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Multiple Object Tracking Across Social Contexts

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To the Graduate Council:

I am submitting herewith a thesis written by James Bramlett entitled "Multiple Object Tracking Across Social Contexts." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

Garriy Shteynberg, Major Professor

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Multiple Object Tracking Across Social Contexts

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Abstract

A series of experiments were conducted to examine the effects of social context on multiple object tracking performance. In both experiments participants performed the task alongside a confederate or alone. In the social conditions participants performed either simultaneous or took turns. Object tracking tasks were separated into two trial blocks with a distraction task performed intermittently, allowing for congruent task order between all conditions. Results were interpreted using the theories of shared attention, social facilitation, and joint action. We predicted that performing the task simultaneously would result in increased performance due to greater allocation of cognitive resources, as would be predicted by shared attention theory. This was found to not be the case. These studies did however produce various surprising results relating to block and gendered effects, perceived closeness, as well as passive learning.

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I. Introduction

Imagine you and a friend are walking down a busy metropolitan street. Through the noise and bustle you hear a man calling for a participant in a street game. He ushers you and your friend over and explains the rules. It's a classic shell game: there are three shells, under one of which is a marble. The object of the game is to track the shell in which the marble is contained, all while they are swiftly shuffled around. Your companion, unamused, stands idly by and browses their phone. Assuming a fair game, to what extent is your ability to track the correct shell impacted by whether your friend is watching?

In offices, schools, sporting events, assembly lines, and any number of occupational venues people work side-by-side every day. It has conventionally been assumed that the mere presence of others will itself augment an individual's performance. This is referred to as social facilitation and it is a very well-studied phenomenon (Travis, 1925; Zajonc, 1965; Zajonc, Heingartner, Herman, 1969). However, one aspect of this concept that remains to be fully explored is to what extent the direction of the attention of the present others will affect one's behaviors and outcomes on task performance. Co-attention, the act of mutually attending to a stimulus (Shteynberg, 2010), may impact how well individuals can effectively divide their attention across multiple targets. By placing participants in social situations that involve varying degrees of co-attention, I hope to trigger the psychological mechanisms that govern performance in an object tracking task.

Current research within the realms of joint action and shared attention attempt to tackle the cognitive effects of simultaneously directing your attention with present others. Where the joint action domain generally deals with task performance, shared attention more commonly examines subjects such as affect, motivation, and attitudes. The present study utilizes demonstrated methodology derived from shared attention research (Haj-Mohamadi, Fles, & Shteynberg, 2018) to examine performance on an established task in cognitive psychology literature. To accomplish this, participants were separated into experimental conditions in which they perform a multiple object tracking task. Participants are either paired with a confederate with which they complete this task simultaneously or asynchronously, or as in the control condition, perform alone. From this we will be able to examine the effects of co-attention on performance using a variety of divergent perspectives. The overall goal of this study is to determine the effect of co-attention on one's ability to divide their attention. In doing so we hope to expand our current understanding of shared attention while filling in gaps found in social facilitation and joint action research.

Multiple object tracking lends itself to this in part by having easily varied difficulty levels of which further predictions can be made. Additionally, performance on this task is directly influenced by the direction of one's own attention (Scholl, 2009). By requiring participants to distribute their attention across multiple targets, this task relies on the allocation of cognitive resources of which the social facilitation, shared attention, and joint action models predict divergent results.

Multiple Object Tracking

Originally implemented to test aspects of multifocal attention, the multiple object tracking task used in the current study was developed by Pylyshyn and Storm in 1988. It has since been applied in a variety of contexts including the study of attentional resource distribution (Alvarez & Franconeri, 2007), spatial resolution (Intriligator & Cavanagh, 2001), perceptual organization (Yantis, 1992), and the effects of transcranial brain stimulation (Blumberg, Peterson, & Parasuraman, 2015).

A typical tracking task begins by presenting the participant with a set of identical objects. A subset of these objects is then indicated as targets, generally by use of an outline or other visual indicator. All the objects begin to move about the screen and the target indicator is removed. After a short time, the movement ceases. An object is then probed, and participants are then asked to indicate it belonged to the original subset. Alternatively, in some cases the participant may be asked to select all original target objects (Pylyshyn & Annan, 2006). Object tracking tasks use a movement speed ranging from approximately 2 to 15 degrees per second. Depending on the nature of the study and number of distracter objects between 2 and 8 targets are generally presented.

It historically has been argued that most people can consistently track about 4 target objects provided a reasonable speed (Intriligator & Cavanagh, 2001). However, Alvarez & Franconeri (2007) determined that one's tracking capacity is determined by flexible cognitive resources. That is, as speed is increased one's spatial resolution is decreased, and the inverse is also true. This negative relationship, they argue, implies a "resource limited" tracking mechanism where one's ability to track objects relies on malleable, attentional resources. This is supported by evidence of enhanced tracking capacity when the task is paired with transcranial stimulation. Blumberg, Peterson, & Parasuraman, (2015) found the stimulation to improve performance on the task by a difference of 6 percent in the more difficult tracking tasks. There is also neurological evidence that multiple object tracking is highly affected by general cognitive load (Jovicich, Peters, Koch, Braun, Chang, & Ernst, 2001).

These findings collectively suggest mechanisms that which alter available attentional resources will affect performance on the task. By providing participants with differing social situations (simultaneous, asynchronous, and solo performance) I aim to elicit this same shift in cognitive resources found in previous studies. As the theoretical models of shared attention, social facilitation, and joint action predict discrepant results across the social contexts, it should be possible to contribute to our understanding of them individually while pitting them against one another.

Shared Attention

Shared attention refers to the mental state one enters when attending to stimuli with close others. It has previously been demonstrated to affect a variety of domains. Effects of the shared attention state range from increased goal-directed motivation, to improved memory, to stronger judgments, among others (Shteynberg, 2015). The properties of the shared attention state are theorized to arise from greater allocation of cognitive resources toward a shared target stimulus. Shared attention theory predicts this increased devotion of cognitive resources to only occur when a similar other is actively, simultaneously attending to the same stimuli. In this way, the qualitative experience of attending to an event shifts from “I am attending” to “we are attending”. As shared experiences have the evolutionary, communal benefits of shared knowledge, these experiences are granted cognitive priority (Shteynberg, 2010). In essence, if you and a friend are paying attention to something at the same time you will, consciously or not, devote more mental resources toward it than if you were by yourself.

Multiple object tracking allows for an examination of the active properties of shared attention. In this task, participants are either able to effectively distribute their attention across the targets during the task or they are not. Previous research has shown that, while performance on multiple object tracking task does depend partially on the previously examined working memory system (Shteynberg, 2010; Smith, Jonides & Koeppe, 1996), it more principally relies on resources devoted to active, attentional distribution (Scholl, 2009). This has yet to be examined under the lens of shared attention theory. It may be the case that while shared attention does indeed increase attentional resources, that it will fail to elicit the necessary, malleable distribution of them found in previous studies.

Utilizing shared attention theory, I predict the highest overall performance across difficulty levels when participants are performing the tracking task simultaneously. Furthermore, I predict this difference to be the greatest when the task is the most difficult. This is to a large degree at odds with the traditional understanding of social facilitation.

Social Facilitation

Originally described by Triplett (1898), social facilitation refers to the difference in one's task performance while in the presence of others due to increased arousal. This increased arousal has been shown to be either beneficial or detrimental depending on difficulty of the task (Zajonc, 1965). The increased arousal on easy or familiar tasks will lead to better performance, while conversely resulting in decreased performance on more difficult, less practiced tasks. According to Zajonc, the "dominant" response becomes more pronounced in the presence of others. In his original work (1965) some distinction is made between "audience effects" and "co-action". Co-action is described as "individuals all simultaneously engaged in the same activity and in full view of one another". Making this distinction Zajonc alludes to Allport's "The Influence of the Group upon Association and Thought" (1920). Here, individuals were asked to perform various tests either separated into individual cubicles or around a communal table. In all instances the tests were performed simultaneously, though the individuals were either isolated or within clear view of one another. Allport found that only tasks which involved well-learned, or automatic responses were performed more successfully when in groups; this is again attributed to an increase in the already dominant response. In this way, unlike shared attention theory, social facilitation makes no real distinction regarding the direction of the attention of the present others. In either case the participants were attending to their own task, however social facilitation simply requires that others are present, and that the presence of other performers is salient.

