SENIOR PROJECTS

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Senior Project 1
European School of Bergen
Maciej Biekewski, Loyola Lafuenete

Investigating the effect of auditory stimuli on perception

Abstract

It is common knowledge that sounds influence the way in which we perceive visual information, for example we often hear that we should study in silence or with quiet, calming music. In order to test this belief, we designed an experiment. The experiment was aiming to confirm the effect of auditory stimuli on the perception of a visual guide. It consisted of two phases, the first with a visual stimulus and the second with a visual stimulus as well as an auditory one. The second phase included a division into two groups, one with an auditory stimulus with the theme of love and a second one with the theme of war. There were 54 participants who took part in the experiment. We expected the auditory stimulus to affect the way in which information is recalled and perceived, specifically, more connections to be made to the surrounding theme. The statistical analysis using the goodness of fit test showed that there was no significant difference in the connections made to the relevant theme. Further analysis saw no significant increase in recall with the auditory stimulus. These results do not show that auditory stimuli affect our perception of visual imagery.

Senior Project 2
European School of Bergen
Alexander Lebedev Barbosa

Can antiseptic-treated face masks help combat “maskne”?

Abstract

In the past two years, the number of cases of “maskne”, a particular face-skin disease triggered by the frequent wearing of a facemask, has increased tremendously due to COVID -19. This startled and inspired me at the same time to go searching for solutions for this new problem. The main idea behind this project is therefore to create a tool which lowers the risk of “maskne”, through effectively diminishing the growth of malignant micro-organisms on the face.

First, a good knowledge of the science behind “maskne” and the factors influencing the growth of pathogens under facemask conditions needs to be gained. Next, research will be conducted on possible remedies, including antiseptics. This will be done through a review of relevant scientific literature, specifically dermatological papers. Based on the information gathered, a few antiseptics, like Povidone-iodine, silver nitrate and benzoyl peroxide, will be selected for subsequent experimental work. This includes testing the efficiency of the down selected antiseptics on “maskne”-causing pathogens both under *in vitro* and later *in vivo* conditions. Also, the application of the most efficient antiseptics onto the fabric of the face mask will be investigated.

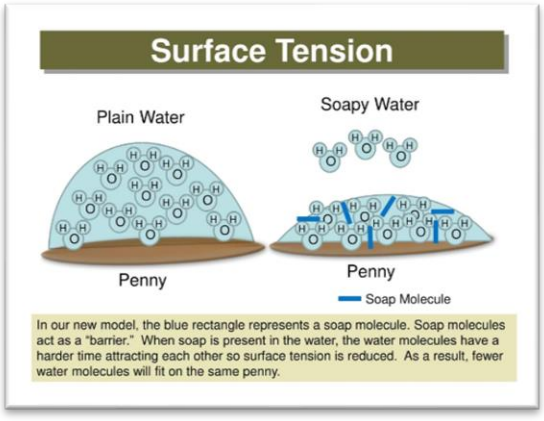
This research not only offers me a unique chance to strengthen my scientific competences, both in chemistry and biology, but also can contribute to solving a global health issue, which negatively affects millions of people of different ages, including teenagers. For this population group, the efficient fighting of “maskne” improves both mental and physical wellbeing.

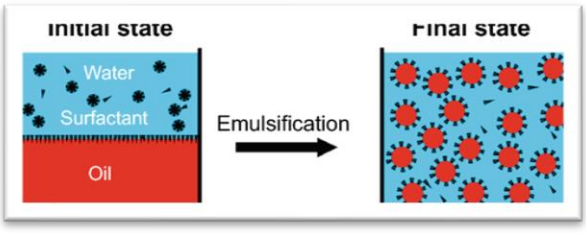
Senior Project 3
European School of Bergen
Maria Nicorescu

Investigating the effects of soaps as an Anti-fog material

Abstract

A commonly used solution to the problem of fogging that divers encounter is a water-soap solution. This has proven to decrease the quantity of condensation on certain surfaces including diving masks. The solution is applied to the inside surface of the mask where it is left for the duration of the dive. This causes a decrease in condensation. Since soap is surfactant, meaning that it reduces surface tension when mixed with water, there is a substantial decline in the mass of water in the form of droplets formed on the surface, also known as condensation.





Therefore, we have decided to investigate and test the way different soaps with different molecular formulae affect this process.

