The Faster Sex: Examining Trial Position Effects on Reaction Time

Honors Research Thesis

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by

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Abstract

Past research has studied the connection between reaction times (RTs) and general intelligence (IQ) in an attempt to understand individual differences in intelligence. Though general intelligence shows no gender differences, researchers have found a gender difference in reaction times. In past research, women showed slower initial choice reaction times compared to men, but became faster than men across a block of 12 trials. The present study examined whether this effect could be replicated across different RT tasks. Twenty six Ohio State University students (twelve men) participated in the study, completing four computer-based tasks: signal detection, in which the participants responded to a rectangle appearing on the screen; line-length judgment, in which the participants responded to the shorter of two lines; brightness discrimination, in which participants judged whether a pixilated rectangle appeared bright or dark; and numerosity judgment, in which participants judged whether there were many or few asterisk shown within a 10x10grid. It was hypothesized that males would outperform females during the first trial, and then females would outperform males during the remainder of the block; consequently, women would show a greater variability in RT in each task, as measured by the coefficient of variance (CV, standard deviation divided by the mean). We found a trial-by-trial effect on mean RTs for all tasks, but no trial-by-trial gender effect on mean RTs or CV across trials in any of the tasks. There was, however, a gender effect on CV across blocks in three of the tasks. These differences in results among tasks may be due to differences in the cognitive demands on each sex for each task, especially considering that sex differences are observed in a variety of tasks. This suggests that the type of tasks used can change the sex effect seen in a given RT study.

The Faster Sex: Examining Trial Position Effects on Reaction Time

Sex differences have captured people's interest since the dawn of time. The idea that men and women are fundamentally different in some way, barring the obvious physical differences, has been studied for centuries in a wide variety of disciplines. In psychology, for example, sex differences have been studied in intelligence and its correlates, such as reaction time.

Reaction time (RT) is typically defined as the time it takes for a person to perceive a stimulus and then show a motor reaction to it (Luce, 1986). It can be demonstrated, for example, in the time participants take to press a button in response to seeing a stimulus on a computer screen, for which sex differences have been found (e.g., Roivainen, 2011). These sex differences, however, appear to be task-dependent; whereas women outperform men on some RT tasks (e.g., tasks involving digits, letters, and rapid naming), men outperform women on other RT tasks (e.g., simple reaction time tasks and finger tapping) (Roivainen).

RT has also been studied in correlation with intelligence, following the hypothesis that people who can think faster are more intelligent (e.g., Sheppard & Vernon, 2008). Intelligence in this type of research is often measured by the Wechsler Adult Intelligence Scale's (WAIS) intelligence quotient, commonly known as IQ (Jensen, 1993; Sheppard & Vernon, 2008; Smith & Stanley, 1983). Sheppard and Vernon (2008) reviewed the last 50 years of intelligence and RT research, focusing on general intelligence (g), which can be measured by the WAIS or the Woodcock-Johnson (WJ) scales. Based on the findings from over one hundred studies, they found that depending on the RT measures used, the correlation between g and RT ranged from r = -0.22 to -0.40, demonstrating that smarter individuals also tend to be faster at reacting to stimuli.

In another review of past RT and intelligence research, Deary (2012) found that there have been varied results across the last 100 years of intelligence research. Since g was first introduced, there has been controversy among researchers in psychology over how to replicate the initial finding that intelligence and sensory discrimination are almost perfectly correlated. Though this was initially difficult to replicate, more recent research on the subject has found the correlation to be reproducible. The correlation between g and RT have been found in a variety of RT tasks, such as Hick paradigm-type tasks, in which the participants respond to a light appearing on a panel (Sheppard & Vernon, 2008) and simple RT tasks, in which participants know what and where a stimulus will be, and respond to it following a preparatory signal (Jensen, 1993).

Unlike sensory discrimination, sex has not been found to influence intellectual ability significantly (e.g., Feingold, 1988). As measured by IQ tests, such as the WAIS-IV and the WJ-III, g seems to show no significant sex differences (Camarata & Woodcock, 2006), although the individual components of these intelligence tests have shown sex differences. On the WJ-III, for example, females showed faster processing speed than males (d=0.378); males, in contrast, performed better on the verbal abilities measure than females (d=0.137), despite many other studies finding that women performed better on tasks involving verbal ability (e.g., Roivainen, 2011). The other broad abilities on the WJ-III (long-term retrieval, visual-spatial abilities, auditory processing, fluid reasoning, and short term memory) showed no significant sex effects (Camarata & Woodcock).