The current methodology provides something of a hybrid approach to the previously discussed method, allowing for a distinction to be made between the discussed theories. As in Allport's isolation condition, all current participants are visibly obscured from one another within individual cubicles. However, they either perform the tracking task at the same time or take turns. In either condition, they are aware of one another's presence, though when performing simultaneously they are actively attending to the same stimuli on the same monitor. Social facilitation should therefore make no discriminatory claims regarding performance across the social, asynchronous and simultaneous conditions. In either case they are performing in, albeit limited, isolation from one another. The social conditions should however, collectively, show increased performance on the easier trials and decreased on the more difficult when compared to the solo, control condition. This is in contrast to joint action in which a large distinction would be made between simultaneous and asynchronous task performance.

Joint Action

Joint action provides a more recent framework with which to examine shared tasks (Wenke, 2011). Sebanz, Bekkering, & Knoblich (2006) broadly define it as "any form of social interaction whereby two or more individuals coordinate their actions in space and time to bring about a change in the environment". Joint action theory proposes that when provided differing tasks individuals will create a mental representation of the task assigned to the other individual (Knoblich, Butterfill, & Sebanz, 2011). In this way individuals in groups can independently anticipate the contributions of the other members and thus effectively work together towards a shared goal. For example, while one person places a railroad steak, another anticipating this action, is ready to drive it in. It has been suggested that this perspective taking occurs largely automatically, even when to the detriment of the individual's ability to perform their own portion of the task (Sebanz, Knoblich, & Prinz, 2003).

Research on joint action traditionally deals with a dual variety of the Simon task (Simon & Wolfe, 1963). Here, participants are organized into pairs and provided with specific, discrepant roles. One participant may be asked to respond to the colors of objects and the other to object shapes. Participants are seated adjacent to one another and attend to the same screen. Depending on the left/right presentation of the stimulus, the participant seated on the opposing side will then show additional latency in their response (Sebanz et al., 2003). This latency is attributed to perspective taking. Even though the participant is tasked with only with identifying shapes or colors, they cannot help but imagine performing the other task from the other individual's perspective.

As with social facilitation, the current study again offers a different perspective on this paradigm. Rather than performing differing tasks at the same time while using the same visual space, in the synchronous condition participants will perform the same task at the same time. In the asynchronous condition they will perform opposing tasks but will not be attending to the same visual information. As it is proposed that perspective taking occurs automatically, even to the detriment of an individual's performance, it may be the case that the effects of this will be observed in our current study. From a joint action standpoint, we can likely expect to find decreased performance in the asynchronous condition, compared to the solo and simultaneous, as participants will be mentally attending to the unrelated task of the other. This effect would likely be exacerbated on the latter trials where individuals are more familiar with the task of the present other, having been exposed to it themselves. Joint action is unique in that it predicts worse performance for the asynchronous condition in comparison to the solo, across all levels of difficulty (see table 1).

II. Study I (Pilot)

Methods

A pilot study was initially conducted to establish a baseline threshold of difficultly regarding speed and number of targets. 95 undergraduates were recruited from the University of Tennessee participant pool. Participants were randomly assigned prior to arrival to either the simultaneous, asynchronous (which as a pair will be referred to as the social conditions), or solo conditions.

In the social conditions participants were greeted, provided a consent statement and seated adjacent to a confederate, who the participants were led to believe had arrived at an earlier time. The solo condition proceeded congruently, the only difference being the absence of a confederate. Participants were then instructed to complete a creativity task (Guilford, 1967) to build affiliation between themselves and the confederate, if present. Following this task, participants were seated in the leftmost of two cubicles facing a television and provided with a keyboard with which to make their response. The experimenter would then explain the tracking task by playing an instructional video and answering and questions regarding task requirements. Participants were instructed to press Y on their keyboard if an initially indicated dot was probed at the conclusion of a trial and N if the probed dot was not indicated at the trial onset.

Participants completed 36 tracking trials across 2 blocks of 18. Trials were evenly divided by difficulty regarding both speed (8, 10, or 12 degrees per second) and number of targets (3, 4, or 5 targets). All trials consisted of 10 total objects and both trial blocks contained equivalently balanced combinations of yes and no correct responses as well as speed-target combinations (see table 2).. All participants received the same trials in the same order which was determined using a random number sequence generator during the planning phase of the study.

After completing the first trial block the participant was provided a distraction task consisting of working on a word search for 4 minutes, the approximate duration of a single tracking task block. The experimenter then collected the word search and initiate the second block of the tracking task. Upon completion, the participant was again provided the word search. Following an additional 4 minutes, the word search was again collected, and the participant was provided a survey.

Across all conditions participants performed the same tasks in the same order, the sole difference between the social conditions was the task provided to the confederate. The simultaneous condition consisted of both participant and confederate completing the tracking task and word search at the same time. In the asynchronous condition the confederate completed the tracking task during the period where the participant was provided the word search and vice versa.

Results

A between subject analysis of variance concluded no main effects between conditions regarding overall accuracy, $F(2, 92) = .922$, $p = .401$. A planned contrast, using this ANOVA, for mean accuracy provided no evidence for overall significant differences between neither the simultaneous and asynchronous when compared to the solo condition, $t(92) = .44$, $p = .663$, nor the social conditions when compared to each other, $t(92) = 1.31$, $p = .195$. The asynchronous condition also did not differ when compared to the combined solo and simultaneous conditions, $t(92) = 1.37$, $p = .19$ (see figure 1).

Separated by block, I found the between condition effect in block 1 to be approaching significance, $F(2,92) = 2.82$, $p = .065$. This was predominately driven by the difference between simultaneous ($M = .762$, $SD = .101$) and asynchronous ($M = .694$ $SD = .119$) conditions, $F(1,59)$

= 5.86, *p* = .019. This difference was not seen when comparing the solo (*M* = .82, *SD* = .116) and simultaneous condition, *F(*1,65) = 1.78, *p* = .188. When compared to both groups, the simultaneous condition demonstrated greater performance overall for block 1, *t(*92) = 2.14, *p* < .05. Likewise, the asynchronous condition performed worse in block 1, when compared to the combined scores of solo and simultaneous, *t(*92) = 2.00, *p* < *.05* (see table 3).

The most pronounced difference in block 1 between social conditions was found at the most moderate difficulty of a speed of 10 degrees per second while tracking 4 target dots, *F*(1,59) = 5.84, *p* = .019. The easiest of trials in block 1 provided similar, near significant results, *F*(1,59) = 3.95, *p* = .051. There was also evidence for overall improvement between trial blocks across conditions, *t*(94) = 2.12, *p* = .037. This was found to be driven nearly entirely by those in the asynchronous group (*M* = .069, *SD* = .160). When compared to those in the synchronous group (*M* = -.014, *SD* = .115) this was a significant difference in improvement (block 1 scores subtracted from block 2), *F*(1,59) = 5.51, *p* = .022. The improvement seen in the solo condition (*M* = .046, *SD* = .159) did not differ from that in the asynchronous, *F*(1,60) = .338, p = .563, nor did it significantly differ from 0, *t*(33) = 1.68, *p* = .103.

Discussion

Overall, I found no discernable differences in terms of overall accuracy between conditions. This pilot study did provide some evidence of variance between social conditions, particularly in the first block. This may have been due to the effects of shared attention having been more greatly pronounced at the onset of the experiment; the sense of novelty and “togetherness” may have simply worn off before participants reached the second block.

