View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Rowan University

Rowan University

Rowan Digital Works

Cooper Medical School of Rowan University Capstone Projects

Cooper Medical School of Rowan University

2019

Sculpting Course impact on medical students' anatomy examination grades

Jessa Hernandez
Cooper Medical School of Rowan University

Follow this and additional works at: https://rdw.rowan.edu/cmsru_capstones

Let us know how access to this document benefits you - share your thoughts on our feedback form.

Recommended Citation

Hernandez, Jessa, "Sculpting Course impact on medical students' anatomy examination grades" (2019). *Cooper Medical School of Rowan University Capstone Projects*. 24.
https://rdw.rowan.edu/cmsru_capstones/24

This Research Paper is brought to you for free and open access by the Cooper Medical School of Rowan University at Rowan Digital Works. It has been accepted for inclusion in Cooper Medical School of Rowan University Capstone Projects by an authorized administrator of Rowan Digital Works. For more information, please contact rdw@rowan.edu.

Jessa Hernandez

Class of 2019

Dr. Elizabeth Cerceo, Internal Medicine Department

Primary Education Research

Scholar's Workshop Domain: Data Collection and Analysis/Biostatistics

Abstract

Objectives:

The primary hypothesis of this project is that those who take the medical sculpting course will be positively impacted on their anatomy practical examinations when compared to those who have not taken the course. The secondary outcome of this project is that those who take the medical sculpting course will have a difference in their pre- and post- mental rotations test.

Methods:

Using the Vandenberg and Kuse mental rotation test, the students taking the sculpting session and a control group of students were pre-screened for their visual spatial awareness. The students who opted into the course then completed a medical sculpting course relevant to whatever course they were enrolled in. After the course they took the mental rotation test again. Both groups then took their anatomy practical examination.

Results:

Comparison of the averages of the anatomy practical examination score control vs course had a p value of 0.8154. Comparison of the pre-test mental rotation scores vs the post-test scores had a p value of 0.0329

Conclusion:

The hypothesis that a medical sculpting course would positively affect the anatomy practical grades of those who took it versus those who did not has been disproven using the current data. Secondly, the hypothesis that a medical sculpting course would positively affect the mental rotation test results pre and post course has been proved correct. Both will also be evaluated further with a larger sample size as the course is ongoing.

Introduction:

Students learn in a variety of different ways; According to “Vark, a guide to learning styles” [1] there are 4 main unique ways in which students learn: Visual, Aural/Auditory, Read/Write, and Kinesthetic. Visual learners gather information through depiction in maps, spider diagrams, charts, graphs, flow-charts, labelled diagrams and all symbols that people use to represent what could have been presented in words. These students learn best by drawing things out and reforming what was presented to them in a visual and possibly colorful depiction to help them remember the material. Aural/Auditory learners have a preference for information that is heard or spoken. They learn best from lectures, group discussions, radio, email, and using mobile phones as well as talking out loud to themselves. The Read/Write student has a preference for information displayed as words. In contrast to the visual learners, they prefer manuals, reports, essays and assignments to lock the information into long term memory. The physical act of writing something or seeing it in writing aids their memory. Finally, the Kinesthetic learner uses experience and practice (simulated or real) to learn. They gather information through concrete personal experiences, examples, and demonstrations. If it can be grasped, held, tasted or felt it aids in the learning experience. Each learner has a specific preference for their learning style, but most students are not solely one type of learner and are called multimodal. Multimodal students still have a preference for which style they learn but can also be strong in another style. When teaching new information to a group of people, the best teachers target multiple learning styles to solidify information for all students.

Although we hope that all classes are taught with a variety of methods, teachers tend to teach the way that they learn information and can neglect the other modalities in the process. For example, anatomy is typically taught in 3 different ways which can be combined depending on the institution. The traditional way to teach anatomy is lectures which cater to the Auditory learner first, and depending if the lecturer has an associated presentation, it caters to the Read/Write and may cater to the Visual learners as well. The second teaching method is through self-directed learning/problem based/computer assisted learning.

This is also best for the auditory learners through the use of discussion in groups. Computer based learning can help the Visual learners through the use of pictures and other visual aids. This does not help the Read/Write or Kinesthetic predominant learners. The final teaching method is prosection and dissection of human cadavers. Prosection helps the Visual learners who are watching the expert, and it can target the Auditory learners through explanations during the prosection. Dissection can target both the visual and kinesthetic learners [2].

Although dissections do target visual and kinesthetic learners, their use in medical school curriculum have been declining. As cadaver donation decreases, so do the use of cadavers in medical schools [3]. Those schools that do not get rid of dissection altogether, increase the size of their anatomy groups which in turn decreased the amount of concrete hands-on experience each student gets per cadaver. As a solution to this problem, there has been a tremendous amount of new online technology to provide a virtual cadaver to explore. Applications such as e-Anatomy the interactive atlas of human anatomy [4]; Visible Body [5]; HeadNeckBrainSpine.com [6]; Complete Anatomy [7]; and virtual 3D anatomy models are some of the resources created for the benefit of the student but by creating these we are losing the Kinesthetic learners in the way anatomy is taught and so need to come up with another way to target those students.

Art and anatomy have been linked since the beginning of medicine as demonstrated by Leonardo da Vinci's anatomical drawings and Andreas Vesalius' groundbreaking illustrated anatomical textbook from the 16th century. Studies suggest that art can be utilized to teach observational skills [8]. According to Lombardi et all, the use of plastic models has been associated with a better memory of anatomy and physiology 2 months after the initial lesson than both traditional organ dissection and virtual dissections. This study shows that the use of more hands-on activities will increase the memory of the subject for the long term [9]. In addition, according to the work of Haspel, students in community college who used clay modeling as a way to learn anatomy felt that modeling was an effective technique to learn human skeletal, respiratory, and cardiovascular anatomy, which included the names and locations of blood vessels [10].

All of these studies point out that using a hands-on artistic modeling approach can be beneficial for students learning anatomy.

