

Overview

Dario Salvucci's research is focused on driver distraction. There are 4 types of driver distractions: physical, cognitive, visual, and auditory. Cell phone use is a physical as well as a cognitive distraction.

A research study, entitled "Driven to Distraction" by Pamela D'Addario (2015), published in Without Prejudice Magazine and posted on the MEA Forensic Website, focused on the time delay in responding to obstacles while driving and being subjected to cognitive distractions. She found that the drivers without cognitive distractions could notice the obstacle and stop accelerating in 1.1 to 1.6 seconds, but the drivers subjected to cognitive distractions took 2 seconds to respond.

This project focuses on 3 types of distraction: visual, auditory, and cognitive. We analyzed the time difference caused by each type of distraction to identify the differences among them.

Project Description

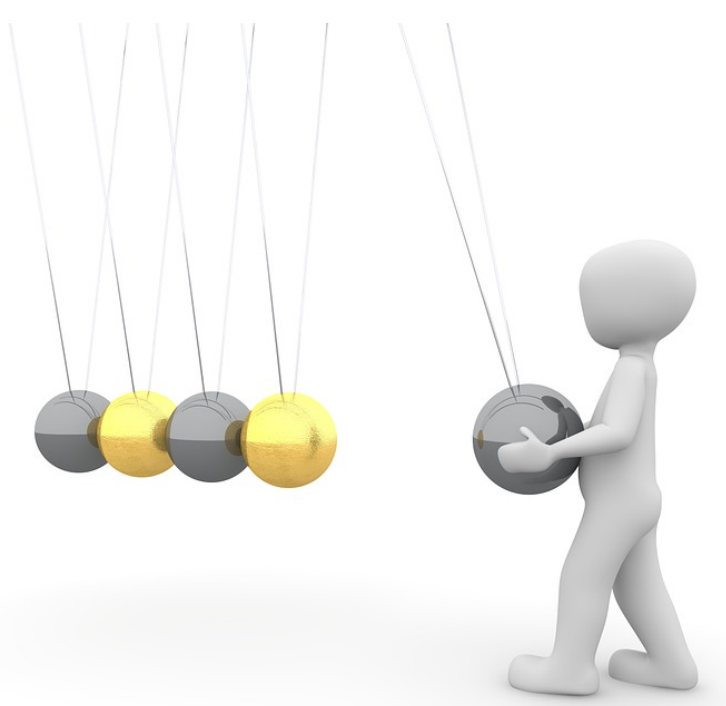
We developed an app for science students to calculate the gravity on a swinging pendulum. The students will get the length and period of the pendulum and solve for the gravity. The app has 5 rounds of problems to solve: a throw-away test, an undistracted trial to be the control, and 3 experimental rounds that are subjected to in-app visual, auditory, and cognitive distractions.

We tested 10 people with the initial version of the app. The data was analyzed to see the time differences between the control group data and the different distraction types to further quantify the time delays associated with each type of distraction. We also found the percent difference in response time as well as the percent of subjects that were distracted by each type of distraction.

These subjects gave us feedback on the app and we enhanced it and tested 13 more people and completed the same analysis of that data.

Social Relevance and Potential Impact:

