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Miquel Solà, PhD (Editor)

Volume III, 2019



III Conference

of Pre-doctoral Researchers

Abstract Book

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**DOCTORAL PROGRAMME IN MOLECULAR
BIOLOGY, BIOMEDICINE AND HEALTH**

UNMASKING *QUERCUS SUBER* AND *QUERCUS ILEX* DRAWING UPON HYBRIDS. TRANSCRIPTOME AND MIRNOME DIFFERENTIAL GENE EXPRESSION

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1. Objectives

Hybridization between cork oak (*Quercus suber*) and holm oak (*Quercus ilex*) is important in Mediterranean forest and yields offspring with varying potential to produce cork and which may increase tolerance to some abiotic stresses compared to cork oak alone. To better understand the molecular mechanisms that give rise to the bark of these individuals, the transcriptome and miRNome of the hybrids is compared to the parental lines and among them. Knowledge of these global profiles can provide relevant information about the mechanism of cork formation and the hybridization between cork oak and holm oak.

2. Methodology

We used outer bark samples from 5 different hybrids (4 similar to holm oak and 1 similar to cork oak) and 4 individuals of each parental line. mRNA and miRNA were extracted and sequenced by the Illumina Sequencing platform. The mRNA reads were cleaned with Trimmomatic² and their quality analyzed with FastQC³. For transcriptome building, the reads were mapped against the *Q. suber* genome using GSNAP⁴, assembled with Cufflinks and merged with Cuffmerge. Total counts were estimated with HTSEQ-COUNT. For differential expression analyses, we used DEseq2, and differential gene annotation was obtained using TOA. For miRNA analysis, we used the UEA-small-RNA-workbench utility to identify the miRNAs either conserved or novel. Their count matrix was obtained and used to perform the differential expression analysis with DEseq2. For target gene prediction, the psRNA-target platform was used.

3. Results and Conclusions

Globally, 75% of the mRNA reads correctly mapped against the *Q. suber* genome (225.297 gene isoforms), and 95% of them were correctly annotated. Regarding miRNAs, 59 miRNAs were detected, 24 were previously characterized, while 35 were predicted as novel. Statistical analyses showed significant differences between all the comparisons performed: between parent lines (1762 upregulated in *Q. suber* and 5479 in *Q. ilex*) and between each of the parent lines versus hybrids, as expected. The differences were lower when barks show a similar phenotype to parent trees (2160 and 3917 differential genes in suberoid and 5645 and 1290 differential genes in ilexoid in comparison to *Q. suber* and *Q. ilex*, respectively). The miRNA comparison between cork oak and holm oak barks showed 6 differential miRNAs: 5 upregulated for *Q. suber* and 1 for *Q. ilex*. The psRNA-target predicted a total of 9.697 candidate genes for differential miRNAs. Gene ontology enrichment will allow specific pathways and functions for each kind of bark to be highlighted.

HORMONE-INDUCED MATURATION OF HUMAN-INDUCED PLURIPOTENT STEM CELL-DERIVED CARDIOMYOCYTES (IPS-CM) INDUCES AN INCREASE IN ELECTRICALLY-TRIGGERED AND BETA-ADRENERGIC RESPONSE OF CALCIUM RELEASE

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1. Hypothesis and objectives

iPS-CM are an invaluable cell model for studying patient-specific cardiac pathologies. However, they present an immature phenotype with incomplete excitation-contraction coupling, inefficient calcium-induced calcium release, and a lack of t-tubules. This compromises the study of calcium handling-related pathologies such as catecholaminergic polymorphic ventricular tachycardia (CPVT). To improve iPS-CM maturity, we treated beating cardiomyocytes with triiodothyronine (T₃) and dexamethasone (Dex), as recently described by Parikh and collaborators (2017).

The aim of this study was to determine the molecular and physiological changes associated with hormone maturation treatment of iPS-CM.

