Training and Gender Differences on a Web-Based Mental Rotation Task

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Previous research, has documented that there are gender differences for the mental rotation task, favoring males (Sorby, 1998). We investigated whether training on a web-based mental rotation task would improve speed and accuracy over a four-week period. There were three training groups: a lab-training group, who had four training sessions in the lab, a self-training group, who had two training sessions in the lab and two training sessions on their own, and a no training group, who only had two training sessions in the lab and surfed the Internet for the other two sessions. Each type of training group had five different sections. We expected to find that initially men would have a significantly higher score on the mental rotation task than women and that the four sessions training groups (either lab or self-training) would improve significantly more in the mental rotation task than the two session (no training) group. We also expected to find that the lab-training group would improve significantly more on the mental rotation task than the self-training. Men did have initially higher spatial scores than women, however both groups improved in both speed and accuracy. For females both laboratory and self-training appeared to be effective and four sessions were more useful than two sessions.

There are numerous careers, as well as everyday activities, that require the use of spatial abilities (Sorby, 1998). Spatial abilities are used by a variety of people ranging from engineers to the quarterback of the high school football team. The perception of one's spatial abilities may be as important as one's actual abilities. If spatial skills are perceived as poor they may influence the type of activities or careers that a person will choose. The purpose of this study is to investigate the possible improvement of one type of spatial skill (mental rotation) for both males and females in three different training conditions.

According to a large-scale meta-analysis (Voyer, Voyer, & Bryden, 1995), there are three types of spatial abilities, spatial perception, mental rotation, and spatial visualization. Spatial perception is defined as the ability to ignore distracting information and identify spatial relations. Spatial perception involves the ability to perceive the location of something vertically and or horizontally. Mental rotation is defined as the ability to rotate two and three-dimensional objects in the imagination. This is to be done quickly and accurately. Spatial visualization is defined as the ability to produce the correct solution when given complex spatial information, which takes several steps to solve.

According to Sorby (1998), there are three stages of spatial development. In the first stage, topological skills are developed. These skills include the ability to recognize an object's closeness to others, its order in a group, and its isolation or enclosure by a larger environment. These skills are usually acquired by age five. The second stage includes the development of projective spatial skill, which is the ability to visualize three-dimensional objects and perceive what they might look like from a different viewpoint or rotated in space. When unfamiliar or moving objects are used, this stage can be very difficult for all ages. This skill is though to be acquired at high school or college age. The third stage includes the abilities to visualize the concepts of area, volume, distance, translation, rotation, and reflection. This stage is the combination of measurement and projective skills.

There is considerable controversy over both the existence and the magnitude of gender differences in spatial abilities. Although some studies have found no gender differences, (Caplan, MacPherson, & Tobin, 1985), other studies have revealed sex differences favoring males that have persisted across development (Linn & Petersen, 1985). A meta-analysis by Linn and Peterson (1985) suggested that this depends on the spatial task that is being measured. For example, there are small but significant gender differences in spatial perception and somewhat larger differences in mental rotation favoring males. Spatial visualization did not show significant gender differences. This was consistent with the findings of Geary, Gilger and Elliot-Miller (1992), which again demonstrated the existence of gender differences, with the most significant differences found in mental rotation.

There are several theories that attempt to explain gender differences in spatial abilities using both biologically based and nonbiologically based perspectives. One socio-biological explanation is presented in the Hunter-Gatherer theory of spatial gender differences (Eals & Silverman, 1996). This theory describes spatial gender differences as a result of human-evolution. Males were hunters and therefore, they excelled in tasks that used spatial abilities. Females were gatherers and they excelled in tasks related to foraging, such as peripheral perception. This may allow females to have a greater recall of objects in arrays. However, this view is controversial, as a variety of social explanations have also been offered.

There is some evidence to support a biologically based explanation. Men showed an increase in right hemispheric activation while they process spatial information (Gur, et al., 2000). Conversely, women did not show an increase in right hemispheric activation. In fact, women showed more bilateral activation in spatial processing. Greater spatial performance is associated with a greater activation of the right hemisphere. The bilaterality of women may underlie the sex differences in spatial performance because the right unilateral activation of men is associated with greater spatial performance (Gur, et al., 2000). A problem with this finding is that differences in lateralization do not mean that one way of processing information is better than the other. The explanation is circular.

