 3.1 Experiment 1

##### 3.1.1 Aim and pre-Experimental Design Steps

In this part of the experiment our aim was to clarify the meanings of our verbs of interest by investigating the effect of different propositional attitude verbs on the interpretation of the truth value of the reported proposition by Turkish speakers. We intended to obtain a clear definition of *zannet* compared to *bil* and *düşün*. The latter two verbs have been studied more extensively (both in English as *know* and *think*, and in Turkish) and there are no studies focusing on *zannet*. As explained in Chapter 2, the expected difference between *bil*, *düşün*, and *zannet* is to be polarity. *Düşün* is expected to be neutral in terms of polarity, which means the hearer will not interpret the speaker to be committing to either to truth or the falsity of the reported proposition. *Bil* is expected to lead the hearer to interpret the speaker to be committing to the truth of the reported proposition while *zannet* will have the opposite effect. Hereinafter, the condition with *bil*, where the reported proposition's polarity is not reversed, will be named as 'context coherent', while the condition with *zannet*, where the polarity of the reported proposition is reversed, will be named 'context incoherent'.

Our experimental design for the evaluation of doxastic verbs was inspired by Lassiter and Goodman (2015), Goodman and Stuhlmüller (2013), and Wu et al. (2018). The setup and application is similar to Wu et al. (2018), while the theoretical model of Lassiter and Goodman (2015) and Goodman and Stuhlmüller (2013) are taken as the template during the construction of this experimental setup.

Exemplified in (1), Lassiter and Goodman (2015) followed a model where speaker's knowledge and opinions (s) about the proposition (p) can be inferred from the chosen word (v→p,s). As seen in (1), with the help of the

chosen propositional attitude verb (*v*) *know* (and its factivity), it is possible to infer Arthur's (subject) actions (talking about Lea) and Lea's (attitude holder) awareness of the said action. Hearer can access the information that the speaker believes the proposition to be true.

- (1)  $v \rightarrow p, s$   
 Lea **knows** that Arthur is talking about her.  
 $v = \text{know}$   
 $p = \text{Arthur talking about Lea}$   
 $s = \text{Lea's awareness of 'p' = Speaker believes p is true}$

As we wanted to test the meanings of our verbs of interest, we used a similar setup for testing the word's (propositional attitude verb's) effect on inferring the knowledge state of the speaker ( $v \rightarrow s$ ), thus accessing information about the world's state through speaker's beliefs. As seen in (1), referring to the speaker's knowledge state provides the ability to encode the world's state in the chosen word. Since attitude verb is our variable, it became easy to manipulate the declared state of the outside world parallel to the speaker's opinion which is our experimental variable between groups. In (2), unlike in (1), it is clearly seen that Lea's beliefs (that Arthur is unreliable) are reported but the word of choice being *think* prevents further elaboration on the truth of the said belief (whether or not Arthur is unreliable) and speaker's opinion of it.

- (2)  $v \rightarrow s$   
 Lea **thinks** that Arthur is unreliable.  
 $v = \text{think}$   
 $s = \text{Lea's beliefs on Arthur (about him being unreliable (p))}$   
 $= \text{Speaker's opinion about p is not included}$

In order to measure such an effect of word of choice, another component was added to the equation by Wu et al. (2018), namely expectation (*e*). Expectation, can be used together with the knowledge state of attitude holder (*a*) to predict the emotional response (*r*) ( $e, a \rightarrow r$ ). As shown in (3), given Lea's expectations/desires (wanting to do bungee-jumping) and change in her knowledge state about a relevant fact (bungee-jumping being banned), response (*r*) (Lea's emotional response) can be predicted quite straightforwardly (she'd be upset). And since the outcome of the events is contrary to her initial expectations, she would be surprised when her knowledge state is changed.

- (3)  $e, a \rightarrow r$   
 $e = \text{Lea wants to do bungee-jumping.}$   
 $a = \text{Lea finding out bungee-jumping is banned in her country.}$   
 $r = \text{Lea would be frustrated. (surprisal)}$

As Wu et al. (2018) are not interested in the effect of the propositional attitude



verb, they followed a different model. Intention (thus expectation(e)), action (as a proposition (p)), and the change in the knowledge state of the attitude holder (a) are given and the emotional reaction (r) is asked to be picked from a set of facial expressions as the outcome is revealed to the participants (e,p,a->r). Example (4) explains this mechanism. Lea's expectation is for Jim to be happy, and her action is towards making Jim happy (ordering a toy for Jim). Through her action, she expects that her goal to be achieved. After results of her actions (Jim's call and his response) are revealed, it becomes obvious that she will be satisfied with the result and her situation would not include surprisal.

- (4) e,p,a->r  
 e = Lea wants Jim to be happy.  
 p = Lea orders a toy that Jim wants.  
 a = Lea receiving a call from Jim, saying he got the toy and liked it.  
 r = Lea would be satisfied. (no surprisal)

With the help of these experimental setups and their logical frame, we constructed the experiment explained below in order to fulfil our aims to make distinction between the verbs of interest as declared in the beginning of this section.

### 3.1.2 Method

#### 3.1.2.1 Design and Materials

Similar to Wu et al. (2018), we started with defining the context and the expectation of the character. And then we reported a statement on character's opinion relevant to the subject by giving a propositional attitude ascription. After providing our participants with a context, an expectation, and the character's opinion, we manipulated the propositional attitude verb on the critical sentence to see how the semantics of these verbs influence the overall meaning. To do this, we used three different propositional attitude verbs (*bil* (know), *düşün* (think), and *zannet* (falsely believe)). Then participants were asked to predict the character's emotional response. They were asked to make a choice between four options. These options were "the character would be happy", "the character would be sad", "it is not possible to know", and "the character's feelings would not be affected". Following their response, they were presented with a comprehension question, as seen in (5d). This question was always about the context previously given (i.e. (5a) and (5b)).

- (5) a. Cenk hayallerindeki işe başvuruyor.  
 Cenk in-dreams-of-his job applies.  
 'Cenk applies to his dream job.'

- b. Mülakatta verdiği bir cevabın müdürü  
During-the-interview gave an answer manager  
sinirlendirdiğini **düşünüyor**.  
angered **thinks**.  
'He **thinks** that an answer he gave during the interview angered  
the manager.'
- c. Mülakat sonucunu öğrendiğinde Cenk nasıl hisseder?  
Interview result when-he-learns Cenk how feels?  
'How does Cenk feel when he learns the result of the interview?'
- d. Cenk'in girdiği mülakatı gerçekleştiren hangisidir?  
Cenk attended interview conducted which-of-these-is?  
'Which of these conducted the interview Cenk attended?'  
(Options: Manager, Boss, CEO)

One of the experimental items is given in (5). In (5a) character, his intention, and the context is introduced. Cenk, the character, having a dream job (which reveals his intention of being accepted to this position), and him applying for the job is the context. In (5b) his thoughts about the interview is reported via one of our three attitude verbs, thus his expectations on the outcome of the interview is implied. Cenk, thinking he angered the manager, is expecting the interview's result to be negative (regardless of the truth value of his opinion). As mentioned earlier, with the help of our setup, we were able to nest the outside world's state or the outcome of these events into this sentence via the verb of choice to see whether participants can infer if the character's expectation will be confirmed or denied by the outcome.

We expected mostly "it is not possible to know" from participants who were in the *düşün* group. Since *düşün* does not contribute to the meaning with a truth value attributed to the complement by speaker, there is no clue about the outcome of the events.

When *bil* was used, we expected that the participants would assume the reported thought fits the real world and deduce the complement is declared to be true by the speaker. Thus, **context coherent option** (coherent with the state in which the proposition's statement is true, independent of which propositional attitude verb is used) would be picked by the participants. In this part of the experiment, one of the two options "the character would be happy" or "the character would be sad" corresponds to the context coherent option. "the character's feelings would not be affected" also represents a similar scenario in which there is no surprisal for the character (where character's expectations align with the world's state). We thought that no surprisal option would be aligned with context coherent option for *bil* and *zannet*, and be aligned with "it is not possible to know" for *düşün* as it implies no commitment by the speaker.

Our expectations for *zannet* group were the opposite of *bil* group. Since *zannet* indicates that the beliefs of the character are contradictory to the facts, context

incoherent (surprisal for the character) option is expected to be picked more by the participants, which is either "the character would be happy" or "the character would be sad", depending on the context. Examples (6) and (7) explain each of the two conditions.

Example (6) is the *zannet* version of the example (5). As Cenk's thoughts are reported via *zannet* instead of *düşün*, the propositional attitude ascription (6b) also means that the proposition is not true according to the speaker. Thus, Cenk's thoughts about him angering the manager are false and he is likely to be accepted for the job. The expected answer is "the character would be happy" (the option that is non-context-coherent). Table 3.1 presents our expectations according to the experimental conditions (verb of choice).

- (6) a. Cenk hayallerindeki işe başvuruyor.  
Cenk in-dreams-of-his job applies.  
'Cenk applies to his dream job.'
- b. Mülakatta verdiği bir cevabın müdürü  
During-the-interview gave an answer manager  
sinirlendirdiğini **zannediyor**.  
angered **falsely-thinks**.  
'He **falsely-thinks** that an answer he gave during the interview  
angered the manager.'
- c. Mülakat sonucunu öğrendiğinde Cenk nasıl hisseder?  
Interview result when-he-learns Cenk how feels?  
'How does Cenk feel when he learns the result of the interview?'

Table 3.1: Expectations according to Verbs of Choice

Example	Expectation	Reason
Mülakatta verdiği bir cevabın müdürü sinirlendirdiğini <b>biliyor</b> . He <b>knows</b> that an answer he gave during the interview angered the manager.	the character would be sad or the character's feelings would not be affected	Manager got angry during the interview, no surprisal for the character, as their expectations were correct.
Mülakatta verdiği bir cevabın müdürü sinirlendirdiğini <b>düşünüyor</b> . He <b>thinks</b> that an answer he gave during the interview angered the manager.	it is not possible to know or the character's feelings would not be affected	No opinion of speaker about truth of the proposition
Mülakatta verdiği bir cevabın müdürü sinirlendirdiğini <b>zannediyor</b> . He <b>falsely-thinks</b> that an answer he gave during the interview angered the manager.	the character would be happy	Manager did not get angry during the interview, surprisal for the character, as their expectations were unrealistic.

In example (7), the proposition is in the opposite direction (optimistic) com-

pared to the example (6). Selin wants to pass her class (7a) and her positive thoughts on her success in the final exam is reported via *zannet* (7b). Thus, according to the speaker, she is wrong about answering most of the questions correctly and she will probably fail. Expected answer for how she feels after the grades are announced is "the character would be sad" (again the option that is non-context-coherent). And table 3.2, shows our expectations for each condition.

- (7) a. Selin bu dönem matematikten geçmeyi çok istiyor.  
Selin this semester maths pass very wants.  
'Selin really wants to pass maths this semester.'
- b. Finalden çıktığında soruların çoğunu doğru yaptığını  
Final after-leaving questions most correctly did  
**zannediyor.**  
**falsely-thinks.**  
'After the final exam, she **falsely-thinks** that she answered most of the questions correctly.'
- c. Notlar açıklandığında Selin nasıl hisseder?  
Grades when-announced Selin how feels?  
'How does Selin feel when the grades are announced?'

Table 3.2: Expectations according to Verbs of Choice

Example	Expectation	Reason
Finalden çıktığında soruların çoğunu doğru yaptığını <b>biliyor</b> .  After the final exam, she <b>knows</b> that she answered most of the questions correctly.	the character would be happy or the character's feelings would not be affected	She gave mostly correct answers, no surprisal for the character, as their expectations were correct.
Finalden çıktığında soruların çoğunu doğru yaptığını <b>düşünüyor</b> .  After the final exam, she <b>thinks</b> that she answered most of the questions correctly.	it is not possible to know or the character's feelings would not be affected	No opinion of speaker about truth of the proposition
Finalden çıktığında soruların çoğunu doğru yaptığını <b>zannediyor</b> .  After the final exam, she <b>falsely thinks</b> that she answered most of the questions correctly.	the character would be sad	She did not give mostly correct answers, surprisal for the character, as their expectations were unrealistic.