As a way to target kinesthetic learners who were not receiving the most out of the traditional anatomy teaching, this project was born. This project is attempting to show that a hands-on approach of figure making, like working with plastic models, will increase students' memory of the anatomy and physiology. Figure making in this case is completed through the molding of tan clay with the addition of red clay for vasculature.

It has been shown that those students who have higher visual-spatial awareness test scores (mental rotations test) systematically score high on anatomy examinations [11] and so to correct for this, each student who participates in the study is taking the Vandenberg and Kuse mental rotations test [see appendix 1 for test] which will be associated with their test scores. According to Wanzel, even one practice session, such as our course, can improve visual-spatial skills scores on the mental-rotations test as well as other visual-spatial skills tests [12]. If this is the case, those who have taken the medical sculpting course will have improved their visual-spatial skills and therefore should perform better on their anatomy practical examinations than their counterparts who did not take the course.

The primary hypothesis of this project is that those who take the medical sculpting course will be positively impacted on their anatomy practical examination when compared to those who have not taken the course. The secondary outcome of this project is that those who take the medical sculpting course will have a difference in their pre- and post- mental rotations test.

Research Design/Methods:

In this study, there are two groups of students, those who are participating in the medical sculpting course and those who choose to be a part of the study as controls. Both groups will sign an informed consent allowing the de-identified release of their grades for the study. See below for more information on the release of grades,

Both groups will take the Vandenberg and Kuse mental rotations test. The test consists of 24 questions completed in a 15-minute time limit. The questions are all in the same format with one "original image" and 4 rotations of similar figures, 2 of which are the same as the original image and 2 are different. The students are tasked with choosing which of the 4 images are the same as the original image. Students can circle one or both of the correct answers for a score totaling 48. Each correct answer earns the student 1 point. Points are deducted for each incorrect rotation that is circled, no points are awarded or deducted for questions that are unanswered. This means that the student could range in points from -48 to 48. If the student circled one correct and one incorrect rotation in the same question, no points are awarded. If the student circled 2 incorrect rotations of the image in the same question 2 points are taken away from the total. And finally, if both circled rotations of the image are correct 2 points are awarded. All points are tallied to create a final score for both the pre- and post-tests.

From there, those interested and available will take a 3-hour medical sculpting course that will both teach anatomical concepts and allow students to be more hands-on with their anatomy understanding. Students can choose this session electively, so course enrollment could be up to 40 students. Students will not be randomized into control and course but will rather choose whether they want to participate as a control or in the course or not engage in the study at all. We will thus not have a randomized design. We recognize that those students who electively choose to take the course may already represent a self-selected population of students who are either more adept at visual spatial perception and are interested in this type of adjunctive session or who may feel uncomfortable with anatomy and thus may select the session as a means of compensating for a perceived deficit. This will be listed as a limitation in the study.

The medical sculpting course itself will be taught by a medical student with the help from an anatomist from Cooper Medical School. This study will run for a total of 3 years with up to 6 sessions in a year. Each session will be about 3 hours long and will cover anatomy topics from the course that the students are currently taking. This can include, but is not limited to any one or more of the following topics per class: bone anatomy, nerves, arteries, veins, surface anatomy, internal anatomy etc. Those

classes that a sculpting course will be taught could include: Cardiology, Pulmonology, Gastroenterology, Women's Health, Skin/Musculoskeletal part 1 (SMS 1), and Skin/Musculoskeletal part 2 (SMS 2).

Each class runs mainly the same way, starting with the Vandenberg and Kuse mental rotation test to have as a baseline number for the participant. Afterwards, the class begins by telling the participants what they are sculpting, they are not informed prior to arrival. The clay and tools are brought out and the instructor goes over the basic shape that the structure takes as well as where it is in the body for context. The material for the class is all gathered from the students' anatomy lectures that they have already seen. Continuing the class there can be a discussion of bone anatomy, nerve, arteries, veins, surface anatomy, or internal anatomy etc. and is limited only by what the students have already been taught. The anatomist is present to correct any misinformation that could be presented. The class concludes by showing off your work if the student wants, and the Vandenberg and Kuse mental rotation post-test. This score will be compared to their original scores to see if there is a change from taking the course. (See data and analysis for further details)

Both groups will have signed an informed consent allowing the release of their grades for the study. The Director of assessment, Matt Gentile, who sees their grades normally, will de-identify and connect their anatomy practical grades with their baseline mental rotation test score. He will also connect the final mental rotations test with the baseline score and with the anatomy practical exams in those that have taken all of the tests listed above. These scores are what will be used to determine if the medical sculpting class helped those students with their anatomy grades.

The primary objective of the course is to show that there is a difference between those students who take the medical sculpting course and those that do not. The secondary objectives are to show that there is a difference in the Vandenberg and Kuse mental rotations test pre and post- sculpting course and to get qualitative data from the participants on the perception of the course's impact on their anatomy education. All concrete data goes through Matt Gentile for de-identification and qualitative data is solicited via email after the practical examinations.

Data analysis and statistics:

Data will be collected from each participant. The original and repeat Vandenberg and Kuse mental rotations test will be given to the students and collected with their names on the worksheets. The results from these tests will be given to the Director of Assessment, Matt Gentile, who will connect the mental rotation test results with the anatomy practical grades. He will create an excel sheet with the results which he will give to Dr. Cerceo, Dr. Gaughan and the assistant on the project. The results are deidentified and the following statistics will be run.

For the data analysis, the pre-post scores can be compared between the intervention and control groups using analysis of variance. Secondly, the pre-test scores can be used as a covariate to adjust the post intervention scores in an analysis of covariance. Students t test will be calculated between the pretest scores of both groups, the averages of the test scores, and between the pre and post changes of the Vandenberg and Kuse mental rotations test as a secondary measure.

Results:

After institutional review board approval and written informed consent were obtained, a total of forty students were recruited for the study. Students assigned themselves to either the course or the control group. Twenty-two students participated in the courses offered: Women's Health for class of 2020, SMS 1 for class of 2021 and cardiology for the class of 2021. Nine students from the class of 2020 participated in the Women's health sculpting course with nine students acting as controls. Ten students from the class of 2021 participated in the SMS 1 course with five students acting as controls. Finally, three students from the class of 2021 participated in the Cardiology sculpting course and four as controls. There were two students from the class of 2021 who acted as controls for both SMS 1 and Cardiology. The demographics are listed in table 1. The study is ongoing.