There is evidence to suggest the effects of practice simply made the task easier overall in the second block. While there was an overall difference in terms of improvement, this was the case only because the asynchronous condition improved so greatly. This same enhanced performance was not observed in either solo or simultaneous conditions. A more likely explanation is that those in the simultaneous group demonstrated ceiling effects, performing better than those in the asynchronous on the initial block and leaving no room for improvement for the subsequent trials. If social facilitation makes no distinction between the directed attention of the other, this would appear to be an incongruent finding, at least for the first block of the experiment.

While there were no main effects, perspective taking, as joint action would suggest, may help to explain the discrepant results found in block 1. The initial difference in tasks for the asynchronous condition may have resulted in ambiguity and ultimately proven a distraction for the participant. If you’re focused on what someone else is doing, it would be helpful to know their actual task. In block 2 the participant, now familiar with both tasks, with this ambiguity cleared, may have been able to better direct their attention to the tracking task.

In terms of the initial hypotheses, none were fully confirmed. Participants did not perform better overall in any condition. Focusing only on block 1, the simultaneous condition did however demonstrate improved performance when compared to both other conditions (though not when exclusively compared to solo). Likewise, the asynchronous condition, performing significantly worse in block 1 when compared to both others provides some limited support for the joint action perspective, as does the simultaneous condition not differing in comparison with the solo. Taken together, this provides a more nuanced perspective than initially expected. Based on the evidence found in the pilot I concluded it appropriate to move forward with an additional study.

III. Study II

Participants and Design

158 undergraduate students at the University of Tennessee were recruited via an online portal and received partial course credit for their participation. As in the pilot study, participants were randomly assigned to two experimental social conditions: asynchronous and simultaneous presentation, as well as a solo control.

Based upon the results of the pilot I enacted two major changes. The speed of the objects was set at the moderate level of 10 degrees per second. This was chosen because it produced the most pronounced difference between conditions in the pilot study. Additionally, I reduced the overall number of trials to 24. Without adjusting the speed of the objects, this allowed for more exposures at the varying difficulty levels regarding the number of target objects. This also reduced the necessary time to complete the experiment to under 30 minutes, allowing for greater efficiency overall.

Stimuli

The task was presented on a 64-inch television located approximately 105 inches from the participant. The participants were seated in the left cubicle, which allowed for a slight 17 degree viewing angle from the center of the screen. The objects moved at a set speed of 10 degrees per second. Both the stimuli and the participants' responses were recorded in Matlab (R2016a) using the Psychtoolbox plugin. The codebase expounded upon previous work by M. Lapierre (2013) and is currently available on GitHub.

The tracking task consisted of 2 blocks of 12 trials, totaling 24. Participants tracked 3, 4, or 5 target dots out of a total of 10. Trials began with a 5 second countdown. Targets were indicated with a white outline at the onset of the trial for 1.5 seconds. Both distractor and target dots appeared in random locations and moved in random directions for a duration of 10 seconds. Dots moved in a straight line, redirecting themselves according to the angle of impact when contacting either the screen's edge or other dots. Following the movement phase, a single probed dot was specified via a white outline. Participants were asked to indicate whether the probed dot was one of the original indicated dots via a Y or N keystroke.

The number of targets and trial order were again fixed across participants. Number of targets and correct probe dots were balanced evenly across blocks. A new trial order was provided via random sequence generation. Correct yes and no responses were balanced evenly across number of target dots. These can be seen in table 4.

Procedure

Participants were greeted by the experimenter and provided a consent cover statement; in the social conditions they were seated in a waiting room adjacent to a confederate. The solo condition proceeded consistently with the others, the sole difference being the absence of a confederate. Upon completion of the consent form the participant and confederate were directed to sit together at a desk. To build affiliation between participant and confederate I provided a creativity task, the object of which being to brainstorm unusual uses for a brick for three minutes (Guilford, 1967). The confederate was instructed to match the approximate rate of answers provided by the participant. After providing instructions, the experimenter would leave the room, returning after three minutes. The experimenter would then congratulate the participant and confederate on their performance and direct them to their seats in front of the television. Next, the participant was always directed to sit in the leftmost of the two chairs. The chairs were located within small cubicles where the participant was provided with a keyboard with which to make their response. In the experimental conditions, the participant was unable to see the confederate for the remainder of the session. The experimenter provided no context as to whether the current study involved either cooperation or competition. Participants were not provided their results as to limit external competition. Objective aside, the task was left as ambiguous as possible.

Across all conditions the participant first performed one block of the tracking tasks. Following this, they were provided with a word search for two and a half minutes, the approximate length of the tracking task. The word search was then collected, and the participant performed the second, final block of the tracking task. They were then given their original word search for an additional two and a half minutes. After collecting the word search, the experimenter provided a survey. The survey consisted of a 20 item PANAS (Watson, Clark, & Tellegen, 1988) along with questions concerning closeness to the confederate, fatigue, motivation, happiness with performance, trait competitiveness, and basic demographic information.

The social conditions differed only in that the confederate performed tasks either simultaneously with the participant or asynchronously. That is, while the participant performed the tracking task the confederate either made their responses simultaneously or in the asynchronous condition was provided a word search. This task swapping was explained to all participants prior to the onset of the first trial block. Confederates in either condition were instructed to strike a key at the end of a trial as to simulate an actual response. Confederate trails in the asynchronous condition progressed automatically regardless of input. This ensured the two-and-a-half-minute word search distraction task to be congruent across conditions. As an immediate progression to the next trial following a participant's response may have implied a lack of participation on the part of the confederate, a 3 second delay following the participant's response was added to ensure faith in the confederate's active participation in the simultaneous condition. This delay was present across conditions and explained away as a delay in response recording should a participant allude to it. As to avoid an observer effect, the experimenter excused themselves from the room for the duration of both the tracking task and word search.

Results

Two participants were excluded from analysis due to experimenter error, leaving 156. Additionally, due to experimenter error, 5 surveys were excluded. The distribution of overall accuracy possessed a skew of -.29 and a kurtosis of -.16. Overall accuracy results were found to be potentially not normally distributed using the Shapiro-Wilk test (p = .016). Levene's test showed the variances between conditions to be equivalent, $F(2,153) = .766$, $p = 0.467$.

An analysis of variance provided no evidence for differences in overall accuracy across conditions $F(2,153)$, $p = .218$. The planned contrast between simultaneous and asynchronous conditions also resulted in no significant difference $t(153) = -1.67$, $p = .97$. This was true when comparing the experimental, social conditions against the solo control, $t(153) = -.523$, p = .60, as well the simultaneous, $t(153) = .432$, $p = .667$ and asynchronous, $t(153) = -1.33$, $p = .185$, against the solo condition individually. No conditions significantly differed from one another in overall accuracy.

The block effect previously found in the pilot failed to replicate in the present study (see table 5). There were no significant differences between conditions for either block 1, $F(2,153) = .113$, $p = .892$, or block 2, $F(2,153) = 2.52$, $p = .084$ (see Figure 2). There were significant differences between social conditions in block 2 however, with those in the asynchronous condition performing roughly 7 percent better overall, $F(1,92) = 4.47$, $p = .037$. This was not true for block 1, $F(1,94) = .048$, $p = .827$. It was additionally not the case when comparing the asynchronous and solo conditions for block 1, $F(1,107) = .265$, $p = .608$ or block 2 $F(1,107) = 2.45$, $p = .121$.

Accounting for difficulty level some additional differences begin to emerge. There were no differences in the 3 target, $F(2,153) = .996$, $p = .372$, and 4 target, $F(2,153) = .230$, trials between conditions (see Figure 3). However, on the more difficult 5 target trials there were significant differences across conditions, $F(2,153) = 3.15$, $p = < .05$; this effect was entirely driven by significantly higher performance in the asynchronous condition in comparison to both the solo, $F(1,107) = 4.67$, $p = .03$, and simultaneous, $F(1,94) = 5.60$, $p = .02$, groups (see figure 4 and table 6).

