EFFECTS OF JOINT ACTION AND NATURE OF TASK SETTING ON TIME PERCEPTION

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EFFECTS OF JOINT ACTION AND NATURE OF TASK SETTING ON TIME PERCEPTION

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ABSTRACT

EFFECTS OF JOINT ACTION AND NATURE OF TASK SETTING ON TIME PERCEPTION

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In this paper we study the effect of social condition on prospective time estimation: do we perceive temporal durations differently long when we perform a task (i) alone, (ii) with a collaborative, or (iii) with a competitive partner? Within the Attentional Gate Model (Block & Zakay, 2006), we argue that joint settings require more attentional resources than the single setting, leaving less resources for time estimation. Therefore, we expect that (i) temporal durations are more underestimated in the joint conditions than in the single condition, and (ii) within the joint conditions, temporal durations are more underestimated in the competitive than in the collaborative setting. N=90 participants were tested (30 in each condition). Participants performed a concurrent Simon task for three different durations (15, 30 and 45 seconds) which was followed by a time reproduction phase. In the single condition, participants performed all Simon as well as all time reproductions trials whereas in the joint conditions participants shared the Simon task and performed only half of the time reproductions. The number of time reproduction trials for participants in all conditions was the same. Participants were told that they would receive points for their correct responses in the Simon task. In the single condition they were told that they would be compared with others individually, in the cooperative condition with other dyads, and in the competitive condition with each other. In results, Helmert contrasts revealed a significant difference between the single and both dual conditions. Reproduction ratios in dual conditions were smaller than in the single condition. Also, the difference between cooperative and competitive conditions was significant. Reproduction ratios were smaller, indicating that durations were more underestimated in the competitive compared to the cooperative condition. The results provide first evidence that social condition affects time estimation.

Keywords: Joint Action, Time Perception, Prospective Time Estimation, Simon Task

ÖZ

ORTAK HAREKET VE GÖREV DOĞASININ ZAMAN ALGISI ÜZERİNDEKİ ETKİLERİ

Usal, Kerem Alp

Yüksek Lisans, Bilişsel Bilimler Bölümü

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Bu çalışmada sosyal durumun ileri dönük zaman algısı üzerindeki etkisini araştırdık: Bir görevi (i) yalnız, (ii) bir yardımcı ile, veya (iii) bir rakip ile yaptığımızda zamanı daha farklı mı algılıyoruz? Dikkat Kapısı Modeli (Block & Zakay, 2006) ile değerlendirdiğimizde, birlikte yapılan işlerde yalnız olmaya göre daha fazla dikkat gerekeceğini ve zaman algısı için daha az kaynak kalacağını öne sürüyoruz. Bu nedenle, (i) birlikte durumlarda sürenin yalnız durumdan daha fazla kısa olarak algılanacağını, ve (ii) birlikte durumlar içerisinde, rekabet durumunda sürenin yardımcı duruma göre daha fazla kısa olarak algılanacağını bekliyoruz. N=90 katılımcı (her grupta 30 kişi) test edildi. Katılımcılar zaman ölçümü ile eşzamanlı olarak, üç farklı sürede (15, 30 ve 45 saniye), Simon görevi gerçekleştirdi ve ardından zaman geri bildirimi yaptı. Yalnız durumda, katılımcı bütün Simon ve zaman görevlerini kendileri yaptı, birlikte durumda ise iki katılımcı Simon görevini paylaştı ve zaman geri bildirimlerini yarı yarıya yaptı. Toplamda her katılımcı aynı sayıda zaman geri bildirimi yaptı. Katılımcılara doğru yanıtları için puan verileceği söylendi. Yalnız durumda bu puanların diğer katılımcılar ile karşılaştırılacağı, yardımcı durumda diğer takımlar ile karşılaştırılacağı ve rekabetçi durumda iki katılımcının birbiriyle karşılaştırılacağı söylendi. Sonuçlarda, Helmert kıyaslaması yalnız ve birlikte durumlar arasında anlamlı bir farklılık olduğunu gösterdi. Birlikte durumlarda zaman geri bildirim süreleri yalnız durumdan daha kısaydı. Ayrıca, yardımcı ve rekabetçi durumlar arasındaki farklılık da anlamlıydı. Geri bildirim oranları rekabetçi durumda daha küçüktü yani süreyi yardımcı durumdan daha kısa olarak algılamışlardı. Sonuçlar, sosyal durumun zaman algısını etkilediğine dair ilk kanıtı sunmuştur.

Anahtar Sözcükler: Ortak Hareket, Zaman Algısı, İleri Dönük Zaman Tahmini, Simon Görevi

To My Family

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LIST OF ABBREVIATIONS

AGM	Attentional Gate Model
ANOVA	Analysis of Variance
CV	Coefficient of Variance
EGM	Executive Gate Model
METU	Middle East Technical University
ms	milliseconds
SD	Standard Derivation
SE	Standard Error
s	Seconds
SET	Scalar Expectancy Theory

CHAPTER 1

INTRODUCTION

People have struggled to understand the passing of time throughout history, noted by the Latin idiom “tempus fugit”, which is still use in English as its translation “time flies”. At first humans observed natural events such as the rising and setting of the sun or seasons passing by but that turned to be too long as an interval for many events. So they have conceived and built clocks using very different methods such as exploiting the angle of the sun, the passing of water or sand through a tiny opening, gears, digital computing and finally electromagnetic radiation as in modern atomic clocks. With these methods we have been able to define time on the level of nanoseconds, but even counting seconds is still not the same as feeling the passing of the time, subjectively. The feeling that time flows is dependent on these external tools and machines, instead humans have internal and innate mechanisms for keeping track of time (Dibner, Schibler & Albrecht, 2010). These mechanisms have been studied and explained with internal clock models which facilitate the understanding of how cognitive factors can distort time estimation (Droit-Volet, 2013).

Recent studies (Kornbrot, Msetfi, & Grimwood, 2013; Rudd, Vohs, & Aaker, 2012), proved what lots of people have been feeling from time to time: Our cognition of time may not always be the same as what the clock shows us. Depending on our situation time may fly away like a jet plane or crawl even slower than a snail. When you are depressed, happy, or in awe, your perception of time might be flawed. Motivation is another factor that affects time perception: people judge durations to be shorter when they are positively motivated (Gable & Poole, 2012).

Even though correct timing is crucial for survival, time perception is distorted by many environmental or internal factors such as the amount of cognitive load (Block, Hancock & Zakay, 2010), rewards (Failing & Theeuwes, 2016), mood (Mioni et al., 2016) or emotions (Johnson, 2014).

Modality of the stimuli is another factor that affects subjective time estimation (Meck, 2003). Many studies in the literature (Penney, 2003; Shelton & Kumar, 2010; Zelanti & Droit-Volet, 2012) show that when participants were tested with different stimulus modalities, there was a significant difference between their time estimations. Several studies on the difference of time perception between presentations of auditory and visual stimuli (Behar & Bevan, 1961; Goldstone & Goldfarb, 1964; Walker & Scott, 1981; Wearden et al., 1998) have revealed that the duration of visual stimuli is more underestimated than the duration of auditory stimuli in different time judgment paradigms. When the stimulus was an unpleasant odor (Millot, Laurent & Casini, 2016), participants who were tested with a temporal bisection task, i.e., when they had to indicate whether a presented time interval was shorter or longer than a reference interval, underestimated the duration of the odor when they compared the duration of odor to an anchor duration of 400 milliseconds, whereas different participants overestimated the duration of the same odor in comparison to an anchor duration of 2000 milliseconds. Another study (Indraccolo et al., 2015) has reported that the average amount of reproduced time was smaller when participants were presented with auditory stimuli, in comparison to visual stimuli. The same study has also shown that stimuli with higher intensity (brightness for visual stimuli and loudness for auditory stimuli) resulted in longer reproduced times compared to stimuli with lower intensity.

Besides amount of cognitive load, physical load is another aspect that affects time perception. Physical load of the task is how much physical energy participants need to spend during the task, such as running or climbing. Physical load affects time reproduction since undertaking a task that requires a big amount of physical load also requires the participant's attention (Block, Hancock, & Zakay, 2016). As several studies have shown (Baldauf, Burgard & Wittman, 2009; Busca et al., 2011), when participants are under high amounts of physical load, they reproduce shorter durations in prospective duration judgment tasks, i.e., when they know that they have to judge the time duration afterwards.

Repetition of the stimulus and expectation are other factors that have an effect on time perception. When the same item is presented repeatedly, people underestimate the duration of repeated items compared to novel items (Matthews & Gheorghiu, 2016). Impulsivity of the participant is another variable that results in overestimation of time compared to more self-controlling participants (Wittman & Paulus, 2008).

Changes in time perception may also be permanent, thus, habits in daily life alter temporal judgment not only for the short term but also for the long term. As shown in a previous study (Rivero et al., 2013), participants who reported to play computer games regularly performed better in temporal bisection tasks when tested in the milliseconds

range. However, the same study revealed that this effect was not seen for the multi-seconds range. Another study (Siu et al., 2014), revealed that age was also a factor that affects time perception. When tested with time reproduction and time discrimination tasks, participants between 15-25 years of age underestimated time in contrast to overestimation seen in participants who were between 35-55 years of age.

Time perception is susceptible to neural disorders, such as depression and anxiety (Mioni et al., 2016) or Huntington's Disease (Righi et al., 2016). Huntington's Disease is a chromosomal anomaly which results in neural degeneration and neuropsychological deficits. When they were tested with a temporal bisection task, patients have shown impairments in time perception, as they overestimated short durations and underestimated long durations (Righi et al., 2016). Depressive patients overestimate time intervals whereas anxious patients underestimate durations and show more variance (Mioni et al., 2016).

In this study, the focus of research is the effect of joint action on time perception. Joint attention and joint action are indispensable for a society. For a long time they were believed to be specific to humans and despite a few studies which have argued for signs of primitive versions of joint attention in chimpanzees (Okamoto-Barth & Tomonaga, 2006), only humans are considered being capable of undertaking joint tasks.

In daily life, humans are presented with many obstacles they cannot overcome on their own, as well as many goals which require more than one person to accomplish. Such actions range from hunting activities of the Stone Age to huge corporations of our time, from two parents raising a child together to players in team sports and soldiers in wars. These actions, called joint actions (Taylor, 1987), may have different cognitive requirements than single actions, such as creating mental representations of the other participant's mind (Sebanz, Knoblich, & Prinz, 2003) and coordination of movements (Vesper et al., 2011).

Joint action requires joint attention. Around 12 to 18 months (Moore & D'Entremot, 2001), humans develop the ability to engage in joint attention with another person – and simply everything changes for the infant! Studies with adults (Dudarev & Hassin, 2016; Ruissen & de Bruijn, 2016) have shown that people's performance in any task is heavily affected by joint attention. Factors such as entrainment, as well as perception-action matching (Loehr, Sebanz & Knoblich, 2013; Ramenzoni, Sebanz & Knoblich, 2014) are also important for coordination during the joint task.

Skill in performing joint actions is very important for an individual's standing in society. According to previous studies (Mein, Fay & Page, 2016), people who are less willing to participate in joint actions, for various reasons such as anxiety, receive lower ratings, i. e. they were less liked, when assessed by their partners. This finding suggest that people who fear negative reactions participate in fewer joint actions in daily life and in return they are less liked by their peers in comparison to more sociable people that participate in numerous joint action tasks.

Social warmth is another factor that affects performance during a joint action task (Fiske, Cuddy & Glick, 2007). Warmth and competence between individuals that share a task affects their behavioral and emotional responses (Cuddy, Fiske & Glick, 2008). When participants carry out temporal bisection tasks with photographs of facial expressions, that show either negative emotions such as anger or positive emotions such as happiness, result in underestimation of time for positive emotions, and overestimation for negative expressions (Droit-Volet & Meck, 2007).

There have been few studies on the effects of the nature of the social condition of a task (Decety et al., 2004; Ruissen & de Bruijn, 2016), These studies have shown that participants in a competitive condition show less self-other integration in comparison to participants in a cooperative condition, suggesting that the participants in a competitive condition are more focused on their own task than those in a cooperative condition. Also, it is harder for the participants in a competitive condition to predict their partner's actions, which would increase the amount of cognitive load.

Social facilitation is another factor that effects cognitive performance (Sellaro, 2013). The difference between joint action and social facilitation is that during joint action, participants share aspects of the task they are given and perform together, whereas in social facilitation participants carry out the task in the same environment but do not interact and perform independently. Social facilitation increases individual performance during simple tasks but in contrast, performance is impaired in complicated tasks.

Our aim in this study is to provide further experimental evidence of the effect of the social condition on time perception – whether the task is performed individually or with a partner. The results of this study will broaden our understanding of how human time perception is affected by social condition and the nature of the social condition – whether the partners cooperate or compete.

Chapter 2 of this thesis will provide a literature review on time perception, joint action, the Simon task which serves as the concurrent task in our study, and various factors that affect time perception. Information about paradigms and methods of duration judgment will be given and the contrasts between different paradigms of duration judgment, as well as the reason behind the choice of our paradigm and methodology in this study will be explained. Current models of time perception will be presented. Information about recent studies on joint action and cognition will be discussed. In chapter 3, the hypotheses of this study will be explained. Chapter 4 will cover the methods used in our study, and in Chapter 5 the results of this study will be presented. Chapters 6 and 7 will provide discussion and conclusion, respectively.

CHAPTER 2

LITERATURE REVIEW

This study brings together two lines of research in cognitive science: time perception and joint action. Time perception is a basic cognitive ability implied in a wide variety of experimental tasks and everyday activities (Grondin, 2010; Zakay, 2016). Hitherto, time perception has been investigated in individual studies, however, more often humans are engaged in joint action. Yet, we do not know how their time perception is affected by the social setting of the task – whether they do the task alone or together with a partner. Previous studies (Sebanz, Knoblich, & Prinz, 2003; Vesper et al., 2011) have shown that people's performance in any task is heavily affected by joint action and joint attention. In this study, our aim is to experimentally show people's time perception is also affected by the social setting.