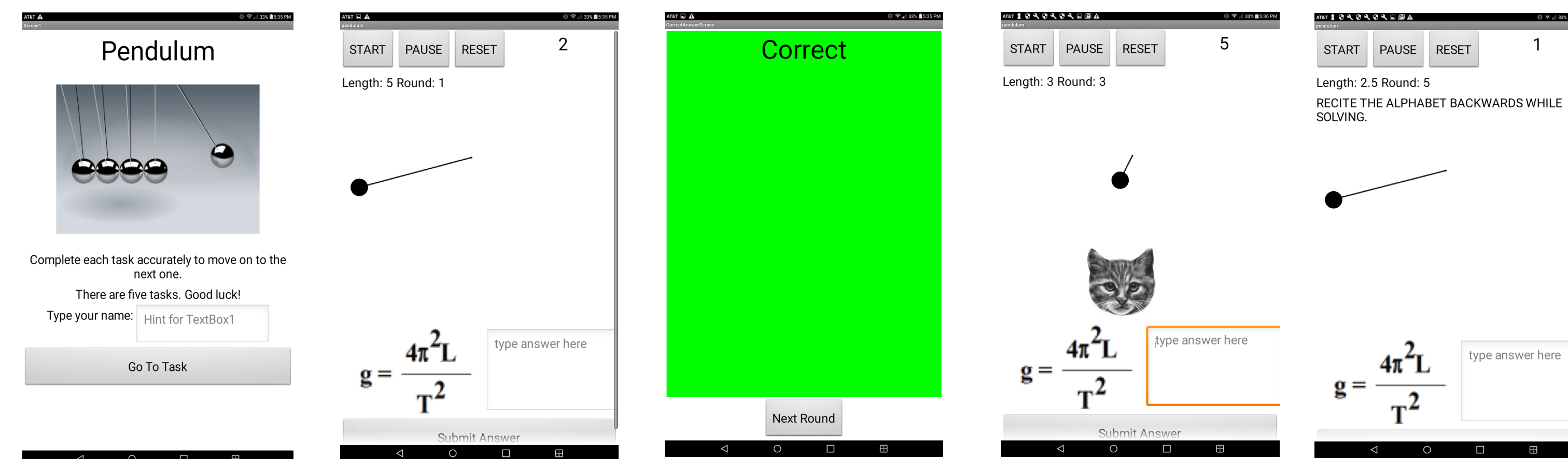
Distraction is everywhere. Cell phones beg for our attention, games addict us, pop up ads tempt us and yet we still need to focus to effectively drive vehicles, learn new material, and develop our abilities. Our research investigates the time delay experienced when trying to achieve a task in an app as accurately and rapidly as possible while being subjected to controlled distractions within the app. Once this is quantified it can be used to educate people to work on modifying their behavior.