Further, I again observed an effect driven by the results of block 2 (see Figure 4). The benefit of performing asynchronously rather than simultaneously on the more difficult trials was only realized in the second trial block. This was true when comparing simultaneous and asynchronous conditions for both the 4, $F(1,94) = 4.29$, $p < .05$, and 5, $F(1,94) = 7.92$, $p < .05$, target trials. The 5 target trials in block 2 showed a particularly large, 15 percent difference between simultaneous ($M = .60$, $SD = .71$) and asynchronous ($M = .75$, $SD = .23$) conditions. Within the simultaneous condition there was a significant interaction between block and 5 target accuracy, $F(1,46) = 6.18$, $p < .05$.

The results of the PANAS were largely inconclusive, showing no significant differences between conditions on any individual or aggregate positive, $F(2,149) = .288$, $p = .796$, or negative affect variables, $F(2,149) = .430$, $p = .651$. It was found through a multiple regression analysis that aggregate positive ($\beta = .004$, $p < .01$) and negative ($\beta = -.005$, $p < .05$) PANAS responses did however explain 7.7% of the variance in overall accuracy ($R^2 = .077$, $F(2,149) =$

6.02, $p < .01$. Intuitively, "excited" r(152) = .231, $p < .01$ and "attentive" r(152) = .221, $p < .01$ were the two items found most predictive of success.

Though participants were provided no feedback at any time on their performance, there was evidence that they were at least somewhat aware of how they performed. Enjoying the task (r(152) = .229, $p < .01$) and liking one's performance (r(152) = .271, $p < .01$) were both correlated with actual overall success. Furthermore, broken down by trial block, these items showed significant correlation only block 2 performance (see table 7), indicating responses to these items were likely biased to the more recently performed block 2.

The scale used for trait competitiveness was split between two latent constructs of goal and interpersonal competitiveness. Neither goal ($F(2, 148) = .887$, $p = .41$), nor interpersonal ($F(2, 148) = .286$, $p = .75$) differed between conditions. Interpersonal competitiveness, but not goal competitiveness, was found to correlate positively with the aggregate positive PANAS items, along with motivation, liking one's performance, wanting to outperform the confederate, and the explicit measure of feeling competitive. Neither was associated with general performance on the task (see table 8). A univariate analysis of variance demonstrated no interaction for trait competitiveness and condition in terms of overall accuracy for either interpersonal ($F(3, 141) = .72$, $p = .54$) or goal ($F(3, 141) = 1.13$, $p = .34$) competitiveness.

There was no difference in reported motivation to perform well across conditions, $F(2,147) = .299$, $p = .74$. There was also no evidence of an interaction between motivation and condition for performance overall, $F(3,146) = 2.06$, $p = .11$.

Those in the simultaneous condition reported higher aggregate closeness compared to those in the asynchronous $F(1,79) = 5.56$, $p < .05$. The included survey items consisted of "socially close", "interpersonally close", "psychologically close", and "connected" regarding the confederate. The degree of reported closeness was not correlated with overall accuracy in the simultaneous condition $r(41) = -1.57$, $p = .37$.

There were no overall differences in performance related to sex, $F(1,149) = 2.84$, $p = .094$. Men ($M = .77$, $SD = .15$), men did however outperform women ($M = .69$, $SD = .15$) in the second trial block, $F(1,149) = 8.13$, $p < .01$. An improvement score, taken from the difference between block 1 and block 2 performance, demonstrated an interaction between condition, sex, and improvement between conditions, $F(2,145) = 5.00$, $p < .01$. This difference was most pronounced in the simultaneous condition (see table 9). Where women in the solo condition performed similarly for block 1 and block 2 and improved in the asynchronous condition, those in the simultaneous showed a decrease in performance ($M = -.11$, $SD = .17$). This was the only decrease in performance for either sex in any condition. Conversely, men in the simultaneous condition improved more than any other group ($M = .12$, $SD = .25$).

Due to the nature of the task, it is possible to also examine the results using signal detection theory. Correct responses to a probed dot being an original target were evenly distributed across trials. That is, half of the correct answers were "yes, this dot was a target" and the other half "no, the probed dot was not a target". This allows for the categorization of responses between "hits", "misses", "correct rejections", and "false alarms". The signal detection model assumes two normal distributions on an axis representing perceived intensity of the signal. One distribution represents the frequency of trials in which the participant states a target was absent (not probed) and one in which they respond the target was present (probed). These distributions will have varying amounts of overlap between individuals. The amount of overlap, or more technically the difference between the means of the distributions, is referred to as d' (d prime). This can more easily be conceptualized as how well participants are able to sort noise trials from signal trials. The second important factor is β (criterion). Criterion effectively divides the overlapping distributions into the previous 4 categories of response (see figure 5). A high criterion would result in the individual predominantly answering “no”. This strategy would result in no false alarms but would also accrue misses rather than hits; the perceived signal did not meet the internal criteria for a response. A low d prime, indicating a high amount of overlap (inability to distinguish signal from noise) for the same amount of perceived intensity, would also provide more variability between misses and false alarms for which to place criterion (strategy). Additionally, there is c (bias), which is simply a measure of an individual’s tendency for yes or no responses. The ideal bias is standardized at 0, with more conservative patterns (tenancy to choose “no”) represented by positive numbers and liberal bias represented by negative. There were no main effects for d prime ($F(2,153) = .302$, $p = .74$), criterion ($F(2,153) = 1.17$, $p = .31$) , or bias ($F(2,153) = .295$, $p = .75$). As each participant was exposed to only 8 trials at each of the three difficulty levels, there were many instances (N = 238) in which participants either achieved a 100% hit or 0% false alarm rate per number of targets. This unfortunately makes performing an analysis of variance for task difficulty very difficult as the formula to calculate signal detection measures requires a non-zero rate. Aggregate scores for both condition and difficulty by condition can be seen in tables 10 and 11.

Discussion

I again found no evidence of main effects between conditions. Further, there was no evidence of any difference in terms of overall accuracy between any conditions. In contrast to the pilot, there was evidence of significant differences in block 2 rather than 1. Here I observed stability within the asynchronous condition and a decline in performance among those in the simultaneous. This decline, driven by the more difficult trials within block 2, was large enough for the simultaneous and asynchronous conditions to significantly differ. The decline in performance for most difficult trials within the simultaneous condition was also large enough for a significant interaction to occur between blocks.

All participants received the same order of word search and tracking tasks across conditions. One potentially overlooked difference however is that in the asynchronous condition the tracking task was continuous. For the entire duration of the study it was either being performed by the confederate or the participant with no break between sessions, unlike those found in the solo and simultaneous conditions. It may be possible that those in the asynchronous condition were afforded the opportunity to practice the tracking task between blocks by watching the ongoing confederate trial. This is not supported by the positive correlation between block 2 performance and word search completion, $r(49) = .397$, $p = < .05$. Those that performed well in block 2 generally were also able to complete more of the word search, making it unlikely that they ignored it in favor of actively attending to the confederate tracking trial. It would seem unlikely participants would make up the difference in the second word search period. Word search completion was unfortunately not recorded between trial blocks.

Another explanation may be that the continuous presence of the tracking task served as a reminder and as in the joint action literature, participants were encouraged to take the perspective of the confederate. Rather than decreased performance as seen in the other conditions, this may have functioned as a reminder and allowed for a sustained amount of resources devoted to the task, effectively resulting in additional practice between trials.

IV. General Discussion

It is difficult to reconcile the results of the pilot with study 2. Given the exception of duration and varying speed, there were little overall differences in methodology. It may be possible that altering the order in which participants are exposed to each difficulty level in some way affected the overall outcomes. As in both studies participants received multiple exposures at each difficulty level per trial block, this explanation seems implausible. A G*Power analysis indicated a necessary sample size of approximately 100 participants per condition, totaling 300. I failed to recruit this amount, which may have also led to inaccurate findings overall. It is also possible that the methods failed to effectively manipulate the cognitive resources required to perform multiple object tracking. Previous tracking tasks largely increased cognitive load through the implementation of dual tasks. It may be the case that the social conditions I chose did not meet the threshold to alter performance. Additionally, an increased devotion or overall available amount of cognitive resources does not necessarily equate to the appropriate manipulation of those specifically required for success in this task: namely the ability to effectively divide one's attention across multiple targets.