Comprehension questions (as seen in (5d)) were implemented for checking if participants carefully read the items before answering, as a tool for identifying any frivolous participants.

In addition to abovementioned, after each experimental item (i.e. whole (5)),

participants were asked a simple arithmetic question for disguising the actual purpose of the experiment. Multiplication of two numbers were given and participants were asked if it is greater than or less than the other given number.

For all the experimental items, including comprehension and arithmetic questions, see Appendix A.

### 3.1.2.2 Participants

34 participants, native Turkish speaker university students, were contacted online and given the link to experiment.

### 3.1.2.3 Procedure

Three experimental groups were randomly formed. Each group received critical items with one of the three verbs of interest. So, the verb was manipulated as a between-subject variable. In total 24 sets of questions were asked, each have a story question, a comprehension question, and an arithmetic question. 6 of these questions were critical items and the rest were fillers. Fillers were included to prevent participants from recognizing the critical verbs (verbs of interest). Participants were told the experiment measured the effects of guessing emotional response on arithmetic calculation times. The experiment's actual purpose was revealed to participants at the end. For relevant ethical committee approval documents see Appendix D.

### 3.1.3 Results and Discussion

Descriptive statistics for context coherence and no surprisal scores for each verb is shown in Tables 3.3 and 3.4. Context coherence scores were calculated by only considering the context coherent response (either "the character would be happy" or "the character would be sad"). No surprisal scores were calculated by adding "the character's feelings would not be affected" option to context coherent answers.

Table 3.3: Descriptive statistics of Context Coherence Score/Verb Type

Context Coherence	Mean	Range	SD
<i>bil</i> (know) condition	2.20	[0-5]	1.40
<i>düşün</i> (think) condition	0.64	[0-3]	0.92
<i>zannet</i> (falsely believe) condition	0.27	[0-1]	0.47

Table 3.4: Descriptive statistics of No Surprisal Score/Verb Type

No Surprisal	Mean	Range	SD
<i>bil</i> ( <i>know</i> ) condition	3.80	[2-5]	0.79
<i>düşün</i> ( <i>think</i> ) condition	0.82	[0-3]	0.98
<i>zannet</i> ( <i>falsely believe</i> ) condition	0.36	[0-2]	0.67

As shown in Figure 3.1, even though the participants mostly picked the option "it is not possible to know" for all groups, relative number of context coherent and context incoherent answers for each verb are similar to our expectations. Either with or without considering the option "the character's feelings would not be affected" as context coherent, each of the three groups have significantly different number of context coherent answers. As expected there is not any context incoherent answer given in either *düşün* or *bil* groups.

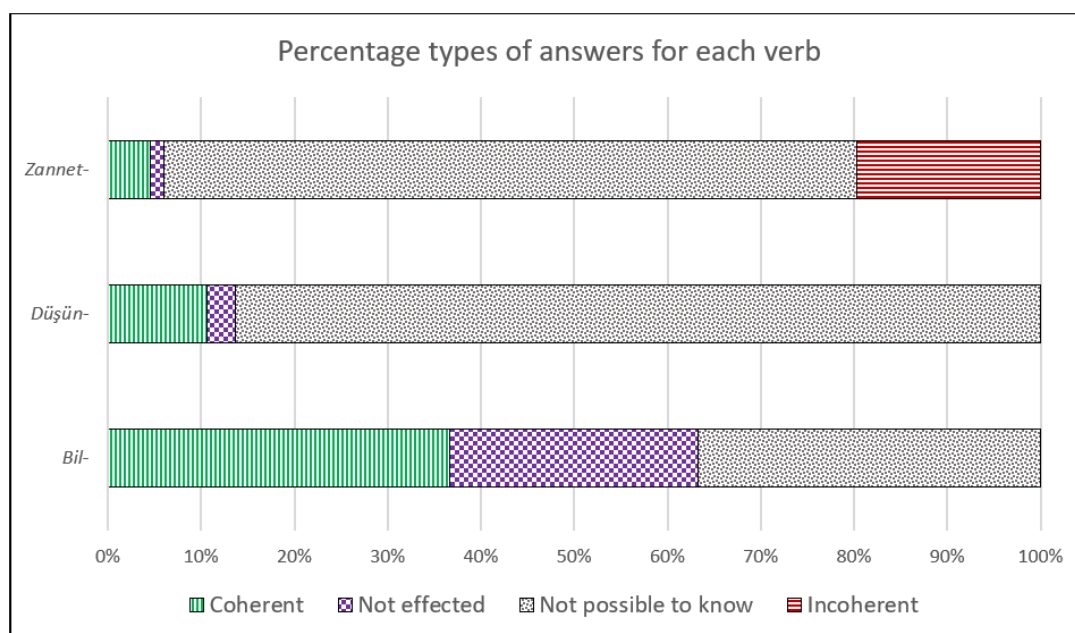


Figure 3.1: Percentage of types of answers for each verb

By looking at the different participants' data, we suspected that there may be two clusters among them, in line with their tendency or ability to process pragmatic information. Since cognitive attitude verbs include reporting and the information we were interested in was about the way of reporting, we thought this ability to infer the outcome and to predict others' emotional response according to it may be relevant to the Theory of Mind.

Since the data is dominated by "it is not possible to know" option (especially for *düşün* and *zannet*), further experiments were revised accordingly. On the other hand, participants in *bil* group were not as conflicted and selected "it is not possible to know" option much less. We can infer that *bil* has as a stronger influence on the proposition it is used for reporting.

Presence of too many options might have made the decision closer to a more personal matter. Having too much to think on, participants may empathize with the character and respond according to how they would react instead of predicting the character's reaction. But, as we mentioned in emotional prediction, we were relying on this mechanism being innate and automatic. It can be sad that we were looking for a more direct comprehension of the character's emotional state instead of a complex behavioral analysis before the prediction. Thus, a simpler, more straight-forward set of options would serve better to our purpose.

## 3.2 Experiment 2

### 3.2.1 Aim

Due to our suspicions about the clustering among participants, we prepared this experiment aiming to both evaluate the semantics of the verbs of interest with a larger sample size (as in Experiment 1) and implement another scale to measure participants' ToM related skills. We aimed to replicate the results of the previous experiment and look for a mechanistic explanation for the results we obtain. In order to be able to do the latter, we decided to use an independent measure of participants' ToM related skills (ability to process pragmatic inferences, in addition to interpret others' emotional responses and mental states). Since ASD is a disorder that shows symptoms related to these abilities, AQ questionnaire seemed to be a suitable measure. Thus, we included it in our experiment to get a scalar measure on ToM related skills.

Comparing two parts' (evaluation of doxastic verbs and AQ) results, our expectations were to see correlation between higher scores in an Autism Spectrum Disorder questionnaire and higher context coherent scores for *zannet* group.

### 3.2.2 Method

#### 3.2.2.1 Design and Materials

First part of the experiment was again the evaluation of doxastic verbs. It was applied as reported in Section 3.1.2.1 with the following revisions. One of the revisions was reducing the difficulty of arithmetic questions. The other one was decreasing the number of options and making the test a forced-choice one. Options "it is not possible to know" and "the character's feelings would not be affected" were removed since the former gives the participants a way out without making a decision and the latter is too similar to the context coherent option anyway.

We expected a normal distribution for the scores of participants who were in the *düşün* group. Since *düşün* does not contribute to the meaning with a truth

value attributed to the complement by speaker, selection would be random between either of two options.

For when *bil* was used, we expected that the participants would assume the reported thought fits the real world, and deduce the complement is declared to be true by the speaker. Thus, context coherent (no surprisal for the character) option would be picked by the participants.

Our expectations for *zannet* group were the opposite of *bil* group. Since *zannet* indicates that the beliefs of the character are contradictory to the facts, context incoherent (surprisal for the character) option is expected to be picked more by the participants.

The second part of this experiment was Autism-Spectrum Quotient (AQ) test. AQ is a self-administered questionnaire developed by Baron-Cohen et al. (2001). It is not a diagnostic measure but a screening tool. It measures that to what extent the traits associated with ASD is possessed by adults. Measurement is in 5 different categories, namely; social, communication, imagination, attention to detail, and attention-switching. Results of this test are evaluated both overall and by the sub-categories. Turkish translation of Autism-Spectrum Quotient (AQ), (Otizm Spektrum Anketi (OSA-TR) by Kose et al. (2013)) was used as the participants were all native Turkish speakers.

AQ is made up of 50 statements. Participants are asked to choose the option that suits them best for each statement. Options are: Definitely Agree, Slightly Agree, Slightly Disagree, Definitely Disagree. Each statement is worth 1 point for either "agree" or "disagree" options. Max score that can be obtained is 50, in that case participant is showing all 50 "autistic" traits tested in AQ. Since our participants were all neurotypicals, no participant was expected to score above 30/50.

For both AQ and OSA-TR tests' contents, see Appendix B

### **3.2.2.2 Participants**

64 native Turkish speaker university students participated in this experiment. Data were collected in classroom by participants on their mobile devices via the link shared by the experimenter.

### **3.2.2.3 Procedure**

Three experimental groups were randomly formed. Each group received critical items with one of the three verbs of interest. In total 24 sets of questions were asked, each have a story question, a comprehension question, and an arithmetic question. 6 of these questions were critical items and the rest were fillers. Fillers were included to prevent participants from recognizing repeating verbs (verbs of interest). Participants were told the experiment measures effects of guessing emotional response on arithmetic calculation times.



After completing the first part, participants in *zannet* group were contacted and asked to fill another questionnaire. Only 17 of the 22 participants attended this part. Standard Autism-Spectrum Quotient (AQ) test is applied in Turkish as Otizm Spektrum Anketi (OSA-TR).

### 3.2.3 Results and Discussion

#### 3.2.3.1 Context Coherence and Verb of Choice

Descriptive statistics of the Context Coherence score in each verb type are summarized in Table 3.5. To analyze whether the verb type influenced the amount of context coherent scores, we fitted a linear mixed effects logistic regression model that belongs to a class of generalized linear models. This analysis is well-suited to our data because (i) we want to understand the probability of a binary response variable (i.e., context coherence) as a function of an explanatory factor (verb type) and (ii) we want to model a possible random variations that might be observed across participants and items.

Table 3.5: Descriptive statistics of Context Coherence Score/Verb Type

Context Coherence	Mean	Range	SD
<i>bil (know) condition</i>	5.05	[1-6]	1.20
<i>düşün (think) condition</i>	3.05	[0-6]	1.53
<i>zannet (falsely believe) condition</i>	1.95	[0-5]	1.59

Our response variable was a binary numeric vector, which we called 'Context Coherence'. As mentioned above, participants tried to predict the emotional response of the character in the story they read. The character has a particular desire (i.e., she wants or does not want X to happen) and a particular expectation about the outcome (i.e., that X will happen). This expectation is revealed in three different verbs, namely *bil (know)*, *düşün (think)*, and *zannet (falsely believe)*, which respectively indicates (i) that the character is sure about the outcome and the speaker of the utterance believes that she is right (i.e., she knows that X will happen), (ii) that the character has an expectation about the outcome but the speaker of the utterance does not have any knowledge/attitude about the correctness of the character's expectation (i.e., she believes that X will happen), and (iii) that the character is sure about the outcome but the speaker knows that the character is wrong (i.e., she falsely believes that X will happen).