Table 1: sample demographics

	Course	Control
% Female	77.27	38.89
# from Class of 2020	9	9
# from Class of 2021	13	7

The following data was obtained through the study:

Table 2: Results

	Average	**Standard Deviation**
Control		
Mental rotations pre-test score	36.11	10.28
Anatomy examination scores	85.82	4.631
Course		
Mental rotations pre-test score	33.14	10.76
Mental rotations post-test score	35.82	12.36
Anatomy examination scores	85.44	5.0477

Two students' data was excluded from the test score, one from the controls and one from the course grouping because they were determined to be outliers from the other data.

Table 3: Statistics

	p score	95% CI
Pre-test control vs Pre-test course	0.3805	- 3.81 to 9.76
Anatomy examination score control vs course	0.8154	-2.8470 to 3.5937
Pre-test vs Post-test course	0.0329	-5.12 to -0.24

Discussion:

As stated previously, there are four main ways in which students learn: Visual, Auditory, Read/Write and Kinesthetic. The Kinesthetic learners, due to the way anatomy is taught and the direction that cadaver donation and technology are heading are not being targeted as much as they could be or learning opportunities in anatomy. This course was designed as a study aid for those students who self-identified as needed the extra bit of help getting a hands-on learning experience, or just wanted a fun way to be studying. Those who chose to take part have said the following about the course:

"Of all the anatomy we had to learn, the OBGYN anatomy I remember the best was most likely due to the sculpting experience"

"The course really helped me understand conceptually and spatially the relationship between the muscles, bones, and functions. Taking the time to model the muscles enhanced the learning process, especially since this method of learning went beyond rote memorization. I was able to return to the anatomy lab and teach my group the set of muscles we had focused on in the sculpting course."

"I enjoyed my time in your sculpting class. It was a nice break from the rigors of book studying for an evening and I felt helped me get a better grasp on the anatomy in question- especially some of the larger concepts like specific ligaments, etc."

"Although I am not the best sculptor, I felt that Jessa's sculpting course helped solidify the anatomy of the vagina and uterus and helped me feel more prepared for the practical exam. I would definitely have attended more events like these if they were offered."

The students who participated in the course had a general feeling of enjoyment from the course as well as learning some new concepts or clarification of concepts that were introduced in earlier lectures while sculpting the anatomy and reviewing the functions. As stated above, it helped them feel more prepared and helped solidify the information that they had previously gotten.

The primary aim for this study was to compare the anatomy practical grades of those who took the course vs controls after controlling for significant differences in their Vandenberg and Kuse mental rotations score which has been shown to affect anatomy grades. After comparing the control group versus the sculpting course groups' mental rotations scores using the student t test, with a p value of 0.3805 it showed that there was no statistical difference between the mental rotations test results of the two groups making it applicable to just compare the anatomy practical grades of the two groups using the student t test. With a p value of 0.8154, this test showed that there was no statistical difference in the anatomy practical grades of those who took the sculpting course and those who did not. This disproves the hypothesis that there would be a difference in the anatomy practical grades of those who completed the sculpting course and those who did not.

There are many reasons why this study could have yielded the above result. The first is as this is an ongoing study, there is a limited number of participants being analyzed by this data in its current state. As stated in the methods section, there was no randomization into groups, allowing students to self-select into the sculpting group. It is possible that those students who selected to take the sculpting course felt they needed the extra study session, needed extra help, or felt that they needed a hands-on activity to learn

the material that was already presented to them in lecture format. These students could have performed better than they would have having not taken the course, but there is no study designed that could prove or disprove how they would have done without the course. Another potential area of result is that there were more men in the control group than women, and more women took the course than men. The final area for improvement within the entire study could be to include more structures/more of the anatomy lectures taught per sculpting session. As there is limited time for both the instructor and the students taking the course, the amount of information that can be sculpted and reviewed during the course has been limited to only one-two lectures given out of many that are included on the exam. This creates a gap in the students learning in that if there are only 4-5 questions per lecture given then the material that is covered in the sculpting course represents only a fraction of what will be on the anatomy practical exam. Perhaps the students who took the course performed better on the questions that were directly relevant to what was taught in the medical sculpting course but fell short on other questions. It would be incredibly difficult to find which questions were directly related to the information reviewed during the sculpting course and analyze only those questions in the controls versus those who took the medical sculpting course but would yield more accurate results and could directly tie the sculpting course to the information presented on the examination.

The secondary result that was looked at was whether the sculpting course would have an impact on the mental rotations test result scores. With a p value of 0.0329, there was a significant difference between the mental rotation test results before taking the course and after taking the course. Learning to look at something you know through different angles gives you different perspectives, both literally and figuratively, when looking at the things around you. This result has the implication that you can improve your ability to rotate an object in your mind, by practicing rotating physical objects. This information is important to note because it can help those students who have difficulty with being spatially aware of the organs of the body and how all the pieces fit together, to become more adept at that skill. With this new skill, those students who previously struggled in anatomy can be taught how to become better at rotating objects in their mind, as well as how to apply that skill to other areas. This skill can be valuable during

surgeries, when organs are pushed aside or removed to better be able to examine them and to put them back into the body in anatomical position. It especially helps in the pathology department. Those students who can find one landmark that they are familiar with on an organ/specimen, will be able to create a mental image of what that organ should look like and what other landmarks should be where to see the distortion of pathology and identify natural variations in anatomical structure. This result could be due to the course and practicing rotating objects, but it could also just be that the student got better results after seeing the information the first time.

Conclusion:

The hypothesis that a medical sculpting course would positively affect the anatomy practical grades of those who took it versus those who did not has been disproven using the current data. The study is ongoing and so will look at the same question with a larger sample size. Secondly, the hypothesis that a medical sculpting course would positively affect the mental rotation test results pre and post course has been proved correct and will also be evaluated further with a larger sample size as the course is ongoing.