2. Methodology

We generated iPS-CM using a heparin-based differentiation protocol (Lin et al., 2016) followed by glucose starvation (Sharma et al., 2015). We treated beating cardiomyocyte monolayers with T₃ and Dex from day 16 until day 30 of differentiation. We measured the expression of tubulogenesis markers (*JPH2* and *CAV3*), beta adrenergic receptors (*ADRB1* and *ADRB2*), calcium handling-associated genes (*RYR2* and *PLN*), and the fetal and adult isoforms of *SCN5A* by qPCR. We also determined whether the sarcoplasmic reticulum (SR) had a higher contribution in electrically-induced calcium transients in hormone-treated iPS-CM. Finally, we characterized calcium transients elicited by caffeine pulses in both basal and β -adrenergic stress conditions (100nM isoproterenol).

3. Results

Our qPCR results showed an increase in the expression of the tubulogenesis marker *JPH2* (2.20-fold), beta adrenergic receptor *ADRB1* (10.11-fold) and calcium handling-related gene *PLN* (1.61-fold). In addition, we found that hormone treatment promotes a switch in the relative expression of the neonatal isoform of *SCN5A* to the adult isoform. Moreover, we found that hormonal treatment induced a higher contribution of the SR in electrically-induced calcium transients. We also found that caffeine sensitivity was increased in hormone-treated *vs.* control cells in the presence of isoproterenol ($K_d_{T_3+Dex}=1.38\pm 0.06\text{mM}$; $K_d_{Ctrl}=1.92\pm 0.16\text{mM}$).

4. Conclusions

In summary, our results demonstrate that the hormone treatment induced upregulation of the *JPH2*, *ADRB1* and *PLN* genes, together with an increased expression of the adult *SCN5A* isoform. The treatment also promoted a more robust contribution of the SR to electrically-induced calcium transient and a higher caffeine sensitivity in β -adrenergic stress conditions. All these changes indicate that using our improved differentiation protocol, iPS-CM can achieve a more mature functional and structural phenotype.

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MORPHOMETRIC INVESTIGATION OF PULMONARY BAROTRAUMA: A STUDY IN FORENSIC AUTOPSIES OF SCUBA DIVING FATALITIES

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1. Introduction

Self-contained underwater breathing apparatus (SCUBA) diving is one of the most popular and practiced underwater activities. Although recreational diving is considered safe overall, diving accidents are potentially serious and even fatal. Drowning is the main cause of death, but others have been implicated, including arterial gas embolism following pulmonary barotrauma (PBt/AGE), decompression sickness, natural disease and trauma. PBt/AGE has been described as the cause of death in 13-24% of cases, and we hypothesized that it causes histomorphological changes in lung tissue that can be quantified and that are different from those resulting from drowning.

The aim of this study is to describe histopathological changes of acute pulmonary emphysema observed in lung tissue samples from forensic autopsies of PBt/AGE in the context of scuba diving as compared to those in forensic autopsies from a diagnosis of drowning.

2. Methodology

The study population are people who died on the Girona coast as a result of submersion diagnosed as PBt/AGE or drowning.

The pulmonary histological preparations used will be selected according to the type of death, with three groups defined: 6 cases of PBt/AGE, 8 cases of drowning (positive control group), and 8 cases of acute internal bleeding (negative control group).

For each histological preparation, 4 fields will be selected. Each field will be photographed with a high-resolution microscopic camera coupled to a triochial microscope. The captured images

will be analysed (to see the presence/absence of microscopic emphysema) and the following variables measured: total alveolar area and average thickness of the alveolar wall. The morphometric analysis will be carried out by means of image analysis software. This project has been approved by the ethics committees of Bellvitge University Hospital (Barcelona).

3. Conclusions

Morphometric analysis of lung tissue can provide objective quantitative data about air spaces and their alterations and more reliable data for Pbt/AGE diagnosis. It is not the aim of this study to demonstrate that Pbt/AGE can be diagnosed by microscopy. Rather, it is a first proof of a concept that tries to show that in the case of deaths caused by Pbt/AGE, histomorphological changes can be found in lung tissue that are quantifiable and different to those resulting from other causes of death. This study could therefore be the basis for further research on the topic.