In the condition with *bil (know)*, context coherent response is the one that is in line with the outcome expected by the character so it does not include any surprisal on the part of both the character and the participant. In the conditions with *düşün (think)*, the character might have some expectations about the outcome but this expectation is not reported to be either true or false, so it may or may not involve surprisal for the participant; therefore, context coherence would not be biased towards any side in *düşün (think)* condition. Finally,

in the condition with *zannet* (*falsely believe*), the character has an expectation that would surely fail (according to the speaker) so the character would be surprised as a result of the outcome thereby leading to the smallest amount of context coherence in *zannet* (*falsely believe*) condition compared to both *bil* (*know*) and *düşün* (*think*). Thus, the participants' responses were hand-coded as 1 for the context coherent responses and 0 for context incoherent ones.

Histograms showing number of participants according to the number of context coherent answers they gave are shown in Figures 3.2, 3.3, and 3.4.

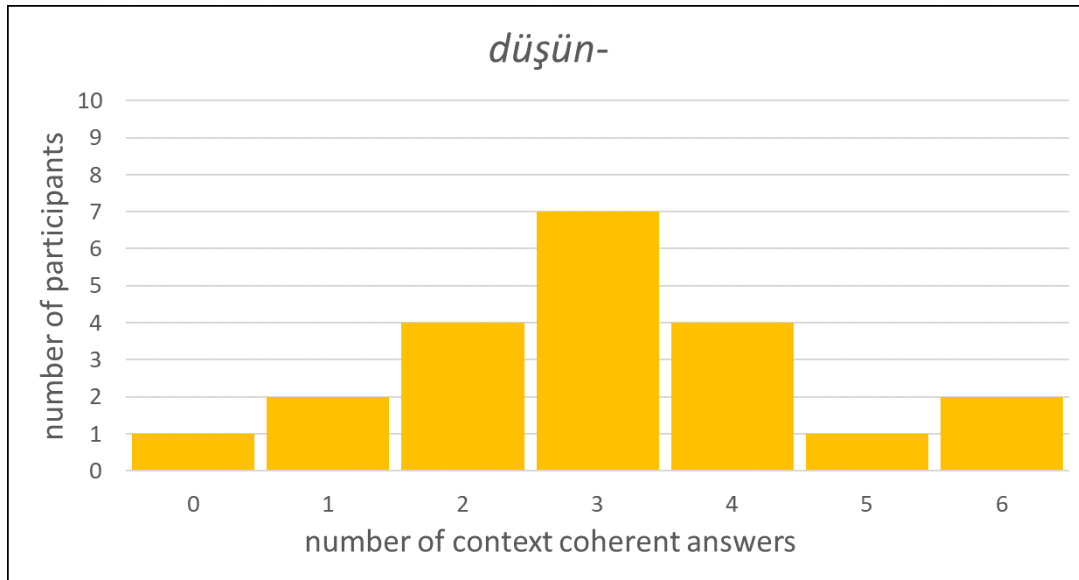


Figure 3.2: Distribution of participants according to scores for *düşün* group

As expected *düşün* fits to a normal distribution pattern as it does not include any indication about the truth of reported statement (Figure 3.2). Thus, participants had to pick one of the two options randomly. This satisfies our expectations about *düşün* as we defined its semantics as neutral. Hence, it is possible to take *düşün* as a baseline for a comparison made between these cognitive attitude verbs.

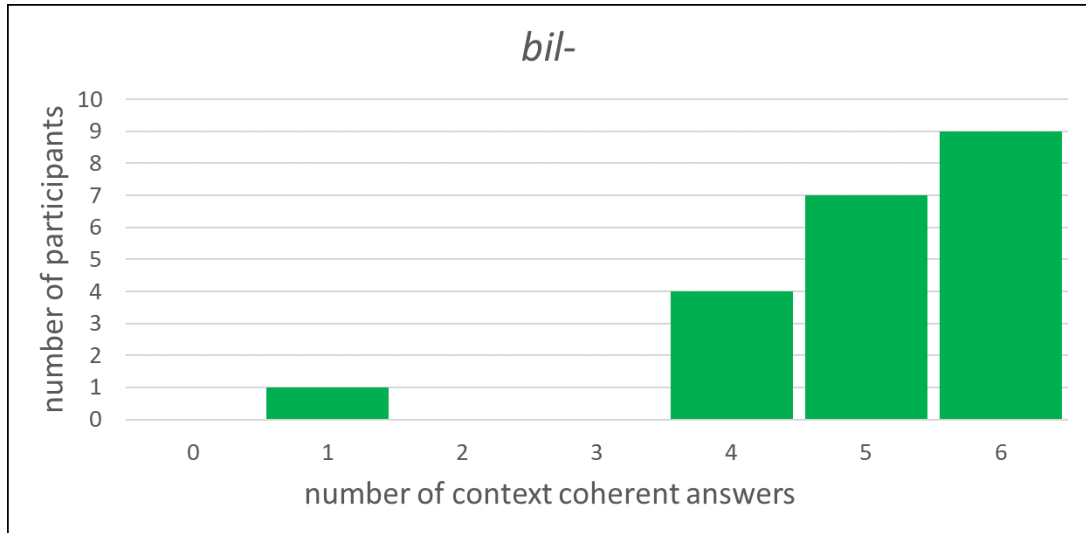


Figure 3.3: Distribution of participants according to scores for *bil* group

In *bil* condition, the tendency is towards the context coherence and most of the participants gave answers that are all context coherent (Figure 3.3). So, it is possible to say that using *bil* strongly suggests that the reported statement is true.

Despite the *zannet* condition shows a trend opposite to *bil* condition, it is not as strongly suggesting as *bil* condition does (Figure 3.4). This may be due to the cognitive load increased by the arithmetic questions which clouded participants' judgements on already weaker component of *zannet* which says that the reported statement is incorrect. Also, as arithmetic questions do, negation demands more from the working memory. Thus, *zannet* can be effected most by the cognitive load brought by arithmetic questions on the working memory.

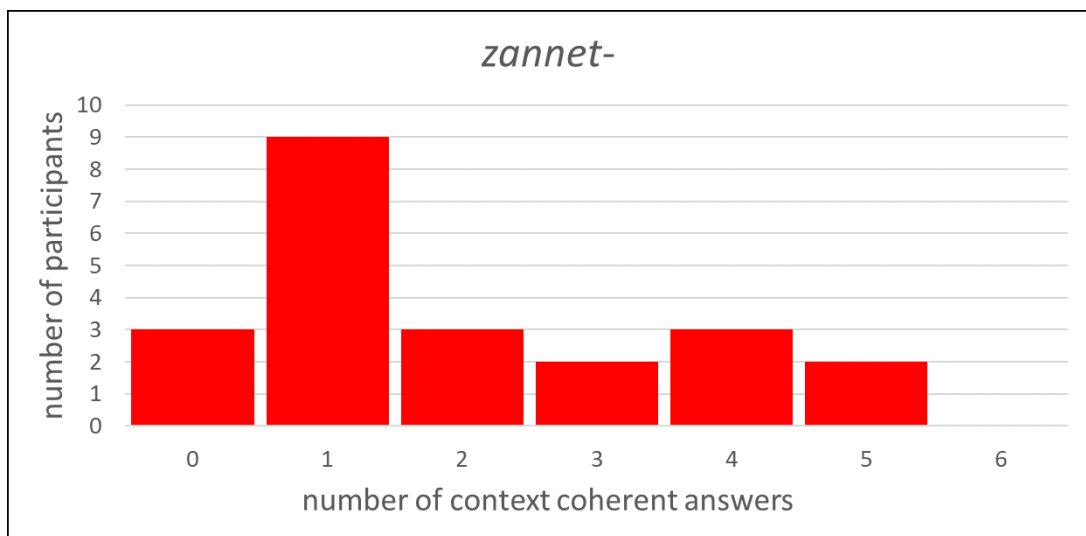


Figure 3.4: Distribution of participants according to scores for *zannet* group

We used the *lme4* package and *lmer* function in R (Bates et al., 2012) to perform the analysis. We entered the Condition (i.e., Verb Type) as a fixed effect and as random effects we had intercepts for participants and individual items, and we had by-participant and by-item random slopes for the effect of Condition. We obtained the p values by likelihood ratio test of the full model against the null model.<sup>1</sup> According to this, there was a significant effect of condition [ $\chi^2(2)=38.06$ ;  $p < .0001$ ] (Table 3.6) such that the log odds of context coherence in *düşün* (*think*) condition was  $.33 \pm .07$  lower and it was  $.51 \pm .07$  lower in *zannet* (*falsely believe*) condition than in *bil* (*know*) condition (Table 3.7)(Figure 3.5).

Table 3.6: Comparison of the Null Model with the Full Model

Model	Df	AIC	BIC	logLik	deviance	Chisq	p
Null Model	4	505.95	521.76	-248.98	497.95		
Full Model	6	471.89	495.59	-229.94	459.89	38.065	5.425e-09 ***
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1							

Table 3.7: Fixed effects

	Estimate	Std. Error	t-value
<b><i>bil</i> (<i>know</i>) condition</b>	0.84127	0.05518	15.245
<b><i>düşün</i> (<i>think</i>) condition</b>	-0.33333	0.07315	-4.557
<b><i>zannet</i> (<i>falsely believe</i>) condition</b>	-0.51551	0.07232	-7.128

<sup>1</sup> Full Model: `lmer(context_coherence ~condition + (1+condition|participant) + (1+condition|trial_ID), data=blizandus, REML=FALSE)`; Null Model: `lmer(context_coherence ~1 + (1+condition|participant) + (1+condition|trial_ID), data=blizandus, REML=FALSE)`