Recently, sex differences in cognitive abilities may be getting more difficult to find. Feingold (1988), for example, found that significant sex differences in cognitive ability observed in the 1940s have nearly disappeared today. His results suggest that the sex differences found on the Differential Aptitude Tests (DAT) in 1947 to favor women on spelling, language, and clerical speed and accuracy tests have decreased significantly as of 1980. Although men scored higher in mechanical reasoning and space relations tasks in 1947, these differences had also declined by 1980. The effect size of sex on scores had decreased by 57% from 1947 to 1980 on the mechanical reasoning task, for example, highlighting the fact that significant sex differences in general intelligence measures are not found in more recent literature (Feingold, 1988; Halpern & LaMay, 2000).

Similarly, declines in sex differences were found on the Preliminary Scholastic Aptitude Test (PSAT; Feingold, 1988). In just 14 years, from 1960 to 1974, the sex difference favoring men on the mathematical subtests on the PSAT declined by 50%; by 1980, the former sex difference favoring women on the PSAT verbal subtests was no longer statistically significant. On the whole, most of the cognitive sex differences favoring males on mathematical and spatial tasks and females on verbal tasks have declined severely or disappeared over the past few decades (Feingold).

A review of research on simple visual RT found that men and boys showed faster RTs than women and girls, d=0.17 (Silverman, 2006; Lock & Berger, 1993). Silverman's study analyzed 72 effect sizes of sex on RT taken from 21 studies. Silverman noted that the effect sizes of sex on RT have narrowed in the past 70 years, as the year the participants were tested accounted for 61.0% of the variance in effect size. According to Silverman, this may be due to the widespread participation of people in fast-action sports and driving, both of which require quick reactions to visual stimuli. Reviewing the influence of sex in motor performance, Jimenez-Jimenez et al. (2011) found that males outperformed females on a variety of motor performance tasks, including finger tapping, movement between two points, and walking time.

In particular, it seems that women have faster decision times than men, while men have faster movement times than women. When performing a choice RT task involving pressing buttons to indicate a choice, women decided which choice to make (indicated by removing their fingers from a rest button) faster than men, but men had shorter movement times (the time they took moving their finger from the rest button to the response buttons). This indicates that men are faster than women on tasks that mainly test motor skills (Landauer, 1981). In another study, men outperformed women in tasks using the Dynavision apparatus, a large board studded with lights that requires the participants to use their peripheral vision to see a light and then strike the light with their hand to indicate a response. Women appeared to move less aggressively during this task, which correlated with longer RTs (Klavora & Esposito, 2002).

Despite these sex differences in motor performance, Roivainen (2011) concluded that the sex effects seen in RT are affected by sex differences in reading and writing fluency. Women appear to have an advantage in tasks involving the alphabet or rapid-naming tasks, whereas men seem to have an advantage in simple RT tasks and finger-tapping.

Burns and Nettelbeck (2005), on the other hand, found that women have an advantage on the digit symbol (DS) test from the WAIS ($d = -0.42$), which requires subjects to match a symbol with a digit as quickly as possible. Thus, the nature of RT tasks seems to be a factor contributing to gender differences and to the direction of these differences.

Roivainen (2011) reviewed the recent research on RT gender differences and found that men outperformed women on most simple RT tasks, as well as a finger-tapping task. The RT tasks used in the studies Roivainen reviewed were largely signal detection tasks, in which the subjects had to press a key every time the digit 0 appeared on the display, or press one of four keys corresponding to when the digits 1, 2, 3, or 4 appeared on the display. The finger-tapping task measures simple motor speed by measuring the amount of times a person can press a lever with their index finger in a given time. Men performed significantly better on the finger-tapping task than women, suggesting that some of their superior performance on simple RT tasks may be due to faster motor responses rather than a cognitive difference. However, sex differences accounted for only 16-20% of the overall variance in how quickly they could tap their fingers (Heaton, Miller, Taylor & Grant, 2004). Therefore only a small amount of the overall sex difference in reaction time can be explained by differences in motor responses based on sex.