Although research has shown different brain activations for males and females, there is still controversy as to what extent nature and nurture is involved. The type of environment and the activities that are suggested for each gender will also influence the development of spatial abilities. According to Baenniger and Newcombe (1989), males have an environment that provides them with more opportunities to engage in spatial tasks and are also encouraged to participate in more activities that require the use of spatial skill than women. For example, males are more often encouraged to participate in contact sports and given more toys that require hand-to-eye coordination, which aids in the development of these skills (Baenniger & Newcombe, 1989).

The extent to how much spatial abilities can be trained is an important issue. Practice effects have also been observed in previous research for spatial abilities. Saccuzzo, Craig, Johnson, and Larson (1996) found that both men and women showed improvement in their spatial abilities with practice, even if the practice occurred on computer-based tests. Initially males performed significantly better than females; however, with practice females improved at a significantly higher rate. There is some controversy as to how much training benefits the two genders. Saccuzzo's et al. (1996) research also revealed that men scored higher than women in all areas of the spatial ability tasks that were tested. However, Baenniger and Newcombe (1989) suggested that women might have more room for the improvement of spatial skills because men are operating closer to their maximum potential. However, research done by Sorby (1998) suggests that there is significant room for improvement of spatial skill for both men and women depending on the difficulty of the task. The current research hopes to investigate this issue.

Baenniger and Newcombe (1989) set some guidelines for research that involves the training of spatial skills. There are several characteristics of effective training. This research states that training needs to be spatial in nature and it must allow both duration and content to be reported in detail. Duration involves the length of the sessions and the number of the sessions, and content refers to the detail of instruction. Duration is broken down into three categories: long, medium, and short. Long duration is defined as semester long. Medium duration is more than one administration that lasts for more than three weeks or that is part of a curriculum that lasted less than one semester. Finally, short duration is defined as single or brief administrations, which lasted less than three weeks and is not part of a curriculum.

Baenniger and Newcombe (1989) also defined two different types of training, which include practice effects samples and pre-test/post-test samples. Practice effects samples are defined as repeated administration of a sample spatial ability measure. Pre-test/post-test samples require that two administrations of the same spatial ability measure. They also classified training as general or specific. General training will focus on a broad range of spatial abilities, whereas specific focuses on a single area. Finding improvement within task-specific training supports the concept that it is possible to directly train spatial abilities. By following these prescriptions of training, Baenniger and Newcombe (1989) found that any type of training would significantly increase spatial test performance. The current study uses the task-specific practice effect sample style of training because it focuses only on a single area, mental rotation. The mental rotation task also has a medium duration because it consisted of four administrations, which lasted four weeks.

The distribution of practice also has an effect on training. Massed practice, which occurs all at once, is better for short-term training, but is not sufficient for long-term training. Rather, spaced practice, or practice spread out over time, is ideal for long-term retention (Druckman & Bjork, 1991). We hope that by using spaced practice, we will increase the chances for long-term retention. There is a need for scientific research on spaced practice because most studies use massed practice due to time and financial constraints. Mass practice is less efficient because it does not produce long-term retention (Druckman & Bjork, 1991).

In our study, we investigated the effectiveness of three types of training for male and female college students. The lab training group came to the lab four times one week apart and completed a mental rotation task. The self training group came to the lab in week 1 and then were asked to log onto the site on their own in weeks 2 and 3 and then returned to the lab for the final session in week 4. Investigating self-training is new to this field and the result can be vital for the implementation of training. If people are willing to do training on their own, this could make training more widely accessible and economically feasible. The no-training groups came to the lab for four weeks but completed the mental rotation task only in week 1 and week 4, so in essence they were a two session training group.

We hypothesized that the men would be faster and more accurate on the mental rotation task than women. According to previous research (Voyer, et. al, 1995), the mental rotation task is the spatial skill that shows the largest difference between men and women. However we were interested in whether one type of training might be more useful for women and whether men and women would improve at different rates. We hypothesized that the training group (either lab or self-training) would improve significantly more in the mental rotation task than in the no training group. Additionally, previous research has shown that spacing training sessions out, as we are doing in our research, is significantly more effective than massed training (Druckman, & Bjork, 1991).