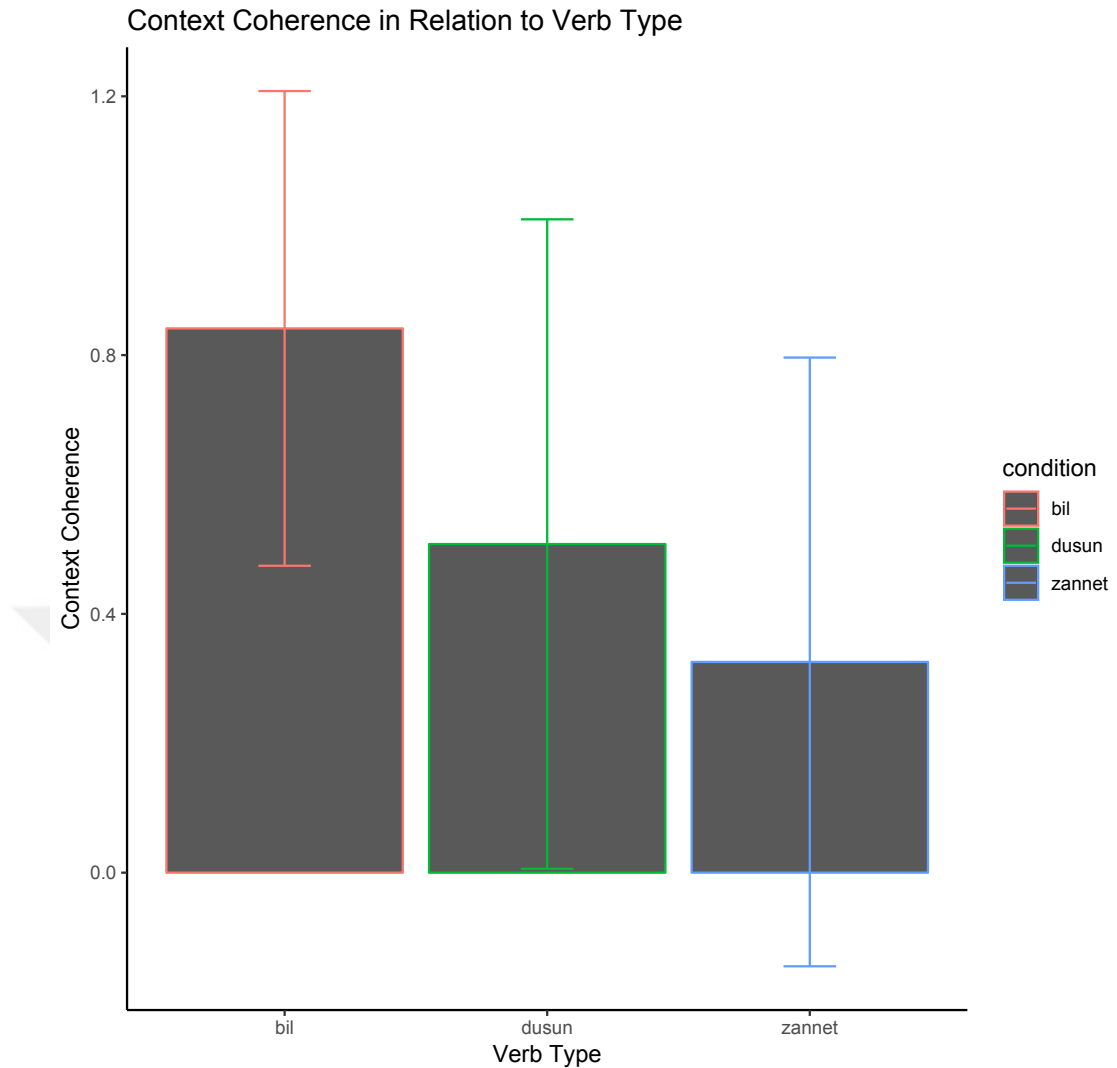


Figure 3.5: Context-coherence (i.e., no surprisal) in each condition

Tables C.1 and 3.8 present the coefficients for the effect of Condition for each participant and for each item, respectively. We see that the effect of condition modulated by three different verbs is around .8 for *bil* (*know*) condition while it is around -.3 and -.5 for *düşün* (*think*) condition and *zannet* (*falsely believe*) condition, respectively. These coefficients show that although there is little variation in the amount of this effect among participants, we see a consistency across participants in general with respect to the effect of verb type on their context coherence score (Table C.1 in Appendix C). The same is true for variation across items; although there is some variation (a little greater in the *düşün* (*think*) condition) across items, the values are in the positive for the *bil* (*know*) condition while they are in the negative for the other conditions (Table 3.8).

Table 3.8: Coefficients for the effect of Condition for each item

Item	Bil	Düşün	Zannet
1	0.8487860	-0.3221164	-0.5075038
2	0.8305942	-0.3579169	-0.5135596
3	0.8015340	-0.4179835	-0.5188003
4	0.8596544	-0.2978502	-0.5083190
5	0.8559676	-0.2885237	-0.5350905
6	0.8510828	-0.3156092	-0.5098004

### 3.2.3.2 Context Coherence and Autism-spectrum Quotient (AQ)

Descriptive statistics of the AQ total score and sub-scores are summarized in Table 3.9 and Figure 3.6 shows the number of participants in each AQ Score. The distribution of scores are normal compared to the data of Baron-Cohen et al. (2001). Mean score of students in Baron-Cohen et al. (2001)'s study is 17.6 (SD = 6.4), in our study it is 18.6 (SD = 4.7).

Table 3.9: Descriptive statistics of the ASD Quotient total score and sub-scores

Factor	Mean	Range	SD
AQ Total Score	18.625	12-28	4.745173
Communication Skills	2.3125	0-6	1.701715
Social Skills	4.4375	1-8	1.998958
Imagination Skills	2.875	1-5	1.310216
Attention to Detail Skills	5.5	3-9	1.861899
Attention Switching Skills	3.5625	1-7	1.547848

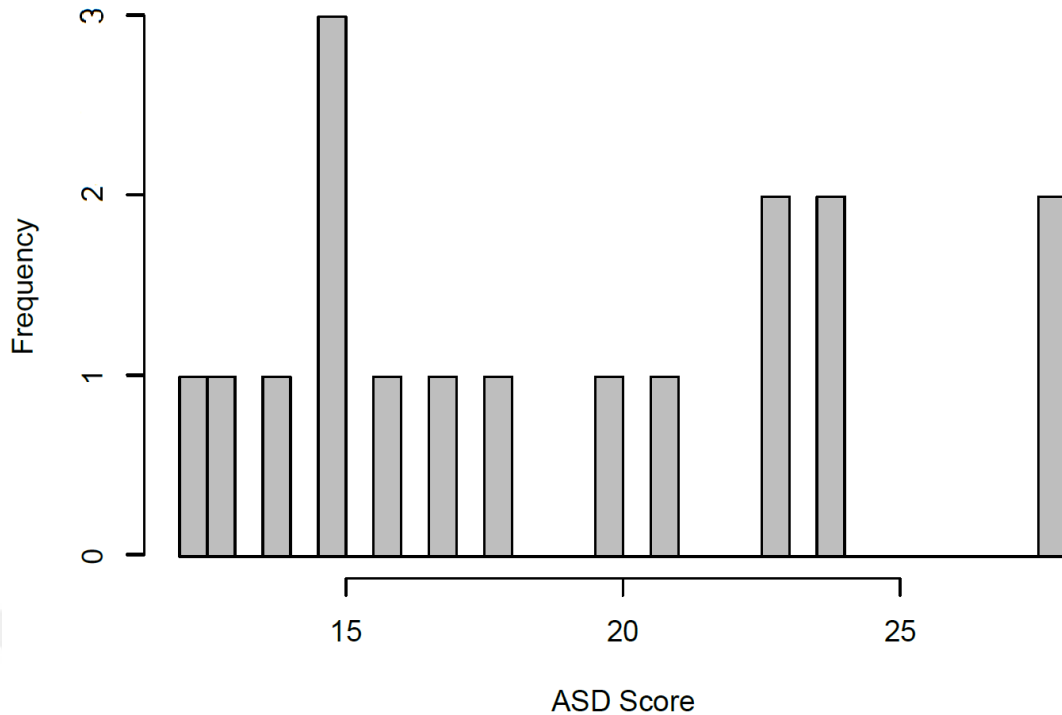


Figure 3.6: Histogram showing the number of participants in each ASD Quotient Score

Table 3.10: Estimates for the AQ Score and AQ Subscale Scores and the Context Coherence Score in *zannet (falsely believe)* Condition

Predictor	Coefficients	SE	t-value	p
Intercept	4.51987	1.46172	3.092	0.00744 **
Total AQ Score	-0.01791	0.07378	-0.243	0.81153
Intercept	4.6043	0.5774	7.975	8.95e-07
Communication Skills	-0.1616	0.1714	-0.943	0.361
Intercept	3.1255	0.8666	3.606	0.00259 **
Social Skills	0.2414	0.1823	1.324	0.20529
Intercept	5.5926	0.7665	7.297	2.62e-06 ***
Imagination Skills	-0.4630	0.2269	-2.040	0.0593*
Intercept	4.152174	1.208805	3.435	0.00368 **
Attention to Detail Skills	0.004348	0.206064	0.021	0.98344
Intercept	3.5570	0.9616	3.699	0.00214 **
Attention Switching Skills	0.1726	0.2483	0.695	0.49746

To understand the relationship between the context coherence score (i.e., the number of context coherent responses) in the *zannet (falsely believe)* condition and the ASD Quotient Score, we used the linear regression model. We used the *lm* function in R to fit the model. Table 3.9 presents the parameter estimates, of the total ASD Quotient Score as well as all the sub-scores. Figure 3.7 visually depicts the relationship between the ASD scores and the context coherence scores shown in Table 3.10. According to this, neither the overall

ASD Quotient Score nor its subscales except for one were significant. Only one of the sub-scales of ASD quotient, namely the Imagination Subscale was marginally significant such that the estimated log odds ratio of context coherence score got 0.463 lower as there was a one unit of increase in the Imagination subscale score (Table 3.10).

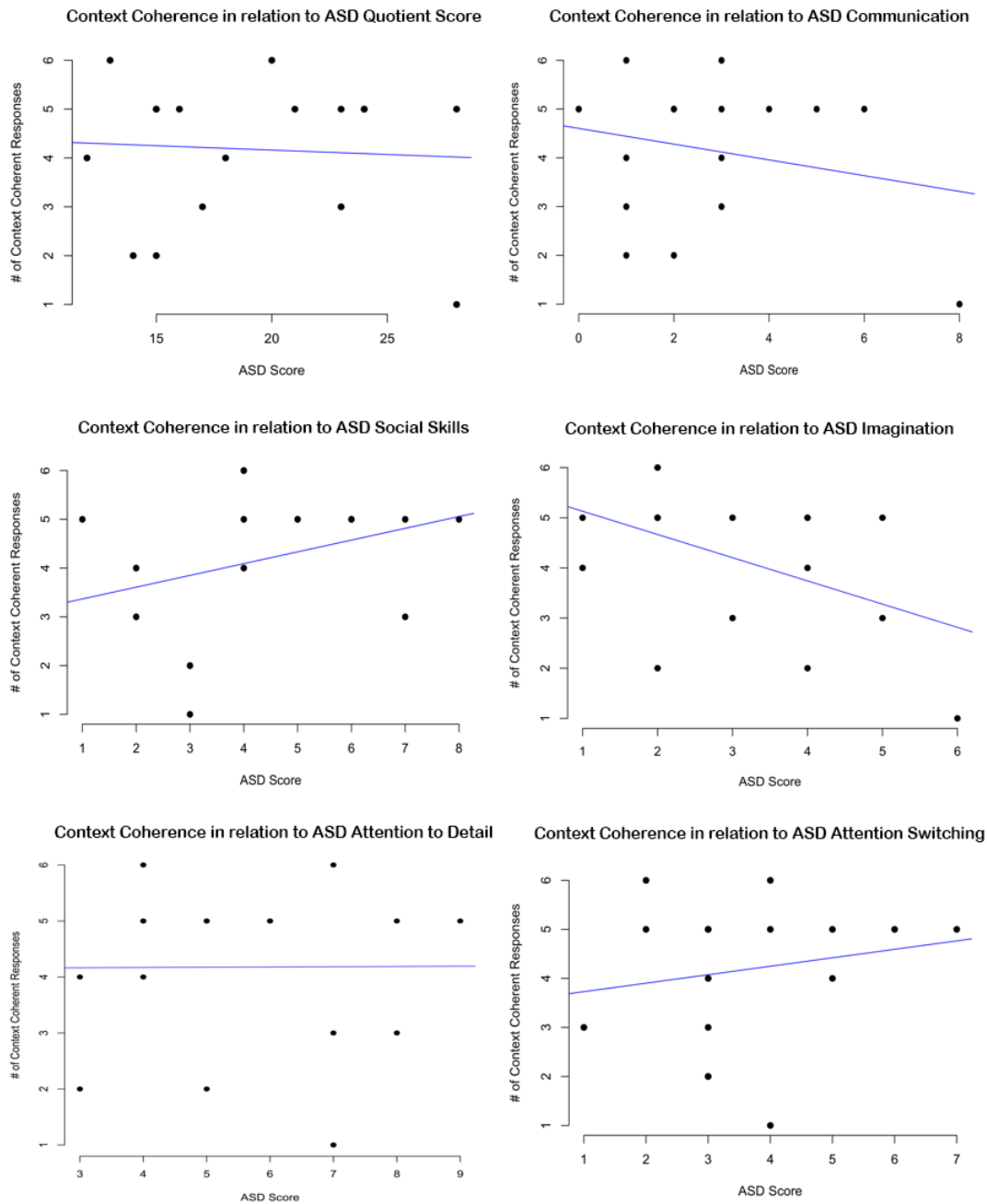


Figure 3.7: Relationships between AQ scale and subscale scores and context coherence scores

Given the limited number of participants, we cannot have a conclusive evidence for or against the pattern we hypothesized for. It seems that a lower



imagination score may be weakly associated with the ability to reason about other's emotions on the basis of their desires and beliefs revealed by a propositional attitude verb that requires a greater access to other minds. But we were not expecting any negative correlations between context coherence and AQ scores. Thus, what we see in imagination score was uncalled for.