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Activities

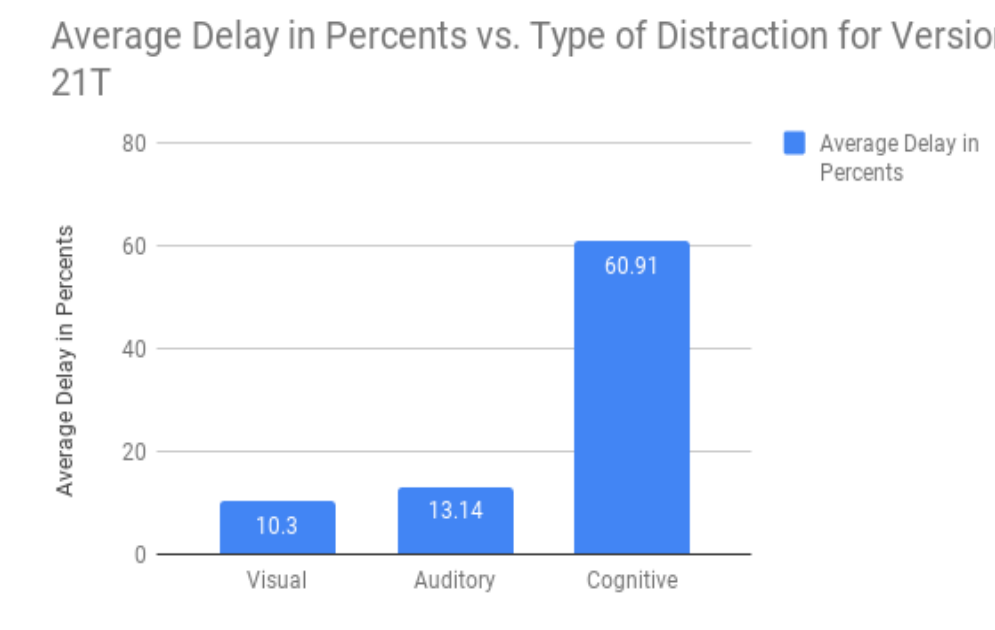
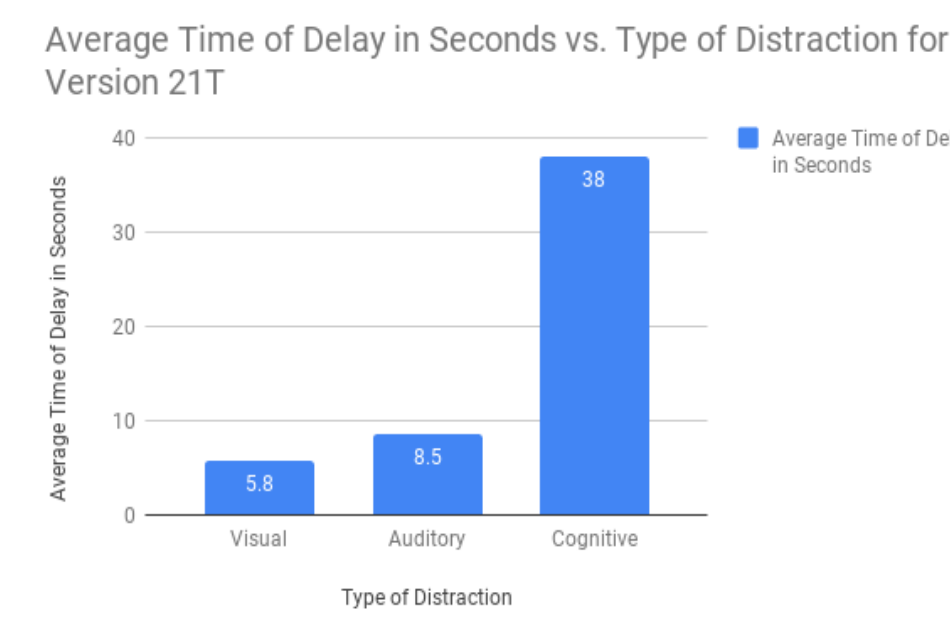
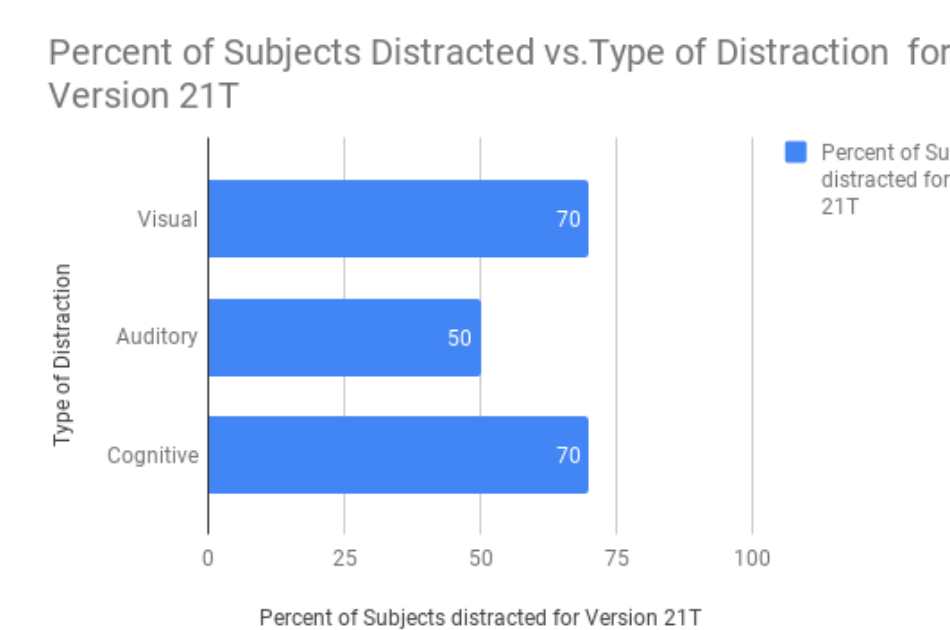
Developed the pendulum app using MIT App Inventor and added distractions



Test #1: 10 test subjects solved the app's problems using the control version and the experimental versions and we analyzed the data.

T1U throwaway	T2U control	T3V visual	T4A auditory	T5C cognitive	seconds	Time interval U-U (%)	Time interval U-V (%)	Time interval U-A (%)	Time interval U-C (%)
33	35	35	35	44	0	0	1	9	11
58	35	43	42	51	0	8	7	16	19
57	36	40	79	54	0	4	43	19	19
51	49	50	40	35	0	1	-9	-14	-14
133	54	61	60	69	0	7	6	15	15
39	35	29	21	25	0	-8	-14	-10	-10
60	34	32	33	36	0	-2	-1	2	2
233	42	63	32	188	0	21	-10	146	146
108	130	145	186	315	0	15	56	185	185
92	71	80	69	82	0	9	-2	11	11
avg time difference:					0	5.8	8.5	38	38