The next section will provide information on paradigms and methods of duration judgment which are used in time perception studies. Models of internal time-keeping mechanisms will be briefly explained. The effect of internal and environmental factors on time perception will be discussed in the following sections.

2.1. Paradigms of Duration Judgment

Humans' ability to perceive and estimate time is under the influence of cognitive functions, most of all attention and memory. Therefore, the paradigm in which the duration judgment is studied has an effect on the estimated time. There are two paradigms for duration judgments: Prospective and retrospective (Zakay, 1993).

In the prospective duration judgment paradigm, participants are instructed that they will be asked to evaluate an elapsed time interval afterwards, either in the form of a verbal

temporal estimation (e.g., 10 seconds) or to reproduce how much time has passed during the given interval, so they have prior knowledge that they will perform some temporal evaluation, e.g., in the form of time reproduction. In the retrospective duration judgment, participants are not given any information that they will perform some temporal evaluation, e.g., time reproduction but after the given interval ends, they are asked to do so (Grondin, 2014). Participants in the prospective duration judgment paradigm focus on the passing of time since they know they will be required to present an estimate for it later, whereas participants in the retrospective duration judgment paradigm would not specifically focus on time since they do not have any information regarding the reproduction phase that will happen next. Therefore, participants in the prospective duration judgment paradigm use their attentional resources as well as their memory for keeping track of time, however, participants in the retrospective duration judgment paradigm can only rely on their memory (Zakay & Block, 2004). Another important difference between these two paradigms is that the prospective duration judgment can be used repeatedly on the same participant, which is not possible in the retrospective duration judgment since the participants would know that they are supposed to perform a time reproduction after the first time reproduction phase.

2.1.1. Prospective Duration Judgment

In the prospective duration judgment paradigm, the participants are aware that they will perform a time reproduction. This paradigm is also called "experienced duration" (Block, 2014). Participants use their attentional resources to keep track of time, even though this might come secondary to a concurrent task they are performing during that interval. In accordance with the Attentional Gate Model (Block & Zakay, 2006), the amount of attention allocated to keeping track of time might decrease in more demanding concurrent tasks compared to easier tasks, which would result in an underestimation of the actual duration of the concurrent task (Duzcu & Hohenberger, 2014).

2.1.2. Retrospective Duration Judgment

In the retrospective duration judgment paradigm, the participants are not provided with any previous information regarding that they will perform a time reproduction. Since they do not know that they will need to reproduce the length of the duration, participants may not focus on keeping track of time explicitly and use all their attentional resources on any task which they are performing in that duration. So when they are instructed to perform a time reproduction for that duration, they can only rely on their memory and because of that, the retrospective duration judgment paradigm is also called "remembered duration" (Block & Reed, 1978).

2.2. Methods of Duration Judgment

There are many different methods for collecting data on participants' time estimation. Popular methods include verbal estimation, production of the requested duration, interval reproduction and comparison of given intervals (Grondin, 2014). Verbal estimation is a method in which the participants are directly asked how long the duration was, usually in seconds (Matthews, 2011), but this can also be done in other time scales such as minutes. The problem with verbal estimation is that participants may tend to round up numbers, which might increase variance. In the duration production method, participants are instructed to produce a certain duration. This can be done in various ways, such as pressing a button for starting the time count and pressing it for a second time to stop, or pressing the button constantly for the target duration (Levin & Zakay, 1989). However, in the duration production method, time estimation is usually the primary task and does not allow for another concurrent task to be performed at the same time. Also, previous studies have shown that it is difficult for participants to produce very short durations, which makes this method only viable for longer duration lengths such as minutes (Gil & Droit-Volet, 2011). In the comparison method, participants are presented with two or more durations and they are instructed to compare these durations (Poynter, 1983). In temporal bisection tasks, subjects are first trained with anchor duration as references for short and long durations. After that, they are tested with a range of durations between these two anchor durations, including the anchor durations themselves, and they are instructed to judge the presented durations as either short or long (Ortega & Lopez, 2008).

In the reproduction method, participants recreate the duration of a certain time interval after it has passed. A previous study (Mioni et al., 2014) has revealed that the method used for the reproduction of time affects the amount of time reproduced. Three groups of participants, were tested in a prospective duration judgment: (1) participants only pressed the button at the end of the reproduced duration, (2) participants pressed the button both at the beginning and at the end of the reproduced duration, and (3) participants continuously pressed the button for the entire interval. The accuracy was higher for group (2) in which the participants pressed the button both at the beginning and at the end of the reproduced interval. On the other hand, variability was smaller in group (3) where participants continuously pressed the button.

The interval reproduction method can be used either prospectively or retrospectively. An important advantage of this method is the possibility of another task to be performed in parallel (Duzcu & Hohenberger, 2014). Also, since the reproduction is performed by pushing buttons, there is no risk of participants rounding up the numbers as in verbal estimation, which makes interval reproduction method more viable for use in joint action tasks. Because of these advantages, the reproduction method was preferred in this study.

2.3. Time Perception Models

Studies in the field have shown that time estimation changes from person to person, hence there should be an internal time-keeping mechanism. Even though time is not a direct environmental stimulus to be perceived such as light or sound, this mechanism allows humans to perceive time (Zakay, 2016). There are dedicated and intrinsic models for time processing (Ivry & Schlerf, 2008), and it is still under debate which model correctly represents the timing mechanism in humans: do we have one internal clock or separate clocks for different duration ranges or isn't there any internal clock after all? The dedicated models are modular, such as the pacemaker-counter (or pacemaker-accumulator) model (Gibbon, 1977) or the cerebellar timing hypothesis (Ivry et al., 2002). On the other hand, the intrinsic models of time processing suggest that time perception does not take place in a certain part of the brain but instead it is distributed in various neural networks.

The number of internal clocks is also subject to discussion (Van Rijn & Taatgen, 2008) since people possess the ability of tracking multiple time intervals simultaneously. This can be achieved by either using the same pacemaker with multiple counters or possessing multiple pacemakers.

In the pacemaker-counter model, there is a pacemaker which emits pulses continuously on a certain rate, whereas the counter system keeps track of how many pulses have passed since the beginning of the event and stores that information in memory. Later, the number of pulses are retrieved from memory to represent how much time has passed during the given event.

2.3.1. Scalar Expectancy Theory

Scalar Expectancy Theory has been developed by Gibbon (Gibbon, 1977) on the basis of time estimation of animals. This models consists of perception, memory and decision processes (see Figure 1). Time perception occurs through a pacemaker that creates pulses, an accumulator that counts pulses, and a switch between the pacemaker and the accumulator that starts or stops the connection. The information from the accumulator is stored in memory, alongside information regarding when the counting has begun. Then the decision on the amount of time that has passed is based on the latest information from the accumulator, the beginning of the counting of the pulses, and a threshold (Church & Meck, 2003).

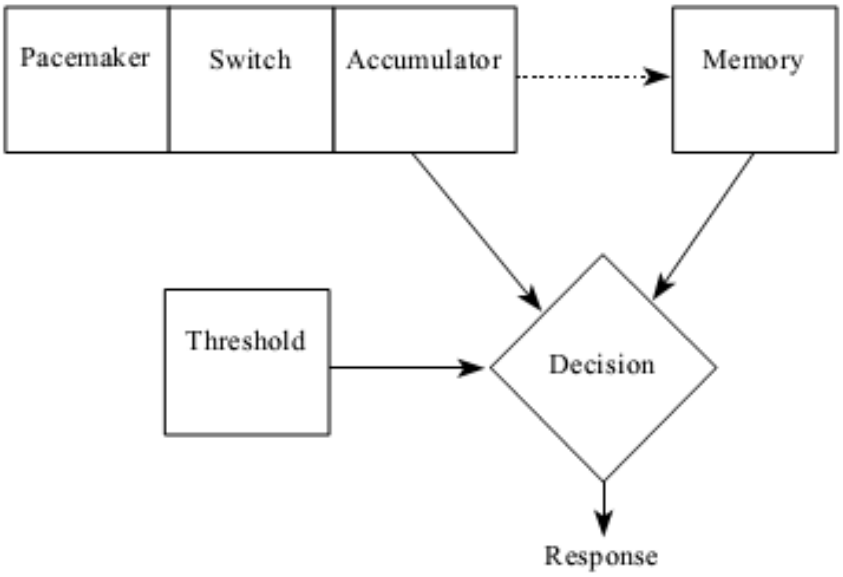

Figure 1. A Scalar Expectancy Theory Model, Church & Meck, 2003.

2.3.2. Attentional Gate Model

The Attentional Gate Model is based on Scalar Expectancy Theory but it contains an additional attentional mechanism which has been suggested for the explanation of mistakes in time estimation seen in humans, especially when there are other attention-demanding tasks in parallel with time estimation (Zakay, 2015).

The Attentional Gate Model consists of several subparts (see Figure 2). First, a pacemaker that creates pulses at a constant rate, although it can be affected by arousal on a small scale. These pulses flow through an attentional gate, which is regulated by an executive function that determines whether attentional resources should be directed to the task at hand or to the keeping of time. This executive function triggers a switch that determines if the number of emitted pulses will be counted by the accumulator. Then, the accumulator counts the pulses which flow through the attentional gate and the switch, storing the number in working memory, as well as in reference memory and long-term memory if the situation demands a comparison and/or long-term retrieval (Zakay & Block, 1995).

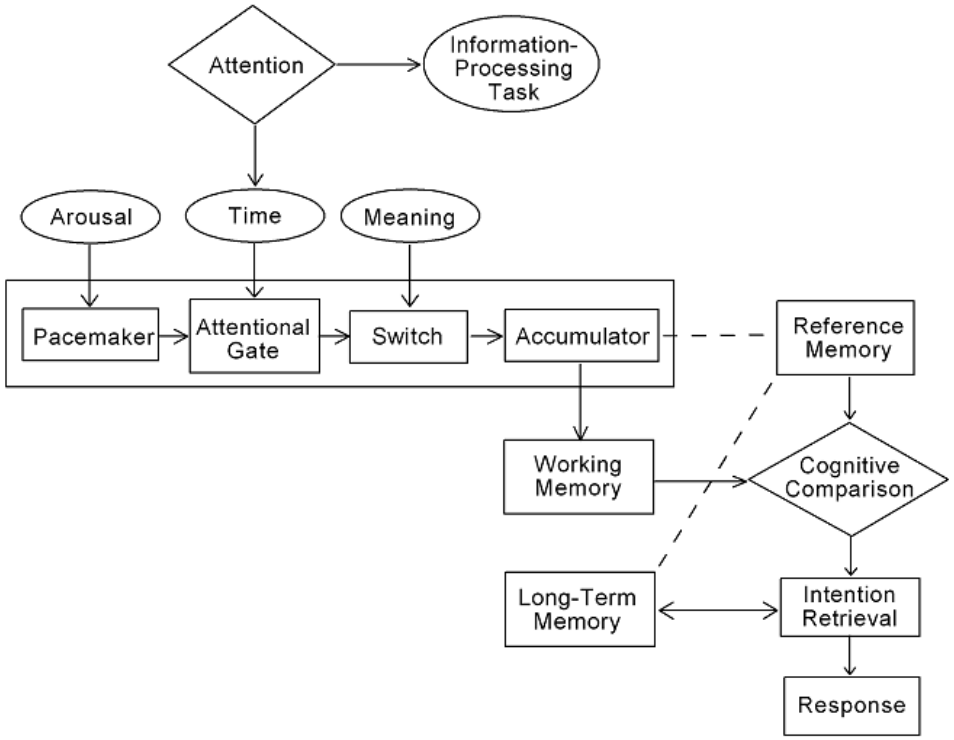

Figure 2. Attentional Gate Model (Block & Zakay, 2006).

Many studies have shown that, in accordance with the Attentional Gate Model, executive task in particular use attentional sources and thus lead to an underestimation in time reproduction (Duzcu & Hohenberger, 2014; Biyik Sari, 2015). As the amount of cognitive load increases, the ratio of reproduced duration to actual duration decreases, which means that participants tend to underestimate time more (Block, Hancock, & Zakay, 2010). This finding is explained by the Attentional Gate Model as follows: the attentional gate is down, because the participant is focusing on the difficult task at hand, and therefore more pulses of the pacemaker are missed.

2.4. Mood and Time Perception

Studies in the literature suggest that time perception is under heavy influence of a person's mood at that time (Kornbrot, Msetfi, & Grimwood, 2013; Rudd, Vohs, & Aaker, 2012). One of these studies (Rudd, Vohs, & Aaker, 2012), has pointed out that awe, which is described as the feeling of encountering something so vast that mental schema's are updated, also expands the understanding of time at hand. This study has shown that feeling of awe results in the perception of an increase in the available time to perform a task compared to other feelings and thus participants that felt more awe behaved more patiently. Another study (Kornbrot, Msetfi, & Grimwood, 2013) suggests that a high level of arousal and more focused attention to given stimuli results in a shorter time estimation. The same study also points out that during a mood state of

dysphoria, which is a minor level of depression in which people are able to follow a normal daily life even though they show signs of depression, patients benefit from depressive realism, a mental state that allows their cognitive system to better grasp realistic perceptions, so their perception of time is more accurate than that of other people.

A study which compared patients with depression to patients with anxiety disorder through time reproduction and time production tests (Mioni et al., 2016) suggested that clinical mood disorders have a significant effect on time perception, too. Patients with major depressive disorder, which is a heavier form of depression that impairs the ability to cope with the necessary tasks of daily life, has shown a highly distorted perception of time since they have lower arousal levels and are not able to focus their attention, resulting in a subjective time perception which is much slower than the real passing of time. Patients with anxiety disorder, however, perceive time to be flowing faster. It is argued in the same study that the underestimation in anxiety is caused by the decrease in attention, however the overestimation in depression is the result of a decrease in the speed of the pacemaker.

Another study (Failing & Theeuwes, 2016) has shown a relation between monetary rewards and time perception. When participants were shown stimuli that were colored differently as an indication of the amount of monetary reward, stimuli with higher reward were perceived to appear longer on the screen in comparison to stimuli with lower or no monetary reward.