We also hypothesize that the lab-training group (meeting in the lab every week) will improve significantly more on the mental rotation task than the self-training group (training on their own every week). In this research, self-trainers will be expected to do their weekly sessions on their own. However, the lab-trainers will have supervised weekly sessions, which will guarantee that they are doing the training. Although there is little previous research for self-training, if the members of this group do not fulfill their training sessions or take them seriously, we would not expect their improvement to be as great as the members of the lab-training group.

Method

Participants

One hundred and sixteen undergraduate students at Penn State Erie, The Behrend College received course credit for participating in this experiment. There were fifty males and sixty-six females. The participants were randomly assigned to three groups, which are based on the type of training the participant received. The three types of training were lab-training, self-training and no training. The lab-training group consisted of fifteen males and twenty females. The self-training group consisted of twenty males and twenty-six females. The no training group consisted of fifteen males and twenty females.

Materials

We used 10 Internet ready computers in a small lab setting to the access the on-line mental rotation task at The Visualization Assessment and Training site (http://www.psbeh7/VIZ/). The site asked for informed consent each time the participant logged on. Feedback was given upon completion of the task (Blasko & Holiday-Darr, 1999).

The participants completed The Mental Rotation Task (Blasko & Holiday-Darr, 1999), which is a web-based training program with forty-eight, randomly presented, mental rotation problems. Each mental rotation problem consisted of two separate flat patterns. The figure on the left side of the screen was the reference object, and the figure on the right side of the screen was the test object. The participant was asked to indicate whether the objects are the same only rotated in space, or if the objects are completely different. The participants pressed the 1 key if they were the same and the 2 key if they were different. The web-based mental rotation task consisted of two practice problems, which contained the option of having the program rotate the object to show the reasoning behind the correct answer. This was done by clicking the, “show me”, button on the screen. When the practice problems were completed, the actual trials began. There were 48 trails in two pools, so that when the subjects repeated the task they received different items. The program presented the items in a different random order to each participant. The participants were required to press the return key after each problem.

An ID number was given to the participant immediately after they logged onto the site. The ID number allowed anonymity of the participants. A demographic survey was administered on the web the first time the participant used the mental rotation task. This survey asked questions on gender (male or female), age group, experience with graphics, and dominant hand.

The Multidimensional Aptitude Battery-form L was given (Jackson, 1996) was administered at the end of the fourth session. This test is a subscale of an intelligence test, which was given to assess concurrent validity. This test required a total of seven minutes to administer.

If people do not enjoy a task or find it frustrating, then they are unlikely to do the task again; therefore, a usability survey was developed. It consisted of twelve questions, which focused on the participant’s thoughts and feelings about the program and how it could be improved. The survey was scored using a 3-point scale; with 3 being the lowest rating and 1 was the highest rating. The survey asked questions about the participant’s familiarity with computers and Internet use, about the ease of use of the computers, the directions of the task, the mental rotation task itself. Questions about how much the participant liked the task on the computer, the layout of the program, and completing the mental rotation task were also asked. Questions pertaining to learning the mental rotation task and spatial skills were also asked in the survey. The final questions dealt with the aspect of training with the mental rotation task.

Design and Procedure

The participants were randomly assigned to one of three possible training groups. Each group participated in four sessions. The lab-training group came to the psychology lab for all four one-half hour sessions and completed the mental rotation task each time. The self-training group came to the psychology lab for the first and fourth sessions and did the mental rotation task; however, for the second and third sessions, this group was asked to log onto the site and complete the mental rotation task on their own. The no training came to the psychology lab for all four sessions, but only completed the mental rotation task on the first and fourth sessions and surfed the web for the second and third sessions.

The first session for all groups consisted of a demographic survey that asked for the participant's gender, age, experience with graphics and handedness, was given prior to beginning the task. Then, a copy on instructions was given to the participants, so they could read along while the instructions were given to them. A take-home sheet that listed the dates and times that the participants need to return, or in the case of the self-trainers, the dates and times that they needed to complete the mental rotation task was given at the end of the first session.

The second session consisted of the lab and no trainers returning to the psychology lab. The lab-trainers completed the web-based mental rotation task, while the no trainers surfed the Internet. The self-trainers did not return to the psychology laboratory for the second session because they were to complete the task on their own.