Senior Project 4
European School of Bruxelles 1 / Uccle
Marin de Vanssay de Blavous, Máthé Julian

RoomSafe: How physics can curb the spread of epidemics

Abstract

The science around the transmission of and susceptibility to COVID-19 is in its early days, and what is known is not widely understood or applied. Indeed, the spread of respiratory pathogens depends on several parameters which vary with season, location, and the people involved. Thus, universal guidelines cannot curb the spread of disease while also keeping businesses and schools open. If we are to live with COVID-19, the spread must be controlled at the local level by adjusting situational factors. That is why we have developed RoomSafe, a web app that helps users assess the personal risk of activities based on direct input of data readily available to users themselves. RoomSafe users maybe: hosts or guests.

• Hosts: create events, enter local conditions, adjust event specifics, and receive a RoomSafe Score for the event based on the calculated risk of transmission.
• Guests: join events, personalize their attendance, and receive their own SafeGuest Score for each event. The RoomSafe Score for the event is updated in real time with information on each new guest. Importantly, RoomSafe offers guidance to all users encouraging safer choices and quantifying the effects of those choices. Users leave the system better informed.

The RoomSafe algorithm is based on the Wells-Riley theory of indoor disease-spread. In particular, we adapt the methods developed by Martin Z. Bazant and John W.M. Bush to real rooms (as opposed to ideal rooms), where individuals wear different quality masks for different periods of time, engage in different respiratory activities, and have different levels of immunity.
RoomSafe is hosted on Gandi. The web app is coded in Python, and each separate page is coded in html, with some use of css and javascript. An SQL database is used for storing user information and event information.

Senior Project 5
European School of Bruxelles 1 / Uccle
Lisa Banti, Carolina De Lera Sanjurjo

STEM subjects and Gender Gap in the last years of High School

Abstract

The purpose of the survey was to investigate the attitude of high school students, especially female students, toward STEM subjects to determine whether gender plays a part in the choice of pursuing a career in this field. In this report are presented the final findings of the survey that are most relevant to its purpose. During the spring/summer of 2021, this survey was conducted, through the REMIX project.

Project REMIX

The REMIX project conducts research in the use of natural material in Regenerative Medicine. It is a joint research coordinated by the Biotech Center for Biomedical Technologies within the University of Trento (Italy), led by prof. Antonella Motta. Through the connections the University of Trento provided, we reached out to many of the high schools collaborating with them.

www.remix-term.eu

Objective

The survey targeted a number of high schools connected to the REMIX project: Italy, Portugal and Mongolia. These high schools have connections with the partner universities of REMIX, either because they are under the same management or because they send their students to do internships in these universities.

In addition to these high schools, the European School of Brussels 1 was included in the survey as well. That is because of its special features which separate it from the other schools: it's a school that adopts an International Curriculum and its students come from many different nationalities.

The complete lists of the schools that participated are:

- Agrupamento de Escolas de Póvoa de Lanhoso - Portugal
- Agrupamento de Escolas de Santa Maria Maior - Portugal
- European School of Brussels 1 - Belgium
- Istituto De Carneri - Italy
- Istituto Di Istruzione Lorenzo Guetti - Italy
- ITT Buonarotti - Italy
- Liceo Russell - Italy
- MUST High School - Mongolia

The total number of respondents was **827**, all students from the last three years before graduation. **78%** of them attended a scientific curriculum, with the rest studying IT, Languages, Management, Vocational Training, Humanities and Technology.

Senior Project 6
European School of Bruxelles 2 / Woluwé
Irmak Kanyilmaz, Martin Rezessy, Mihail David Staicu

The Effects of Music on Plant growth

Abstract

Music is widely known to have a positive impact on humans. But does this also apply to plants? Do plants that are exposed to music grow faster and/or develop better than ones that are not? To test this hypothesis, we made beans grow and exposed some of them to different types of music. Furthermore, we tried to isolate the effects of variables in music : frequency (pitch), intensity (volume), and tempo. Our experiments demonstrate that it is plausible for music to have an effect on plant growth and that plants may grow better when exposed to music with a slow rather than a rapid tempo and a high rather than a low frequency range.