2.5. Joint Attention and Joint Action

The ability to engage in joint attention and perform joint actions is crucial for social life, and therefore an indispensable attribute of human cognition. Joint attention makes it possible to share a task with another person, learn from other people's actions, anticipate another person's behavior, and, if necessary, to also coordinate actions between two or more people (Sebanz, Bekkering & Knoblich, 2006).

It is common in everyday life that people need to perform an action together, which is called a joint action. There have been numerous studies on the nature of such joint actions. One of these studies, using the "Simon task" as an experimental paradigm (Sebanz, Knoblich & Prinz, 2003) has shown that an individual's actions are represented in the other participant's mind and have an impact on their actions. Therefore, the joint Simon task, also called "Social Simon task" (see below) results in the same findings as the regular individual Simon task, i. e., participants show a spatial compatibility effect, even if the described task does not necessarily have a spatial description.

There are two types of joint action: emergent and planned (Knoblich, Butterfill & Sebanz, 2011). In the emergent joint action, participants act in similar ways because of

shared perception-action couplings, and in the planned joint action, participants act in a coordinated way as a result of pursuing the same goal.

When several groups of people are instructed to perform a joint action in multiple groups (Tsai, Sebanz & Knoblich, 2011), these groups also tend to mimic each other, and this effect is called the GROOP effect. It was also found that groups tend to mimic other groups more than they mimic an individual's actions even though the performed action is the same.

Joint action may also require coordination between individuals. A previous study (Vesper et al., 2011) has investigated how people who are performing a joint action task handle the coordination of their movements. The results have shown that as the number of available actions got smaller, it became easier for people to act together in the correct fashion. This finding applied to cases where the performers were supposed to act simultaneously or sequentially, but not to cases where individuals performed separate tasks next to each other. Moreover, performance speed also increased when the temporal variability was reduced.

2.5.1. Cooperation and Competition

Our study involves two different conditions for the joint action task paradigm: Cooperation and Competition. Current studies regarding joint attention and joint action in humans usually focus on cooperation rather than competition (Reboul, 2010; Tomasello et al., 2012). It is suggested that while competition is the key element of nonhuman primate sociability, cooperation is the main characteristic of human social cognition (Reboul, 2010). The main reason behind this idea is that humans, even 3-year-olds, can commit to joint goal situations regarding collaborative action, in contrast to primates who break their commitment to the task and lose attention (Tomasello et al., 2012). Moreover, another study (Iani et al., 2011) revealed that participants who perform a task together tend to perceive the situation as if they were in cooperation, even if they are not explicitly instructed of such a condition.

In a previous study that investigates both cooperation and competition (Ruissen & de Bruijn, 2016), participants first played Tetris either by themselves, in cooperation with a partner or against another person, and then all participants, including those who have played Tetris alone, were tested with both the standard Simon task and the Social Simon task. Cooperation and competition was only effective in Tetris, and all participants performed the Social Simon task in the same, neutral setting. Participants' performance on the standard Simon task was not affected by the setting of the previous Tetris game, however, the effect of the previous setting was seen in the Social Simon task. The participants who had played Tetris in cooperative or competitive settings had lower reaction times in comparison to participants who had played Tetris alone, due to the effect of self-other integration during joint conditions of Tetris.

2.5.2. Social Faciliation

Social facilitation is a concept that stems from social psychology (Triplett, 1898; Allport, 1920). Main focus of this theory is the effect of the presence of other people on the performance of individuals. Social facilitation improves performance in simple tasks, however, performance in complicated tasks are impaired due to loss of attention (Sellaro, 2015). Several reasons have been suggested as the reason behind social facilitation, including increase in drive (Zajonc, 1965), fear of being evaluated (Henchy & Glass, 1968) and distraction (Baron, Moore & Sanders, 1978).

2.6. Effects of Joint Action on Cognitive Performance

Humans are inherently social and prone to participate in joint action whether they are clearly instructed to help or not, which has been shown by previous studies in the field (Dudarev & Hassin, 2016). When dyads of participants were placed in front of a screen to perform executive tasks, each participant tracked and represented their partner's task even though it was not required. When they were asked afterwards, the participants reported that they were not aware of doing so. This reveals that taking part in another person's executive task might be an unintentional, automatic process.

2.6.1. Joint Action and Time Perception

In order to perform a joint action, it is suggested that the participants in the joint task are required to construct a mental representation of each other, which results in an increase in the amount of cognitive load (Sebanz, Knoblich & Prinz, 2003). Previous studies have shown that the increase in the amount of cognitive load results in underestimation of time (Block et al., 2010; Biyik Sari, 2015), which is in accordance with the Attentional Gate Model (Zakay & Block, 2004). Therefore, our study is based on the hypothesis that a concurrent joint action task would result in underestimation of the duration of the test as compared to an individual concurrent task.

In a joint action task, being the agent of the action affects time perception (Capozzi et al., 2016). When dyads of participants performed a time judgment task in cooperative, competitive and sequential conditions to generate tones, participants judged the tones they have generated to be closer in time compared to the tones generated by the other participant in the dyad.

2.7. The Simon Effect

The Simon task is a spatial compatibility task first described in a paper by Simon & Rudell (1967). The first true Simon effect was shown in another study by Simon & Small (1969). The Simon task is a two-choice reaction task and stimulus has relevant

(e.g. color) and irrelevant (e.g. location) dimensions. Participants are instructed to respond according to the relevant dimension of the stimulus and not to the irrelevant dimension. The Simon task consists of congruent trials in which the irrelevant dimension is spatially compatible and incongruent trials in which the irrelevant dimension is not spatially compatible.

Experiments (Hommel, 2011; Simon & Small, 1969) showed that participants react faster to congruent trials in comparison to incongruent trials, and this is called "the Simon effect", an effect that is observed at the level of response selection. As an example (Joyce et al., 2014), a visual horizontal Simon task might consist of a circle, either in red or blue as a relevant dimension, and either appearing on the left or right side of the screen as the irrelevant dimension, and the participants are instructed to respond with a certain color-key matching (e.g. left button for red and right button for blue) while ignoring the location of the stimulus. In congruent trials, the task-relevant spatial aspects are compatible with the location of the stimulus (e.g. right button response and stimulus on the right side of the screen), whereas in incongruent trials, they are at the opposite (e.g. left button response and stimulus on the right side).

2.7.1. The Social Simon Effect

The Social Simon effect is a version of the Simon effect in which more than one person (usually two) share a Simon task. Studies have shown that the Simon effect is influenced by the presence of another individual as compared to carrying out the task alone (Dolk et al., 2011; Tsai et al., 2006; Vlainic et al., 2010). A previous study in the field (Sebanz, Knoblich & Prinz, 2003), has shown that the presence of another individual is salient enough to affect the results of one person's response time during the task.

Nature and mechanism of the Social Simon task is still under debate. Co-representation is one of the suggested mechanisms. Participants in a Social Simon task give slower responses when they react to a stimulus which was meant for the other participant, and moreover, electrophysiological findings indicate similar results for stimulus that refer to the individual's own instruction and for stimulus that refer to the other participant (Sebanz et al., 2006; Welsh, 2009). Spatial referential account is another suggested mechanism. When the participants' hands are not crossed and they both use their right hands to perform the task for the respective button on their side, referential frames align for both agent-based and response-based frames, and Social Simon effect is observed. However, when the participants' hands are crossed, frames of reference do not align and Social Simon effect is not observed (Dolk et al., 2013; Dolk et al., 2014; Liepelt, Wenke & Fischer, 2013).

Another study, (Ford & Aberdein, 2015) has tested participants with a Social Simon task, first side by side with another participant and then once again on their own. The results indicated to a strong Simon effect even in the following single setting. The degree of the Simon effect was not influenced by the status of the co-actor: whether the second participant was a friend or a stranger. However, in cases where two friends

participated together, there was a correlation between empathy and the robustness of the Simon effect, which was not seen amongst strangers.

The kind of dependency between the partners in the Simon task also affects performance. When participants were tested with an auditory Simon task in couples (Ruys & Aarts, 2010), couples showed signs of shared action representations not only in the cooperative setting but also in the competitive setting. This result revealed that shared action representations are necessary for the assessment of the partner's performance, whether the performance has a positive or negative effect on the outcome for the participants themselves. On the other hand, another study (Iani et al., 2014) reported that the Simon effect was only observed in cooperative condition and not in competitive condition.

In the present study, the Social Simon Task will be used as a concurrent executive task. The primary focus of our study, however, is not to show whether a Social Simon effect exists or not. We used the Social Simon task as a very well-suited paradigm that allows two individuals to engage in a joint task. Furthermore, it is equally suited for cooperation and competition. Of course, our results will add to the growing literature on the Social Simon effect as well.

2.8. Duration Lengths and Time Perception

The effect of duration length on time perception, as shown in previous studies (Fetterman & Dreyfus, 2013; Macar, Pouthas & Friedman, 2013; Michon & Jackson, 2012), is that long durations are more underestimated by participants in comparison to short durations. This effect has been known for a long time as "Vierordt's law" (Vierordt, 1868; Lejeune & Wearden, 2009). This effect is observed to be stronger when time estimation is carried out in parallel with a difficult task (Duzcu & Hohenberger, 2014), which might be due to the attentional resources being more depleted over time.

The effect of modality differences in stimuli also depends on the duration. Although perceptual modality affects time perception across modalities in short durations, this effect is not seen in longer durations (Block & Gruber, 2014).

2.9. Neural Correlates of Time Perception

In the human brain, there is not a certain neurological location which has been identified as the master clock (Merchant, Harrington & Meck, 2013). The basal ganglia and cerebellum are responsible for the processing and keeping track of the flowing of time (Zakay, 2016). Hippocampus is crucial for storing and retrieving information regarding reference durations and hippocampal lesions impair the ability to discriminate duration and decrease temporal sensitivity (Meck, Church & Mattell, 2013). Also, neuronal firing rates in frontal and striatal areas provide temporal representation, precision and accuracy (Coull, Cheng & Meck, 2011). Another study in the field (Harrington, Haaland &

Knight, 1998), showed that people with lesions in the right hemisphere of the prefrontal, frontal or parietal cortex have impaired time perception whereas people with left hemisphere lesions perform successfully in time perception tasks. These clinical findings point to a right hemisphere and inferior-parietal cortical network for the perception of time. Another study (Yin et al., 2016), proposes that the coordination between the striatum and the claustrum plays a key role in the integration of time-based sensory perceptions.

The ability to perform joint action tasks develops around the ages of 12 months to 18 months as the ability to form joint attention emerges (Moore & D'Entremot, 2001). Also, the development of the ability to share representations about the environment is a necessity for successfully performing joint action tasks (Sebanz, Bekkering & Knoblich, 2006). The same study also suggests that the superior temporal sulcus is involved in the prediction of other people's actions as well as the mirror neurons in the premotor and parietal cortex. Moreover, a functional Magnetic Resonance Imaging study (Grezes et al., 2003) has shown that when an individual witnesses another person carrying out an action, that individual's representation system for the same action is also activated. Another study (Sebanz & Frith, 2004) has shown that ventral premotor cortex is active during joint action tasks too, which points to the ability of predicting the other person's behavior with whom the individual is sharing the task.

The cognitive mechanisms underlying joint action between individuals are still under research. There is an array of different possible mechanisms (Obhi & Sebanz, 2011). First of all the perception of another person who is doing a certain action results in the activation of the same motor areas in the perceiver's brain, hinting at co-representation. Also, it is observed that people predict the other person's behavior when they are performing a joint action task together. Functional Magnetic Resonance Imaging studies suggest that inferior frontal gyrus of the right cerebral cortex and right cerebellar hemisphere are significantly more active during incongruent joint action motor tasks versus congruent joint action motor tasks. Furthermore, it has been found that only intentional actions result in a shorter perception of the real time between the performed task and the effect that action creates in the environment.

CHAPTER 3

HYPOTHESES

In this theses, three main hypotheses are formulated regarding participants' behavior in the time reproduction task and in the concurrent executive Simon task.

The first hypothesis of this study is that subjects' time perception during a task is affected by the task's social setting. Due to the attention demands of sharing a joint task with a co-actor, we expect that subjects will perceive time as proceeding faster during a joint task than during an individual task. As a consequence, they will reproduce shorter time intervals.

The second hypothesis of this study is that the nature of the joint task setting – whether it is cooperative or competitive – affects time perception. If subjects experience competitive settings as more attention demanding they would underestimate time more in a competitive joint task than a cooperative joint task.

We also expect a Simon effect (Simon & Small, 1969) will occur in the single task condition as well as in the joint task conditions, called the Social Simon effect (Sebanz, Knoblich & Prinz, 2003), so the task characteristics will be comparable. However, the (Social) Simon effect is not the primary focus of this study, it is only instrumental as a concurrent executive task.

To summarize, we are expecting that the mean average of reproduced time will be shorter in the competitive setting than the cooperative setting, and the mean average of reproduced time during both joint task settings will be shorter than the individual task setting.

CHAPTER 4

METHODOLOGY

4.1. Participants

A total of 90 participants (42 males, mean age: 25.90, SD=5.234) were tested in three different groups. The Single Task group (n=30, 14 males, mean age: 26.03, SD=6.206) were tested alone whereas the Cooperative Task group (n=30, 14 males, mean age: 25.03, SD=5.442) and the Competitive Task group (n=30, 14 males, mean age: 26.63, SD=3.819) were tested in dyads. Dyads always consisted of participants from the same gender. Participants were recruited through e-mail invitation. They were undergraduate or graduate students from various METU departments. All participants were right-handed and had normal or corrected-to-normal vision. All participants voluntarily attended the study.

Before the study, ethics approval has been obtained from METU Human Studies Ethical Committee.