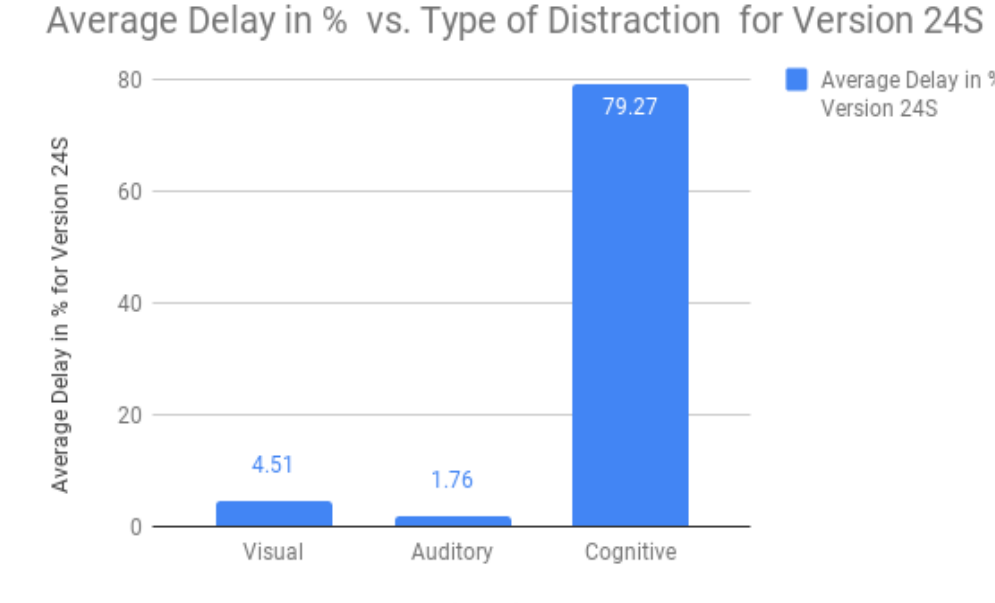
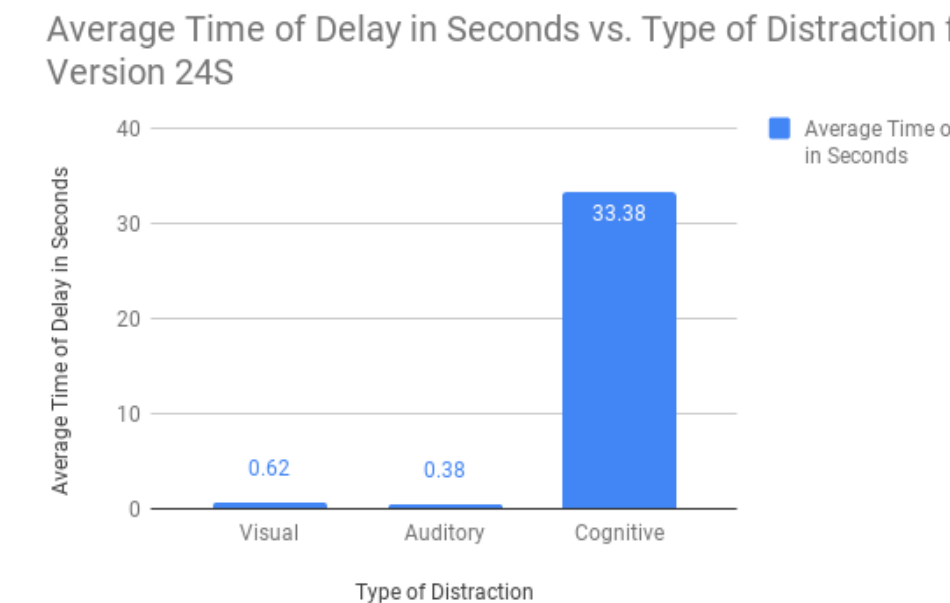
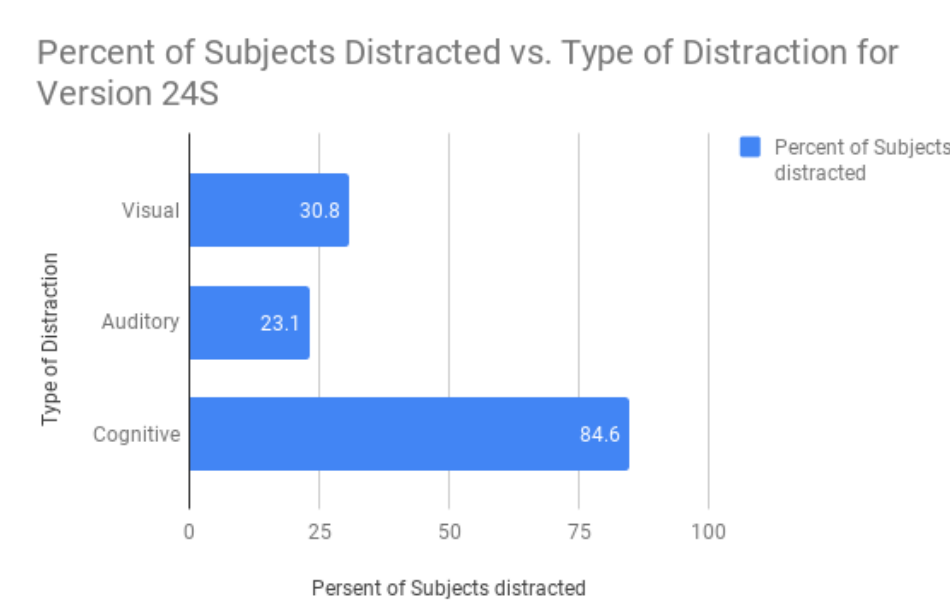
Data set #1