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TRAFFICKING OF THE CARDIAC VOLTAGE-GATED SODIUM CHANNEL IS PROMOTED BY N-GLYCOSYLATION OF ITS β_2 SUBUNIT

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The voltage-gated sodium channel is a protein complex that plays an important role in cardiac cell contraction. It is mainly composed of a pore-forming α subunit ($\text{Nav}1.5$ in the heart) and two β subunits. β_2 (encoded by *SCN2B*) promotes trafficking of α to the plasma membrane, where it performs its function. Pathogenic mutations in β_2 are associated with fewer channels at the cell surface, leading to atrial fibrillation and Brugada syndrome (1,2).

1. Hypothesis

N-glycosylation plays an important role in β_2 intracellular trafficking and is required for β_2 to promote $\text{Nav}1.5$ trafficking to the plasma membrane.

2. Methodology

We explored the glycosylation profile of β_2 and its effect on $\text{Nav}1.5$ localization at the plasma membrane. We employed biochemical and fluorescence microscopy approaches in polarized Madin-Darby canine kidney (MDCK) cells.

3. Results

We found that β_2 is N-glycosylated at Asn 42, 66, and 74, being sialylated only at Asn 42. Lack of complex glycosylation prevented β_2 from efficiently reaching the plasma membrane, leaving the subunit retained in the endoplasmic reticulum. Nonetheless, a fraction of the triple unglycosylated mutant could still be detected at the cell surface. In addition, we demonstrate that wild-type β_2 that has not yet undergone full glycosylation still traffics to the plasma membrane bypassing the Golgi apparatus. More importantly, we found that β_2 glycosylation is essential for its function, as unglycosylated β_2 did not promote surface trafficking and localization of $\text{Nav}1.5$.

4. Conclusions

We provide evidence at cellular level that N-glycosylation of $\beta 2$ is key for its localization and its role in ensuring Nav1.5 trafficking to the cell surface.

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Keywords: *SCN2B*; Nav1.5; cardiac sodium channel; glycosylation; trafficking; MDCK

SILENCING OF ALPHA_{2,3}-SIALYLTRANSFERASES IN PANCREATIC CANCER CELLS REDUCES CELL MIGRATION AND INVASION IN VITRO

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1. Introduction and Hypothesis

Pancreatic ductal adenocarcinoma (PDA), the most frequent pancreatic tumor, has one of the worst prognoses of all cancers. PDA patients have extremely low survival rates, mainly due to late diagnosis and resistance to standard therapies. For this reason, finding new potential therapeutic targets and reliable biomarkers for early diagnosis is a challenge for the scientific community nowadays.

Glycosylation changes are a commonly associated hallmark of cancer transformation and they also occur in PDA. One of the altered glycans frequently found in PDA is the carbohydrate antigen Sialyl-Lewis x (SLe^x), which is known to contribute to the invasive and metastatic potential of PDA. In the later stages, SLe^x synthesis is catalyzed by specific alpha_{2,3}-sialyltransferases, which are frequently upregulated in cancer.

2. Methodology

In this study we targeted the alpha_{2,3}-sialyltransferases (ST3Gal3 and ST3Gal4) by reducing them to find a more comprehensive understanding of the influence of SLe^x expression on the aforementioned processes.

From a panel of seven PDA cell lines, we characterized the intracellular levels of different enzymes related to SLe^x synthesis using real time PCR (RT-qPCR). The levels of different glycans on the cell surface were also analyzed through flow cytometry and western blot. From these results we selected the two cell lines which expressed moderate to high levels of SLe^x (Capan-1 and BxPC-3). Both cell lines were silenced using lentiviral particles with ten specific shRNAs against the two target sialyltransferase genes.

3. Results and Conclusions

Silenced shCapan-1 and shBxPC-3 cells were analyzed using RT-qPCR to determine the ST3Gal3 and ST3Gal4 mRNA expression, and using western blotting and flow cytometry to evaluate the SLe^x levels. Genetic reduction of alpha2,3-sialyltransferases resulted in a significant decrease in SLe^x biosynthesis. Although all shCapan-1 and shBxPC-3 reduced the gene expression of the aforementioned genes, we selected the two which gave the greatest reduction in SLe^x levels for each gene for further functional assays.