4.2. Stimuli

Stimuli were prepared using E-Studio Experiment Design Environment E-Prime 2.0 and presented through a personal computer. For the Simon task, red or blue rectangles appeared on either side of the white background screen, and for the time reproduction task, a red or blue square appeared on the center of the screen with white background (See Figure 3). Simon task trials had three different durations: 15, 30 and 45 seconds. Before each Simon trial, participants were warned with a written message on the screen to be ready. This written message stayed on the screen for 2 seconds, followed by the first item of the Simon task. The items stayed on the screen until the participant presses

any keys and then they were followed by another item until the length of the trial has finished. After each Simon trial has finished, another written message on screen warned the participants that Time Reproduction Phase was about to begin. This written message stayed on the screen for 2 seconds, followed by the square for the Time Reproduction Phase.

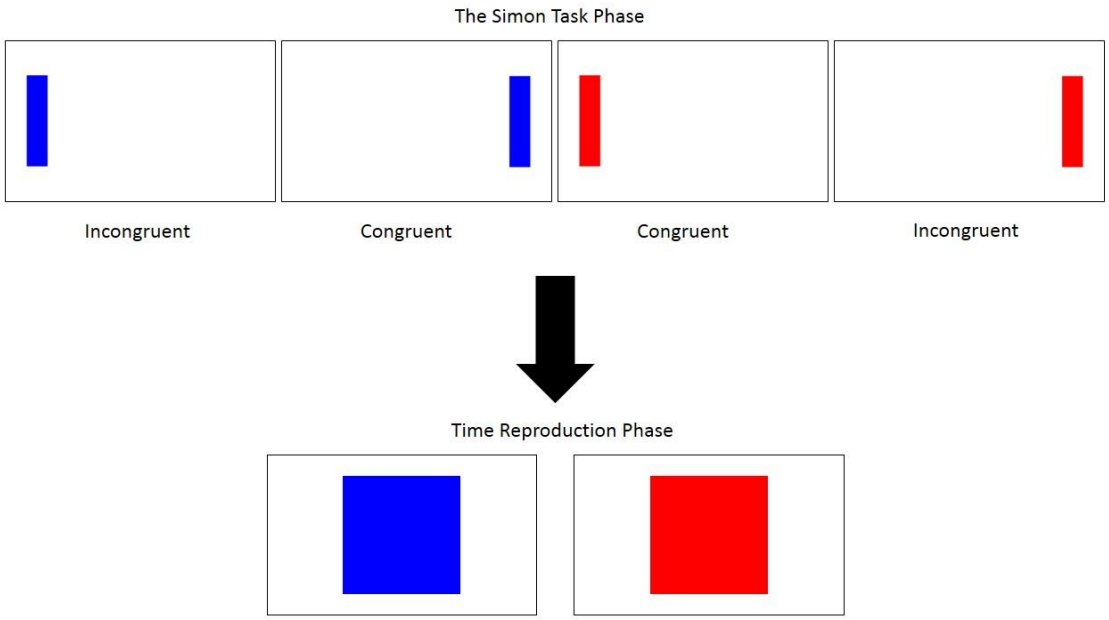

Figure 3. Flow chart of the experimental design.

4.3. Procedure

Single Task

The participant was taken to a silent and well-lit room where he/she was seated in front of a computer with a Q-style keyboard (See Figure 4). The participant was instructed to put his/her right hand index finger on the '.' button of the keyboard and left hand index finger on the 'z' button of the keyboard. These keys were chosen because 'z' is on the left edge of a Turkish Q-style keyboard whereas '.' is on the right edge, so they are horizontally apart from each other for comfortable use. The participant was told to press 'z' only when there was a red rectangle on the screen and to press '.' only when there was a blue rectangle on the screen. The participant was told that the position of the rectangle was not important and informed that he/she would receive (+) points for pressing the correct button when there was a rectangle on the screen matching the color of the assigned button. The participant was also informed that he/she would receive (-) points every time they pressed the incorrect button, and after the task was completed participants were going to be compared with each other according to their points.

With this information, the participant performed the Simon task in three different durations (15, 30 and 45 seconds). There were 3 trials of each duration. After each trial, participants had to reproduce the subjective duration of that time interval. After all 9 trials were completed, the participant performed a second block of the same setup.

After every trial, there was a time reproduction phase. Before the reproduction phase begun, the participant was informed through a message on the screen that he/she was going to see a big square in the middle of the screen, indicating the time reproduction phase has begun. Participants used the same button for the time reproduction phase. They were instructed to wait as long as they thought the previous trial has lasted and then press the button to indicate the end of the duration. A message on the screen warned the participants before each time reproduction phase, which stayed on the screen for 2 seconds and the time reproduction has begun automatically afterwards.

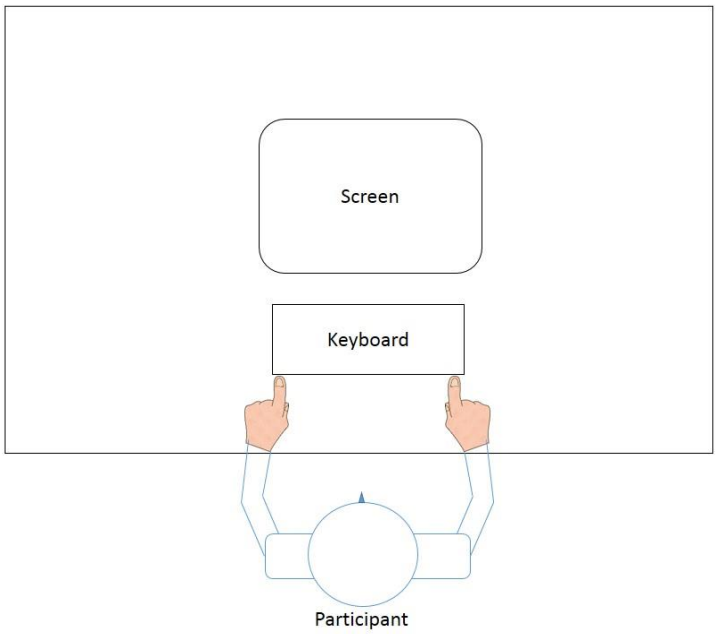

Figure 4. Position of the participant during the single task.

The Dual Task

Participants were placed on two chairs side by side in front of a computer with a Q-style keyboard (See Figure 5). Who would sit on the right side and who would sit on the left side was determined randomly. They were asked whether they were comfortable with their sitting position or not and if not, necessary arrangements were made so they can see the screen clearly and reach their button comfortably.

Participants always kept their right hand index finger on their respective buttons ('z' and '.') and never moved during the experiment. They also pressed the same button ('z' or '.') when it was their turn for time reproduction so that their fingers were always on their

buttons and they did not require any additional move for the time reproduction phase. They were warned that they should never press their button when it was the other participants turn for time reproduction. In the setup, there was a warning text message before the time reproduction phase so they had time to stop the Simon task and realize it was time for time reproduction phase.

The participant who was seated on the left side placed his/her right hand index finger on the 'z' button of the keyboard. The participant who was seated on the right side placed his/her right hand index finger on the '.' button of the keyboard. The participant on the left was told to press only when there was a red rectangle on the screen and the participant on the right was told to press only when there was a blue rectangle on the screen. They were told that the position of the rectangle was not important. The participants were informed that they would receive (+) points every time they pressed their assigned button when there was a rectangle on the screen matching the color they were responsible for. They were also informed that they would receive (-) points every time they pressed when there was a rectangle on the screen matching the other participant's color.

In The Cooperative Dual Task they were informed that the points were going to be evaluated as a team and compared to other teams, in The Competitive Dual Task they were informed that the points were going to be evaluated individually and also compared individually.

With this information, they performed the Simon task in three different durations (15, 30 and 45 seconds). There were 6 trials in each duration, i. e. 3 trials for each participant. After each trial, one of the participants had to reproduce the subjective duration of that time interval.

Before the reproduction phase begun, the participants were informed through a message on the screen that they were going to see a big square in the middle of the screen and if that square was in the color they were responsible for, they were assigned to do the time reproduction. In other words, in every reproduction phase a red or blue square appeared on the screen. If it was red, the left participant did time reproduction and if it was blue, the right participant did time reproduction. The order of the color was random and balanced between subjects so every subject has done 3 time reproductions in each duration.

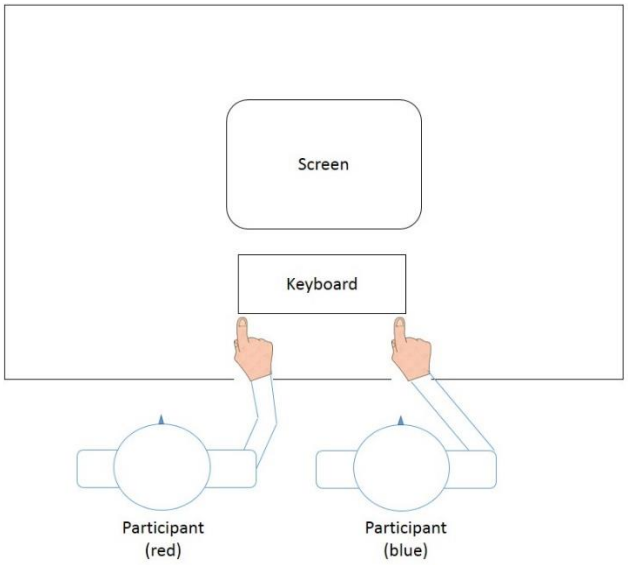

Figure 5. Position of participants during dual tasks.

After all 18 trials were completed, they performed a second block of the same setup.

4.4. Data Preparation

After the experiments, raw data from E-Studio Experiment Design Environment E-Prime 2.0 data files were transferred into Microsoft Office Excel Worksheet files.

For the Simon task, incorrect responses were eliminated. In order to eliminate outliers, all responses of each subject were z-transformed and original responses whose z-values were greater than +/- 2.58, corresponding to 2 Standard Deviations, were eliminated. After this cleaning procedure average reaction times were calculated for congruent and incongruent conditions for each subject. Average values of each block per subject were then transferred into IBM SPSS Statistics 22.0. An Analysis of Variance (ANOVA) was conducted with group and gender as between-subject factors, and, block and congruency as within-subject factors. Also another ANOVA was conducted with the same factors except blocks which were analyzed together.

For the time reproduction durations, reproduction durations were taken from E-Studio Experiment Design Environment E-Prime 2.0 data files and transferred into Microsoft Office Excel Worksheet files. Here, the ratio of reproduced duration/objective duration for each subject was calculated. This data were then transferred into IBM SPSS Statistics 22.0. An Analysis of Variance (ANOVA) was conducted with group and gender as between-subject factors, and, block and congruency as within-subject factors. Also another ANOVA on Absolute Errors was conducted with the same factors, after calculating the errors in a Microsoft Office Excel Worksheet and then transferring the data into IBM SPSS Statistics 22.0.

4.5. Questionnaire

Participants were presented with questionnaires right after they have finished their tests in order to assess their emotional status during the experiment. Questionnaires were anonymous and necessary arrangements were made in order to prevent the participants in dyads from seeing each other's answers. Every question had five options, with the furthest one on the left being the most negative and the furthest one on the right being the most positive. First 5 questions were presented to all social conditions (see Figure 6) whereas question numbered 6 to 9 (see Figure 7) were only present in the questionnaires which were given to the participants in dual conditions. The questionnaire for the dual conditions also had a 10th question which were different between cooperative and competitive conditions (Figures 8 and 9).

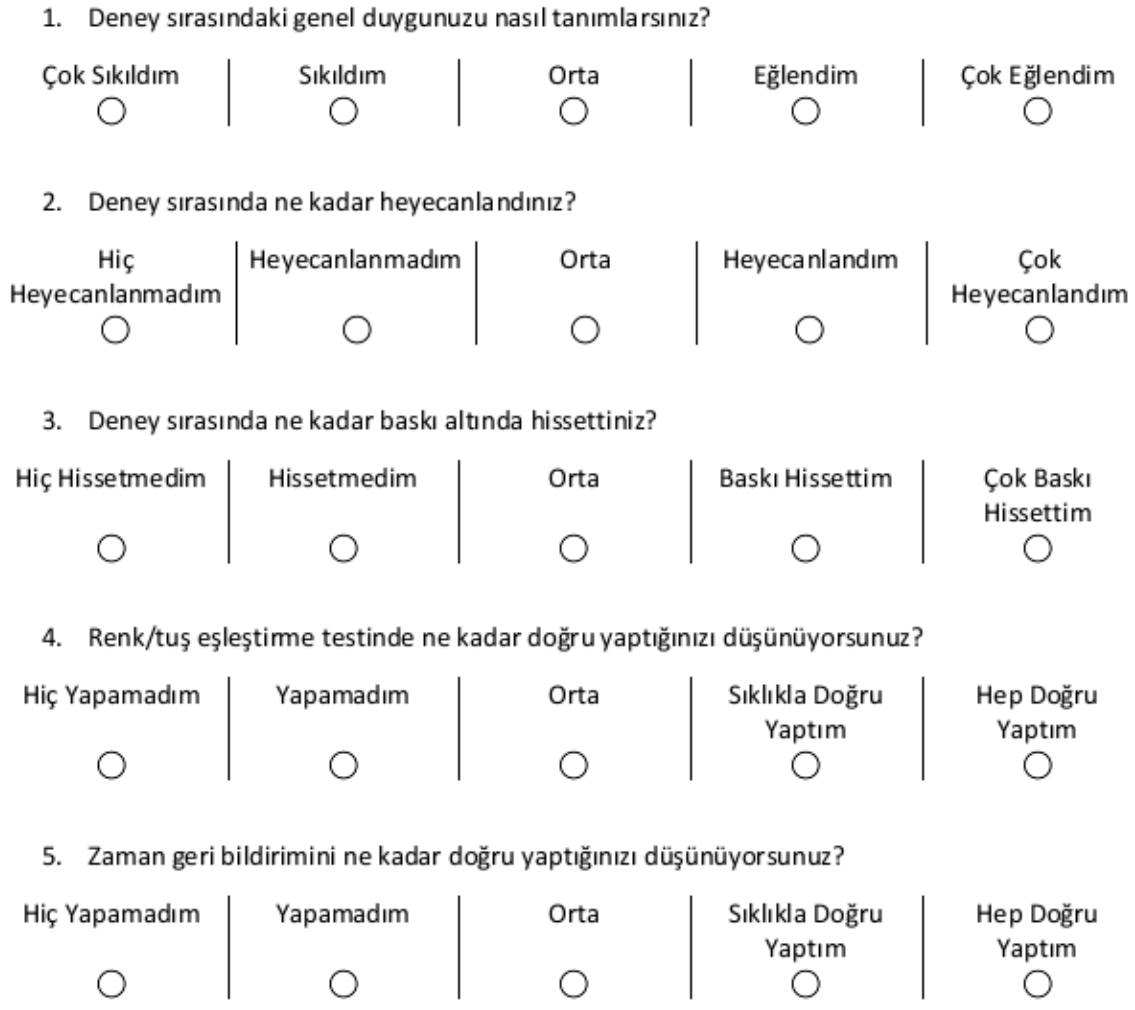

Figure 6. Questions that were presented to all participants.