Senior Project 7
European School of Bruxelles 4 / Laecken
Iren Kirilova Varbanova, Iseult Saliez-Dabertrand

Phytoremédiation
Comparaison de l'efficacité du kale, de la fétuque et de l'euphorbe pour purifier le sol

Abstract

Les sols et les eaux sont de plus en plus pollués, empêchant toute exploitation agricole et marine. Par le biais de la phytoremédiation (la purification des sols et des eaux par les plantes), il est possible de les rendre exploitables à nouveau. Avec la hausse de population et le changement climatique, nous avons plus que jamais besoin de ces sols. Nous avons donc comparé l'efficacité du kale (chou frisé), de la fétuque bleue et de l'euphorbe pour purifier le sol : nous avons versé du sulfate de zinc ($ZnSO_4$) à différentes concentrations (100 mg_{Zn}/kg_{terre} et 776,4 mg_{Zn}/kg_{terre}) dans la terre des plantes (pour une sorte de plante : deux plantes avec des concentrations différentes, une plante témoin), puis nous avons attendu 4 semaines et analysé à l'aide d'un spectrophotomètre l'indice d'absorption des feuilles broyées des plantes. La différence d'absorption n'indiquant pas forcément l'indice d'extraction du zinc du sol, nous ne pouvons émettre qu'une hypothèse sur l'efficacité d'une plante ou d'une autre, mais nous pensons que **l'euphorbe** est plus efficace sur les sols avec une grande concentration de zinc, alors que sur les sols avec une plus faible concentration, nous pensons que c'est la **fétuque**.

Senior Project 8
European School of Bruxelles 4 / Laecken
Yasmina Assakhen, Anaïs Camacho Rouiller

Comparaison et évaluation de la valeur ajoutée de l'utilisation de gels hydroalcooliques artisanaux par rapport aux gels hydroalcooliques industriels.

Abstract

Nous cherchions à comparer et évaluer l'efficacité des gels hydroalcooliques maison par rapport au gels hydroalcooliques industriels. Pour cela, 16 volontaires ont testé les gels de la manière suivante : nous avons supervisé le lavage de leur mains à 12:40 puis les sujets ont continués leurs journée normalement. Ensuite, à 15:10 nous avons désinfecté leurs mains de façon à ce que les 9 premières personnes aient le gel hydroalcoolique industriel sur leur main droite et celui fait maison sur la gauche. Pour le reste, le gel maison était appliqué sur la main droite et le gel hydroalcoolique industriel sur l'autre, de cette manière, le fait qu'une personne soit droitière ou gauchère n'aura pas influencé nos résultats. Par la suite, ils ont apposés leurs mains sur des boîtes de pétri, les avons laissé incuber pendant 4 jours à 37°. Le logiciel « Mesurim 2 » a été utilisé pour mesurer la surface colonies microbiennes.

Pour déterminer lequel des deux est préférable, nous avons pris en conte l'efficacité biologique, le confort d'utilisation, le coût et la difficulté de fabrication. En terme d'activité biocide, le gel hydroalcoolique industriel l'emporte, mais de peu. Cependant, par rapport au confort et au coût, le gel maison semble être une meilleur alternative. De plus, il n'est pas difficile de s'approvisionner en matière première ni d'en fabriquer.

Senior Project 9
European School of Karlsruhe
Layla BRUGGER, Mila STOJANOVIC

Examination of wrapping papers for their stability

Abstract

In our research project we asked ourselves the question, 'how stong is wrapping paper?'. We came up with that question after christmas when we realised, that presents were wrapped in different wrapping paper and that besides the aesthetic aspect they also had various levels of difficulty when unwrapping the present.

In our first approximation we have determined that this could be due to the different strengths (thickness) of paper. The strength of paper therefore directly proportional to the grammage, meaning the mass per square meter.
Through research of the production and processing of the paper we could recognise that even paper with the same grammage shows different tear resistence when experimenting; since it is the processing of the pulp fibres that is most important.

To carry out a well-founded examination, we developed two different approaches. Firstly, we want to investigate the kinetic energy or the punctual impulse in the form of stability that a sheet of wrapping paper can withstand during an impact. Secondly, we want to measure the tear strength of a sheet of wrapping paper.
We are investigating the correlation between grammage, stability and tear strength and have found that these are directly related.

For the wrapping of the gifts, we can now say that paper with a lower grammage is easier to open on average, but must be rated lower in terms of curious eyes, since a gift is more securely wrapped in paper with a more elaborate grammage and finish.

Further, this could be followed by two adjacent studies: Firstly, a price/effort study and secondly, a joy/happiness/effort study, which could then be linked together and subsequently result in a recommendation on the use of a good gift wrap grammage. Due to time constraints, we have not yet conducted this study.