### 3.3 Experiment 3

#### 3.3.1 Aim

Since results of Experiment 2 did not give us clear results about the correlation between ability to comprehend pragmatic inferences of *zannet* and ToM related skills (AQ scores) due to low sample size, we decided to perform Experiment 3. The purpose of this experiment is to have a larger sample size to make more certain statements on how do these two sets of scores correlate if they actually do.

#### 3.3.2 Method

##### 3.3.2.1 Design and Materials

The first part of the experiment was again the evaluation of doxastic verbs. It was applied as reported in Section 3.1.2.1. But this time only *zannet* group was formed since a higher number of participants were required. And semantic clarification of *zannet* compared to *düşün* and *bil* was done in Experiment 1 and Experiment 2, providing us with satisfying results. Also arithmetic questions were removed. Removal of arithmetic questions were to see if they affect the participants' judgements due to a possible increase in the cognitive load this calculation might bring on the working memory.

Our expectations for this experiment were similar to the *zannet* groups of previous experiments. The only expected difference was to see clearer results for *zannet* that is similar to *bil* in Experiment 2, since removal of arithmetic questions may be decreasing the cognitive load and allow better comprehension of pragmatics of *zannet*.

Second part of this experiment was also AQ. It was applied as reported in Section 3.2.2.1. Differently, this time gender data was also collected.

##### 3.3.2.2 Participants

92 participants, native Turkish speaker university students, were contacted online and given the link to experiment.

### 3.3.2.3 Procedure

All participants received critical items with *zannet*. In total 24 sets of questions were asked, each have a story question and a comprehension question. 6 of these questions were critical items and the rest were fillers. Fillers were included to prevent participants from recognizing repeating verb (*zannet*). Right after the evaluation of doxastic verbs test, participants were directed to AQ questionnaire.

### 3.3.3 Results and Discussion

Since there is not a comparative setting according to verbs in this experiment, there is also no analysis for relation between context coherence and verb of choice. Results of this experiment consists of the analysis for the relation between context coherence and AQ scores.

#### 3.3.3.1 Context Coherence and Autism-spectrum Quotient (AQ)

Descriptive statistics of context coherence scores and the ASD Quotient total score and sub-scores are summarized in Table 3.11 and Table 3.12 respectively. Figure 3.9 shows the number of participants in each ASD Score. The distribution of scores are normal compared to the data of Baron-Cohen et al. (2001). Mean score of students in Baron-Cohen et al. (2001)'s study is 17.6 (SD = 6.4), in our study it is 19.4 (SD = 4.7).

Table 3.11: Descriptive statistics of Context Coherence Score

Context Coherence	Mean	Range	SD
<i>zannet (falsely believe)</i>	1.47	[0-6]	1.61

Table 3.12: Descriptive statistics of the ASD Quotient total score and sub-scores

Factor	Mean	Range	SD
AQ Total Score	19.4022	10-31	4.711594
Communication Skills	1.8804	0-6	1.595615
Social Skills	3.8152	0-9	2.277117
Imagination Skills	2.8696	0-8	1.742913
Attention to Detail Skills	5.9783	1-10	2.075383
Attention Switching Skills	4.8587	1-8	1.661335

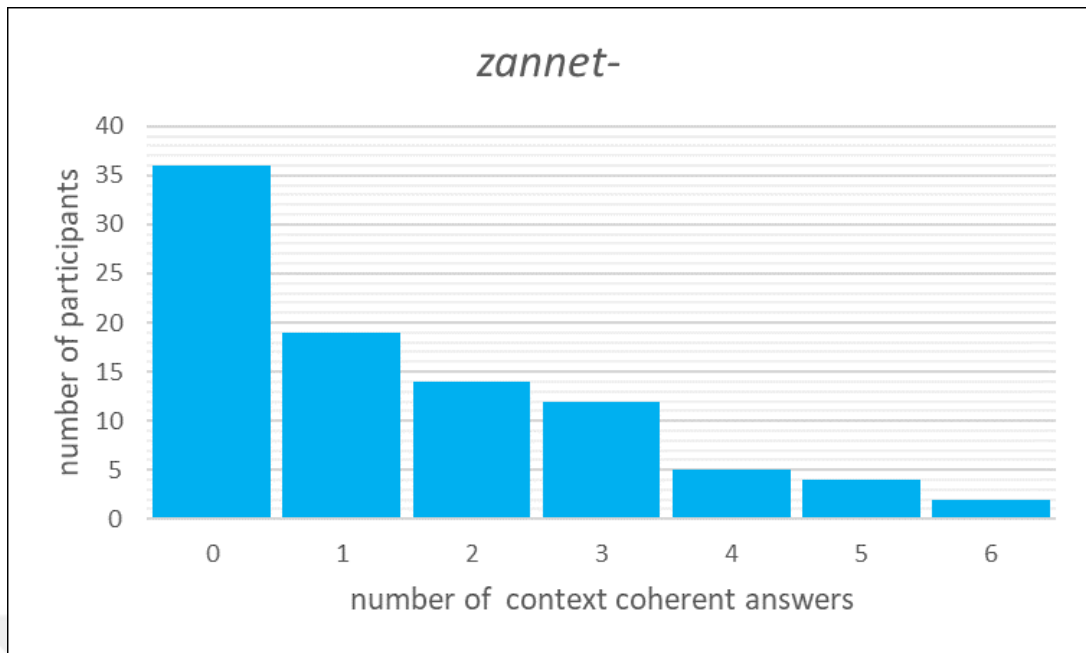


Figure 3.8: Distribution of participants according to scores (for *zannet*)

Even though the effect of *zannet* is more strongly visible in Experiment 3 than in Experiment 2, it is still not as strong as the effect of *bil*. Despite the lowered cognitive load, there are still participant falling in the far end of the range causing a more skewed graph (see Figures 3.3, 3.4, and 3.8)

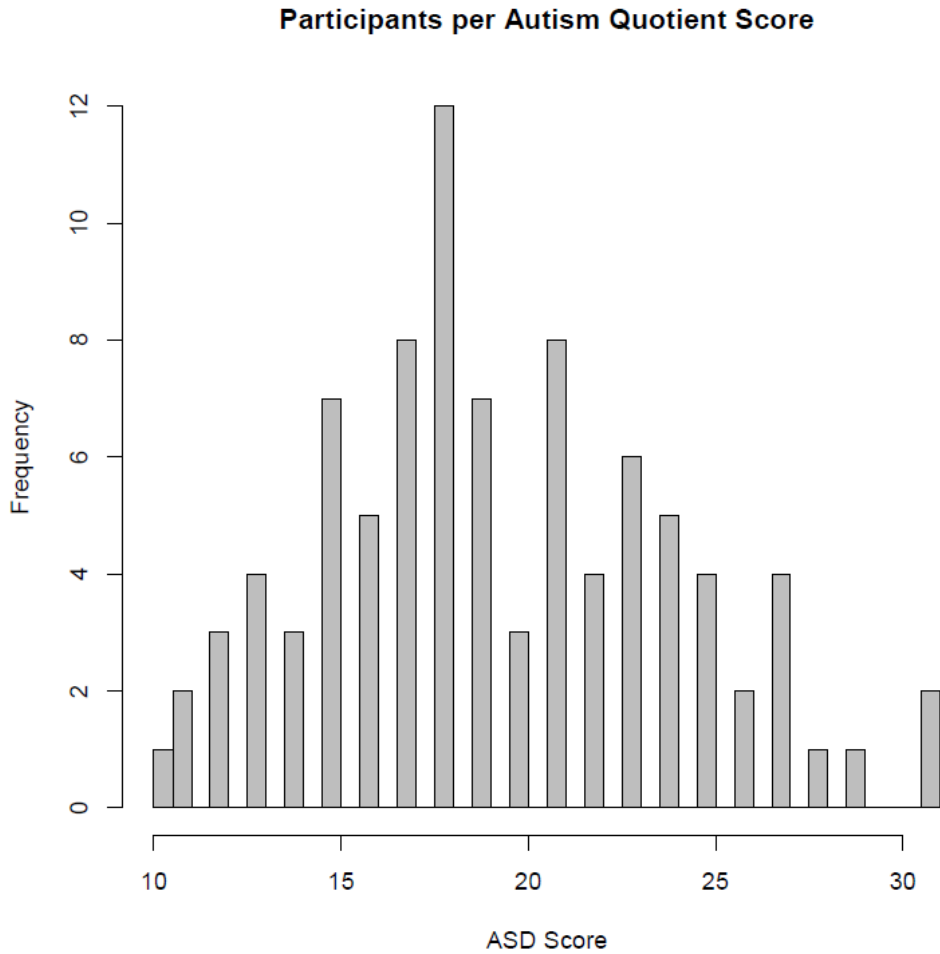


Figure 3.9: Histogram showing the number of participants in each ASD Quotient Score

Table 3.13: Estimates for the AQ Score and AQ Subscale Scores and the Context Coherence Score (*zannet* only)

Predictor	Coefficients	SE	t-value	p
Intercept	1.96004	0.71852	2.728	0.00766 **
Total ASD Score	-0.02539	0.03600	-0.705	0.48241
Intercept	1.49059	0.26225	5.684	1.61e-07 ***
Communication Skills	-0.01234	0.10658	-0.116	0.908
Intercept	1.71848	0.32994	5.208	1.2e-06 ***
Social Skills	-0.06581	0.07437	-0.885	0.379
Intercept	1.52336	0.32707	4.658	1.1e-05 ***
Imagination Skills	-0.01950	0.09756	-0.200	0.842
Intercept	1.22435	0.51758	2.366	0.0202 *
Attention to Detail Skills	0.04065	0.08184	0.497	0.6206
Intercept	2.0076	0.5219	3.847	0.000223 ***
Attention Switching Skills	-0.1112	0.1017	-1.093	0.277223

To understand the relationship between the context coherence score (i.e., the number of context coherent response) in the *zannet (falsely believe)* condition and the AQ Score, we used the linear regression model. We used the *lm* function in R to fit the model. Table 3.12 presents the parameter estimates, of the total AQ Score as well as all the sub-scores. Figure 3.10 visually depicts the relationship between the AQ scores and the context coherence scores shown in Table 3.13. According to this, neither the overall AQ Score nor its subscales were significant.