First 5 questions, which every participant answered consist of questions that would provide information on the emotional aspect of the task and their self-evaluation. First question was “How do you define your general emotion during the experiment” with options ranging from “I was very bored” to “I had a lot of fun”. Second question was “How excited were you during the task?” with options ranging from “I was not excited at all” to “I was very excited”. Third question was “How much under pressure have you felt during the task?” and the options ranged between “I was under no pressure at all” and “I felt under a lot of pressure”. Fourth and fifth question were about how correct the participant believed themselves to be in the Simon task and the time reproduction phase respectively and the options ranged between “Not at all” and “Always”.

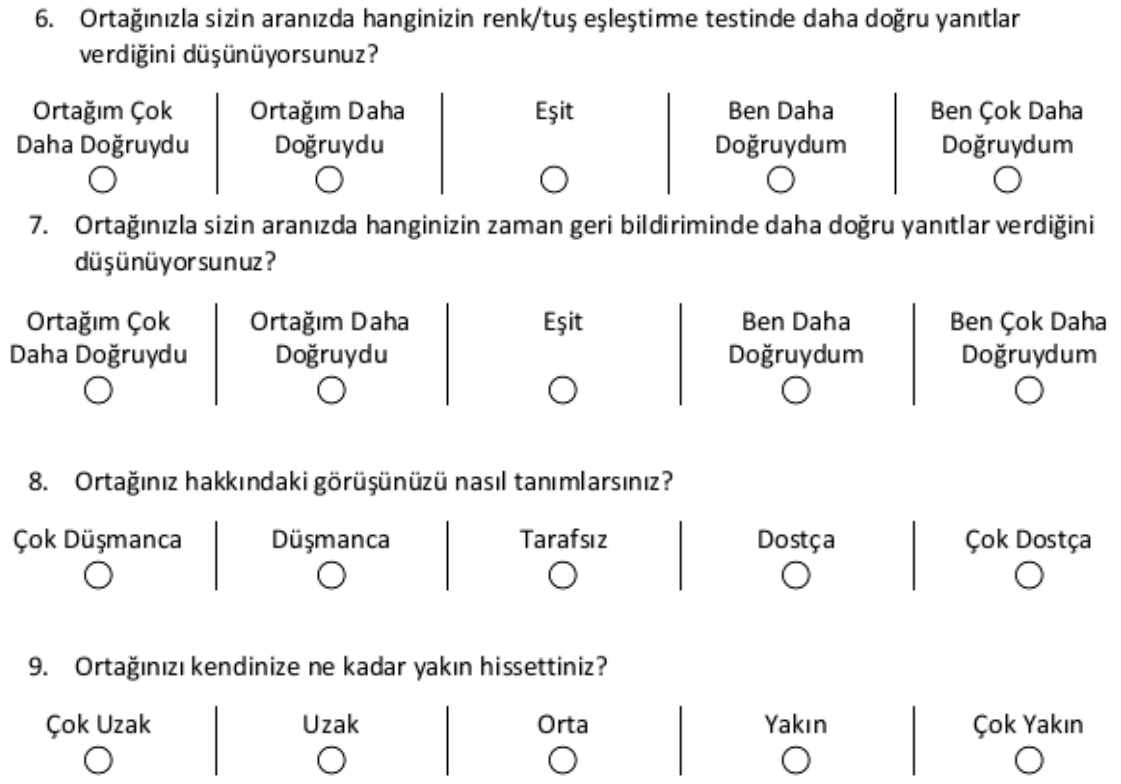

Figure 7. The questions which were common for both dual conditions.

Next four questions were only presented to participants who were in the dual conditions. Sixth and seventh questions were asked for self and peer-evaluation whereas eighth and ninth questions were about social warmth. Sixth and seventh questions were about whether they think their partners were more accurate than them or not during the Simon task and the time reproduction phase respectively, with options ranging from “My partner was much more accurate” to “I was much more accurate”. Eighth question was “How would you describe your view of your partner?” and options ranged between “Very hostile” and “Very friendly”. Ninth question was “How close have you felt to your opponent?” with options ranging from “Very far” to “Very close”.

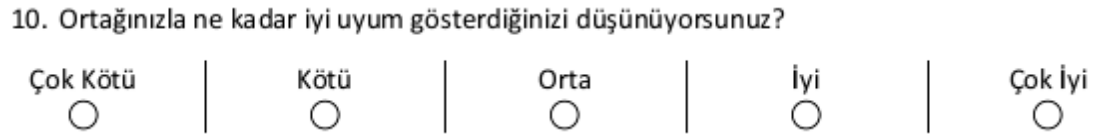

Figure 8. The last question for the cooperative condition.

Participants who were in the cooperative condition were presented with a tenth question in order to investigate their self-evaluation of the cooperation. The question was "How well do you think you worked together with your partner" with options ranging from "Very bad" to "Very good".

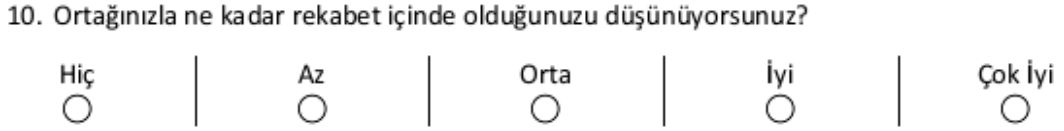

Figure 9. The last question for the competitive condition.

Participants in the competitive condition were asked a tenth question for the assessment of their self-evaluation of the competition. The question was "How much competition did you feel between you and your partner" and the options ranged between "Not at all" and "Very much".

CHAPTER 5

RESULTS

In this section, the results of the analyses of the time reproductions (primary task) and the Simon task (secondary task) are reported. Also the results of the questionnaire tapping various cognitive, motivational, and emotional aspects of the social task setting are presented.

5.1. Time Reproduction

For the time reproduction, three dependent measures were calculated and analyzed: Duration Ratio (Reproduced Duration/Objective Duration), Absolute Error/Actual Duration and Coefficient of Variation (SD/Mean).

For all three dependent variables, a 3 (Task Setting: Single, Cooperative, Competitive) x 3 (Duration: 15, 30 and 45 seconds) Mixed ANOVA was conducted in order to find out whether social setting and the variation of duration have any effects on the perceived time. Task Setting was a between-subject factor and Duration a within-subject factor. Please refer to Table 1 for descriptive statistics.

Table 1. Participant's mean responses (SE) for each type of task setting across durations.

	Single			**Cooperative**			**Competitive**		
	Durations								
	15 s	**30 s**	**45 s**	**15 s**	**30 s**	**45 s**	**15 s**	**30 s**	**45 s**
Raw Estimates in seconds (SE)	10.92 (2.40)	18.52 (4.97)	25.68 (7.10)	10.10 (1.85)	15.82 (3.31)	21.83 (4.51)	8.30 (2.05)	13.45 (4.03)	17.41 (5.53)
Difference Score in s	4.08	11.48	19.32	4.90	14.18	23.17	6.70	16.55	27.59
Ratio (Estimates/ Actual Duration)	.73	.62	.57	.67	.53	.49	.55	.45	.39
Absolute Errors in s	4.53	11.79	19.48	5.13	14.22	23.17	6.68	16.58	27.59
Absolute Error/ Actual Duration	.30	.39	.43	.34	.47	.51	.44	.55	.61
Coefficient of Variation (SD/Mean)	.19	.20	.17	.17	.21	.16	.16	.18	.17

5.1.1. Ratio of Reproduced/Objective Duration

The ratio of Reproduced Duration/Actual Duration was used in the first analysis. A 3 (Task Setting: Single, Cooperative, Competitive) x 3 (Duration: 15, 30 and 45 seconds) Mixed ANOVA was carried out in order to assess whether social setting and the variation of duration have any effects on the perceived time.

The main effect of duration was statistically significant ($F(2,174)=174.64$, $p<.001$, $\eta_p^2=.67$). Simple contrasts revealed that reproduction ratios were smaller for long durations ($M=.48$, $SE=.014$) as compared to moderate ($M=.53$, $SE=.015$) ($F(1,87)=49.93$, $p<.001$, $\eta_p^2=.37$) and short durations ($M=.65$, $SE=.015$) ($F(1,87)=225.26$, $p<.001$, $\eta_p^2=.72$), indicating that long durations were underestimated more than moderate and short durations, which is in accordance with Vierordt's law. There was a main effect of task setting ($F(2,87)=14.59$, $p<.001$, $\eta_p^2=.25$). Helmert contrasts were carried out for further analysis. There was a significant difference when the single task setting was compared to both dual task settings ($F(1,88)=18.30$, $p<.001$, $\eta_p^2=.17$). The reproduction ratios in the dual task settings were smaller ($M=.51$, $SE=.023$) than in the single task setting ($M=.64$, $SE=.023$), indicating that duration was more underestimated by the participants in the dual task settings as compared to single task setting. Also, the difference between the cooperative task setting compared to the competitive task setting was significant ($F(1,58)=11.42$, $p=.001$, $\eta_p^2=.16$). Reproduction ratios were smaller, hence durations were more underestimated in the competitive task setting ($M=.46$, $SE=.023$) compared to the cooperative task setting ($M=.56$, $SE=.023$) (see Figure 10).

However, the interaction between task setting and duration was not statistically significant ($F(4,174) =1.05$, $p>.05$, $\eta_p^2=.02$).

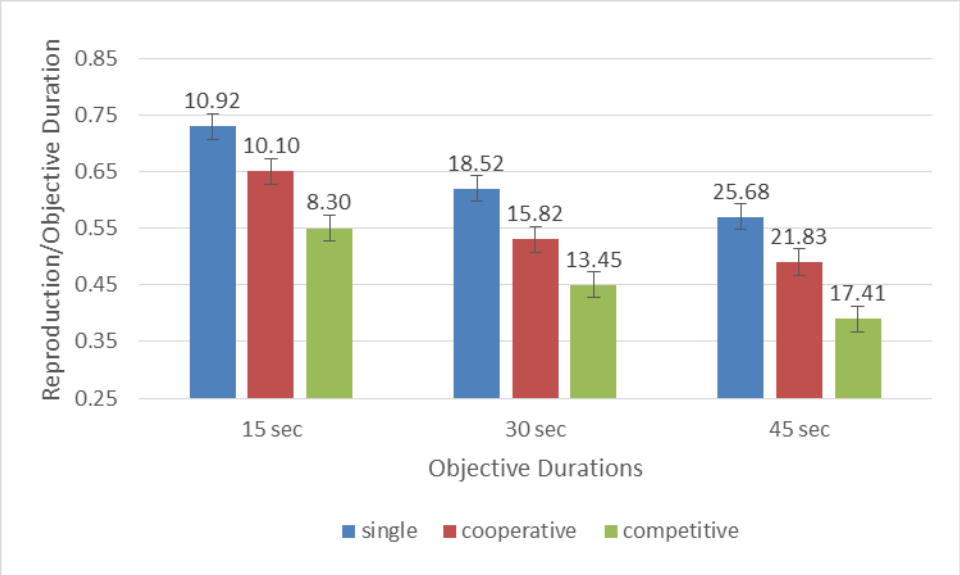

Figure 10. Mean Ratio of Reproduced/Objective Duration across duration lengths for all task settings. Error bars show SE and the numbers above the bars show mean reproduced duration in seconds.

5.1.2. Absolute Errors and Ratios of Absolute Errors to Objective Durations

Absolute Errors and the Ratio of Absolute Errors to Objective Durations were calculated in the second analysis. In order to calculate these, each reproduced duration was subtracted from its objective duration regardless of whether the reproduced time was

shorter or longer than the objective time. After that, the mean score was divided by the objective duration it belonged to. However, comparing the ratio of absolute errors to objective duration instead of directly analyzing absolute errors is preferred because this way the duration length does not affect the outcome.

A 3 (Task Setting: Single, Cooperative, Competitive) x 3 (Duration: 15, 30 and 45 seconds) Mixed ANOVA on ratios of Absolute Errors to Objective Durations was conducted. The main effect of duration was significant ($F(2,174)=157.77$, $p<.001$, $\eta_p^2=.64$). Ratios were higher, indicating that the inaccuracy of participants time estimation was higher in the long duration ($M=.52$, $SE=.13$) than the short duration (M=.36, SE=.12) and the medium duration ($M=.47$, $SE=.14$). Also, the setting of the task had a significant effect on accuracy ($F(2,87)=15.38$, $p<.001$, $\eta_p^2=.26$). Helmert contrasts were carried out to follow up on this main effect. As the first Helmert contrast revealed, participants in both dual task settings showed higher ratios ($F(1,88)=18.56$, $p<.001$, $\eta_p^2=.17$), hence were less accurate ($M=.49$, $SE=.021$) compared to the single task setting ($M=.38$, $SE=.021$). Moreover, as the second Helmert contrast revealed ($F(1,58)=11.42$, $p=.001$, $\eta_p^2=.16$), ratios were lower, hence accuracy was lower in the competitive task setting ($M=.54$, $SE=.021$) than the cooperative task setting ($M=.44$, $SE=.021$). The effect of interaction between duration and task setting was insignificant ($F(2,87)=1.45$, $p>.05$, $\eta_p^2=.03$) (see Figure 11).