Assuming predominately null results, this study acts as partial evidence that the effects of shared attention are either not applicable to the ability to distribute one's attention or may require a period of elaboration following presentation of a stimulus. Those in the simultaneous condition did report a significantly higher degree of closeness with their partner, a phenomenon also recently observed in a concurrently conducted study. In future studies it may be of some interest to further examine the effects of simultaneously performing a task on reported closeness to one's partner. I did not find an increase in motivation, something typically seen shared attention research. While motivation was measured as highest in the shared condition, the amount did not reach significance. Given this, it is also possible that this task was not viewed as suitable for "sharing". It may also be the case that motivation demonstrated a ceiling effect across the social conditions, resulting in no overall increase in the participants' focus.

There was also little overall evidence for the occurrence of social facilitation. Participants generally did perform worse on the trials intended as more difficult. Those performing in a social context however, did not demonstrate any detriment to their performance for the more difficult trials in comparison to the solo condition. In fact, those in the asynchronous condition performed better than those performing alone on the most difficult trials. It is tempting to suggest that those in the asynchronous condition had the added stimulation of performing socially, without the anxiety of simultaneously performing. This was however not reflected in the results of the PANAS. This may again be attributed to a low sample size. It may also be the case that multiple object tracking is too automatic of a skill. While there is previous research indicating various factors of influence on ability it may be that social context simply does not affect it in the same fashion as more deliberate tasks.

The expected effects of joint action were not observed in the present study. Those who performed differing tasks than that of their partner did not show any decrease in performance attributable to perspective taking. In fact, there was an indication to the contrary. Evidence from joint action literature, in this context, largely relies on individuals performing tasks within the same visual field. Had I included a second task on the television, rather than a word search, our study design would have been more similar to traditional experiments in this domain. It is possible that the increase in performance found in block 2 for those in the asynchronous condition may still be attributable to perspective taking. This would require participants maintain an awareness of the tracking task being performed by the confederate as they completed the word search. In turn, this awareness would then need to equate to a form of passive practice, even as the individual maintained focus on an unrelated task. While inconclusive, this again provides a potential avenue for future research on perspective taking acting as practice in the absence of active attention.

References

Allport, F. (1920). The influence of the group upon association and thought. *Journal Of Experimental Psychology*, *3*(3), 159-182. doi: 10.1037/h0067891

Alvarez, G., & Franconeri, S. (2007). How many objects can you track?: Evidence for a resource-limited attentive tracking mechanism. *Journal Of Vision*, *7*(13), 14. doi: 10.1167/7.13.14

Annan, V., & Pylyshyn, Z. (2006). Dynamics of target selection in Multiple Object Tracking (MOT). *Spatial Vision*, *19*(6), 485-504. doi: 10.1163/156856806779194017

Blumberg, E., Peterson, M., & Parasuraman, R. (2015). Enhancing multiple object tracking performance with noninvasive brain stimulation: a causal role for the anterior intraparietal sulcus. *Frontiers In Systems Neuroscience*, *9*. doi: 10.3389/fnsys.2015.00003

Dedrick, D., Trick, L., Fodor, J., Brodeur, D., Brook, A., & Clark, A. (2009). *Computation, Cognition, and Pylyshyn*. Cambridge: MIT Press.

Guilford, J. (1967). *The nature of human intelligence*. New York: McGraw-Hill.

Haj-Mohamadi, P., Fles, E., & Shteynberg, G. (2018). When can shared attention increase affiliation? On the bonding effects of co-experienced belief affirmation. *Journal Of Experimental Social Psychology*, *75*, 103-106. doi: 10.1016/j.jesp.2017.11.007

Intriligator, J., & Cavanagh, P. (2001). The Spatial Resolution of Visual Attention. *Cognitive Psychology*, *43*(3), 171-216. doi: 10.1006/cogp.2001.0755

Jovicich, J., Peters, R., Koch, C., Braun, J., Chang, L., & Ernst, T. (2010). Brain areas specific for attentional load in a motion tracking task. *Journal Of Vision*, *1*(3), 348-348. doi: 10.1167/1.3.348

Knoblich, G., Butterfill, S., & Sebanz, N. (2011). Psychological research on joint action: Theory and data. In B. Ross (Ed.). *The Psychology of Learning and Motivation* (Vol. 54, pp. 59–101). Burlington, MA: Academic Press. http://dx.doi. org/10.1016/B978-0-12-385527-5.00003-6.

Lapierre, M., Dual-task Multiple Object Tracking and Visual Working Memory Experiment, (2013), GitHub repository, https://github.com/mlapierre/dual-task-mot-vwm

Higham, P.A. and Arnold, M.M. (1970) Beyond reliability and validity: The role of metacognition in psychological testing. In, DeGregorio, R.A. (ed.) *New Developments in Psychological Testing*. Hauppauge, USA. Nova Science, pp. 139-162.

Pylyshyn, Z. W., & Annan, V. (2006). Dynamics of target selection in multiple object tracking (MOT). *Spatial vision*, *19*(6), 485-504.

Scholl, B. J. (2009). What have we learned about attention from multiple-object tracking (and vice versa)? In D. Dedrick & L. Trick (Eds.), *Computation, cognition, and Pylyshyn* (pp. 49-77). Cambridge, MA, US: MIT Press.

Sebanz, N., Bekkering, H., & Knoblich, G. (2006). Joint action: bodies and minds moving together. *Trends In Cognitive Sciences*, *10*(2), 70-76. doi: 10.1016/j.tics.2005.12.009

Sebanz, N., Knoblich, G., & Prinz, W. (2003). Representing others' actions: just like one's own?. *Cognition*, *88*(3), B11-B21. doi: 10.1016/s0010-0277(03)00043-x

Shteynberg, G. (2010). A silent emergence of culture: The social tuning effect. *Journal Of Personality And Social Psychology*, *99*(4), 683-689. doi: 10.1037/a0019573

Shteynberg, G. (2015). Shared Attention. *Perspectives On Psychological Science*, *10*(5), 579-590. doi: 10.1177/1745691615589104

Simon, J. R. (1990). The effects of an irrelevant directional cue on human information processing. In R. W. Proctor & T. G. Reeve (Eds.), *Advances in psychology, Vol. 65. Stimulus-response compatibility: An integrated perspective* (pp. 31-86). Oxford, England: North-Holland.

Simon, J., & Wolf, J. (1963). Choice Reaction Time as a Function of Angular Stimulus-Response Correspondence and Age. *Ergonomics*, *6*(1), 99-105. doi: 10.1080/00140136308930679

Smith, E., Jonides, J., & Koeppe, R. (1996). Dissociating Verbal and Spatial Working Memory Using PET. *Cerebral Cortex*, *6*(1), 11-20. doi: 10.1093/cercor/6.1.11

Travis, L. (1925). The effect of a small audience upon eye-hand coordination. *The Journal Of Abnormal And Social Psychology*, *20*(2), 142-146. doi: 10.1037/h0071311

Triplett, N. (1898). The Dynamogenic Factors in Pacemaking and Competition. *The American Journal Of Psychology*, *9*(4), 507. doi: 10.2307/1412188

Watson, D., Clark, L., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal Of Personality And Social Psychology*, *54*(6), 1063-1070. doi: 10.1037//0022-3514.54.6.1063

Wenke, D., Atmaca, S., Holländer, A., Liepelt, R., Baess, P., & Prinz, W. (2011). What is Shared in Joint Action? Issues of Co-representation, Response Conflict, and Agent Identification. *Review Of Philosophy And Psychology*, *2*(2), 147-172. doi: 10.1007/s13164-011-0057-0

Yantis, S. (1992). Multielement visual tracking: Attention and perceptual organization. *Cognitive Psychology*, *24*(3), 295-340. doi: 10.1016/0010-0285(92)90010-y

Zajonc, R. (1965). Social Facilitation. *Science*, *149*(3681), 269-274. doi: 10.1126/science.149.3681.269