Senior Project 10
European School of Luxembourg 1
Henri AHOLA

Dolor eXtented

Abstract

DolorX (short for Dolor eXtended) is the second full version of the Dolor project [appendix A]. Dolor, and the new DolorX, are minimum-effort systems for conveying the level of chronic pain experienced by the user to a medical doctor. Simplicity and ease-of-use have been prioritised in the design of both systems, making them suitable for people with less technical experience, such as children or the elderly.

The DolorX system builds on top of Dolor, and it functions around the same principle. The user has a wearable device with which they indicate when and how much pain they are feeling. The data is transferred over the internet to a web server, and from there to an interface used by a medical doctor to analyse the data. The key difference is the amount and richness of the data collected. While Dolor could only record how much pain there was and how much it disturbed the patient, DolorX additionally collects heart rate data, physical activity data, sleep information, and when the patient takes their pain medication.

DolorX has the same goal as Dolor: to better understand the experienced pain, its strength, when it occurs, and if it has any patterns.

Senior Project 11
European School of Luxembourg 1
Krzesimir Hyżyk

Development of an inverse Cryptographic Hash Function

Abstract

Cryptographic Hash Functions are mathematical algorithms that are used to map an arbitrary-length message to a fixed-size message digest i.e. hash. They are widely used in cryptography, and ideally the only way to reverse them is by using brute-force attacks. This project demonstrates vulnerabilities of SHA-1, as well as other similar algorithms. It shows that under certain assumptions hash functions can be inverted i.e. it is possible to recover the original message from the digest. This is a cybersecurity project that can contribute to a better understanding of the limitation of the well-known hashing methods, as well as provide another reason to switch to newer and better Cryptographic Hash Functions. Moreover, this project demonstrates optimization techniques for algorithms running on an NVIDIA RTX-series GPU. Security of cryptographic algorithms depends on the time required to brute-force the algorithm. In this context, optimization techniques play an important role in making the best use of available computing resources.

Senior Project 12
European School of Munich
Fachin Enrico

E-BIKE RECHARGING SYSTEM

Abstract

The purpose of this apparatus is to charge the battery of an electric E-Bike during a ride. Said apparatus uses a magnetic generator wherein the stator and rotor, mounted on the same axes, are counterrotating. These two components are provided as usual respectively with coil and magnets. The counterrotation will be achieved by means of a gear wheel connecting the rotor and stator. This arrangement provides for improved power production as well as slow as at high speed of the bike. Particularly at low speed of the bike, the counterrotation provides for a higher angular speed(rpm) between the rotor and the stator, assuring better energy production. No important increase of human power is needed in this arrangement because the friction factor of the gearwheel will be designed to minimize its loss of efficiency. This apparatus will be mounted on the shaft of one of the bike wheels. The main goal of this apparatus is to provide good energy production, particularly at low speed, and to increase the battery life through recharging the said battery.

Senior Project 13
European School of Munich
Max Horstmannshoff, Oscar Pelaez Garcia, Ulysse Barrere-Dupasquier

Verkehrssimulation zur Optimierung des Verbrauches und der Fahrdauer am Beispiel einer Münchener Kreuzung

Abstract

In unserem Projekt simulieren wir auf Basis der Programmiersprache "Python" eine vielbefahrende Kreuzung in München.

Unser Projekt setzt sich mit der optimalen Dauer der Schaltung der dort befindlichen Ampeln auseinander, um so den Kraftstoffverbrauch von Fahrzeugen auf ein möglichst geringes Level zu halten. Zudem wollen wir mit der Simulation die benötigte Zeit der Autos, um die Kreuzung zu passieren minimal halten.

Die Idee kam uns durch einen Artikel, der sich mit Verkehrssimulationen befasst [WebSim].

Für das Projekt nutzen wir nicht nur unsere Fachkenntnisse aus dem Bereich der Informatik, sondern auch aus dem der Physik. Die Auswertung der Daten soll über den momentanen Kraftstoffverbrauch aller Fahrzeuge durchgeführt werden.

Unser Programm basiert auf dem Code der Internetseite, auf der wir den Artikel gefunden haben [WebSim].

Diesen haben wir für unser Projekt stark verändert und somit an unsere Bedürfnisse angepasst. Da der Code durch eine MIT Licence geschützt wird, bewegen wir uns hier aber im legalen Rahmen.