To evaluate sex differences in RT further, Deary and Der (2005), conducted a study in which a sample of 500 participants, in three age cohorts (16, 36, and 56 years) were tested on simple and choice reaction time. They tested the subjects using a portable machine with response keys arranged underneath a screen (see Deary, Der, & Ford, 2001, Figure 1). In the simple RT task, the participants pressed the ‘0’ key in response to a stimulus, whereas in the choice RT task, they pressed any key from 0 to 4 to reflect the number that appeared on the screen. Deary and Der observed that women had a greater overall variability on RTs than men in every age cohort, although this variability difference between sexes was more pronounced in older participants. They hypothesized that the observed sex differences were due to the effects of sex hormones on the participants’ brains, causing greater cognitive variability in women (Deary & Der; Reimers & Maylor, 2006).

Subsequently, Deary and Der (2006) found that the RTs of women are on average both slower and more variable than those of men. Their subjects completed a simple reaction task, in which they pressed a key each time the numeral 0 appeared on the display. They also performed a choice RT task in which they pressed the keys 1, 2, 3, or 4 in response to which corresponding digit appeared on the display. The results showed that sex had a statistically significant effect on both simple RT mean, $\eta^2=0.012$, and on choice RT mean, $\eta^2=0.003$. There was also a significant effect of sex on intrasubject standard deviation, for simple RTs, $\eta^2=0.004$, and for choice RTs, $\eta^2=0.017$. In light of these results, Deary and Der hypothesized that sex difference in RTs might be due to the speed-accuracy tradeoff, that is, women might be reacting more slowly but making fewer errors than men. However, when they analyzed the variance between the error rate and sex, no interactions were significant for either of the tasks.

Also following Deary and Der (2005), Reimers and Maylor (2006) were interested in determining the reason for a sex difference in variability. They hypothesized that if you consider the RT for each trial in a block of trials separately, an interaction between trial number and sex would be evident. They believed that this was a more compelling reason for the sex effect on RT variability seen in Deary and Der than sex hormones. Reimers and Maylor’s participants performed three RT tasks: sex classification, in which participants responded to either a male or female face; emotion classification, in which participants responded to either a happy or sad face; and switching, in which participants responded to a mix of male/female and happy/sad faces. Each participant responded to one block of twelve trials for each task.

When analyzing the data with a split-plot analysis of variance, they found that across a block of 12 trials, the initial performance was slower for women than men, but the final performance was faster for women than men; there was a statistically significant interaction between trial number and sex, $F(3.98, 20388.86) = 14.96$, $p<0.001$. Reimers and Maylor argued that the way performance changed across trials accounted for the sex differences in RT, which caused the greater variability seen in women's RTs. This increased variability in women's performance across a block of trials may account for their apparent poor performance in some RT tasks in comparison to men.

In Reimers and Maylor (2006), however, there were no practice trials included in the blocks, which may exaggerate the trial-to-trial differences at the beginning of a block. This could be a problem especially because they used a relatively short block of 12 trials. The present study seeks to determine whether Reimers and Maylor's trial-to-trial gender effect can be replicated in RT tasks of different nature and whether the effect would change when examining longer blocks of trials, disregarding initial practice trials.

We hypothesized that the sex effects seen by Reimers and Maylor (2006) might be due in part to the nature of the tasks they chose, since it is known that certain RT tasks favor one sex's performance over the other (e.g. Roivainen, 2011). To test this hypothesis, we used four different computer RT tasks, viz., brightness discrimination, signal detection, line length judgment, and numerosity judgment. We hypothesized that in each task, women would be slower than men on the initial trials but faster than men on the final trials, and women would show overall greater variability in RT in each task.

Our study aims to further RT research by demonstrating that the tasks used to measure RT can have a significant effect on the results, specifically on the sex differences and sex and trial position interaction effects found. This may help future research in this area by suggesting that researchers should look carefully at the effect of task nature on their results before generalizing their findings based on RT.

Method

Participants

Data were collected from 40 participants, who were recruited through flyers posted in the Psychology Department on Ohio State's Columbus Campus and received up to $30 for their complete participation. Fourteen of these participants took part in a pilot study; we report the results of the remaining 26 participants. They ranged in age from 18 years and 6 months to 28 years and 11 months, with a mean age of 22 years and 6 months. There were 14 women and 12 men.