The third session consisted of the lab and no trainers again returning to the psychology laboratory. The lab-trainers completed the web-based mental rotation task, while the no trainers surfed the Internet. The self-trainers did not return to the psychology lab for the second session because they were to complete the task on their own.

At the fourth and final session, all groups completed the web-based mental rotation task. The Multidimensional Aptitude Battery-form L (Jackson, 1996) was administered at the end of the session. The usability survey was also administered at the end of the session.

Results

Our first question was whether attrition rates were equivalent based on sex and group. The attrition rates for each training group were as follows: male lab-trainers 40%, female lab-trainers 5%, male self-trainers 55%, female self-trainers 35%, male no trainers 27%, and female no trainers 15%. Collapsed across the groups, there was no significance differences in attrition between males and females, χ^2 (1, N = 198) = 1.20, $p > .05$. Three male lab-trainers and five female lab-trainers were also lost due to experimental error.

Before we could assess whether training was effective in the different groups we first needed to establish that our groups were equivalent at the outset. We completed a series 2 (sex) X 3(training group) ANOVAs to compare the three groups on accuracy and reaction time at Session 1. We found no differences between any of the training groups , $p > .05$. There was however, a significant sex difference for accuracy, F (1, 73) = 8.63, $p < .01$, but not for accuracy. These results reveal that males were significantly more accurate at the first session than females but that the three training groups are indeed equivalent

The means and standard deviations of scores across the three groups for Session 1 and 4 are shown in Tables 1 (accuracy) and Table 2 (reaction times). A series of 3 (Group: lab training, self training, no training) x 2 (Sex: male, female) x 2 (Session: Session 1, Session 4) ANOVAs were conducted for accuracy and reaction time. For accuracy there was a main effect of Session, F (1, 66) = 18.83, $p < .001$, indicating that Session 4 produced more accurate scores. There was also a significant main effect of sex, with males out performing females, F (1, 67) = 7.17, $p < .01$. There was an overall significant difference in reaction time between Sessions 1 and 4, F (1, 66) = 78.93, $p < .001$ indicating that Session 4 yielded faster response times. There was no significant main effect of sex on reaction time, $F < 1$.

For reaction time there were no significant, $p < .05$, interactions between sex, session and group, however, the two way interaction between group and sex approached significance, $F(2,69) = 2.60$, $p = .08$. For accuracy there were also no statistically significant interactions, however a number of effects approached significance, the interaction between session and group, $F(2,93)$, $p = .06$, the interaction between group and sex F (2, 69) , $p = .09$, and the three-way interaction between session, group and sex $F(2,69)= 2.46$, $p = .09$. This suggests that the training effects may not be completely equivalent between the groups and motivated follow-up analyses to exploring the effects within the groups.

Table 1
Means and Standard Deviations of Accuracy (number correct out of 48)
For Session 1 and Session 4

	Session 1		Session 4	
Condition	*M*	*SD*	*M*	*SD*
Lab Trainers	34.45	5.99	37.70	6.75
Males	36.00	7.96	37.50	9.14
Females	33.79	5.13	37.79	5.87
Self Trainers	37.19	4.74	39.96	5.56
Males	38.78	3.34	41.33	4.24
Females	36.39	5.20	39.28	6.10
No Trainers	36.68	7.31	37.61	7.32
Males	41.45	2.70	42.54	3.27
Females	33.59	7.74	34.41	7.50

Table 2
Means and Standard Deviations of Reaction Time (seconds) for Sessions 1 and 4

	Session 1		Session 4	
Condition	*M*	*SD*	*M*	*SD*
Lab Trainers	6.04	2.61	3.41	1.15
Males	6.93	3.47	3.20	0.71
Females	5.66	2.20	3.51	1.30
Self Trainers	7.77	3.47	4.55	2.29
Males	6.18	2.31	3.86	2.14
Females	8.56	3.72	4.90	2.34
No Trainers	6.88	3.38	5.38	2.13
Males	7.87	3.07	5.82	1.69
Females	6.24	3.50	5.09	2.37

Paired Samples t-tests were used to determine if males and females in all groups improved in accuracy and speed between Session 1 and Session 4. Note that interpretations of the analyses are limited in that the sample sizes for some of the groups are quite small. For males in the lab-training group there was no significant difference for accuracy, t (13) = 1.02, *ns*; however, there was a significant difference for females, t (13) = 3.35, $p < .01$ indicating that females were more accurate at Session 4. For males in the self-training group there was no significant difference for accuracy, t (8) = 1.38, *ns*; however, for females in the self-training group there was a significant difference, t (17) = 3.08, $p < .01$ indicating that females were again more accurate at Session 4. For males in the no-training group there was no significant difference for accuracy, t (10) = 1.47, *ns*, females also failed to show a significant difference for accuracy, t (16) = .99, *ns*.