Zajonc, R., Heingartner, A., & Herman, E. (1969). Social enhancement and impairment of performance in the cockroach. *Journal Of Personality And Social Psychology*, *13*(2), 83-92. doi: 10.1037/h0028063

Appendices

Appendix A: Tables

Table 1

Ranked Relative Performance Predictions by Theory

	Condition		
Theory	Solo	Simultaneous	Asynchronous
Shared Attention	2	1	2
Social Facilitation (easy tasks)	2	1	1
Social Facilitation (difficult tasks)	1	2	2
Joint Action	1	1	2

Table 2

Run Order by Block for Study 1

	Block 1			Block 2		
Trial	Targets	Speed	Y/N	Targets	Speed	Y/N
1	4	12	1	3	12	1
2	5	10	1	5	10	1
3	5	12	0	4	12	0
4	3	8	0	3	12	0
5	3	10	1	5	8	0
6	5	12	0	3	10	0
7	5	8	0	3	8	1
8	3	8	1	4	8	0
9	5	8	1	5	8	1
10	4	10	0	4	10	1
11	5	12	1	4	12	1
12	5	10	0	5	12	1
13	4	8	1	4	8	1
14	3	12	1	5	12	0
15	4	10	1	4	10	0
16	4	8	0	3	8	0
17	3	12	0	3	10	1
18	3	10	0	5	10	0

Table 3

Mean Accuracy by Block for Study 1

	Block					
	Block 1		Block 2		Total	
Condition	Mean	SD	Mean	SD	Mean	SD
Solo	.727	.446	.763	.419	.750	.433
Simultaneous	.763	.434	.749	.434	.756	.430
Asynchronous	.694	.461	.764	.425	.729	.445
Total	.730	.444	.762	.426	.746	.435

Table 4

Run Order by Block for Study 2

	Block 1		Block 2	
Trial	Targets	Y/N	Targets	Y/N
1	4	Y	3	Y
2	3	Y	5	N
3	5	N	3	Y
4	4	Y	4	Y
5	3	N	5	Y
6	4	N	3	N
7	5	Y	5	Y
8	3	N	4	N
9	4	Y	4	N
10	5	Y	3	N
11	5	N	5	N
12	3	N	4	Y

Table 5

Mean Accuracy by Block for Study 2

	Block					
	Block 1		Block 2		Total	
Condition	Mean	SD	Mean	SD	Mean	SD
Solo	.710	.139	.717	.141	.713	.109
Simultaneous	.716	.164	.692	.170	.704	.120
Asynchronous	.723	.123	.760	.150	.742	.103
Total	.716	.141	.723	.153	.719	.111

Table 6

Mean Accuracy by Targets by Condition for Study 2

	3 Targets		4 Targets		5 Targets		Total	
Condition	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Solo	.81	.16	.68	.19	.65	.19	.71	.11
Simultaneous	.78	.16	.69	.16	.64	.19	.70	.12
Asynchronous	.76	.17	.73	.16	.72	.15	.74	.10
Total	.78	.17	.70	.17	.67	.18	.71	.11

Table 7

Correlations for Accuracy Variables and Performance/Enjoyment for Study 2

Measure	Overall Accuracy	Block 1 Accuracy	Block 2 Accuracy	Liked Performance	Enjoyed the Task
Overall Accuracy	____				
Block 1 Accuracy	.73**	____			
Block 2 Accuracy	.77**	.12	____		
Liked Performance	.27**	.13	.27**	____	
Enjoyed the Task	.23**	.13	.21**	.54**	____

Note. * indicates $p < .05$; ** indicates $p < .01$.

Table 8

Correlations for Trait Competitiveness and Survey Measures for Study 2

Measure	1	2	3	4	5	6	7	8	9
1. Interpersonal Competitiveness	____								
2. Goal Competitiveness	.075	____							
3. Positive PANAS	.220**	.131	____						
4. Negative PANAS	.065	.059	.115	____					
5. Motivation	.202*	.001	.572**	.209*	____				
6. Liking One's Performance	.265**	-.05	.571**	-.133	.453**	____			
7. Felt Competitive	.346**	.026	.248**	.042	.413**	.245**	____		
8. Wanting to Outperform	.555**	.087	.237**	.306**	.334**	.356**	.787**	____	
9. Overall Accuracy	.131	.052	.189*	-.180*	.150	.271**	.119	.111	____

Note. * indicates $p < .05$; ** indicates $p < .01$.

Table 9

Mean Improvement by Condition by Sex for Study 2

	Sex			
	Male		Female	
Condition	*M*	*SD*	*M*	*SD*
Solo	.05	.18	.00	.17
Simultaneous	.12	.25	-.11	.17
Asynchronous	.03	.20	.05	.17

Table 10

Signal Detection Measures for Study 2

	Condition								
	Solo			Simultaneous			Asynchronous		
Measure	3	4	5	3	4	5	3	4	5
d'	1.77	.930	.800	1.53	1.00	.739	1.47	1.26	1.21
B	1.19	1.13	1.08	1.18	1.02	1.07	1.40	1.10	.903
C (bias)	.100	.130	.102	.107	.015	.086	.230	.078	-.085

Table 11

Aggregate Signal Detection Measures for Study 2

	Condition		
Measure	Solo	Simultaneous	Asynchronous
d'	1.16	1.09	1.31
B	1.14	1.09	1.14
C (bias)	.110	.070	.073