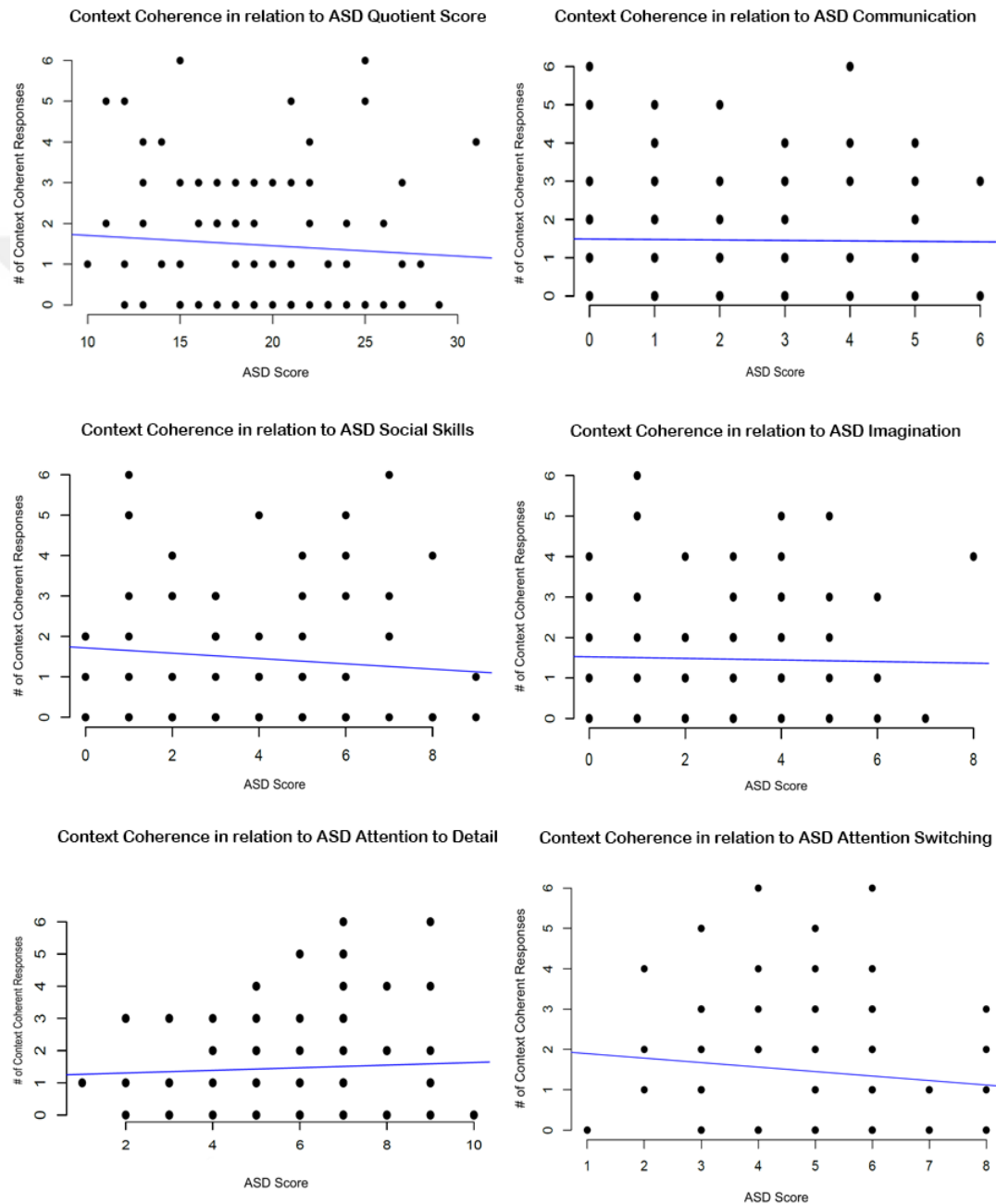


Figure 3.10: Relationships between AQ scale and subscale scores and context coherence scores

Even though attention switching seems to be the closest scale to show a correlation with context coherence scores, none of the scales actually show a significant correlation. Thus, we can conclude that the low number of participants is not the reason for the lack of correlation in Experiment 2. We cannot say any of the scales from AQ is associated with the ability to reason about other's emotions on the basis of their desires and beliefs revealed by a propositional attitude verb that requires a greater access to other minds.



## CHAPTER 4

### CONCLUSION AND FUTURE DIRECTIONS

#### 4.1 Conclusion

##### 4.1.1 About *zannet* (propositional attitude verbs)

Results show that *zannet* has a meaning that is opposite to meaning of *bil*. While they both report the same for the attitude holder's beliefs on the proposition, their implications for the speaker's beliefs about the proposition are opposites. Even with many options which cause confusion in Experiment 1 (not forced choice as in Experiment 2), only *zannet* can give rise to a meaning that the proposition is in fact not true. On the other hand, there are still some participants that inferred the proposition is true in *zannet* group, and there are many more that are reporting it to be ambiguous compared to *bil* group. Despite *zannet* being perceived almost as ambiguous (around 75 %) as *düşün* (around 85 %), *zannet* refers less to the truth of proposition and much more to the falsity of it. This supports our claims on classification of cognitive propositional attitude verbs shown in Table 4.1 (as mentioned in Chapter 2 Table 2.7). Nevertheless, it is obvious there is more to it than that just *bil* and *zannet* being opposite to each other. Compared to clear representation of *bil* in participants, *zannet* causes a confusion and isn't as well-understood.

Table 4.1: Classification of Verbs of Interest

	Att. holder +	Att. holder ?	Att. holder -
Speaker +	<i>bil</i>		<i>inkar et</i>
Speaker ?	<i>düşün</i>		<i>reddet</i>
Speaker -	<i>zannet</i>		<i>pretend</i>

One reason for this asymmetry between strengths of *bil* and *zannet* may be instead of having an absolute positive or negative implications, these verbs can be compared in a scalar manner. As mentioned in previous chapters Lassiter and Goodman (2015) classified modal words (i.e. possible, probable, likely and so on) in a linear fashion depending on the implied probability/certainty. Our verbs of interest can also be put on a linear scale. Figure 4.1 shows a possible distribution of our verbs of interest but further investigation is required.

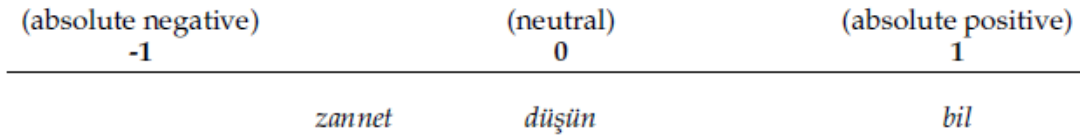


Figure 4.1: Approximate Scalar Distribution of Verbs of Interest

The difference observed in context coherence scores of *bil* and *zannet* conditions in Experiment 2 was intriguing. It supported our findings from Experiment 1, about *zannet* being less clear than *bil*. Nevertheless, in Experiment 3 (with arithmetic questions removed) context coherence scores for the only condition (*zannet*) shows a more similar trend to *bil* in Experiment 2. These results suggest that, with lower cognitive load, meaning of *zannet* is more clearly understood or easily processed compared to the higher cognitive load condition even though the comprehension of *zannet* among participants is not as common compared to *bil* (two participants completely treated *zannet* as it was *bil* while there is not even a remotely similar behaving participant in *bil* group). The negation nested in *zannet* requires more effort to process. The effect of cognitive load (increase in accurate processing of *zannet* as the cognitive load decreased) on working memory also interferes with the processing of *zannet*.

There is also the 1<sup>st</sup> person complication of *zannet* that may have been the reason for the confusion in *zannet* group's data. As explained in Example (13) of Chapter 2, when used in 1<sup>st</sup> person, *zannet* has two contradicting parts of its meaning, one being the speaker believes that the proposition is true and the other being the speaker knows that his beliefs about the proposition are false. Thus, more prominent one (speaker believing, not knowing, that the proposition is true) survives this sentence, implying only a weak commitment to the proposition by speaker. Simply, *zannet* becomes *düşün*. Some of the participants may have evaluated the situation as if they are involved in it, instead of as a third person. Their go to method for assessing a sentence that reports a belief can be empathizing with the character or the speaker, both for getting one layer closer to the reported action. If they do not keep the negation nested in *zannet* while getting deeper in the propositional ascription, it is easy for them to procure the false belief of the character without realizing that it is reported to be incorrect. In other words, they make the case reported with *zannet* a bit personal and get effected by the aforementioned 1<sup>st</sup> person complication of the verb. Another related explanation for this can be that there are two "dialects" that have two different *zannet* items, one of which being much closer to *düşün*.

#### 4.1.2 About Theory of Mind

Even though we were not checking the effect of emotion prediction mechanisms, we observed that it in fact works as an innate mechanism in a low-error



way. Results obtained from *bil* group in Experiment 2 clearly shows that our experimental setup is well built in terms of relying on the emotion prediction mechanism. The fact that there is little confusion in *bil* group and that there is not any participant that could not infer the expected result through a verb with a well-established meaning such as *bil*, show us that the emotion prediction mechanism is implemented properly and worked reliably.

We suspected that the only AQ scale showing correlation was subscale imagination in Experiment 2 is because of the low sample size. We were not expecting to see a negative correlation. Our expectation from Experiment 3 was to see stronger positive correlations between more scales and context coherence. Results revealed this is not the case. Not even AQ subscale imagination showed a correlation with context coherence in Experiment 3. We tried to increase our sample size (n=92) but it still may not have been sufficient for seeing a correlation. Maybe, if we had more participants we might have observed the individual variations better and detected a correlation. Another possibility is that AQ being a self-report questionnaire resulted in more normalized results. Use of a more covert measure for ToM related skills could make the individual variations more accessible. On the other hand, lack of a correlation does not disprove that these variables can be related. Theoretically, both the mechanism for evaluation of propositional attitude verbs and patterns measured by AQ scales are relying on similar mental pathways. Theory of Mind (ToM) is the main ability that is related to both of these mental processes. Although our experiments didn't yield results that show the relation between "autistic traits" and ability to process the secondary meaning residing in a statement via a propositional attitude verb, it would be senseless to claim that these two processes are completely irrelevant to each other and rely on totally different mechanisms to take place.

The reason why AQ scores are not showing any correlation with ability to comprehend secondary meaning behind *zannet* may be that all our participants were neurotypicals. Even though the mechanisms seem related, people who are not diagnosed with ASD may not be showing the relevant symptoms enough to be distinguished in such a setting. It may also be the case that having a ToM is going beyond a threshold. As Baron-Cohen (1991) states, while there are precursors to ToM such as understanding attention and recognizing interest in others, these abilities cannot substitute for ToM. According to this approach, ToM can be defined similarly to the ability of conceptualization/abstraction. As abstraction grants access to a new plane in our mental spaces, we are able to calculate, estimate, and make plans comprehensively. It allows us to see the physical world with a different pair of glasses. Similarly, ToM makes the parallel thinking and planning behaviour available but in the social interactions plane. Both of these abilities, namely abstraction and ToM, can be observed developing during childhood. Yet when they are completed, individual's abilities and tools for survival increase drastically. None of the developmental stages can be compared to the vast possibilities and uses of these abilities when they are complete.

Our expectations were built on the hypothesis that variation among people with a developed ToM was significant. Nevertheless, even showing patterns

related to ASD, neurotypicals are beyond this threshold of ToM and our data that are relevant to *zannet* only represent the variation in the population of neurotypicals instead of a significant variation regarding ToM. Despite that AQ has a range of [0-50], all our participants' AQ scores are in the range [10-31]. And scores below 35 are not critical for being on the spectrum. This is also related to why many studies are conducted with children around the age they develop a ToM. To observe presence or absence of ToM results in a more distinct outcome compared to the variation among participants who all have a ToM and the said variation may not be as significant as we thought/expected it to be.

## 4.2 Future Directions

In their study, Wu et al. (2018) used a probabilistic model (a Bayesian model that they fit their data), we can test our findings similarly and implement a probabilistic model in further studies.

Testing the relationship between implicatures of these cognitive propositional attitude verbs in a scalar manner may yield a clearer definition for these verbs.

A broader range of participants regarding ToM related skills can be preferred. Instead of neurotypicals, people diagnosed with ASD may be tested with a similar setup. This would allow a wider range of variation for the evaluated patterns and abilities. Testing children with a developing Theory of Mind may also yield more significant results.

In addition to the theoretical and cognitive parallels drawn between mechanisms of Theory of Mind and pragmatic inference processing. Implementing a neuroimaging method such as EEG, MEG, or fMRI may also be useful for investigating structural/neural parallels between these mechanisms.