Paired Samples t-tests were also performed to investigate differences in reaction time between sessions one and four for males and females in all three training groups. Males in the lab-training were faster in session 1 than in session 4, t (13) = 2.99, $p < .05$ Females in the lab-training group also showed a significant difference for reaction time, t (13) = 4.53, $p < .01$ indicating that females were also faster at session four. Males in the self-training group were also faster at session 4 than at session 1, t (8) = 4.28, $p < .01$. Females followed this same pattern for reaction time, t (17) = 5.83, $p < .001$ indicating that females were faster at session four. Males in the no training group also showed a significant difference for reaction time, t (10) = 2.95, $p < .05$ indicating that males were also faster at session four. Females again followed this pattern showing a significant difference for reaction time, t (16) = 2.19, $p < .05$ indicating that females were faster at session four.

An independent samples $\underline{t}$-test was performed on the overall usability measure for gender. A significant sex difference was found, t (73) = 3.59, $p < .01$ indicating that males rated the usability of the program more highly. An independent samples $\underline{t}$-test for gender in each group was also performed. There was a significant sex difference in the lab-training group, t (18) =

2.32, $p < .05$ indicating that males scored higher. There was no significant sex difference in the self-training group, t (25) = 1.40, ns. There was a significant sex difference in the no training group, t (26) = 2.77, $p < .05$ indicating that males scored higher.

A univariate analysis of variance 2 (male, female) x 3 (lab, self, no) for the average of the usability measure was performed. There was a significant sex difference, F (1, 72) = 11.66, $p < .01$ indicating that females rated the usability more neutrally than males. There were no significant differences for the usability survey between groups, F (2, 71) < 1.

To examine content validity of the mental rotation task, MAB scores and accuracy in session one were correlated. Consistent with our expectations, the MAB was positively correlated with the accuracy of session one, r (74) = .55, p <. 001 indicating that the web based mental rotation task was a valid measure of spatial abilities.

Discussion

Our first hypothesis was that the participants in the lab and self-training groups would improve more than the participants in the no training group. However everyone showed improvement in both accuracy and reaction time. This could be attributed to the fact that the no training group was in reality a two session training group, so they did receive some training. We also hypothesized that the lab-training group would improve significantly more on the mental rotation task than the self-training group. This hypothesis was not supported because there was no significant difference between groups for improvement in accuracy and reaction time. However, there was marginal significance for improvement of both accuracy and reaction time suggesting that self-trainers might have improve slightly more. Our third hypothesis that initially men would have significantly higher spatial scores on the mental rotation task than women was supported by our research. This hypothesis was supported across all training conditions, with males initially being significantly more accurate and having significantly faster reaction times.

The results for accuracy revealed that there is a significant difference between sessions one and four for all groups. This shows that there was a significant improvement in overall accuracy between the first and last sessions, with everyone being more accurate at the fourth session. This leads one to believe that training yields higher accuracies for the mental rotation task, which both males and females could benefit from. There was also a significant sex difference for accuracy between sessions 1 and 4. This shows that males were significantly more accurate at session 4 than females. This suggests that it might take more than four training sessions for females to close the gap in spatial performance between themselves and males. There was also a significant difference for reaction time between session 1 and 4. This shows that there was a significant improvement in overall reaction time between the first and last sessions, with everyone responding faster at the fourth session. However, there was not a significant sex difference for reaction time, which shows that males and females had equal improvement between session 1 and 4.