Measures

Following Leite (2009) and Bennett (2011), RT was measured in four tasks (signal detection, line length judgment, brightness discrimination, and numerosity judgment) completed on personal computers using the Linux operating system. The tasks were presented in 14 blocks of 36 trials each, preceded by a practice block of 20 trials. The length of the blocks was extended from Reimers and Maylor's (2006) 12 trials in order to determine if the same sex effects (women initially slower than men, then later faster than men) would be observed in longer blocks of trials. Participants were given feedback in the form of "TOO FAST" or "Too slow" messages when their responses fell out of the typical range of RTs for each task, as determined by the results of the pilot study. The participants were also given an "ERROR" message during the line length, brightness discrimination, and numerosity judgment tasks following an incorrect response.

Signal Detection. In this task, participants were required to look at a fixation mark in the center of the screen. The fixation mark remained on the screen for a variable interval, between 300 and 1200 ms, after which a 20^2- or 50^2-pixel yellow square appeared anywhere on the 640- by 480-pixel screen. This variable interval between the fixation mark and the stimulus appearance was intended to prevent participants from responding to a fixed interval rather than the stimulus. When the yellow square appeared, participants responded by pressing the "/" key. The "TOO FAST" message was given if the RT was shorter than 25 ms, and the "Too slow" message was given if the RT was longer than 800 ms. After a response was given, there was a lag time with a blank screen showing for 400 ms plus another 400 ms if feedback was given.

Line Length Judgment. In this task, two different length vertical lines were drawn under each third of a horizontal line. The horizontal line spanned 44 pixels, while the vertical lines were 85 or 71 pixels long. All three of the lines were about 3 pixels wide. The participants responded to the shorter of the two lines, either on the left or right, by pressing the "z" and "/" keys, respectively. The "TOO FAST" message was given if the RT was shorter than 50 ms, and the "Too slow" message was given if the RT was longer than 1200 ms. There was an intertrial interval of 250 ms plus 400 ms if they received feedback.

Brightness Discrimination. In this task, participants judged whether a 160- by 100-pixel square on the screen filled randomly with black and white dots appeared brighter or darker, again by pressing the "z" and "/" keys. For half of the participants, "z" corresponded to brighter and "/" corresponded to darker; the reverse was true for the other half of the participants. There were two difficulty levels, depending on the percentage of black and white dots present; in the easy condition, the block was considered to be darker if it had 62.5% black dots, whereas in the difficult condition it was considered to be darker if it had 57.5% black dots. The "TOO FAST" message was given if the RT was shorter than 100 ms, and the “Too slow” message was given if the RT was longer than 1200 ms. There was an intertrial interval of 250 ms plus 400 ms if they received feedback.

Numerosity Judgment. In this task, participants judged whether there were many or few asterisks present within a 10-by-10 grid on the screen, by pressing either the “z” or “/” keys. For half of the participants, “z” corresponded to many asterisks and “/” corresponded to few asterisks. The opposite was true for the other half of the participants. The grid could contain up to 100 asterisks; it was considered to have few asterisks if there were fewer than 50 present, and many asterisks if there were 50 or more present. To keep the task from being too simple, the number of asterisks presented was never less than 41 or more than 60; the easy condition ranged from 41-45 and 56-60 asterisks and the difficult condition ranged from 46-50 and 51-55 asterisks. The “TOO FAST” message was given if the RT was shorter than 100 ms, and the “Too slow” message was given if the RT was longer than 1300 ms. There was an intertrial interval of 250 ms plus 400 ms if they received feedback.

Results

We analyzed the data using repeated measures analysis of variance (ANOVA), with either block or trial number as the within-subjects factor and sex as the between subjects factor. We analyzed both mean RTs and the coefficient of variance (CV – defined as standard deviation divided by the mean) of the RTs.

In order to attempt to replicate Reimers and Maylor’s (2006) findings that women have slower RTs in the first trial than men and then faster RTs in later trials, we initially analyzed just the first twelve trials in each block. Unlike Reimers and Maylor, we did not find any significant sex effects on the mean RTs for any of our tasks across trials (Figure 1). We did, however, observe a significant sex effect on CV across blocks in three of the four tasks: signal detection ($p = .016$), line length judgment ($p = .010$), and numerosity judgment ($p = .040$). In addition, we found a trial position effect on CV in the signal detection task ($p = .047$) and an interaction effect of trial position and sex in the numerosity judgment task ($p = .020$; Figure 2).