Appendix B: Figures

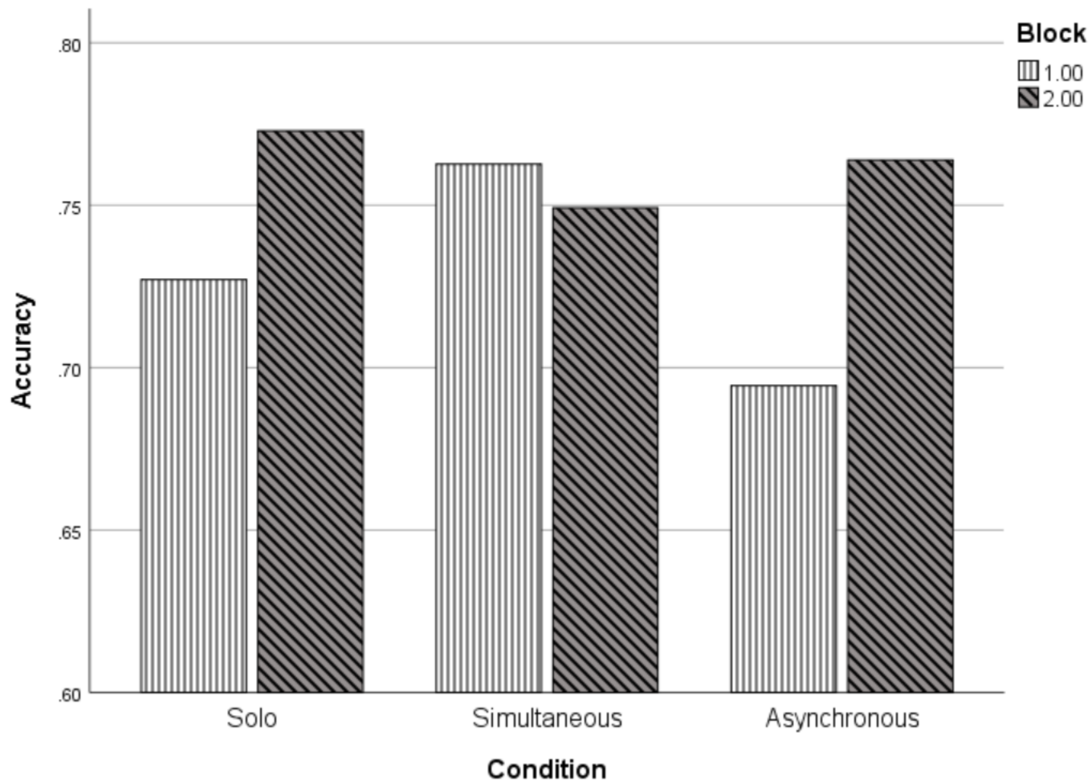

Figure 1: *Mean Accuracy by Condition by Block for Study 1*

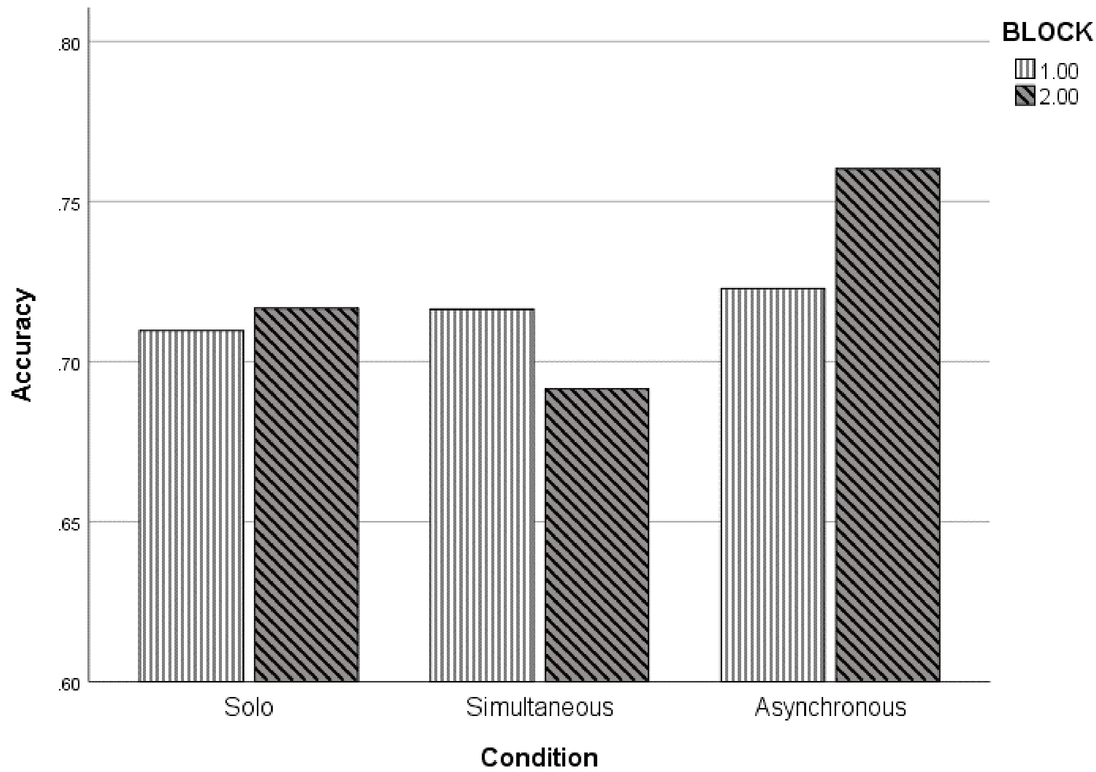

Figure 2: *Mean Accuracy by Condition by Block for Study 2*

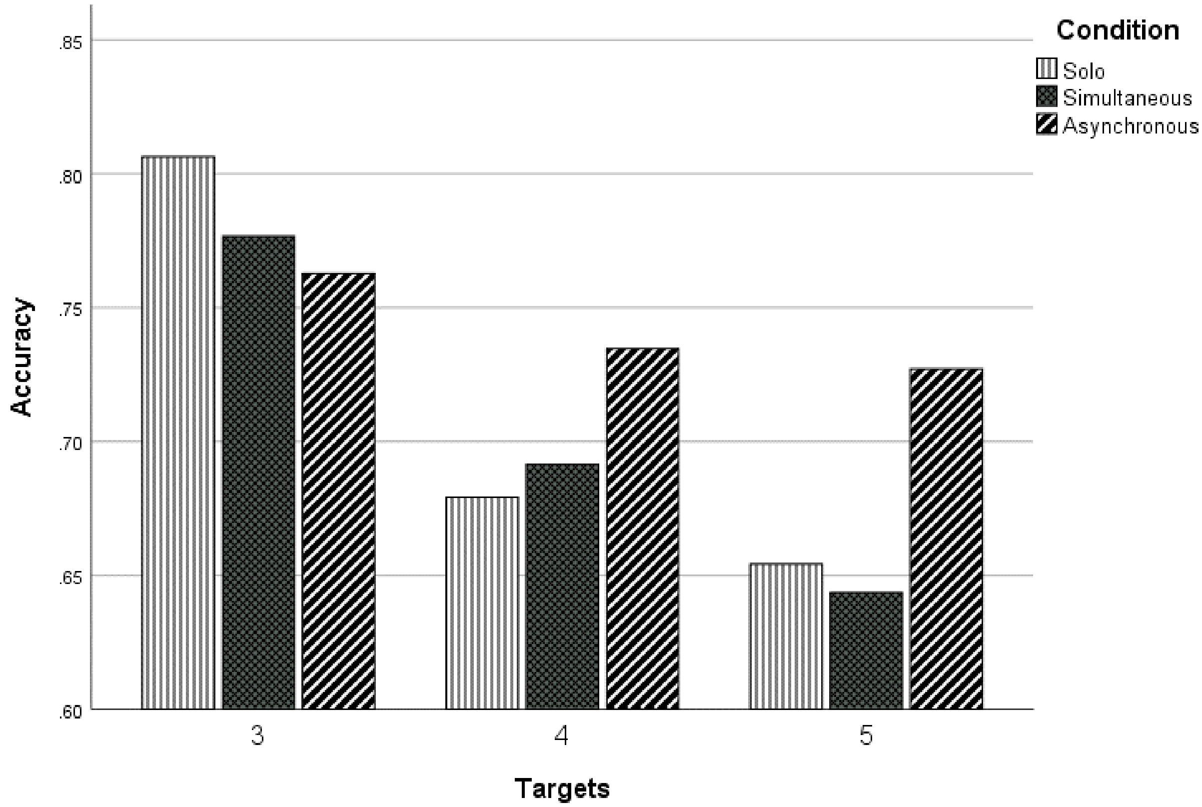

Figure 3: *Mean Accuracy by Targets by Condition for Study 2*

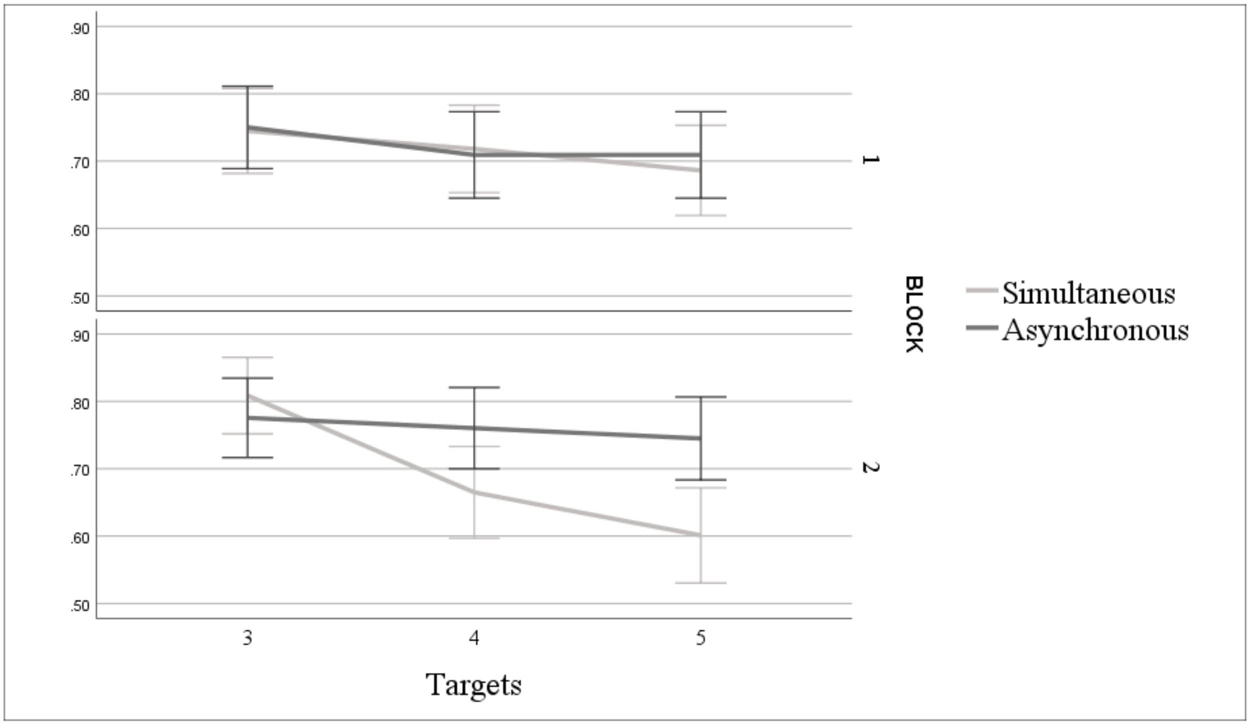

Figure 4: *Mean Accuracy by Targets by Block by Condition in Study 2*

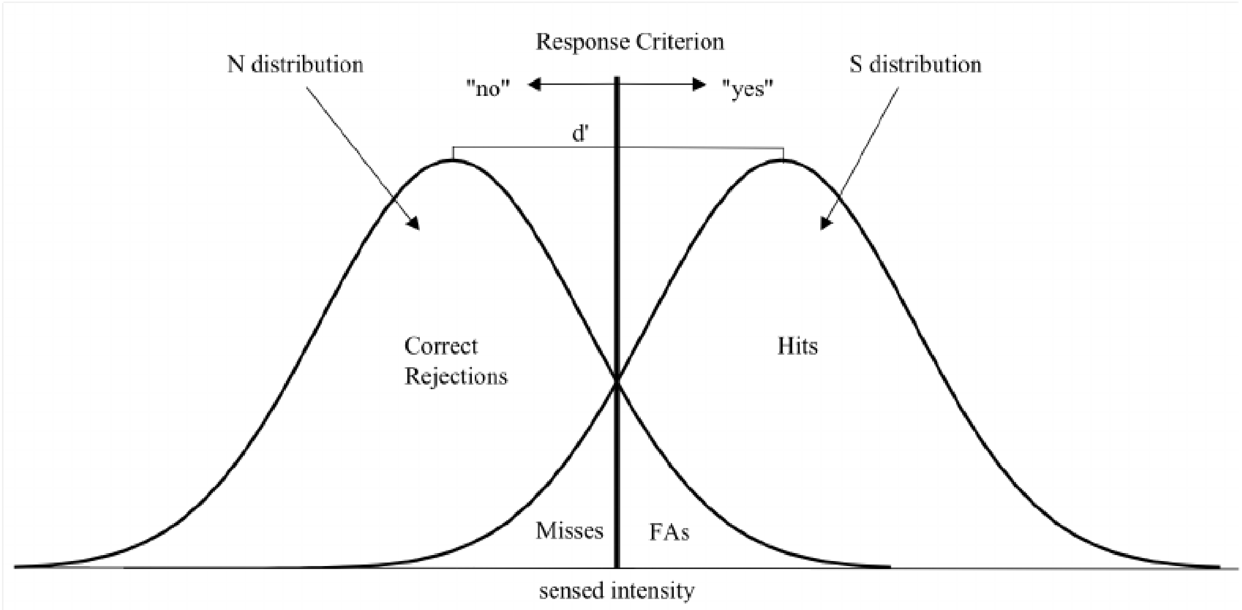

Figure 5: *Signal Detection Model* (Higham & Arnold, 1970)

Appendix C: Materials

Survey

Indicate to what extent you felt this way during the dot tracking task

1	2	3	4	5
Not at All	**A Little**	**Moderately**	**Quite a Bit**	**Extremely**

___________ **1. Interested**	___________ **11. Irritable**
___________ **2. Distressed**	___________ **12. Alert**
___________ **3. Excited**	___________ **13. Ashamed**
___________ **4. Upset**	___________ **14. Inspired**
___________ **5. Strong**	___________ **15. Nervous**
___________ **6. Guilty**	___________ **16. Determined**
___________ **7. Scared**	___________ **17. Attentive**
___________ **8. Hostile**	___________ **18. Jittery**
___________ **9. Enthusiastic**	___________ **19. Active**
___________ **10. Proud**	___________ **20. Afraid**

Indicate to what extent you feel this way

1	2	3	4	5
Not at All	**A Little**	**Moderately**	**Quite a Bit**	**Extremely**

__________ 21. How mentally fatigued do you feel?

__________ 22. How physically fatigued do you feel?

Indicate to what extent you felt this way <u>about the dot tracking task</u>

__________ 23. How motivated were you to perform well?

__________ 24. How much did you enjoy this task?

__________ 25. How much did you like your performance?

__________ 26. Did you feel at all competitive?

Indicate how well the following sentences describe your feelings <u>in general.</u>

1	**2**	**3**	**4**	**5**
Strongly Disagree				**Strongly**

_____1. I would want to get an A because that is the best grade a person can get.

_____2. I perform better when I am competing against someone rather than when I am the only one striving for a goal.

_____3. I do not care to be the best that I can be.

_____4. When applying for an award I focus on my qualifications for the award and why I deserve it, not on how the other applicants compare to me.

_____5. I do not feel that winning is important in both work and games.

_____6. When I win an award or game it means that I am the best compared to everyone else that was playing. It is only fair that the best person wins the game.

_____7. In school, I always liked to be the first one finished with a test.

_____8. I am not disappointed if I do not reach a goal that I have set for myself.

_____9. I have always wanted to be better than others.

_____10. Achieving excellence is not important to me.