Follow up:

This study will run for a total of 3 years with up to 6 sessions in a year, and so will be completed by the end of 2020. The study will re-evaluate the current findings at that time and will analyze a subset of the data to see if any course individually, positively affected the anatomy practical grades of those who participated. A possible follow up study could try to randomize students into 2 groups, those who look at plastic models, in addition to cadaver dissection, prosection, lectures, and online resources, and those who create their own models through sculpting, in addition to the resources listed above. This however, could be a difficult study to control for since no educator would want to willingly restrict the resources that could help a student learn the material. Finally, another follow-up study could use the VARK model to

have students either self-identify, or use the test to be sorted into, which learning style they prefer and target those students who are Kinesthetic learners to be the test subjects and act as the controls to truly isolate whether sculpting/clay modeling helps the kinesthetic learner on their anatomy practical examinations.

References:

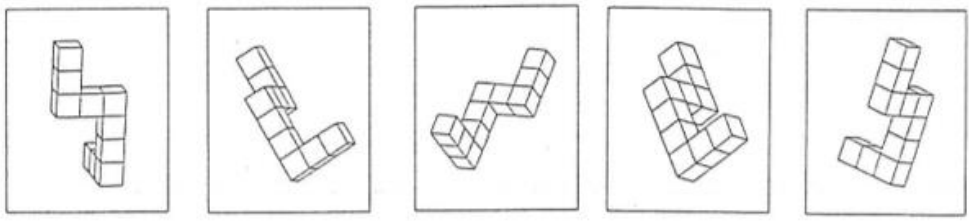
1. Vark-learn. Vark, a guide to learning styles. VARK Learn Limited, 2018. http://vark-learn.com/introduction-to-vark/the-vark-modalities/
2. Turney, BW. "Anatomy in a Modern Medical Curriculum." Ann R Coll Surg Engl. V. 89 (2007): pg. 104-107. Print
3. McCall, Matt. "The Secret Lives of Cadavers." National Geographic. July 29, 2016, National Geographic, https://news.nationalgeographic.com/2016/07/body-donation-cadavers-anatomy-medical-education/
4. Imaios, e-Anatomy, "e-Anatomy: interactive atlas of human anatomy". https://www.imaios.com/en/e-Anatomy. Published 2008, updated 2018. Accessed 12/6/18
5. "Visible Body". Visible Body, www. Visiblebody.com. published 2018. Accessed 12/6/18
6. Young, B. Duke university Medical Center. HeadNeckBrainSpine.com, published 2018. Accessed 12/6/18
7. "Complete Anatomy". 3D4Medical. 3d4medical.com/press-category/complete-anatomy. Published 2018. Accessed 12/6/18
8. Bell, LT and DJ Evans. "Art, anatomy, and medicine: Is there a place for art in medical education?" Anat Sci Educ. 2014. 7 (5): 370-8
9. Lombardi, SA et al. "Are all hands-on activities equally effective? Effect of using plastic models, organ dissections, and virtual dissections on student learning and perceptions." Adv Physiol Educ. 2014, 38(1): 80-6
10. Haspel, C et al. "The implementation of clay modeling and rat dissection into the human anatomy and physiology curriculum of a large urban community college." Anat Sci Educ. 2014; 7(1): 38-46
11. Vorstenbosch et al. "Learning anatomy enhances spatial ability". American Association of Anatomists. July 2013. Accessed July 29th, 2017
12. Wanzel et al. "Effect of visual-spatial ability on learning of spatially-complex surgical skills" Lancet, Vol. 359, no 9302, p230, 1/19/2002. Accessed July 29th, 2017

Appendix

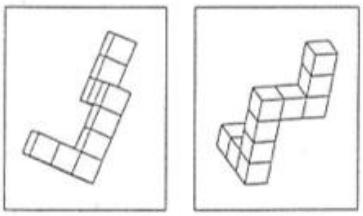
MENTAL ROTATIONS TEST 1

AUTOCAD drawings of Vandenberg & Kuse (1978)* items. Michael Peters, PhD, Dept. Psychology, University of Guelph, Guelph, ON, Canada N1G 2W1

Look at these five figures.



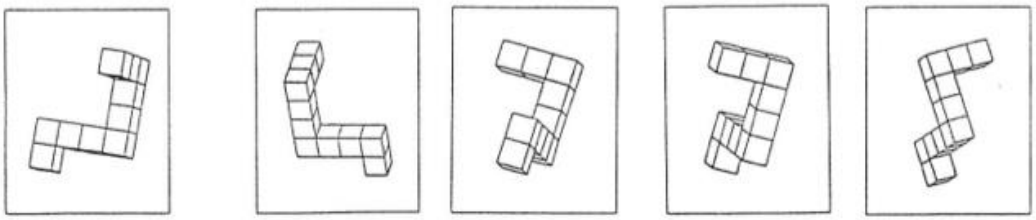
Note that these are all pictures of the same object which is shown from different angles. Try to imagine moving the object (or yourself with respect to the object), as you look from one drawing to the next.



Here are two drawings of a new figure that is different from the one shown in the first 5 drawings. Satisfy yourself that these two drawings show an object that is different and cannot be "rotated" to be identical with the object shown in the first five drawings.

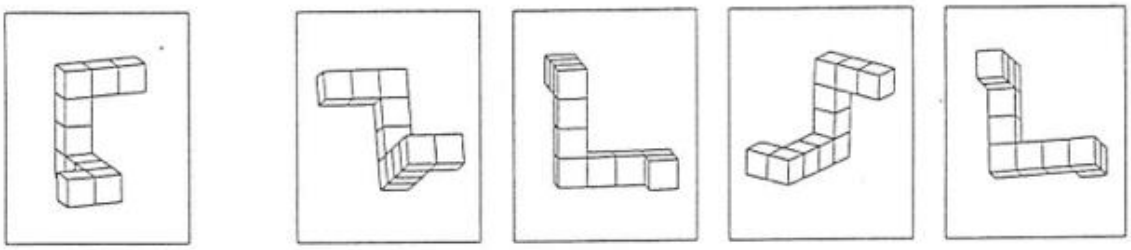
Now look at this object:

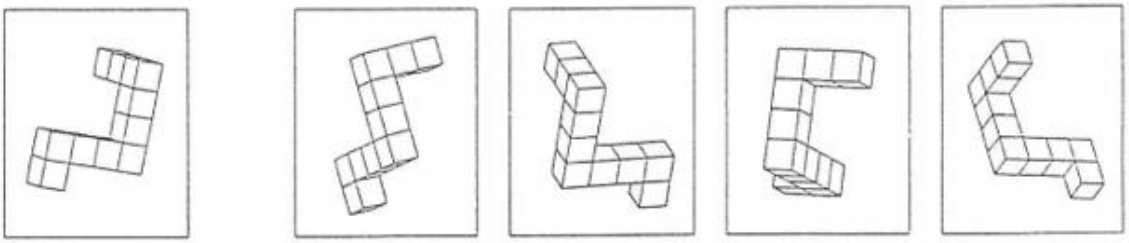
Two of these four drawings show the same object. Can you find those two ? Put X's in the lower right corner.

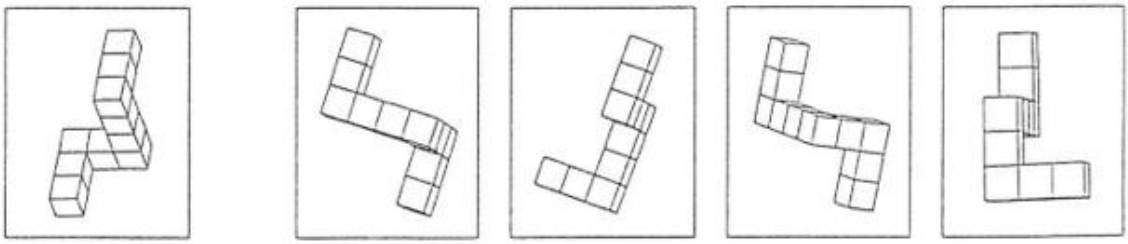


If you marked the first and the third drawings, you made the correct choice.

Here are three more problems. Again, the target object is shown twice in each set of four alternatives from which you choose the correct ones.





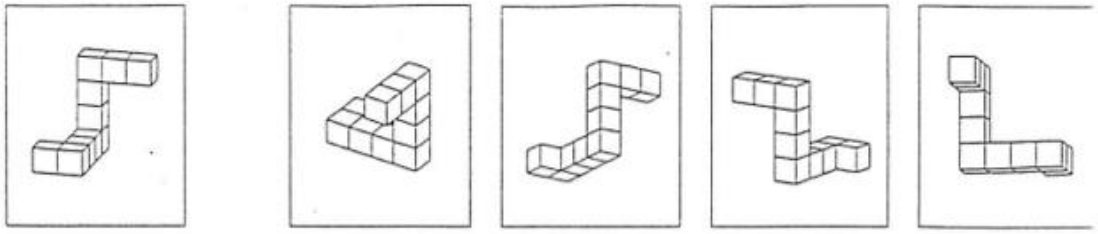


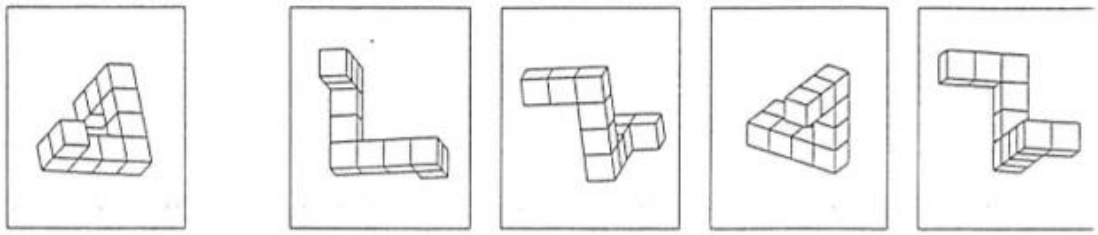
Correct choice for 1: second and third, for 2: first and fourth
3: first and third

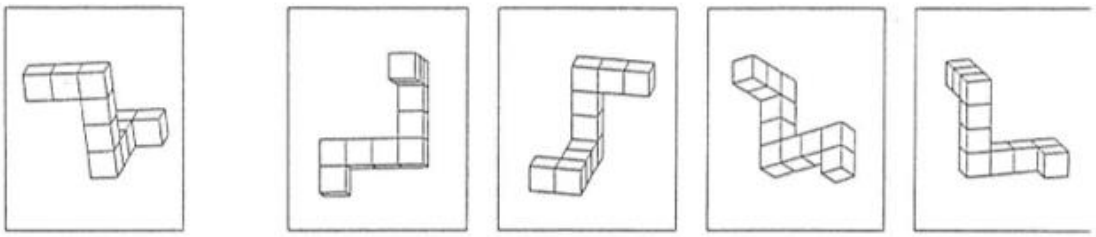
When you do the test, please remember that for each problem set there are two and only two figures that match the target figure. What is your best strategy in doing the problems ? Because an incorrect choice is subtracted from a correct one, you are better off to check only one of the figures if you can be only sure of one. Of course, you will always try to get both of the figures that match.