Because the first trial in each block typically showed the longest RTs, we examined whether removing the first trial in each of the blocks would eliminate the interaction effect between trial position and sex in the numerosity judgment task. A reanalysis of the numerosity judgment data without the first trial from each block produced a non-significant interaction effect of trial position and sex, ($p = .082$; Figure 3).

Next, we extended the analysis to the entire block of 36 trials, in order to determine if a longer block of trials would have an effect on the results. The results of these analyses are summarized in Table 1. In the longer blocks of trials, both the signal detection and numerosity tasks showed no sex effect on RT, and no interaction between trial position and sex. The line length task also showed no significant sex effect on RT, but it did show a significant effect of block position on RT ($p = .003$). Consistent with Reimers and Maylor (2006), women started out slower than men on the first trial and then gradually became faster than men on trials 2 through 36. However, this sex and trial position interaction was not statistically significant for any of the tasks. In the brightness task, we found a significant effect of sex on RT ($p = .016$). In this task, men were, on average, faster than women throughout all of the blocks. However, the brightness discrimination task did not show an interaction effect of trial position and sex.

The signal detection task and brightness discrimination task also did not show a significant effect of sex on the coefficient of variation of blocks, a measure of the variability in RTs. However, the other two tasks did show a significant effect of sex on coefficient of variation of blocks, line length judgment ($p = .032$) and numerosity judgment ($p = .028$). In both tasks, women were more variable than men across blocks.

Across trials, signal detection and line length tasks did not show any sex effect on the coefficient of variation. However, the other two tasks did show a significant effect of sex on coefficient of variation across trials: brightness ($p = .043$) and numerosity ($p = .020$). Again, in both tasks, women were more variable than men across trials. Figure 4 illustrates the pattern of these results. Removing the first trial from the analyses in this case did not alter the results (see Table 2 and Figure 5). The effect of sex on RT was significant in only the brightness discrimination task ($p = .016$), and the effect of sex was significant on CV in the brightness discrimination ($p = .041$) and numerosity judgment tasks ($p = .020$).

In our design, we also used a mix of easy and difficult trials for each task. In order to be sure that these different conditions did not confound the results, we analyzed the easy and difficult conditions in each task separately. For the easy condition, the signal detection, line length judgment and numerosity judgment tasks did not show any significant effects of sex on RT. The brightness discrimination task did show an effect, however ($p = .036$). The coefficients of variation showed a significant effect of sex in the line length discrimination task ($p = .015$) and the numerosity judgment task ($p = .029$). Neither signal detection nor brightness discrimination showed a significant effect of sex on coefficient of variation.

In the difficult condition, only the brightness discrimination task showed a significant effect of sex on RT ($p = .009$). The other three tasks did not show any effect of sex on RT. There was a significant effect of sex on the coefficients of variance of line length judgment ($p = .030$), brightness discrimination ($p = .031$), and numerosity judgment ($p = .028$). There was no effect of sex on the coefficient of variance in the difficult condition of the signal detection task. In short, the results of the easy and difficult conditions do not differ from the overall results of the longer trials, indicating that the easy and difficult conditions did not confound the results (Table 3). In addition, we removed the first occurrence of an easy or difficult trial in each block and reran the analyses, obtaining the same results: the brightness discrimination task showed significant sex effects in both easy ($p = .031$) and difficult ($p = .008$) conditions (Table 4).

Discussion

The present study examined the interaction effect between trial position and sex on RT, as found in Reimers and Maylor (2006). The participants completed four RT tasks, responding to 14 blocks of 36 trials for each task. We tested the hypothesis that women would have slower RTs in the initial trials than men, and then faster RTs in the following trials, as in Reimers and Maylor (2006). We also hypothesized that women would show an overall greater variance in RTs, as measured by coefficient of variance (CV – defined as standard deviation divided by the mean).

Consistent with our first hypothesis, we found that women were initially slower and then later faster than men across a block of trials in the brightness discrimination task. Contrary to that hypothesis, however, the other three tasks did not show this result. This difference in results across tasks is favorable to an explanation based on task nature differences. That is, based on what we found, it is plausible that the cognitive demands in brightness discrimination affect the two sexes differently across trial positions, but the demands of other RT tasks are such that no sex-trial position interaction exists.