_____11. When nominated for an award, I focus on how much better or worse the other candidates' qualifications are as compared to mine.

_____12. I would want an A because that means that I did better than other people.

_____13. I wish to excel in all that I do.

_____14. Because it is important that a winner is decided, I do not like to leave a game unfinished.

_____15. I would rather work in an area in which I can excel, even if there are other areas that would be easier or would pay more money.

1	2	3	4	5
Never	**Rarely**	**Occasionally**	**Frequently**	**Very Frequently**

________ 1. How often do you play videogames by yourself that require hand-eye coordination?

________ 2. How often do you play videogames with others that require hand-eye coordination?

________ 2. How often do you participate in sports (organized or recreational) that require hand-eye coordination?

________ 3. How often do you drive a vehicle?

Sex:

Male ○ **Female** ○

Age: __________ **years**

Ethnicity:

○ **African American/Black**

○ **Asian or Pacific Islander**

○ **Caucasian**

○ **Latino or Hispanic**

○ **American Indian or Alaskan Native**

○ **Other**

For experimenter:

Vita

James Bramlett was born and raised in Memphis, TN. His immediate family includes his loving parents: Amy and Rusty, along with his sister: Elizabeth. He is a graduate of Cordova high, where he played football, received passable grades in a variety of honors courses, and met lifelong friends with whom he still argues. James applied solely to The University of Tennessee and was unceremoniously accepted. He was swiftly placed on academic probation before deciding he had a stronger interest in science and psychology than learning how to write computer programs. This interest and change of field allowed him to remain at the University and eventually earn his bachelor's degree. James then worked a variety of restaurant jobs before securing a position as a case manager for a local mental health clinic. Within two years he again worked in a restaurant. Social work proved to be a poor fit for James and his personal mental health. Two years later he began retaking courses to meet the modest standards of the University of Tennessee Graduate School. During his period, he met his advisor, Garriy Shteynberg, with whom he helped design and program a study that would eventually become James's first publication. He was accepted to the Experimental Psychology department as a master's student and two years later, upon some demonstration of competency, as a doctoral student.

James's hobbies include: competitive gaming, billiards, debates, camping, playing guitar, as well as submitting to the occasional vice. He largely skirts by on his intelligence, but never fails to deliver, eventually. James has proudly fought against bureaucratic nonsense at the University of Tennessee since 2007.