Interestingly, shCapan-1 and shBxPC-3 for both genes showed an important decrease in adhesion to human recombinant E-selectin, consistent with the lower expression of Lewis antigens within the different clones of a particular cell line. To further investigate if cellular migration is correlated with ST3Gal3/Gal4 and Sialyl-Lewis x levels, cell migration and invasion through Matrigel was assessed using modified Boyden chambers. ShCapan-1 and shBxPC-3 showed a significant reduction, demonstrating a positive correlation between alpha2,3-sialyltransferases' expression (ST3Gal3 and ST3Gal4) and their key role in the regulation of the adhesive and migratory potential of pancreatic adenocarcinoma cells.

NE-SFL and NE-SSC PARAMETERS AS SCREENING FOR SEPSIS

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1. Introduction

Sepsis is a leading cause of mortality in critically ill patients. Fast and accurate diagnosis followed by rapid treatment is essential to reduce mortality. However, differentiating sepsis from non-infectious diseases can sometimes be very difficult. Several markers have been proposed as a sepsis biomarker (procalcitonin, C-reactive protein, and interleukine-6, among others), but none are specifically for sepsis. When blood infection occurs, neutrophils are activated by microorganisms and inflammatory cytokines. Sysmex XN hematology analyzer can measure these neutrophil changes using side-scattered light (NE-SSC) and the cellular nucleic acid content using side-fluorescence light (NE-SFL). The aim of this study is to determine whether NE-SSC/NE-SFL could be a favorable parameter in differential diagnosis of sepsis.

2. Methodology

From October to December 2018, 65 patients were examined and distributed in two groups: a sepsis group (30 patients) and a reference group (38 subjects). The CBC and NE-SSC, NE-SFL parameters were obtained from Sysmex XN. Sepsis was diagnosed following The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). Results between both groups were compared with the Mann-Whitney U test. Receiver Operating Curves (ROC) were analyzed for the best parameter.

3. Results and conclusions

Both NE-SSC and NE-SFL presented higher values in the sepsis group compared to the control group (median and interquartile range in scatter intensity were: NE-SSC 157.1 (153.8-160.0) vs 153.1 (151.1-157.2), $p < 0.01$; NE-SFL 53.0 (50.1-58.55) vs 46.4 (45.18-47.95), $p < 0.001$). The best NE-SFL cutoff observed was 49.9 (sensitivity 80% and specificity 89.5%). ROC analysis

showed Area Under the Curve (AUC) for NE-SFL of 0.877. A cutoff of 49.9 was established and NE-SFL was 80% sensitive and 89.5% specific.

Neutrophils are activated when bacterial infection occurs, especially in cases of sepsis. Sysmex XN provides information of the activity of these neutrophils through NE-SSC and NE-SFL analysis. According to recent studies these parameters can be used in the differential diagnosis of sepsis. In this study, we suggest NE-SFL as a reliable marker for sepsis. A cutoff value of 49.9 SI is appropriate to distinguish septic patients from the control group.

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DIFFERENTIAL EGFR GLYCOSYLATION IN A2,3-SIALYLTRANSFERASE-SILENCED PANCREATIC CANCER CELL LINES.

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1. Introduction

Pancreatic ductal adenocarcinoma (PDA) is currently the third leading cause of cancer mortality in developed countries and presents a 5-year survival rate of only 8%¹. This unfortunate prognosis is mainly due to its delayed diagnosis once metastases have already occurred, and its resistance to existing therapies.

Epidermal growth factor receptor (EGFR) is overexpressed in various types of cancer cells and participates in the regulation of carcinogenesis. EGFR is highly glycosylated and during the neoplastic process its glycan structures can undergo several modifications that alter its activity and signalling².

Our aim was to analyse the changes in the glycosylation pattern of EGFR in PDA cell lines deficient in alpha2,3-sialyltransferases (STs) ST3GAL3 and ST3GAL4, which are involved in the biosynthesis of tumour-associated carbohydrate antigen Sialyl-Lewis x. We also aimed to determine the influence of such changes in the function and signalling of the EGFR in these cell lines.

2. Methodology

EGFR levels were evaluated in ST3GAL3 and ST3GAL4 silenced BxPC-3 and Capan-1 cell lines by flow cytometry and western blot (WB). In order to study the glycosylation pattern of the EGFR, the receptor was immunoprecipitated from cell lysates and the glycosylation pattern of each cell line was examined by WB.