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## Appendix A

### APPENDIX A - EXPERIMENTAL ITEMS FOR EVALUATION OF DOXASTIC VERBS

#### A.1 Evaluation Questions

Table A.1: Experimental items for Evaluation of Doxastic Verbs

Item	Sentence1	Sentence2	Question
C01	Ayça en sevdiği müzik grubunun konserine gitmek istiyor.	Arda'nın ona sürpriz yapacağını duyduğunda konsere bilet aldığını Şyor.	Arda sürprizin ne olduğunu söylediğinde Ayça nasıl hisseder?
C02	Burcu artık doğum gününde ailesinin ona oyuncak bebek almasını istemiyor.	Doğum günü yaklaştığında ailesinin ona yine oyuncak bebek aldığını Şyor.	Paketi açıp hediyesini gördüğünde Burcu nasıl hisseder?
C03	Berk elindeki işleri bitirip tatile çıkmayı sabırsızlıkla bekliyor.	O ayki tüm işleri bitirdiğini Şyor.	Aylık iş takvimi açıklandığında Berk nasıl hisseder?
C04	Ece ve Kuzey ikisi de derslerini geçerse birlikte kampa gitmeye karar veriyorlar.	Ece Kuzey'in bir dersten kaldığını Şyor.	Kuzey'in notlarını öğrendiğinde Ece nasıl hisseder?
C05	Selin bu dönem matematikten geçmeyi çok istiyor.	Finalden çıktığında soruların çoğunu doğru yaptığını Şyor.	Notlar açıklandığında Selin nasıl hisseder?
C06	Cenk hayallerindeki işe başvuruyor.	Mülakatta verdiği bir cevabın müdürü sınırlendirdiğini Şyor.	Mülakat sonucunu öğrendiğinde Cenk nasıl hisseder?
F07	Çağrı bu hafta sonu kardan adam yapmak istiyor.	Hava tahminine baktığında Cuma gecesi kar yağacağını görüyor.	Cumartesi sabahı kar yağmadığını gördüğünde nasıl hisseder?
F08	Esra tenis maçında Göksu'nun tarafını tutuyor.	Maç günü Göksu'nun bileğini incittiğini öğreniyor.	Maç sonucunda Esra nasıl hisseder?

Table A.1 continued from previous page

F09	Mehmet öğle yemeklerini her gün yemekhanede yiyor.	Bugün pırasa yemeği olduğunu duyunca heyecanlanıyor.	Öğlen yemeğe gittiğinde Mehmet nasıl hisseder?
F10	Melike yüksek lisans için hedeflediği okula başvuruyor.	Başvuruda istenen belgelerden birini eksik gönderdiğini fark ediyor.	Okula yine de kabul edildiğini öğrenince nasıl hisseder?
F11	Oğuzhan mağazanın vitrininde gördüğü ayakkabıyı çok beğeniyor.	Birkaç gün sonra ayakkabının indirime girdiğini duyuyor.	Mağazaya gidip ayakkabının satıldığını öğrenince nasıl hisseder?
F12	Canan para biriktirmek için bir kumbara alıyor.	Bir miktar para biriktirdikten sonra kumbarası olduğunu unutuyor.	Aylar sonra kumbarası tekrar aklına geldiğinde nasıl hisseder?
F13	Elif Kars'a gitmek için tren bileti almak istiyor.	Biletlerin salı günü satışa çıkacağını okuyor.	Salı akşamı bilet almaya gittiğinde Elif nasıl hisseder?
F14	Barış tatilde İstanbul'daki arkadaşlarını ziyaret etmek istiyor.	Tatilin ikinci haftasında İstanbul'a gitmeyi planlıyor.	Tatilin ilk haftası Barış nasıl hisseder?
F15	Emre aldığı bir dersten kalmaktan korkuyor.	Hocası sınıftan sadece altı kişinin geçtiğini söylüyor.	Notlar açıklandığında Emre nasıl hisseder?
F16	Zeynep ve Leman birbirlerini özledikleri için buluşmaya karar veriyorlar.	Zeynep buluşacakları kafeye erkenden gidiyor.	Leman geldiğinde Zeynep nasıl hisseder?
F17	Taylan kendisine akşam yemeği hazırlıyor.	Tencereyi ocağa koyduktan sonra içeri gidip televizyon izliyor.	Bir saat sonra mutfaka döndüğünde Taylan nasıl hisseder?
F18	Aylin'in canı çilek yemek istiyor.	Abisi pazara gitmek için evden çıkarken ona çilek almasını söylüyor.	Abisi çilek alıp döndüğünde Aylin nasıl hisseder?
F19	Nurcan her hafta fizik dersine gidiyor.	Dersten çıkınca öğretmeninin ödev verdiğini unutuyor.	Ödevi olduğunu hatırladığında Nurcan nasıl hisseder?
F20	Funda yolda yürürken yerde bir piyango bileti buluyor.	Eve gidip bilete ikramiye çıkıp çıkmadığını kontrol ediyor.	Çekiliş sonuçlarını öğrendiğinde Funda nasıl hisseder?



**Table A.1 continued from previous page**

F21	Simay kamp ateşi için odun toplamaya ormana gidiyor.	Yeterli miktarda topladığında geri dönmeye karar veriyor.	Kaybolduğunu fark ettiğinde Simay nasıl hisseder?
F22	Volkan yoğun bir günün ardından eve dönüyor.	Kapıya geldiğinde anahtarını bulamıyor.	Biraz sonra ablasının eve geldiğini gördüğünde Volkan nasıl hisseder?
F23	Dilara çarpışan arabalara binmek istiyor.	Babası Dilara'yı lunaparka götürüyor.	Gidip lunaparkın kapalı olduğunu gördüklerinde Dilara nasıl hisseder?
F24	Cem Tokyo'ya gitmek için uçak bileti alıyor.	Uçuş günü trafiğe yakalanıp havaalanına geç gidiyor.	Uçuşu rötör yaptığı için yetiştiğini görünce Cem nasıl hisseder?

## A.2 Comprehension Questions

**Table A.2: Comprehension Questions**

Item	Comprehension Question	Correct Answer	Incorrect Answer	Incorrect Answer
Q01	Ayça'ya kim sürpriz yapmak istemektedir?	Arda	Melih	Burhan
Q02	Ailesi Burcu'ya genelde ne hediye almaktadır?	Oyuncak bebek	Oyuncak araba	Ayakkabı
Q03	Berk nerede çalışmaktadır?	Ofis	Fabrika	Mağaza
Q04	Ece ve kuzey nereye gitmek istemektedir?	Kamp	Konferans	Tatil köyü
Q05	Selin'in geçmekte sıkıntı yaşadığı ders hangisidir?	Matematik	Fizik	Edebiyat
Q06	Cenk'in girdiği mülakatı gerçekleştiren hangisidir?	Müdür	Patron	CEO
Q07	Çağrı kar yağınca hangisini yapmak istemektedir?	Kardan adam	Kartopu savaşı	Kayak
Q08	Esra'nın hangi spor müsabakalarıyla ilgilendiği bilinmektedir?	Tenis	Sırıkla atlama	Basketbol
Q09	Mehmet'in öğle yemeklerini yediği yer hangisidir?	Yemekhane	Restoran	Kantin
Q10	Melike hangi eğitim seviyesi için başvuru yapmıştır?	Yüksek lisans	Lisans	Önlisans
Q11	Oğuzhan'ın vitrinde beğendiği şey hangisidir?	Ayakkabı	Ceket	Pantolon

**Table A.2 continued from previous page**

Q12	Canan hangisini yapmak istemektedir?	Para biriktirmek	Kumbara biriktirmek	Para kazanmak
Q13	Elif nereye gitmek istemektedir?	Kars	Ardahan	Batum
Q14	Barış tatilin kaçınıcı haftasında İstanbul'a gitmeyi planlamıştır?	Birinci	İkinci	Üçüncü
Q15	Dersi kaç kişinin geçeceği söylenmiştir?	Altı	Dokuz	Üç
Q16	Zeynep ve Leman nerede buluşacaklardır?	Kafe	Park	Restoran
Q17	Taylan hangi öğününü hazırlamaktadır?	Öğle yemeği	Akşam yemeği	Kahvaltı
Q18	Aylin hangi meyveyi yemek istemektedir?	Çilek	Muz	Armut
Q19	Nurcan'ın gittiği ders hangisidir?	Fizik	Matematik	Biyoloji
Q20	Funda yerde ne bulmuştur?	Piyango bileti	Cüzdan	Para
Q21	Simay ormanda ne toplamaktadır?	Odun	Çöp	Kozalak
Q22	Volkan nasıl bir gün geçirmiştir?	Yoğun	Sıkıcı	Rahat
Q23	Dilara lunaparka ne için gitmek istemektedir?	Çarpışan arabalar	Gondol	Güldüren aynalar
Q24	Cem nereye gitmektedir?	Tokyo	Londra	New York

**A.3 Arithmetic Questions****Table A.3: Arithmetic Questions**

Item	Question	Correct	Incorrect
A01	81x55 işleminin sonucu 4620'den	küçüktür	büyüktür
A02	76x46 işleminin sonucu 3681'den	küçüktür	büyüktür
A03	57x26 işleminin sonucu 1647'den	küçüktür	büyüktür
A04	96x75 işleminin sonucu 7097'den	büyüktür	küçüktür
A05	30x66 işleminin sonucu 2150'den	küçüktür	büyüktür
A06	79x85 işleminin sonucu 6520'den	büyüktür	küçüktür
A07	84x42 işleminin sonucu 3741'den	küçüktür	büyüktür
A08	28x35 işleminin sonucu 1078'den	küçüktür	büyüktür
A09	49x17 işleminin sonucu 962'den	küçüktür	büyüktür
A10	23x69 işleminin sonucu 1450'den	büyüktür	küçüktür
A11	37x93 işleminin sonucu 3320'den	büyüktür	küçüktür
A12	81x32 işleminin sonucu 2450'den	büyüktür	küçüktür
A13	22x61 işleminin sonucu 1500'den	küçüktür	büyüktür
A14	47x39 işleminin sonucu 1620'den	büyüktür	küçüktür

**Table A.3 continued from previous page**

A15	26X81 işleminin sonucu 2001'den	büyüktür	küçüktür
A16	91x21 işleminin sonucu 2142'den	küçüktür	büyüktür
A17	43x22 işleminin sonucu 1052'den	küçüktür	büyüktür
A18	16x94 işleminin sonucu 1400'den	büyüktür	küçüktür
A19	99x19 işleminin sonucu 1751'den	büyüktür	küçüktür
A20	25x73 işleminin sonucu 1957'den	küçüktür	büyüktür
A21	87x36 işleminin sonucu 2912'den	büyüktür	küçüktür
A22	77x18 işleminin sonucu 1501'den	küçüktür	büyüktür
A23	54x61 işleminin sonucu 3118'den	büyüktür	küçüktür
A24	45x76 işleminin sonucu 3302'den	büyüktür	küçüktür



## Appendix B

### APPENDIX B - EXPERIMENTAL ITEMS FOR AUTISM-SPECTRUM QUOTIENT (AQ) AND OTIZM SPEKTRUM ANKETI (OSA-TR)

#### B.1 Autism-Spectrum Quotient (AQ)

Table B.1: Autism-Spectrum Quotient (AQ) Questions

1	I prefer to do things with others rather than on my own.
2	I prefer to do things the same way over and over again.
3	If I try to imagine something, I find it very easy to create a picture in my mind.
4	I frequently get so strongly absorbed in one thing that I lose sight of other things.
5	I often notice small sounds when others do not.
6	I usually notice car number plates or similar strings of information.
7	Other people frequently tell me that what I've said is impolite, even though I think it is polite.
8	When I'm reading a story, I can easily imagine what the characters might look like.
9	I am fascinated by dates.
10	In a social group, I can easily keep track of several different people's conversations.
11	I find social situations easy.
12	I tend to notice details that others do not.
13	I would rather go to a library than to a party.
14	I find making up stories easy.
15	I find myself drawn more strongly to people than to things.
16	I tend to have very strong interests, which I get upset about if I can't pursue.
17	I enjoy social chitchat.
18	When I talk, it isn't always easy for others to get a word in edgewise.
19	I am fascinated by numbers.
20	When I'm reading a story, I find it difficult to work out the characters' intentions.
21	I don't particularly enjoy reading fiction.
22	I find it hard to make new friends.
23	I notice patterns in things all the time.
24	I would rather go to the theater than to a museum.