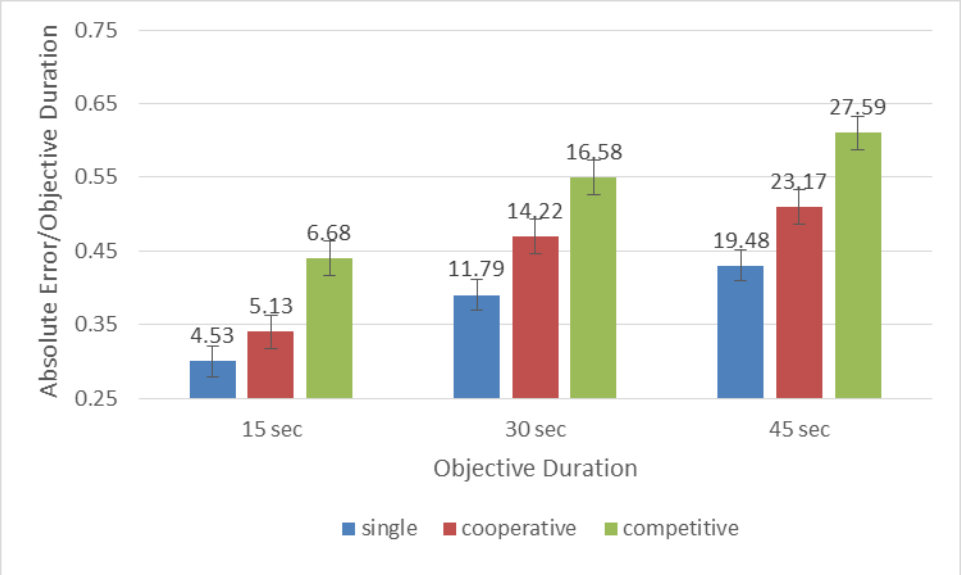

Figure 11. Mean Values of Absolute Error/Objective Duration across duration lengths for all task settings. Error bars show SE and the numbers above show the values of absolute errors.

5.1.3. Coefficient of Variation

A third Mixed ANOVA was carried out on the Coefficient of Variation (CV). The calculation of CV was achieved by dividing the standard deviation of reproduced durations by the mean reproduced durations. The CV is regarded as a very important

variable in Scalar Expectancy Theory because a stable CV is a sign of the scalar invariance of subjective estimation of time across different duration lengths.

A 3 (Task Setting: Single, Cooperative, Competitive) x 3 (Duration: 15, 30 and 45 seconds) Mixed ANOVA was carried out. The effect of duration on CV was insignificant ($F(2,174)=1.58$, $p>.05$, $\eta_p^2=.02$). Task setting also did not have a significant effect ($F(2,87)=2.7$, $p>.05$, $\eta_p^2=.06$). In addition, the interaction effect of duration and task setting was insignificant ($F(4,174)=.83$, $p>.05$, $\eta_p^2=.02$). This analysis revealed that the mean value of CV was similar amongst durations and task settings and their combinations (see Figure 12).

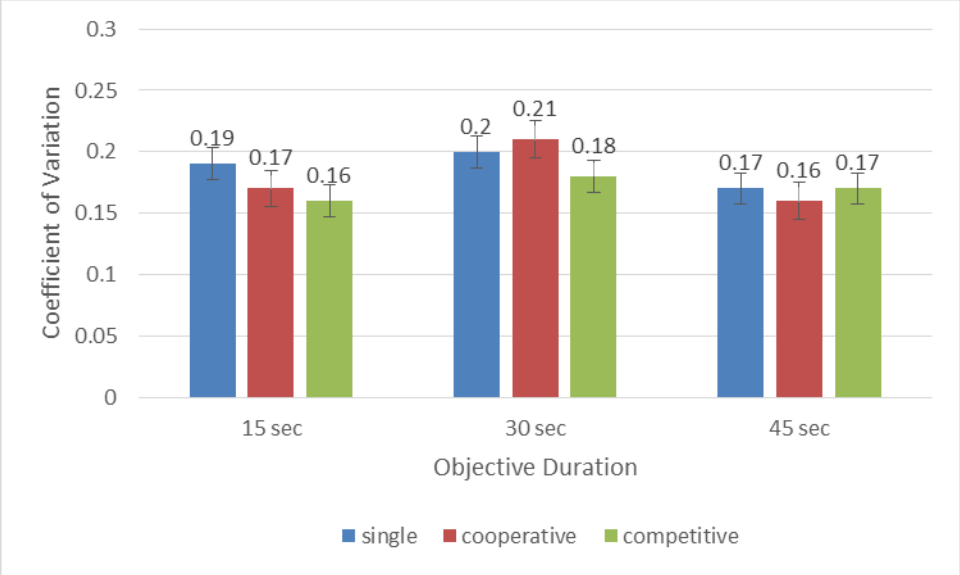

Figure 12. Mean Values of Coefficient of Variation across duration lengths for all task settings. Error bars show SE and the numbers above show the values of CVs.

5.2. The Simon Task

For the Simon task, response times were calculated and analyzed as a dependent measure. A 2 (Congruency: Congruent, Incongruent) x 3 (Task Setting: Single, Cooperative, Competitive) Mixed ANOVA was conducted in order to find out whether social setting has any effects on participants response times. Task Setting was a between-subject factor and congruency a within-subject factor. Please refer to Table 2 for descriptive statistics.

Table 2. Participant's mean responses (SE) for each type of task setting.

	Single	**Cooperative**	**Competitive**
Congruent	532.33 ms (23.62)	525.96 ms (31.73)	518.69 ms (22.47)
Incongruent	538.45 ms (23.49)	532.73 ms (31.74)	528.45 ms (23.36)

This analyses aims at revealing whether the Simon effect – the difference between response times in the incongruent and the congruent condition – is affected by the various task settings. The mean value of each participants' response times in the Simon Task phase were analyzed by a 2 (congruency: congruent, incongruent) x 3 (task setting: Single, Cooperative, Competitive) Mixed ANOVA. This analysis revealed that congruency had a significant effect ($F(1,87)=101.03$, $p<.001$, $\eta_p^2=.54$). Participants' response times were significantly lower in the congruent condition ($M=525.66$, $SE=2.77$) in comparison to the incongruent condition ($M=533.21$, $SE=2.79$) (see Figure 13). This difference amounts to the "Simon effect". Task setting did not have a significant effect on overall response times ($F(2,87)=1.53$, $p>.05$, $\eta_p^2=.03$), the participants' reaction speed was similar in single ($M=535.39$, $SE=4.77$), cooperative ($M=529.35$, $SE=4.77$) and competitive ($M=523.57$, $SE=4.77$) task settings. The interaction effect between congruency and task setting was also insignificant ($F(2,87)=2.24$, $p>.05$, $\eta_p^2=.05$). Participants in all task settings were faster in the congruent condition than in the incongruent condition (see Figure 13). Overall, results reveal that the Simon effect is not affected by the various task settings, indicating that the primary time estimation task did not interfere with the secondary, concurrent task.

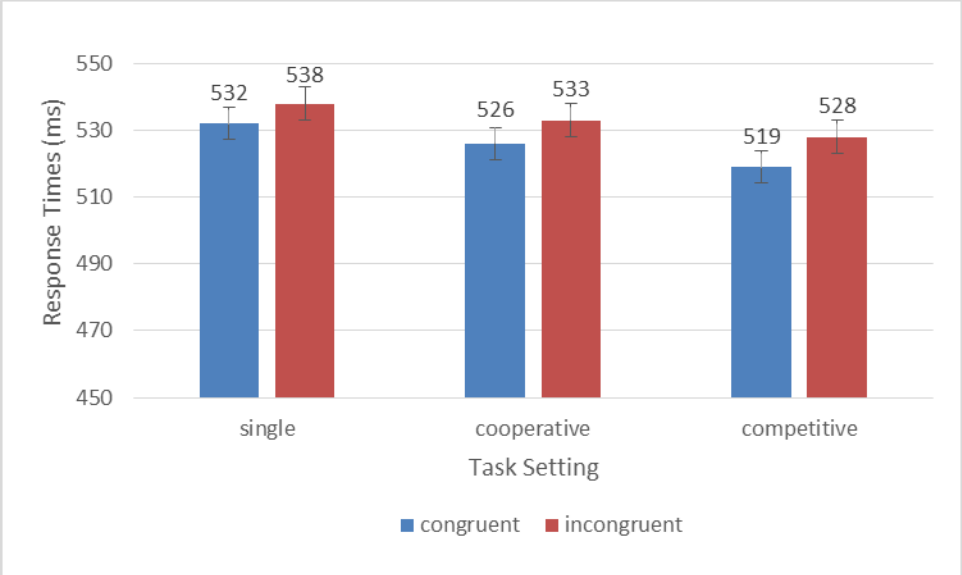

Figure 13. Mean Values of Response Time for task settings across congruency. Error bars show SE and the numbers above show the values of mean response times.

5.3. Questionnaire

For the analysis of the participants' answers, options in the questionnaire were given numerical values ranging from 1 to 5, with the most negative option valued 1 and the most positive option being 5.

5.3.1. Common questions for all task settings

The first 5 questions, which were asked to participants in all task settings, were analyzed with a One-way ANOVA on 3 task settings (Single, Cooperative, Competitive) was conducted for each question. Please refer to Table 3 for descriptive statistics.

Table 3. Participant's mean answers (SD) for each type of task setting across first 5 questions.

	Single	**Cooperative**	**Competitive**
Q1: Fun/Boredom	3.43 (.67)	3.53 (1.07)	3.37 (.99)
Q2: Excitement	2.70 (1.02)	2.60 (.93)	2.67 (1.03)
Q3: Pressure	2.50 (.86)	2.23 (1.01)	2.30 (.84)
Q4: Simon Task Self Evaluation	3.63 (.56)	3.83 (.53)	3.83 (.53)
Q5: Time Reproduction Self Evaluation	2.97 (.62)	3.23 (.68)	3.17 (.59)

The first question was whether the participant had fun or were they bored during the experiment. A One-way ANOVA on 3 task settings (Single, Cooperative, Competitive) was conducted. The main effect of task setting was not significant ($F(2,87)=.242$, $p=.785$). Mean value of answers were similar in Single ($M=3.43$, $SD=.67$), Cooperative ($M=3.53$, $SD=1.07$) and Competitive ($M=3.37$, $SD=.99$) task settings.

The second question was how much excitement the participant had felt during the experiment. A One-way ANOVA on 3 task settings (Single, Cooperative, Competitive) was carried out. The main effect of task setting was not significant ($F(2,87)=.079$, $p=.925$). Mean value of answers were close to each other for Single ($M=2.70$, $SD=1.02$), Cooperative ($M=2.60$, $SD=.93$) and Competitive ($M=2.67$, $SD=1.03$) task settings.

The third question was how much under pressure the participant had felt during the experiment. A One-way ANOVA on 3 task settings (Single, Cooperative, Competitive) was conducted. The main effect of task setting was not significant ($F(2,87)=.706$, $p=.496$). Mean value of answers were similar in Single ($M=2.50$, $SD=.86$), Cooperative ($M=2.23$, $SD=1.01$) and Competitive ($M=2.30$, $SD=.84$) task settings.

The fourth question was how the participant evaluated their success of the Simon task. A One-way ANOVA on 3 task settings (Single, Cooperative, Competitive) was conducted. The main effect of task setting was not significant ($F(2,87)=1.375$, $p=.258$). Mean value

of answers were close to each other for Single (*M*=3.63, *SD*=.56), Cooperative (*M*=3.83, *SD*=.53) and Competitive (*M*=3.83, *SD*=.53) task settings.

The fifth question was how the participant evaluated their success of the time reproduction task. A One-way ANOVA on 3 task settings (Single, Cooperative, Competitive) was carried out. The main effect of task setting was not significant ($F(2,87)=1.457$, $p=.239$). Mean value of answers were similar in Single (*M*=2.97, *SD*=.62), Cooperative (*M*=3.23, *SD*=.68) and Competitive (*M*=3.17, *SD*=.59) task settings.

5.3.2. Second part of the questionnaire

The second part of the questionnaire, which consisted of questions 6-10, were only presented to the participants who were in cooperative and competitive task settings. A One-way ANOVA on 2 task settings (Cooperative, Competitive) was carried out for each question. Please refer to Table 4 for descriptive statistics.

Table 4. Participant's mean answers (SD) for both dual task settings across 6^{th}-10^{th} questions.

	Cooperative	**Competitive**
Q6: Simon Task Partner Evaluation	3.07 (.64)	3.07 (.94)
Q7: Time Reproduction Partner Evaluation	3.07 (.58)	3.23 (.77)
Q8: Friendliness	4.23 (.68)	4.10 (.92)
Q9: Social Warmth	4.00 (.74)	4.00 (.87)
Q10: Cooperation/Competition Evaluation	3.83 (.87)	2.90 (1.32)

The sixth question was how the participant evaluated their partner's success of the Simon task. A One-way ANOVA on 2 task settings (Cooperative, Competitive) was conducted. The main effect of task setting was not significant ($F(1,58)=0$, $p=1$). Mean value of answers were similar in Cooperative (*M*=3.07, *SD*=.64) and Competitive (*M*=3.07, *SD*=.94) task settings.

The seventh question was how the participant evaluated their partner's success of the time reproduction task. A One-way ANOVA on 2 task settings (Cooperative, Competitive) was conducted. The main effect of task setting was not significant

($F(1,58)=.887$, $p=.350$). Mean value of answers were similar in Cooperative ($M=3.07$, $SD=.58$) and Competitive ($M=3.23$, $SD=.77$) task settings.

The eighth question was how friendly the participant felt to their partner during the experiment. A One-way ANOVA on 2 task settings (Cooperative, Competitive) was carried out. The main effect of task setting was not significant ($F(1,58)=.267$, $p=.526$). Mean value of answers were similar in Cooperative ($M=4.23$, $SD=.68$) and Competitive ($M=4.10$, $SD=.92$) task settings.