Senior Project 14
European School of RheinMain
Aaron Niechzial, Shaked Benharosh, Simon El Hadidi

Project E

Abstract

We set out on a mission to create a safe and accessible end-to-end encryption system. For the most part, our system is a slightly simplified and performance-adjusted version of the “Enigma”-machine, used by the German military in WW2. In order to design our system more user-friendly, we decided to remove a few additional components from the final backend-side of the project, leaving unimportant settings to the side, facilitating a smoother user experience (UX) and streamlining the process of encrypting/decrypting a message. Our streamlined encryption algorithm can be easily incorporated into any project and was designed to be used to help victims of domestic abuse, as well as it can be incorporated in an organizations intranet to ensure secure communications and file transfer.

Senior Project 15
European School of Strasbourg
Charlotte Pigerol, Hannah Moore

Quelle est la fiabilité de la règle des 5 secondes ?

Abstract

Dans le cadre de cette expérience nous voulons tester la véracité de la règle des 5 secondes. Le but est de vérifier ses limites pour éviter que les gens ne suivent inconsciemment une règle et courent un quelconque danger pour leur santé.

Nous avons, dans un premier temps, fait un sondage pour savoir combien de personnes suivent cette règle par habitude. Ces données peuvent également être utilisées pour savoir s'il y a des aliments qui aspirent plus confiance que d'autres et ainsi plus concernés par cette règle.

Nos résultats les plus concluants se traduisent par une croissance bactérienne sur un bonbon après son contact avec le sol pendant 10 secondes et sur une barre de chocolat au caramel après que celle-ci est restée au sol pendant 8 et 10 secondes.

Senior Project 16
European School of Tallinn
Roza Maria Kozlowska, Sedef Kaya

Saving the waters with the help of ferries

Abstract

Since the 1960s waste on the surface of the World's waters started causing a great number of environmental problems, Global Warming being the biggest. It is recent that people actually started fighting against those problems. For this year's "European Schools Science Symposium" we have decided to find a solution for the garbage lying on the surface of the seas. This is a minor but effective way to bring an end to the garbage islands forming on the surface. In order to do that we are planning on making a garbage-collecting device that helps us passively collect the garbage lying on the surface. This device is called DebrisMax. DebrisMax connects to ferries. It works by using pressurized water pushed away by the propellers of the ferries. With the help of our project, every time a ferry goes from one harbor to another it will also be cleaning the sea surface. Connecting the device to the ferries is preferable because of the durability of the ferry through harsher weather. There are two reasons why cleaning the surface is our mission. Firstly, it is because most of the waste is caused by plastics and plastics tend to float in water which makes them an easy target for us. Secondly, when we are cleaning the surface, we are also planning to protect the lives of the animals who live in the water. We were inspired to make this project because we recently learned that the Baltic Sea is one of the most polluted seas in the world mainly due to chemical waste but also trash. As we come from Estonia, a Baltic country, that is next to the Baltic Sea, we feel miserable about the general state that it is in. Therefore we want to make a change.

Senior Project 17
European School of Tallinn
Kai Yin

The golden ratio

Abstract

My objective for the "European Schools Science Symposium 2022" is to present the findings of my research about the linkage between nature and art via the possible unofficial but fundamental definition of beauty via ϕ.

The scientific investigation consists of three parts:

1. finding natural occurrences of ϕ
2. finding ϕ's occurrences in human creations
3. solving the enigma: "Could humans/artists have used ϕ intuitively?"

I have collected various amounts of data on ϕ's occurrences in nature, in 2 categories: *non-organic* natural output, such as the Bohr radius; *organic* natural output, such as DNA. In parallel, I have also collected a good amount of data on ϕ's appearances in human outputs, like the ϕ's occurrences in nature, the data is distributed in 2 categories: *voluntary* human outputs, such as the Greek Parthenon; *involuntary* human outputs, such as Pascal's triangle.

The data collected shows a great number of occurrences of ϕ in nature, as well as the occurrences of ϕ in art and architecture, mostly voluntary human outputs, but despite the large amount of natural and voluntary human outputs of ϕ. I came across several cases of involuntary human outputs of ϕ, such as the pyramid of Giza, where the golden ratio was not yet discovered; the Chinese characters (traditional), which originated from the clerical scripts during the Han Dynasty, where ϕ was not yet introduced.

From the evidence collected, there is a high possibility that some artists have used the ϕ in their art while not being aware of it. The answer will be supported by a few visual examples of applications of the golden ratio and some of its derivative products such as the Fibonacci sequence.