The effect of silencing STs on EGFR activation following stimulation by its EGF ligand was determined by WB analysis of the phosphorylation levels (activation) of EGFR specific tyrosine/serine EGFR residues involved in proliferation signalling pathways and internalization of the receptor.

3. Results

EGFR expression level of BxPC-3 and Capan-1 silenced cell lines did not change significantly compared to the scramble (control) ones. Slight changes in the levels of EGFR sialylated determinants of the ST-silenced cell lines compared to scramble ones were shown by WB.

After EGF stimulation, Y1173 and Y1068 specific EGFR residues involved in the proliferation signalling pathways increased their phosphorylation in BxPC-3 silenced cell lines compared to scramble ones. S1046/47 and Y1045 residues, involved in the internalization of the receptor, also showed a higher level of phosphorylation in BxPC-3 and Capan-1 silenced cell lines versus scramble ones.

4. Conclusions

Altogether, these preliminary results suggest that silencing of ST3GAL3 and ST3GAL4 in PDA cell lines alters the phosphorylation pattern of the receptor that regulates the proliferation and internalization pathways.

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GENETIC STUDIES REVEAL THE PRESENCE OF UNEXPECTED SPECIES IN COMMERCIAL FISHERIES

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1. Introduction

Conservation genetics have become a valuable resource for proper stock management in wild fish populations. Analysis of the genetic variability permits better identification of the species but it also allows the population status to be assessed (Ward, 2000). Small tuna are a well characterised group of pelagic and migratory fish species usually exploited by traditional fisheries. In spite of that, morphological similarity between species of the same genus can lead to incorrect species identification (Collette & Nauen, 1983). Thus, the presence of multiple species within a single fishery can complicate its management, hampering the viability of the populations. In addition, due to their life history traits, it has been postulated that these species are not prone to present population heterogeneity. However, several studies have shown population differentiation in some species (Gonzalez, Pedraza-Lara, & Doadrio, 2014; Palumbi, 1994; Viñas, Alvarado Bremer, & Pla, 2004).

2. Hypothesis and objectives

In this work, we genetically validated the species of two sets of individuals from both *Euthynnus alletteratus* and *Auxis rochei* fisheries.

3. Methodology

We analysed 138 *E. alletteratus* individuals from three populations (Portugal, Tunisia and Ivory Coast) and 438 *A. rochei* individuals from eight populations (Portugal, Ceuta, Malaga, Cartagena, Valencia, Tarragona, Algeria and Tunisia). All specimens were sequenced for the mitochondrial DNA control region marker (mtDNA CR) and for each species a subset of individuals was also tested for the Tmo4c4 nuclear marker.

4. Results

Euthynnus alletteratus

The mtDNA CR analysis showed an extremely high differentiation between Ivory Coast and the two northern populations of Portugal and Tunisia. On the other hand, we didn't find any differences between these populations at the TmO4c4 locus.

Auxis rochei

The mtDNA CR BLAST analysis revealed the presence of 7 *Auxis thazard* individuals within the *A. rochei* fishery in the Ceuta population. These individuals were tested for the TmO4c4 marker and the results were concordant between the two markers.

5. Conclusions

The mtDNA CR results show an extremely high level of population structure within *E. alletteratus* suggesting a possible speciation event between populations. Although the TmO4c4 marker failed to show any differentiation between locations, it could be explained by the low variability of this marker, even within the genus. We are currently testing more markers to confirm the hypothesis of a recent speciation.

Regarding *A. thazard*, this is the first evidence of this species in Mediterranean waters and alerts us to a putative mixed fishery.

These results confirm genetic analysis as a valuable tool for species identification and its application to fisheries management.

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IDENTIFICATION AND CHARACTERIZATION OF ACETYLATED LYSINES IN GATA4 TRANSCRIPTION FACTOR

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1. Hypothesis

Aberrant expression of the sodium channel gene (*SCN5A*) has been proposed to disrupt cardiac action potential and cause human cardiac arrhythmias, but the mechanisms of *SCN5A* gene regulation still need to be further understood.

Previous studies in the lab have shown that GATA4 transcription factor plays an important role in the regulation of *SCN5A* expression in human heart tissue [1]. These findings also support several studies highlighting the key function of GATA transcription factors in gene regulation [2].