The ninth question was about social warmth between partners during the experiment. A One-way ANOVA on 2 task settings (Cooperative, Competitive) was conducted. The main effect of task setting was not significant ($F(1,58)=0$, $p=1$). Mean value of answers were close to each other for Cooperative ($M=4.00$, $SD=.74$) and Competitive ($M=4.00$, $SD=.87$) task settings.

The tenth question was different between the two task settings. Participants in the cooperative task setting were asked how would they assess the cooperation between them and their partners, whereas participants in competitive task setting were asked how would they assess the competition between them and their partners. A One-way ANOVA on 2 task settings (Cooperative, Competitive) was conducted. The main effect of task setting was significant ($F(1,58)=10.401$, $p=.002$). Participants in Cooperative task setting assessed their cooperation with a higher value ($M=3.83$, $SD=.87$) than participants in Competitive task setting assessed their competition ($M=2.90$, $SD=1.32$). This means that cooperative dyads reported to feel more as a team, compared to competitive dyads reported to feel as rivals.

CHAPTER 6

DISCUSSION

The aim of this study was to find out the effects of the task's social setting on the participant's prospective time estimation. In accordance with our first hypothesis, we have found that participants in the joint task settings underestimate time more in comparison to participants in the individual task setting. Also, another aim of this study was to investigate the effect of the nature of the task's social setting on subjective time estimation. As we expected in our second hypothesis, our results showed that participants in the competitive task setting underestimate time more in comparison to participants in the cooperative task setting. Moreover, in line with our third hypothesis, our results indicated that there was a Simon effect (Simon & Small, 1969) in the joint task conditions as well as in the individual task conditions, since participants in all conditions had smaller reaction times in congruent trials in comparison to incongruent trials. Even though the (Social) Simon effect (Sebanz, Knoblich & Prinz, 2003) is not the primary focus of this study, the presence of the Simon effect in all conditions showed that the Simon task is a well-suited concurrent task for the experiment and the task characteristics are comparable.

In this thesis work, we investigated the effects of social condition, the nature of the social condition and duration lengths on prospective time estimation. We found that the joint task settings result in a stronger underestimation compared to the individual task setting, and this effect is seen even stronger in the competitive task setting compared to the cooperative task setting. This means that sharing a task shortens the participants' perception of how much time passes during that task, and this effect is even more salient in the competitive condition. Also, longer durations were underestimated more in comparison to shorter durations.

6.1. The effects of joint action on duration judgment

Participants who share a joint task create mental representations of the other participant's share of the task (Sebanz, Knoblich & Prinz, 2003) and this results in a higher amount of cognitive load compared to carrying out the same task individually, especially in cases where the representation of the entire task – distributed over the two – is bigger than the representation of each partner's part of the task. In our study, participants in the individual task setting responded for both colors and they tracked the entire task as well, so the cognitive load created by task representation was equal. However, participants in the joint task setting also created mental representations of their partner, which added more cognitive load. Additionally, participants in the joint task setting had to inhibit their response when the stimulus on the screen was the color of their partner and it was a no-go trial for them, whereas participants in the individual task setting always had a go-trial since they responded to both colors, and only had to keep track of which button to respond. This means that participants in the joint task settings also had an increase in cognitive load caused by task switching. Furthermore, participants in the joint task settings had to monitor their partner's responses as well, since their score contributed to the outcome in both (Cooperative and Competitive) conditions.

Several studies (Block et al., 2010; Duzcu & Hohenberger, 2014; Biyik Sari, 2015) showed that participants who have higher cognitive load underestimate time in duration judgment tasks. This finding is in line with the Attentional Gate Model (Zakay & Block, 2004), because in tasks with higher cognitive load, attentional resources are more frequently allocated to the concurrent task instead of keeping track of time, in comparison to easier concurrent tasks. Therefore, the joint task settings would have higher cognitive load and deplete attentional resources more, which would result in a more salient underestimation of task duration by the participants in the joint task settings, compared to the participants in the individual task setting.

Alternatively, another reason for a shorter time experience might be the fact that when the participant is not acting herself but the partner is acting, these parts are cut out of her time experience, as if the "switch" part of the Attentional Gate Model closes when it's her partner's turn and opens only when it is her turn again. This would create "holes" (or empty intervals) in her time experience. This frequent stopping might be behind the reduced reproduced time because presumably the reproduced time mirrors the time having been involved in the task herself, even though the participants were specifically instructed to reproduce the entire duration of the Simon task phase, and not only the duration they were active. This account would be in line with action-based accounts of cognition. However, it is not possible to explain the difference between cooperative and competitive task groups with this approach. On the other hand, the increase in cognitive load can explain both differences, between individual and joint task groups, and between cooperative and competitive task groups.

The results of this study showed that, as we hypothesized, there is a strong relation between the social condition of a concurrent task and the subjectively perceived duration. Participants estimated the actual duration of the task to be shorter in the joint task settings compared to the single task setting, even though participants in all conditions had similar reaction times.

6.2. The effects of the nature of joint action on duration judgment

Previous studies in the field (Decety et al., 2004; Ruissen & de Bruijn, 2016) showed that, although both cooperation and competition result in self-other integration, participants in the competitive condition also spend attentional resources on keeping track of the differences between themselves and the other participant in the dyad, since cooperative dyads only need to follow their cumulative scores, but during a competition, participants need to follow their performance and their partner's performance as separate information, in order to predict who is more successful. This results in a higher cognitive load and thus more severe underestimation of time.

Our results revealed that, in accordance with our hypothesis, the nature of the joint action had an impact on the amount of this underestimation, as participants in the competitive condition reproduced significantly shorter durations in comparison to the participants in the cooperative condition.

6.3. The effects of duration length on duration judgment

Vierordt (1868) suggested that people tend to underestimate long durations more in comparison to short durations, which is now called "Vierordt's law" (Lejeune & Wearden, 2009). Several studies (Fetterman & Dreyfus, 2013; Macar, Pouthas & Friedman, 2013; Michon & Jackson, 2012) provided further experimental evidence for Vierordt's law. Moreover, Duzcu & Hohenberger (2014) showed that this effect is even more salient in the presence of a difficult concurrent task. The Simon task, and the Social Simon task are both attention demanding, executive tasks and we therefore expected that participants would clearly underestimate long durations more than short durations. Block, Hancock and Zakay (2010) proposed an executive version of the Attentional Gate Model, where the attentional gate is controlled by central executive processes. With this Executive Gate Model (EGM), it is possible that our concurrent executive task, which was the Simon task, and the executive process that controls the attentional gate drew on the same attentional resource, which resulted in the depletion of attentional resources and shorter time reproductions.

The results of this study revealed that participants across all task conditions underestimated time more in the long duration (45 seconds) in comparison to the medium (30 seconds) and the short duration (15 seconds). Task duration was also more underestimated in the medium duration in comparison to the short duration.

6.4. The effects of emotions on duration judgment

Many studies investigated the effects of participant's mood on duration judgment. Kornbrot, Msetfi & Grimwood (2013) showed that participants with a high level of arousal underestimate time more in comparison to other participants. Another study (Mioni et al., 2016) revealed that patients with major depressive disorder, who have a low level of arousal, overestimate time whereas the patients with anxiety disorder, who have a high level of arousal, underestimate durations. The same study argues that the overestimation observed in depressive patients is a result of a decrease in the speed of the pacemaker.

Even though the literature (Kornbrot, Msetfi & Grimwood, 2013; Rudd, Vohs & Aaker, 2012) suggests that mood has a certain effect on time estimation, our questionnaire did not reveal any difference in participants' mood during the experiment, despite the significant contrast in their time estimation. This result suggests that the shorter underestimations were caused by the depletion of attentional resources rather than by the effect of mood on the pacemaker. The results of the questionnaire also revealed that emotional states of participants, including excitement, boredom and anxiety, was similar for all task conditions, which supports that the nature of the task conditions did not have a significant effect on the perceptive abilities of the participants and did not prevent them from following the instructions of the experiment.

The results of the second part of the questionnaire, which was only presented to participants in cooperative and competitive conditions, revealed that participants' feedback in these conditions did not reveal any significant difference considering social warmth between the participants in the dyads. Therefore, the difference in reproduced time between cooperative and competitive conditions cannot be attested to social warmth.

6.5. The Simon effect in reaction times

The Simon task is a spatial compatibility task based on response selection and it consists of congruent (compatible) and incongruent (incompatible) trials (Simon & Rudell, 1967). Experiments revealed that participants' response times are shorter for congruent trials in comparison to incongruent trials, because of the irrelevant aspect (location) of the stimulus, and this finding is called "the Simon effect" (Simon & Small, 1969). There are conflicting reports considering the emergence of the Simon effect in joint conditions: Ruys & Aarts (2010) showed that the Simon effect was observed in all conditions (Indiviudal, Cooperative and Competitive), however, Iani et al. (2014) reported that the Simon effect was only observed in cooperating dyads and not in competitive dyads.

Our results revealed a significant congruency effect in the Simon task, individual or social, which is in line with the vast literature on the Simon task (Hommel, 2011; Joyce et al., 2014), even though the main purpose of this study was to investigate the changes

in time perception for different social task settings and Simon task was only preferred as a very suitable joint concurrent executive task. There was no significant difference regarding response times between joint and single task conditions, as well as between cooperative and competitive conditions. The Simon effect was seen in all task conditions which shows that the secondary executive task did not interfere with time estimation.

CHAPTER 7

CONCLUSION

In this study, our aim was to understand how the social setting of a concurrent task (Individual task and Joint task) affects subjective time estimation in a prospective time judgment paradigm for various durations (15, 30 and 45 seconds). Also, the effect of the nature of the social setting (Cooperative, Competitive) on participant's time estimation was investigated. We predicted that participants in the joint task setting would underestimate time more in comparison to participants in the individual task setting, and participants in the competitive task setting would underestimate time more in comparison to participants in the cooperative task setting. In order to test our hypotheses, a total of 90 subjects, in three groups (Individual, Cooperative, Competitive), participated in our experiment. The experiment consisted of a prospective time reproduction task with a concurrent Simon task (for the Individual task setting) or a social Simon task (for Cooperative and Competitive task settings). The Simon task is a spatial compatibility task in which the participants are instructed to respond to the given stimulus according to the relevant aspect (color) instead of the irrelevant aspect (location) of the stimulus (Simon & Small, 1969). In the Social Simon task, two participants share a Simon task and only respond to the stimulus they were instructed to respond according to the relevant aspect of the stimulus instead of the irrelevant aspect (Sebanz, Knoblich & Prinz, 2003).

In the experiment, participants performed prospective time reproductions after experiencing different durations (15, 30 and 45 seconds), during which they did a concurrent task - either the Simon task (Individual group) or the Social Simon task (Cooperative and Competitive groups). The results showed that there was a main effect of the social condition of the task on subjective time estimation. The participants in the

joint task conditions reproduced significantly lower durations in comparison to participants in the individual task condition. Moreover, participants in the competitive condition reproduced significantly lower durations in comparison to participants in the cooperative condition.

In line with Vierordt's law, there was a main effect of duration length on subjective time estimation (Vierordt, 1868; Lejeune & Wearden, 2009). As expected, the ratio of reproduced duration to actual duration was smaller in longer durations in comparison to shorter durations across all social conditions.

Even though it was not central to our study, we found Simon effects in all social conditions, the results of this study is in line with the vast literature on the Simon effect (Hommel, 2011; Joyce et al., 2014). Reaction times were similar across all social conditions and the Simon effect was observed in all conditions.

Participants in this study answered a short questionnaire after the test. The purpose of this questionnaire was to investigate whether participants in three social conditions had mood and self-evaluation differences. The results of the questionnaire revealed that there was no difference between three social conditions regarding their general emotion during the task, excitement, anxiety and self-evaluation for the Simon task and the time reproduction task.

Participants in the joint task conditions (Cooperative and Competitive) also answered a second part of the questionnaire, which aimed to find out how the nature of the social setting affected their peer-evaluation, and also to investigate if participant in these two settings had any differences regarding social warmth and their feelings about the other participant in the dyad. The results showed that participants in both settings gave similar responses for peer-evaluation for the Simon task and the time reproduction task, and also for social warmth and their feelings towards their partner in the dyad. A tenth question was asked to assess if there was a difference in how much the participants in the joint task settings felt the nature of the social condition. Participants in the cooperative condition gave higher ratings to evaluate their cooperation with their partner, in comparison to participants in the competitive condition. A previous study (Iani et al., 2011) showed that when two participants perform a joint task, they perceive themselves to be in cooperation even if it is not stated explicitly. In line with this finding, it is possible that participants in the cooperative conditions found it easier to perceive themselves in cooperation in comparison to participants in the competitive dyads.

The results of this study provide first evidence that social condition affects time estimation: People perceive time to flow faster when they are performing a task with someone in comparison to when they are alone, and even faster when the nature of the social condition is competitive rather than cooperative. This finding can be applied to daily life in education and workplace, by supporting joint action over individual work. Our findings add to the growing literature on "joint action" (Sebanz, Bekkering, & Knoblich, 2006), showing that there is a strong link between cognitive and social

processes. Our study has theoretical implications for models of time perception, as well as methodological implications in terms of promoting the use of joint settings in cognitive science.

For future studies, the effect of social condition on time perception might be investigated through different concurrent executive tasks, as well as non-executive tasks, with the same social conditions to see whether the task itself has any effect on the outcome. Furthermore, a study comparing subjective time estimation in the Social Simon task with the "go/no-go task" for a single subject may yield interesting results. Since the Social Simon task is actually a go/no-go task, the existence of co-representation in the Social Simon task, the representational load would be higher (twice as high) as in the go/no-go task. Also, in order to assess participants' arousal during the tasks better, physiological measures can be obtained in addition to the questionnaire. However, a study by Schwarz, Winkler & Sedlmeier (2013) has shown that subjective assessment is a reliable method for evaluating the effect of arousal on time perception, and provides better information than measuring heart rate.