This selective influence could also explain why Reimers and Maylor (2006) found the interaction effect between sex and trial position in their tasks, the sex and emotion classification tasks, in which they found women to be slower than men in the first trial of a block, but then faster than men in the subsequent trials. Whether the more complex visual tasks in Reimers and Maylor and our black-and-white pixel contrast use the same cognitive resources or are two distinct examples of tasks in which the sex-trial position interaction can be observed is an open research question. The potential for a selective influence of task nature, however, is similar to that reported in Leite (2009).

We also found significant sex effects on CV across trials in the brightness discrimination and numerosity judgment tasks, as well as sex effects on CV across blocks in the line length judgment and numerosity judgment tasks. Although these results were consistent with the hypothesis that women would show more variability in their RTs, we did not see consistent CV results in all four of the tasks. Again, this may point to a difference in task nature. Each of the tasks is slightly different and therefore may use different cognitive processes, which may cause some of them to show sex effects on CV while others do not.

When analyzing just the first twelve trials of each block to more closely follow Reimers and Maylor's (2006) study, we initially found an interaction effect between sex and trial position in the numerosity judgment task. However, when we removed the first trial and reran the analyses, the interaction effect disappeared. This supports the current convention in reaction time research to disregard the first trial in each block, precisely because that trial tends to show a significantly longer RT than the following trials – typically making it an outlier. This is thought to be due to starting (or restarting) the task, which causes participants to react unusually slowly on the first trial. Removing the first trial from the analysis of the numerosity task caused the interaction to disappear, which suggests that the effect seen in that task was an artifact of including the first, abnormally slow trial in the analysis. It is possible that the effect Reimers and Maylor (2006) observed in their study may have been amplified by including the first trial in their analyses.

In summary, we were only able to replicate Reimers and Maylor's (2006) findings in some of our tasks. This may be due to differences in task nature, especially considering that sex differences are observed in a variety of tasks, with some favoring women and others favoring men. We also found that removing the first trial from the analysis of a task that showed the sex and trial position interaction effect caused the effect to disappear. This supports the convention of removing the first trial from analyses of RT data. The finding is important because it lends support to a standardization of the methods used to analyze data in all RT studies.

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Table 1

Effects of sex on RTs, CV across blocks, and CV across trials

	RT	CV (Across Blocks)	CV (Across Trials)
Signal Detection	NS	NS	NS
Line Length Judgment	NS	p = 0.032	NS
Brightness Discrimination	p = 0.016	NS	p = 0.043
Numerosity Judgment	NS	p = 0.028	p = 0.020

Note. NS = not significant.

Table 2

Effects of sex on RTs and CVs across trials 2-36.

	RT (Trials 2-36)	CV (Across Trials 2-36)
Signal Detection	NS	NS
Line Length Judgment	NS	NS
Brightness Discrimination	p = 0.016	p = 0.041
Numerosity Judgment	NS	p = 0.020

Note. NS = not significant.

Table 3

Effects of sex on RT and CV in the two task conditions

	Easy		Difficult	
	RT	CV (across blocks)	RT	CV (across blocks)
Signal Detection	NS	NS	NS	NS
Line Length	NS	$p = .015$	NS	$p = .030$
Brightness	$p = .036$	NS	$p = .009$	$p = .031$
Numerosity	NS	$p = .029$	NS	$p = .028$

Note. NS = not significant.

Table 4

Effects of sex on RT and CV in the two task conditions for appearances 2-18

	Easy	Difficult
	RT	RT
Signal Detection	NS	NS
Line Length	NS	NS
Brightness	p = .031	p =.008
Numerosity	NS	NS

Note. NS = not significant.