We enhanced the app using feedback from initial test subjects: Enlarged visual distraction, removed rhythm from auditory distraction, and strengthened cognitive test difficulty. Test #2 tested 13 more subjects.

T1U throwaway	T2U control	T3V visual	T4A auditory	T5C cognitive	seconds	Time interval U-U (%)	Time interval U-V (%)	Time interval U-A (%)	Time interval U-C (%)
72	35	28	29	57	0	-9	-6	22	22
216	34	30	33	29	0	-4	-1	-5	-5
158	57	38	56	50	0	-19	-1	-7	-7
193	31	39	30	45	0	6	-1	14	14
132	42	77	90	159	0	35	48	117	117
105	36	76	47	59	0	40	11	23	23
0	39	42	38	56	0	3	-1	17	17
67	44	30	34	123	0	-14	-10	79	79
85	46	39	32	72	0	-7	-14	26	26
65	44	39	46	102	0	-5	2	56	56
56	51	34	38	76	0	-17	-15	25	25
33	44	41	28	87	0	-3	-16	43	43
120	45	45	54	89	0	0	9	24	24
average time diff:					0	0.6153846154	0.3846153846	33.38461538	33.38461538

Data set #2



Initial findings: Cognitive distractions result in the greatest time delay.

Raw data shows that there are two types of learners: distracted and fast learners.

Course Materials

Students will be able to:

- develop a database to store data from various models and compare them
- analyze these comparisons to alter or improve models
- adapt algorithms and create components to track distraction
- assess multiple groups of peers (student groups) to use the app to measure the period and length of the pendulum, and calculate the gravity that is acting on the pendulum while experience distractions (visual, auditory, and cognitive) while using the app to record the time delays that the distractions will cause
- recognize how distractions interfere with everyday life.

Future Work

- Our students will continue to work on the pendulum app.
- AP Computer Science Principles students will collaborate with chemistry students to make versions of the pendulum app with various distractions. Physical science students will be their test subjects. All students involved will analyze the data sets to identify the time delay caused by the types of distractions.
- Counterbalance the rounds
- Test a large, random sample of subjects
- Collect demographic information on subjects to see if there are correlations to age, sex, area of study...
- We hope to continue this project with making other science apps for the students to use.

References

D'Addario, P., & Ising, K. (2015, October). Driven to Distraction. Retrieved July 2, 2018, from http://www.meaforensic.com/distracted_driving_cognitive_distraction_expert

Hossein Hosseini Nourzad, S., Salvucci, D. D., & Pradhan, A. (2018, January 02). *Computational Modeling of Driver Distraction by Integrating Cognitive and Agent-based Traffic Simulation Models*. Lecture presented at COMPUTING IN CIVIL AND BUILDING ENGINEERING ©ASCE 2014.

Mobile Phone Use: A Growing Problem of Driver Distraction. (2011). *World Health Organization*. Retrieved from http://www.who.int/violence_injury_prevention/publications/road_traffic/distracted_driving_en.pdf?ua=1

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