**Table B.1 continued from previous page**

25	It does not upset me if my daily routine is disturbed.
26	I frequently find that I don't know how to keep a conversation going.
27	I find it easy to "read between the lines" when someone is talking to me.
28	I usually concentrate more on the whole picture, rather than on the small details.
29	I am not very good at remembering phone numbers.
30	I don't usually notice small changes in a situation or a person's appearance.
31	I know how to tell if someone listening to me is getting bored.
32	I find it easy to do more than one thing at once.
33	When I talk on the phone, I'm not sure when it's my turn to speak.
34	I enjoy doing things spontaneously.
35	I am often the last to understand the point of a joke.
36	I find it easy to work out what someone is thinking or feeling just by looking at their face.
37	If there is an interruption, I can switch back to what I was doing very quickly.
38	I am good at social chitchat.
39	People often tell me that I keep going on and on about the same thing.
40	When I was young, I used to enjoy playing games involving pretending with other children.
41	I like to collect information about categories of things (e.g., types of cars, birds, trains, plants).
42	I find it difficult to imagine what it would be like to be someone else.
43	I like to carefully plan any activities I participate in.
44	I enjoy social occasions.
45	I find it difficult to work out people's intentions.
46	New situations make me anxious.
47	I enjoy meeting new people.
48	I am a good diplomat.
49	I am not very good at remembering people's date of birth.
50	I find it very easy to play games with children that involve pretending.

**Table B.2: Autism-Spectrum Quotient (AQ) Options**

Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
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## **B.2 Otizm Spektrum Anketi (OSA-TR)**

**Table B.3: Otizm Spektrum Anketi (OSA-TR) Questions**

1	İşleri tek başıma yapmaktansa başkaları ile birlikte yapmayı tercih ederim.
2	İşleri tekrar tekrar aynı şekilde yapmayı tercih ederim.
3	Hayal ederek zihnimde bir resim yaratmak benim için kolaydır.
4	Sıklıkla bir işe diğer işleri gözden kaçırarak kadar kendimi kaptırıyorum.

**Table B.3 continued from previous page**

5	Sıklıkla diğerlerinin dikkat etmedikleri durumlarda, ben küçük gürültülere dikkat ederim.
6	Genellikle araba plakalarına veya benzer sıralı bilgilere dikkat ederim.
7	Ben nazik olduğumu düşünsem de, diğer insanlar sıklıkla söylediklerimin kaba olduğunu belirtiyorlar.
8	Bir hikâye okurken, karakterlerin neye benzediklerini kolaylıkla hayal edebilirim.
9	Olayların tarihlerini bilmekten çok hoşlanırım.
10	Sosyal bir ortamda, farklı insanların konuşmalarını kolaylıkla takip edebilirim.
11	Sosyal ortamlarda rahat ederim.
12	Diğerlerinin dikkat etmediği ayrıntılara dikkat etme eğilimindeyim.
13	Kütüphaneye gitmeyi bir partiye tercih ederim.
14	Hikâye uydurmak bana kolay gelir.
15	Cansız şeylerden çok insanlar ilgimi çeker.
16	Derin ilgi alanlarım vardır ancak ya sürdüremezsem diye üzülürüm.
17	Sosyal muhabbetten (lak-lak) hoşlanırım.
18	Ben konuşurken, başkalarının söze girmek istediklerini hiç fark etmiyorum.
19	Rakamlarla ilgilenirim.
20	Bir hikâye okurken karakterlerin niyetlerini çıkarsamak bana zor gelir.
21	Kurgu okumaktan özellikle hoşlanmam (yazar tarafından hayal edilerek yazılmış hikâye, roman gibi eserler).
22	Yeni arkadaşlar edinmeyi zor bulurum.
23	Her zaman işlerdeki kalıplara dikkat ederim.
24	Tiyatroya gitmeyi, müzeye gitmeye tercih ederim.
25	Günlük rutinim (alıştığım günlük düzenimin) bozulması beni üzmez.
26	Sık sık sohbetin akışını nasıl sürdüreceğimi bilmediğimi düşünürüm.
27	Birisi benimle konuşuyorken “satır aralarını okumayı” kolay bulurum.
28	Resmin bütününe, genellikle küçük ayrıntılardan daha çok konsantre olurum.
29	Telefon numaralarını hatırlamada çok iyi değilimdir.
30	Bir durum veya bir insanın görünüşündeki küçük değişikliklere sıklıkla dikkat etmem.
31	Beni dinleyen biri sıkılmaya başladıysa bunu hissedebilirim.
32	Bir defada birden çok şey yapmak bana kolay gelir.
33	Telefonda konuşurken, konuşma sırasının ne zaman bende olduğundan emin olamam.
34	İşleri spontan (içimden geldiği gibi) olarak yapmaktan hoşlanırım.
35	Şakanın püf (can alıcı) noktasını en son anlayan sıklıkla benimdir.
36	Kişinin sadece yüzüne bakarak, ne düşündüğünü veya hissettiğini çıkarsamayı kolay bulurum.
37	Eğer birisi yapmakta olduğum işi bölse o işe çok çabuk geri dönebilirim.
38	Sosyal muhabbette iyiyimdir.
39	İnsanlar sıklıkla sürekli aynı şey üzerinde uğraştığını söylerler.
40	Küçükken, diğer çocuklar ile rol yapmayı da içeren oyunlar oynamaktan hoşlanırdım.

**Table B.3 continued from previous page**

41	Bazı şeylerin kategorileri (sınıfları) hakkında bilgi toplamayı severim (örn; araba tipleri, kuş tipleri, tren tipleri, bitki tipleri vs.).
42	Başka biri gibi olmanın neye benzeyebileceğini hayal etmek bana zor gelir.
43	Katıldığım etkinlikleri özenle planlamaktan hoşlanırım.
44	Önemli günlerden (doğum günü partisi, düğün,...) hoşlanırım.
45	İnsanların niyetlerini anlamak bana zor gelir.
46	Yeni durumlar beni kaygılandırır.
47	Yeni insanlarla tanışmaktan hoşlanırım.
48	İyi bir diplomatımdır (insan ilişkilerinde her iki tarafı da idare edip çıkarlarımı korumayı bilirim).
49	İnsanların doğum günlerini hatırlamakta iyi değilimdir.
50	Çocuklarla rol yapmayı da içeren oyunlar oynamak bana çok kolay gelir.

**Table B.4: Otizm Spektrum Anketi (OSA-TR) Options**

Kesinlikle Katılıyorum	Sıklıkla Katılıyorum	Bazen Katılıyorum	Kesinlikle Katılmıyorum
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## Appendix C

### APPENDIX C - ADDITIONAL TABLES AND RESULTS

Table C.1: Coefficients for the effect of Condition for each participant in Experiment 2

Participant	Bil	Düşün	Zannet
1	0.7959093	-0.3215593	-0.5120256
2	0.8403403	-0.3367632	-0.5160818
3	0.8825067	-0.3440370	-0.5186820
4	0.8194828	-0.3397272	-0.5855710
5	0.6660131	-0.2878428	-0.5020410
6	0.8392080	-0.3327982	-0.5153538
7	0.8825067	-0.3440370	-0.5186820
8	0.7966583	-0.3464256	-0.6589659
9	0.8423073	-0.3330289	-0.5121761
10	0.8598614	-0.2647360	-0.5041225
11	0.8598614	-0.2647360	-0.5041225
12	0.8012980	-0.4808176	-0.5400003
13	0.8208191	-0.4087904	-0.5280410
14	0.8194828	-0.3397272	-0.5855710
15	0.8651318	-0.3263305	-0.4387813
16	0.8793826	-0.1927088	-0.4921632
17	0.8392080	-0.3327982	-0.5153538
18	0.7959093	-0.3215593	-0.5120256
19	0.8403403	-0.3367632	-0.5160818
20	0.8403403	-0.3367632	-0.5160818
21	0.7966583	-0.3464256	-0.6589659
22	0.8423073	-0.3330289	-0.5121761
23	0.8825067	-0.3440370	-0.5186820
24	0.8194828	-0.3397272	-0.5855710
25	0.8194828	-0.3397272	-0.5855710
26	0.8012980	-0.4808176	-0.5400003
27	0.8825067	-0.3440370	-0.5186820
28	0.8423073	-0.3330289	-0.5121761
29	0.8879564	-0.3196322	-0.3653864
30	0.7959093	-0.3215593	-0.5120256
31	0.8194828	-0.3397272	-0.5855710
32	0.7959093	-0.3215593	-0.5120256
33	0.8403403	-0.3367632	-0.5160818

34	0.8879564	-0.3196322	-0.3653864
35	0.8651318	-0.3263305	-0.4387813
36	0.9107809	-0.3129338	-0.2919915
37	0.8392080	-0.3327982	-0.5153538
38	0.8194828	-0.3397272	-0.5855710
39	0.7817768	-0.5528448	-0.5519595
40	0.8194828	-0.3397272	-0.5855710
41	0.8825067	-0.3440370	-0.5186820
42	0.8989037	-0.1206816	-0.4802040
43	0.8825067	-0.3440370	-0.5186820
44	0.8194828	-0.3397272	-0.5855710
45	0.8403403	-0.3367632	-0.5160818
46	0.8879564	-0.3196322	-0.3653864
47	0.8208191	-0.4087904	-0.5280410
48	0.9107809	-0.3129338	-0.2919915
49	0.8208191	-0.4087904	-0.5280410
50	0.8598614	-0.2647360	-0.5041225
51	0.8825067	-0.3440370	-0.5186820
52	0.8392080	-0.3327982	-0.5153538
53	0.8825067	-0.3440370	-0.5186820
54	0.8403403	-0.3367632	-0.5160818
55	0.7966583	-0.3464256	-0.6589659
56	0.8825067	-0.3440370	-0.5186820
57	0.8392080	-0.3327982	-0.5153538
58	0.8403403	-0.3367632	-0.5160818
59	0.8392080	-0.3327982	-0.5153538
60	0.8989037	-0.1206816	-0.4802040
61	0.8392080	-0.3327982	-0.5153538
62	0.8208191	-0.4087904	-0.5280410
63	0.8194828	-0.3397272	-0.5855710
64	0.8598614	-0.2647360	-0.5041225

## Appendix D

### APPENDIX D - ETHICAL COMMITTEE APPROVAL DOCUMENTS



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Sayı: 28620816 / 31

22 OCAK 2019

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Dr. Öğretim Üyesi Umut ÖZGE

Danışmanlığını yaptığımız Samet ALBAYRAK'ın "Türkçe'de tutum fillerinde önkoşul çıkarımı ve olgusalılık" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve 031- ODTÜ -2019 protokol numarası ile onaylanmıştır.

Saygılarımla bilgilerinize sunarım.

  
Prof. Dr. Tulin GENÇÖZ


Başkan

  
Prof. Dr. Ayhan SOL  
Üye

Prof. Dr. Ayhan Gürbüz DEMİR  
Üye

  
Prof. Dr. Yaşar KONDAKÇI (4.)  
Üye

  
Doç. Dr. Emre SELÇUK  
Üye

  
Doç. Dr. Pınar KAYGAN  
Üye

  
Dr. Öğr. Üyesi Ali Emre TURGUT  
Üye

Figure D.1: Ethical Committee Approval

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Sayı: 28620816 / 39

12 Haziran 2019

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Dr. Öğr. Üyesi Umut ÖZGE


Danışmanlığını yaptığımız Samet ALBAYRAK'ın "Türkçe'deki tutum fiillerinde önkoşul çıkarımı ve olgusalılık" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve 031-ODTÜ-2019 protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

  
Prof. Dr. Tülin GENÇÖZ

Başkan

  
Prof. Dr. Tolga CAN  
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Doç. Dr. Pınar KAYGAN  
Üye

  
Dr. Öğr. Üyesi Ali Emre TURGUT  
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Dr. Öğr. Üyesi Şerife SEVİNÇ  
Üye



Dr. Öğr. Üyesi Müge GÜNDÜZ  
Üye

Dr. Öğr. Üyesi Süreyya Özcan KABASAKAL  
Üye



Figure D.2: Ethical Committee Approval with Revisions