The comparisons of sex differences for each of the training groups on accuracy and reaction time between Sessions 1 and 4 yielded interesting results. Males and females in all three groups were faster at the last session. This shows that everyone has the ability to improve in reaction time despite the number of training sessions they received. Only females in the lab and self-training groups significantly improved in accuracy. This is an interesting finding because males started out more accurate than females. Perhaps males reached a ceiling in their ability to improve, whereas the low initial scores for females made it possible for greater improvement. Because only the females in the lab and self-training groups showed improvement in accuracy, we believe that more than two training sessions is a necessity in order for significant improvement in accuracy.

The results of the overall usability measure for gender revealed an overall significant sex difference, which favored males. This suggests that males found the task more enjoyable than females. In the lab-training group, a significant sex difference also favored males. Once again, males found the task more enjoyable, while females were more neutral. This finding does not hold true for the self-training group, which did not produce a significant sex difference. Both males and females were more neutral on the task. Perhaps this lack of difference is related to the fact that the self-training group completed the task on their own and therefore may have been more comfortable with less social pressure. The no-training group mimicked the lab-training group in that there was a significant sex difference. Once again, males found the overall task more enjoyable, while the females were more neutral. The results showed a significant sex difference for the average usability rating. Males had an overall higher score on the usability measure than females, indicating that they found the task more enjoyable overall. This is of major concern because women may benefit more from this type of training program; therefore, programs that appeal more to women are needed.

This study found that females could significantly improve and benefit from training for the mental rotation task. The exact number of training session was not found because both males and females continued to improve at session four. Further research is needed in this area to determine the number of sessions needed to reach optimal performance of the task. Another concern is that females rated the task more neutrally. Females stand to benefit the most from this type of training, and a program needs to be designed that better suits the needs and tastes of females. Including more participants in this research would enable us to attain more powerful results.

Another area of possible research would be to investigate the duration of the training effects, which could be done several months after the study. This would address the issue of whether constant practice is needed to retain this level of skill. This study also brought to light an interesting finding; self-trainers actually did the task on their own. This is an encouraging finding because it suggests that people are willing to do this type of training on their own. This finding needs to be investigated further.

References

Baenniger, M., & Newcombe, N. (1989). The role of experience in spatial test performance: A meta-analysis. *Sex Roles, 20,* 327-345.

Blasko, D. & Holiday-Darr, K. (1999). The visualization assessment and training site.

Caplan, P.J., MacPherson, G. M., & Tobin, P. (1985). Do sex-related differences in spatial abilities exist? A multilevel critique with new data. *American Psychologist, 40,* 786-799.

Coren, S., Ward, L., Enns, J. (1994). *Sensation and perception* (4th ed.). New York: Harcourt Brace College Publishers.

Druckman, D. & Bjork, R. (Eds.). (1991). *In the mind's eye: Enhancing human performance.* Washington, DC: National Academy Press.

Eals, M., & Silverman, I. (1994). The hunter-gatherer theory of spatial sex differences: Proximate factors mediating the female advantage in recall of object arrays. *Ethology & Sociobiology, 15,* 95-105.

Geary, D., Gilger, J., Elliot-Miller, B. (1992). Gender differences in three-dimensional mental rotation: A replication. *Journal of Genetic Psychology, 153,* 115-117.

Gur, R., Alsop, D., Glahn, D., Petty, R., Swanson, C., Maldjian, J., Turetsky, B., Detre, J., Gee, J., & Gur, R. (2000). An fMRI study of sex differences in regional activation to a verbal and a spatial task. *Brain and Language, 74,* 157-170.

Jackson, D. (1996). *Multidimensional Aptitude Battery-Form L: Performance.* Sigma Assessment Systems, Inc. Research Psychologists Press Division.

Linn, M., & Petersen, A. (1985). Emergence and characterization of sex differences in spatial ability: A meta-analysis. *Child Development, 56*, 1479-1498.

Lohman, D., & Nichols, P. (1990). Training spatial abilities: Effects of practice on rotation and synthesis tasks. *Learning and Individual Differences, 2,* 67-93.

Saccuzzo, D., Craig, A., Johnson, N., & Larson, G. (1996). Gender differences in dynamic spatial abilities. *Personality and Individual Differences, 21,* 599-607.

Sorby, S. (1998). *Developing 3-D visualization skills*. Paper presented at the annual meeting of the Engineering Design Graphics Division, Madison, Wisconsin.

Voyer, D., Voyer, S., & Bryden, M. (1995). Magnitude of sex differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin, 117,* 250-270.

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