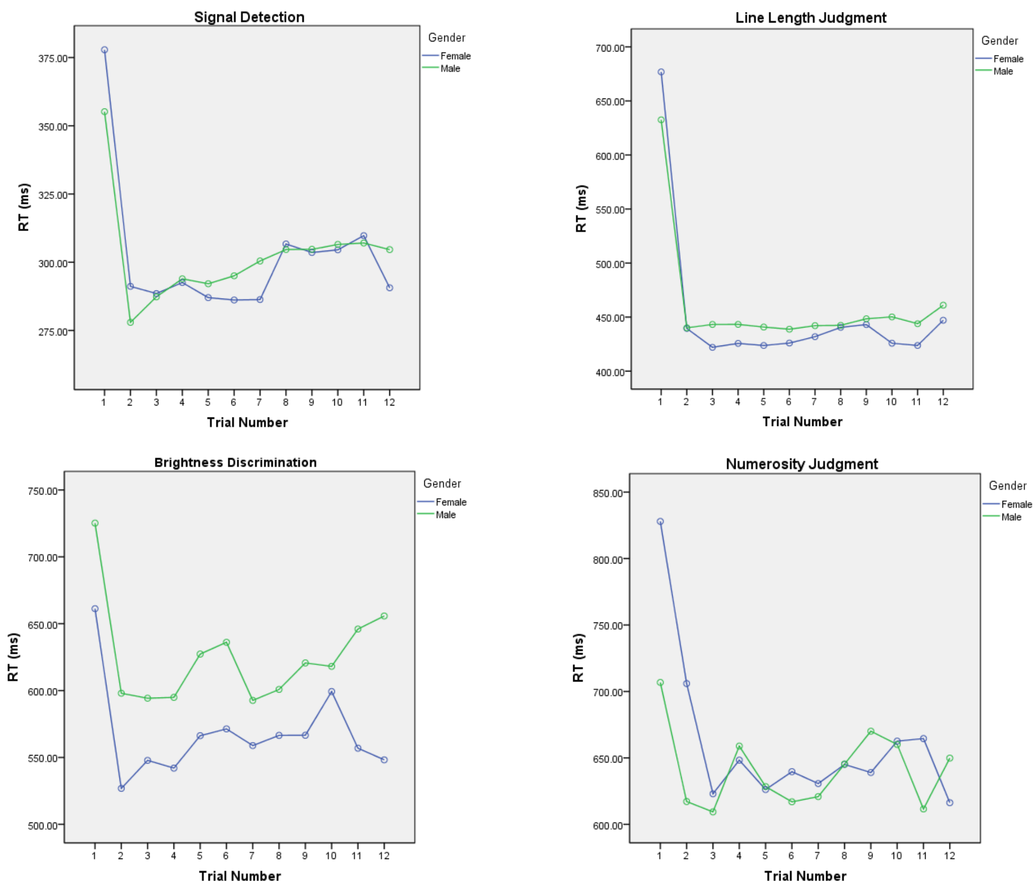

Figure 1. Results of the mean RT analysis of the first twelve trials in each task. The trials have been averaged across the fourteen blocks of tasks.

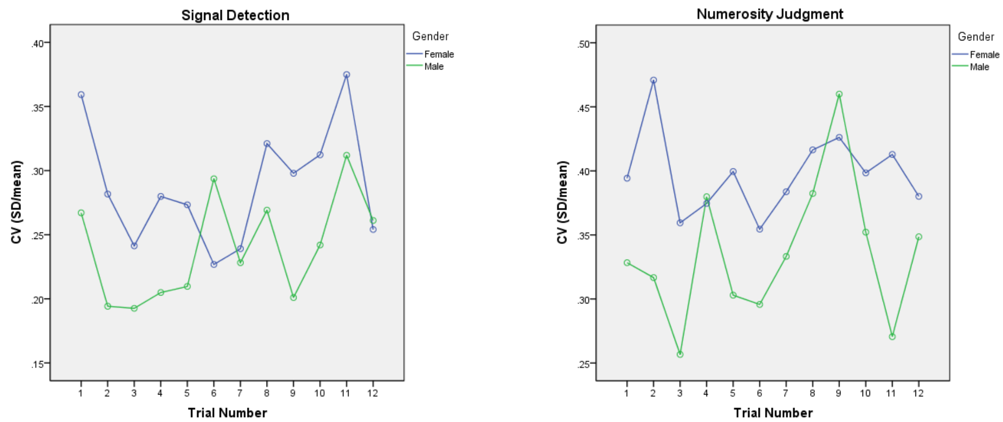

Figure 2. Illustration of the CV across the first twelve trials in the signal detection and numerosity judgment tasks. The trials have been averaged across the fourteen blocks of tasks.