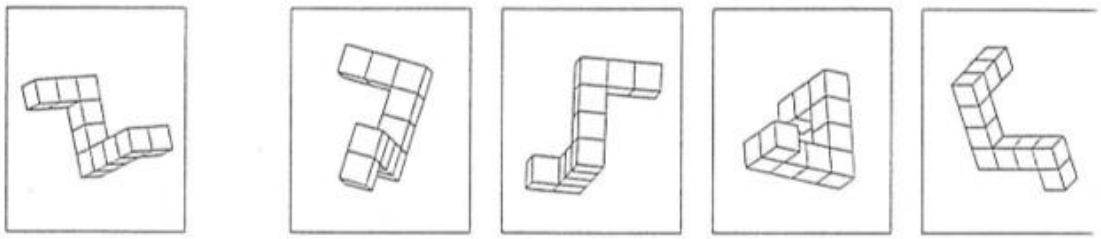
---

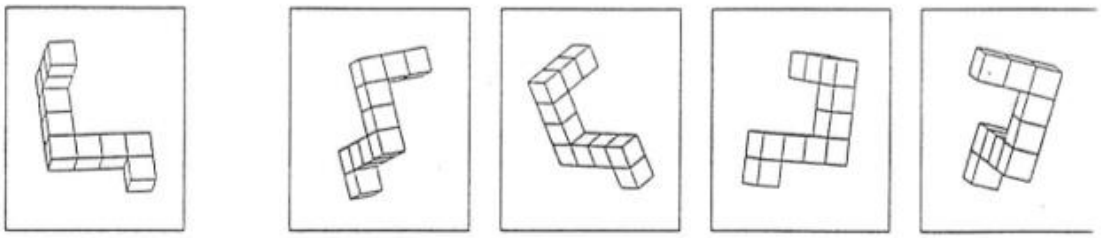
* S.G. Vandenberg of the University of Colorado selected this subset of figures from a larger set devised by Shepard and Metzler. Two versions of the mental rotations test exist: one with 20 problems and one with 24 problems; this is the latter one. Because the quality of available reproductions has deteriorated over the course of making copies of copies, we have redrawn the set of figuras with help of the AUTOCAD drawing program (the AUTOCAD drawings were done by Diane Duncan, School of Engineering, U of Guelph). It was decided not to use the natural perspective option provided by the program because the perspective shown here seems to give the clearest representation of the problems.

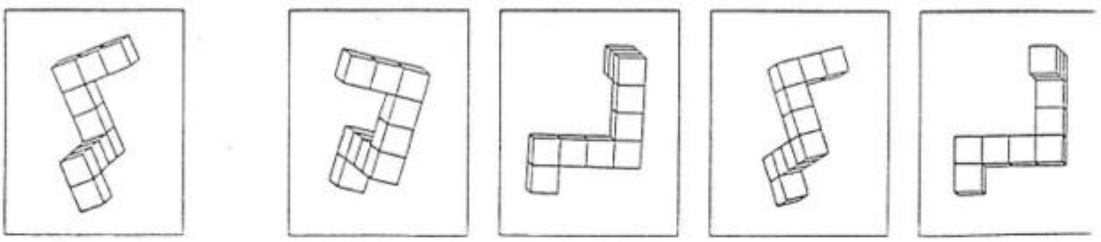
1. 

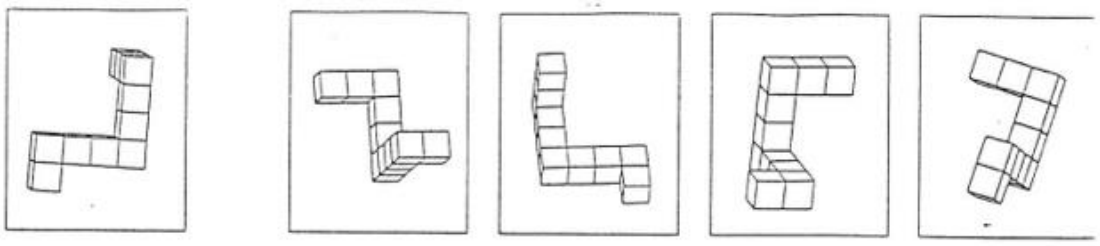
2. 

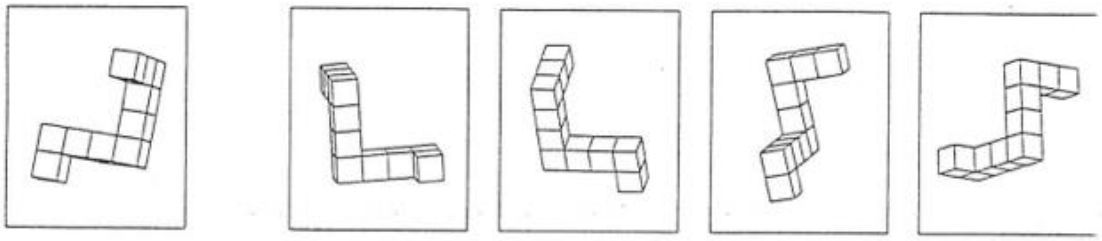
3. 

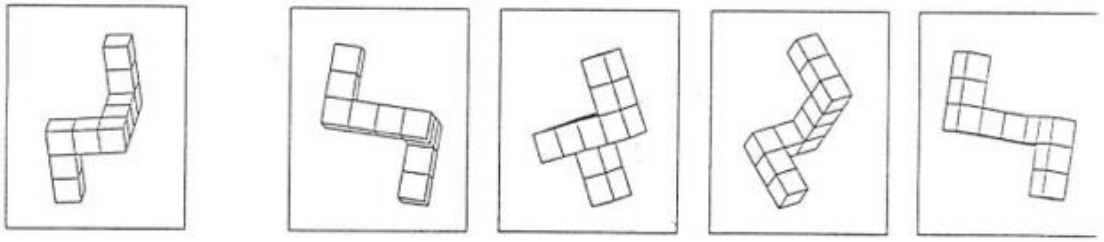
4. 

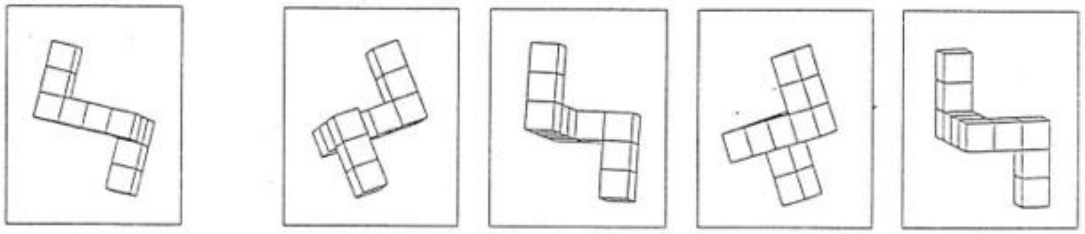
5. 