Another important area for further research is the nature of competition. Studies that investigate the effects of competition on time estimation, or any other cognitive function, are quite rare. Future studies involving the nature of competition would provide more evidence on the effects of competition and the reason behind these effects. Also, different cooperative tasks, such as task where participants are more dependent on each other which require a higher level of coordination, may yield interesting results.

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APPENDICES

APPENDIX A

Voluntary Participation Form

ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU

Bu araştırma, ODTÜ Bilişsel Bilimler Bölümü Yüksek Lisans öğrencisi Kerem Alp Usal tarafından yürütülen bir çalışmadır. Çalışma danışmanı ODTÜ Bilişsel Bilimler Bölümü öğretim üyelerinden Doç. Dr. Annette Hohenberger'dir. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Çalışmanın Amacı Nedir?

Araştırmanın amacı, insan zihninde zaman algısının nasıl gerçekleştiğiyle ilgili bilgi toplamaktır.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?

Araştırmaya katılmayı kabul ederseniz, sizden beklenen şey ekranda gördüğünüz şeridin kırmızı veya mavi olmasına göre klavyede o renk için size söylenecek olan tuşa basmanızdır. Daha sonra sizden deney sırasında geçen süreyi tahmin etmeniz istenecektir. Bu işlem, belli sayıda tur için tekrarlanacaktır. Bilgisayarla yapılan testin ardından sizden kısa bir anketi yanıtlamanız istenecektir. Ankette hiçbir kimlik bilginiz istenmeyecektir. Anket soruları deney sırasındaki duygularınız ile ilgilidir. Bütün çalışma toplamda en fazla 30 dakika sürmektedir.

Sizden Topladığımız Bilgileri Nasıl Kullanacağız?

Araştırmaya katılımınız tamamen gönüllülük temelinde olmalıdır. Deney öncesinde sizden yaşınız ve cinsiyetiniz dışında hiçbir bilgi istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak, sadece araştırmacılar tarafından değerlendirilecektir. Katılımcılardan elde edilecek bilgiler toplu halde değerlendirilecek ve bilimsel yayımlarda kullanılacaktır. Kimlik bilgileriniz hiçbir şekilde açık edilmeyecektir.

Katılımınızla ilgili bilmeniz gerekenler:

Deney, genel olarak kişisel rahatsızlık verecek herhangi bir uygulama içermemektedir. Ancak, katılım sırasında herhangi bir nedenden ötürü kendinizi rahatsız hissederseniz cevaplama işini yarıda bırakıp çıkmakta serbestsiniz. Böyle bir durumda deneyi uygulayan kişiye, deneyi tamamlamadığınızı söylemek yeterli olacaktır.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Deney sonunda, bu çalışmayla ilgili sorularınız cevaplanacaktır. Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için çalışmayı yürüten Kerem Alp Usal (E-posta: kerem.usal@gmail.com) ile iletişim kurabilirsiniz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.

(Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim Soyad Tarih İmza

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APPENDIX B

Questionnaire Presented to Participants in Single Task Setting

Katılım Sonrası Değerlendirme Anketi

Yaşınız:

Cinsiyetiniz:

Mesleğiniz:

Aşağıdaki sorularda size en uygun gelen seçeneği işaretleyiniz. Sonuçlar sadece bilimsel yayınlarda kullanılacaktır.

1. Deney sırasındaki genel duygunuzu nasıl tanımlarsınız?

Çok Sıkıldım	Sıkıldım	Orta	Eğlendim	Çok Eğlendim
○	○	○	○	○

2. Deney sırasında ne kadar heyecanlandınız?

Hiç Heyecanlanmadım	Heyecanlanmadım	Orta	Heyecanlandım	Çok Heyecanlandım
○	○	○	○	○

3. Deney sırasında ne kadar baskı altında hissettiniz?

Hiç Hissetmedim	Hissetmedim	Orta	Baskı Hissettim	Çok Baskı Hissettim
○	○	○	○	○

4. Renk/tuş eşleştirme testinde ne kadar doğru yaptığınızı düşünüyorsunuz?

Hiç Yapamadım	Yapamadım	Orta	Sıklıkla Doğru Yaptım	Hep Doğru Yaptım
○	○	○	○	○

5. Zaman geri bildirimini ne kadar doğru yaptığınızı düşünüyorsunuz?

Hiç Yapamadım	Yapamadım	Orta	Sıklıkla Doğru Yaptım	Hep Doğru Yaptım
○	○	○	○	○

Katılımınız için teşekkür ederiz.

APPENDIX C

Questionnaire Presented to Participants in Cooperative Task Setting

Katılım Sonrası Değerlendirme Anketi

Yaşınız:

Cinsiyetiniz:

Mesleğiniz:

Aşağıdaki sorularda size en uygun gelen seçeneği işaretleyiniz. Sonuçlar sadece bilimsel yayınlarda kullanılacaktır.

1. Deney sırasındaki genel duygunuzu nasıl tanımlarsınız?

Çok Sıkıldım	Sıkıldım	Orta	Eğlendim	Çok Eğlendim
○	○	○	○	○

2. Deney sırasında ne kadar heyecanlandınız?

Hiç Heyecanlanmadım	Heyecanlanmadım	Orta	Heyecanlandım	Çok Heyecanlandım
○	○	○	○	○

3. Deney sırasında ne kadar baskı altında hissettiniz?

Hiç Hissetmedim	Hissetmedim	Orta	Baskı Hissettim	Çok Baskı Hissettim
○	○	○	○	○

4. Renk/tuş eşleştirme testinde ne kadar doğru yaptığınızı düşünüyorsunuz?

Hiç Yapamadım	Yapamadım	Orta	Sıklıkla Doğru Yaptım	Hep Doğru Yaptım
○	○	○	○	○

5. Zaman geri bildirimini ne kadar doğru yaptığınızı düşünüyorsunuz?

Hiç Yapamadım	Yapamadım	Orta	Sıklıkla Doğru Yaptım	Hep Doğru Yaptım
○	○	○	○	○

6. Ortağınızla sizin aranızda hanginizin renk/tuş eşleştirme testinde daha doğru yanıtlar verdiğini düşünüyorsunuz?

Ortağım Çok Daha Doğruydu	Ortağım Daha Doğruydu	Eşit	Ben Daha Doğruydum	Ben Çok Daha Doğruydum
○	○	○	○	○

7. Ortağınızla sizin aranızda hanginizin zaman geri bildiriminde daha doğru yanıtlar verdiğini düşünüyorsunuz?

Ortağım Çok Daha Doğruydu	Ortağım Daha Doğruydu	Eşit	Ben Daha Doğruydum	Ben Çok Daha Doğruydum
○	○	○	○	○

8. Ortağınız hakkındaki görüşünüzü nasıl tanımlarsınız?

Çok Düşmanca	Düşmanca	Tarafsız	Dostça	Çok Dostça
○	○	○	○	○

9. Ortağınızı kendinize ne kadar yakın hissettiniz?

Çok Uzak	Uzak	Orta	Yakın	Çok Yakın
○	○	○	○	○

10. Ortağınızla ne kadar iyi uyum gösterdiğinizi düşünüyorsunuz?

Çok Kötü	Kötü	Orta	İyi	Çok İyi
○	○	○	○	○

Katılımınız için teşekkür ederiz.

APPENDIX D

Questionnaire Presented to Participants in Competitive Task Setting

Katılım Sonrası Değerlendirme Anketi

Yaşınız:

Cinsiyetiniz:

Mesleğiniz:

Aşağıdaki sorularda size en uygun gelen seçeneği işaretleyiniz. Sonuçlar sadece bilimsel yayınlarda kullanılacaktır.

1. Deney sırasındaki genel duygunuzu nasıl tanımlarsınız?

Çok Sıkıldım	Sıkıldım	Orta	Eğlendim	Çok Eğlendim
○	○	○	○	○

2. Deney sırasında ne kadar heyecanlandınız?

Hiç Heyecanlanmadım	Heyecanlanmadım	Orta	Heyecanlandım	Çok Heyecanlandım
○	○	○	○	○

3. Deney sırasında ne kadar baskı altında hissettiniz?

Hiç Hissetmedim	Hissetmedim	Orta	Baskı Hissettim	Çok Baskı Hissettim
○	○	○	○	○

4. Renk/tuş eşleştirme testinde ne kadar doğru yaptığınızı düşünüyorsunuz?

Hiç Yapamadım	Yapamadım	Orta	Sıklıkla Doğru Yaptım	Hep Doğru Yaptım
○	○	○	○	○

5. Zaman geri bildirimini ne kadar doğru yaptığınızı düşünüyorsunuz?

Hiç Yapamadım	Yapamadım	Orta	Sıklıkla Doğru Yaptım	Hep Doğru Yaptım
○	○	○	○	○

6. Ortağınızla sizin aranızda hanginizin renk/tuş eşleştirme testinde daha doğru yanıtlar verdiğini düşünüyorsunuz?

Ortağım Çok Daha Doğruydu	Ortağım Daha Doğruydu	Eşit	Ben Daha Doğruydum	Ben Çok Daha Doğruydum
○	○	○	○	○

7. Ortağınızla sizin aranızda hanginizin zaman geri bildiriminde daha doğru yanıtlar verdiğini düşünüyorsunuz?

Ortağım Çok Daha Doğruydu	Ortağım Daha Doğruydu	Eşit	Ben Daha Doğruydum	Ben Çok Daha Doğruydum
○	○	○	○	○

8. Ortağınız hakkındaki görüşünüzü nasıl tanımlarsınız?

Çok Düşmanca	Düşmanca	Tarafsız	Dostça	Çok Dostça
○	○	○	○	○

9. Ortağınızı kendinize ne kadar yakın hissettiniz?

Çok Uzak	Uzak	Orta	Yakın	Çok Yakın
○	○	○	○	○

10. Ortağınızla ne kadar rekabet içinde olduğunuzu düşünüyorsunuz?

Hiç	Az	Orta	İyi	Çok İyi
○	○	○	○	○

Katılımınız için teşekkür ederiz.

APPENDIX E

Information Form Given to Participants After Questionnaires

KATILIM SONRASI BİLGİ FORMU

Bu araştırma, daha önce de belirtildiği gibi, ODTÜ Bilişsel Bilimler Bölümü Yüksek Lisans öğrencisi Kerem Alp Usal tarafından Doç. Dr. Annette Hohenberger danışmanlığındaki yüksek lisans tezi kapsamında yürütülmektedir. Araştırmanın amacı, insanlarda zaman algısının yalnız veya başka biri ile birlikte aynı işi yapmasına bağlı olarak değişip değişmediğini görmektedir.

Deney üç farklı gruba yapılmıştır. Deney sonuçlarını etkilememesi açısından diğer grupların varlığı sizden gizlenmiş ve sadece sizin içinde bulunduğunuz gruba göre talimatlar verilmiştir.

Gruplar şu şekildedir:

- Yalnız Eylem Grubu: Katılımcı deneyi tek başına yapmıştır.
- Destekleyici Ortak Eylem Grubu: İki katılımcı eylemi birlikte yapmıştır. Puanları birleşik olarak hesaplanıp diğer takımlar ile karşılaştırılacaktır.
- Rekabetçi Ortak Eylem Grubu: İki katılımcı eylemi birlikte yapmıştır. Puanları bireysel olarak hesaplanıp birbirleri ile karşılaştırılacaktır.

Siz …….. grubunda yer almış bulunuyorsunuz.

Bu çalışmadan alınacak ilk verilerin Mayıs 2016 sonunda elde edilmesi amaçlanmaktadır. Elde edilen bilgiler sadece bilimsel araştırma ve yazılarda kullanılacaktır. Çalışmanın sağlıklı ilerleyebilmesi ve bulguların güvenilir olması için çalışmaya katılacağını bildiğiniz diğer kişilerle çalışma ile ilgili detaylı bilgi paylaşımında bulunmamanızı dileriz. Bu araştırmaya katıldığınız için tekrar çok teşekkür ederiz.

Araştırmanın sonuçlarını öğrenmek ya da daha fazla bilgi almak için aşağıdaki isimlere başvurabilirsiniz.

Doç. Dr. Annette Hohenberger (hohenber@metu.edu.tr)
Kerem Alp Usal (kerem.usal@gmail.com)

Çalışmaya katkıda bulunan bir gönüllü olarak katılımcı haklarınızla ilgili veya etik ilkelerle ilgi soru veya görüşlerinizi ODTÜ Uygulamalı Etik Araştırma Merkezi'ne iletebilirsiniz.

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APPENDIX F

Ethics Committee Approval

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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21 Ağustos 2015

Gönderilen : Doç. Dr. Annette Hohenberger
Bilişsel Bilimler Bölümü

Gönderen : Prof. Dr. Canan Sümer
IAK Başkan Vekili

İlgi : Etik Onayı

Danışmanlığını yapmış olduğunuz Bilişsel Bilimler Bölümü öğrencisi Kerem Alp Usal'ın "**Yalnız ve Ortak Eylemler ile Destekleyici ve Rekabetçi Görevler Sırasında Zaman Algısının Karşılaştırılması (Comparison of Time Perception in Single vs. Joint Action and Cooperative vs. Competitive Tasks)**" isimli araştırması "İnsan Araştırmaları Komitesi" tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı

Uygundur

21/08/2015

Prof. Dr. Canan Sümer
IAK Başkan Vekili
ODTÜ 06800 ANKARA

TEZ FOTOKOPİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü	[ ]
Sosyal Bilimler Enstitüsü	[ ]
Uygulamalı Matematik Enstitüsü	[ ]
Enformatik Enstitüsü	[X]
Deniz Bilimleri Enstitüsü	[ ]

YAZARIN

Soyadı : USAL
Adı : Kerem Alp
Bölümü : Bilişsel Bilimler

TEZİN ADI (İngilizce) : EFFECTS OF JOINT ACTION AND NATURE OF TASK SETTING ON TIME PERCEPTION

TEZİN TÜRÜ : Yüksek Lisans [X] Doktora [ ]

1. Tezimin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezimin bir kısmı veya tamamının fotokopisi alınsın. [ ]
2. Tezimin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullanıcılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) [ ]
3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) [X]

Yazarın imzası ..... Tarih .....