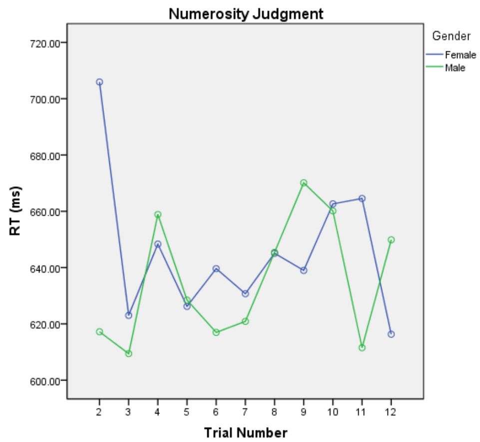

Figure 3. Mean RT over trials 2 through 12 in the numerosity judgment task. The trials have been averaged across the fourteen blocks of tasks.

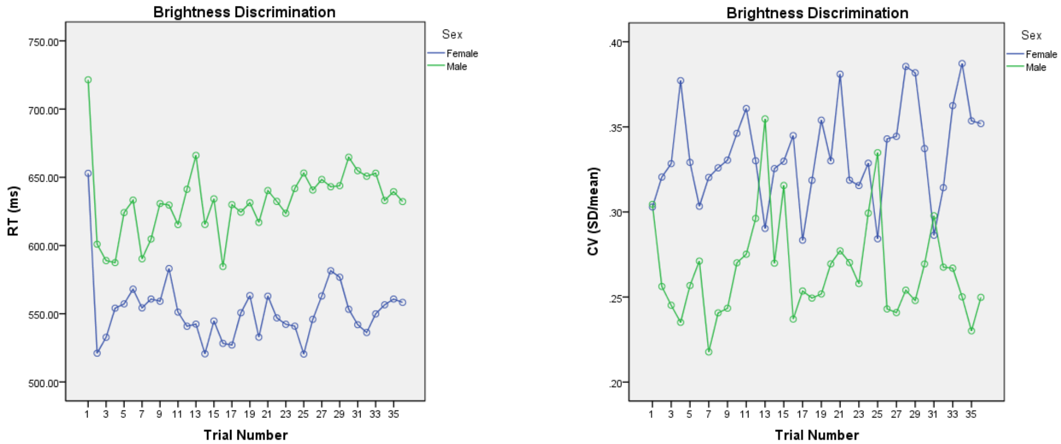

Figure 4. RT across trials and CV across trials for the brightness discrimination task. The trials have been averaged across the fourteen blocks of tasks.

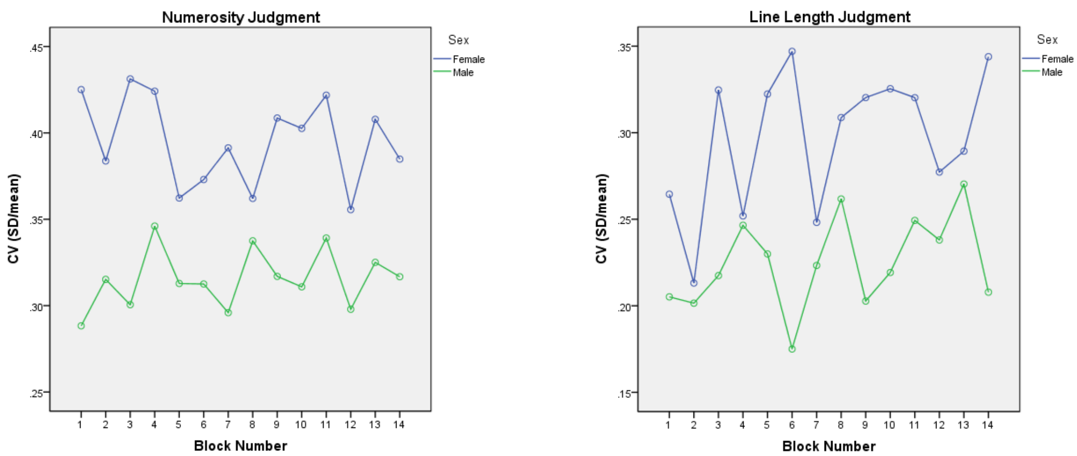

Figure 5. CV across blocks for the numerosity and line length judgment tasks. The trials have been averaged across the fourteen blocks of tasks.