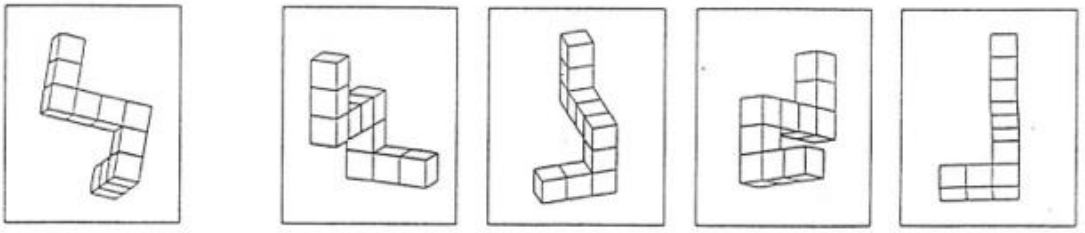
6. 

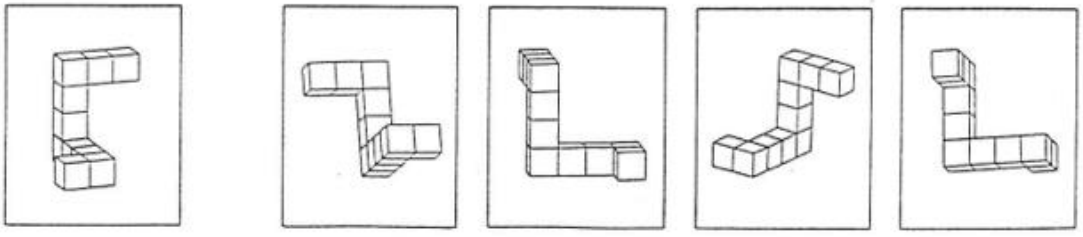
7. 

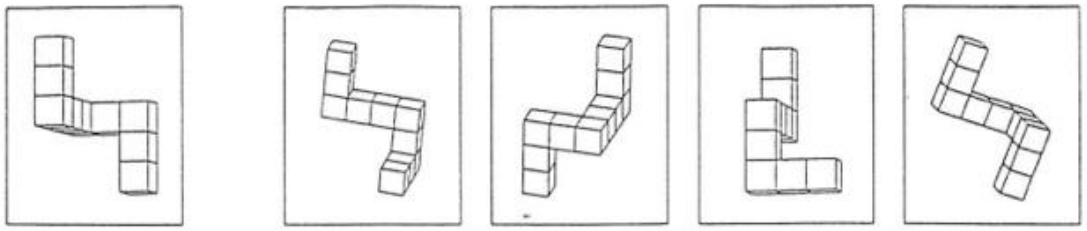
8. 

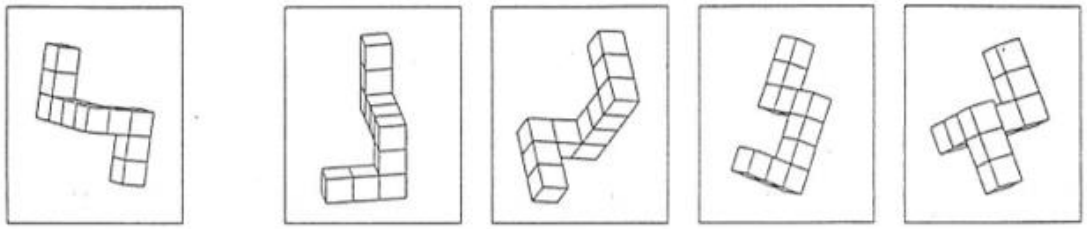
9. 

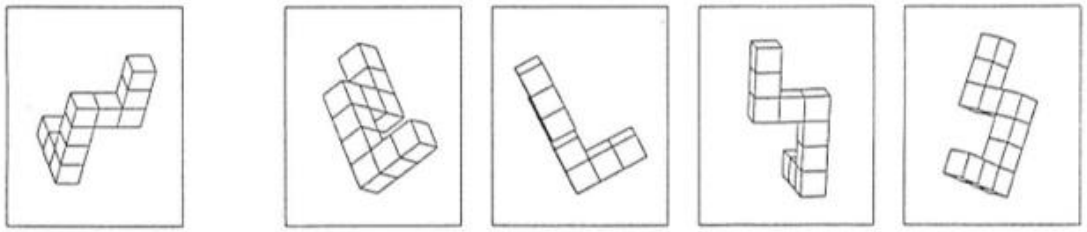
10. 

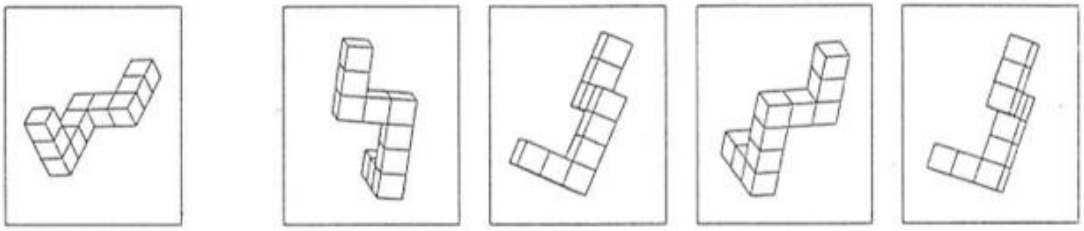
11. 

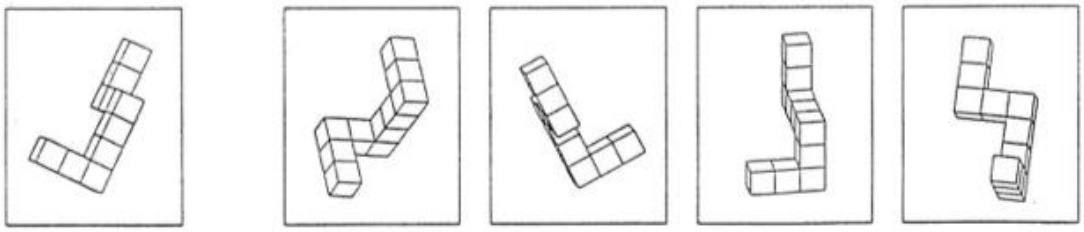
12. 

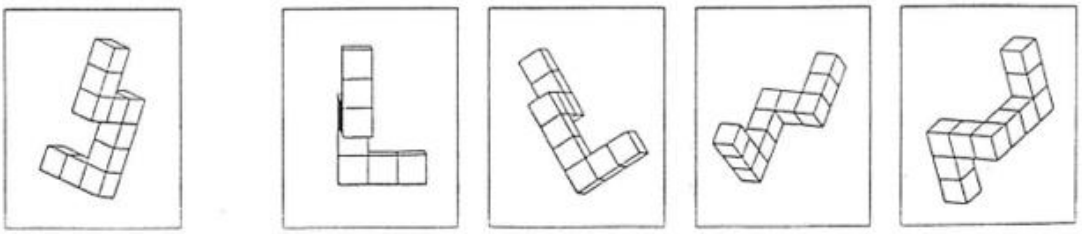
13. 

14. 

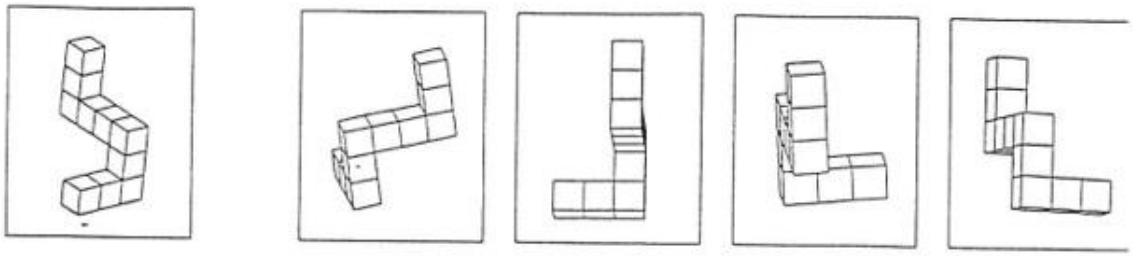
15. 

16. 

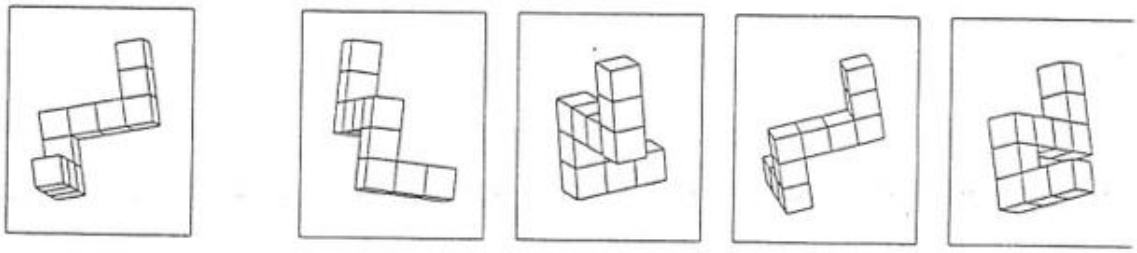
17. 

18. 

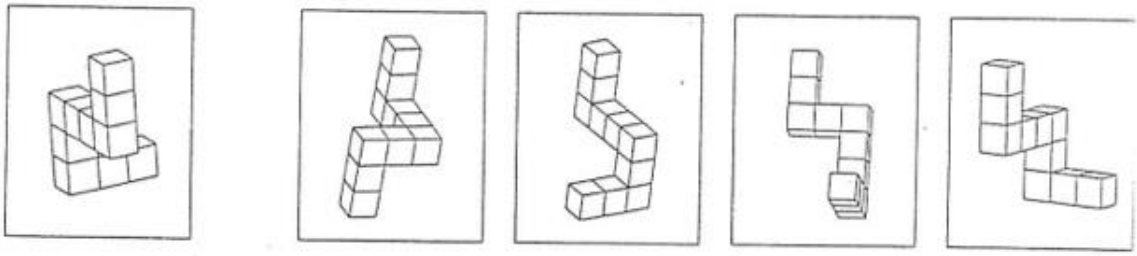
19.



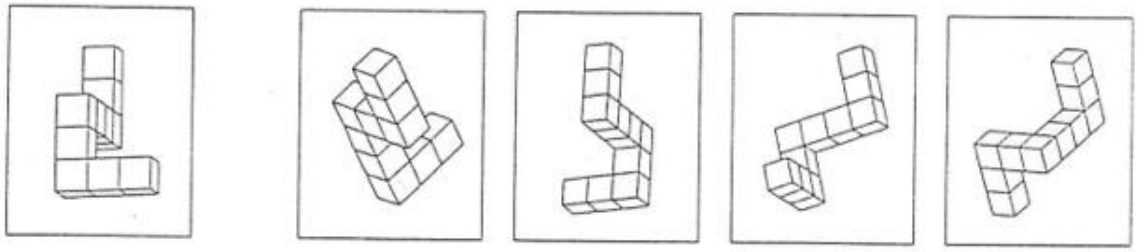
20.



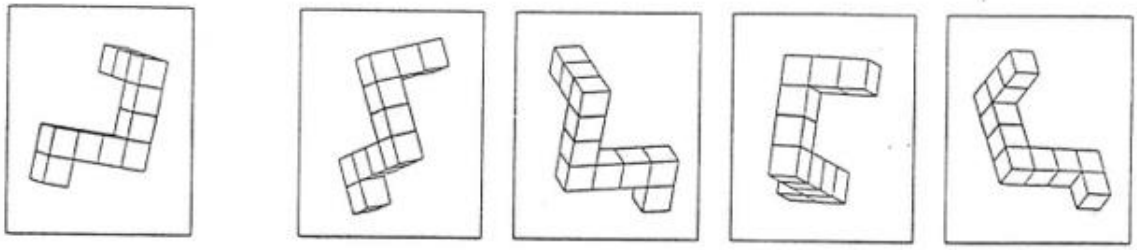
21.



22.



23.



24.