GATA4 is a zinc finger protein that is activated in response to different stimuli such as hypertrophic stimuli. GATA4 activity has been shown to be modulated by multiple posttranslational modifications, including phosphorylation, acetylation and arginine methylation. Acetylation of GATA4 by the histone acetyltransferase p300 has been shown to increase GATA4 transcriptional activity on several GATA4 gene targets. Using mutagenesis and luciferase reporter assays, Takaya and colleagues proposed four GATA4 acetylation sites [3]. However, the exact position of these acetylated lysines has not been mapped with precision methods.

Here, we hypothesize that acetylation of GATA4 at specific lysines could be also be modulating its activity on regulating *SCN5A* expression.

2. Objectives

Our objectives are the following:

1. To identify which lysine residues are acetylated in GATA4.
2. To evaluate the effect of GATA4 acetylation on *SCN5A* transcriptional activation.

3. Methodology

To identify the GATA4 acetylation sites, we performed “in vitro” acetylation reactions on short GATA4 peptides and analyzed the acetylation using mass spectrometry (MALDIT-TOF). In these experiments, we observed that a peptide containing lysines K318, K320 and K322 showed 2 acetyl groups, and another peptide containing lysines K326 and K328 revealed one more acetyl group.

To identify the exact position of the lysines acetylated, we performed site-directed mutagenesis using a GATA4 expression vector to create single mutant GATA4 proteins in which specific lysines (K318, K320, K322, K326, K328) were mutated to alanines.

The wild-type GATA4 DNA and their respective mutants were transfected into HEK293T cells and treated with deacetylase inhibitors (TSA and NA). Samples were immunoprecipitated with an anti-acetylated antibody and analysed in a Western Blot against GATA4. We also performed additional experiments with double and triple lysine mutants.

To evaluate changes in the GATA4 transcriptional activity we performed luciferase reporter assays. We co-transfected a vector containing the *SCN5A* promoter regulating the luciferase protein together with the GATA4 mutant expression vectors in cardiac H9c2 cells. Luciferase activity was analyzed 48 hours later using a luminometer.

4. Conclusions

Western-Blot analysis revealed 3 lysine residues acetylated in GATA4 and also showed a major decrease in acetylation when double and triple mutant versions were used.

Luciferase experiments showed that GATA4 mutants significantly decrease GATA4 transcriptional activity on the *SCN5A* promoter.

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OPTIMIZATION OF THE CRISPR/CAS9 PROTOCOL TO GENERATE TRUNCATED PKP2 HL1 CELL LINES

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1. Introduction

Arrhythmogenic Cardiomyopathy (AC) is a cardiac disease characterized by fibrofatty replacement of myocardium, leading to ventricular arrhythmias and sudden cardiac death^{1,2,3}. AC is a rare genetic disease with autosomal dominant inheritance pattern and incomplete penetrance⁵. Pathogenic mutations in several desmosomal genes have been reported. The most common causative gene for AC is the *pkp2* gene, which encodes plakophilin 2 protein³. PKP2 plays two principal roles: to maintain cell-cell mechanical stability and modulating intracellular signalling. Nowadays, the molecular mechanisms underlying AC are uncertain; whether it is caused by a haploinsufficiency mechanism or negative dominance is still unknown.

HL1 cell line (AT-1 atrial cardiomyocytes)⁴ was the first cellular model described as mimicking cardiomyocyte performance in ACM. They contract even after serial passaging, and retain morphological, biochemical and electrophysiological⁵ properties from differentiated cardiac. CRISPR/Cas9 technique provokes double-strand breaks (DSBs) on target DNA sequences. Thus, the DNA repair mechanism will be activated. However, this mechanism is error-prone and sometimes introduces insertion-deletions (indels) in the target DNA sequence causing a frameshift and a premature stop codon (PTC). Our strategy is based on this error to introduce PTCs in the *pkp2* gene.

2. Hypothesis and Objectives

CRISPR/Cas9 is an efficient technique to obtain isogenic PTC-PKP2 HL-1 lines which will show an altered gene profile expression.

- To obtain several PTC-PKP2 lines expressing truncated PKP2 of different length.
- To study the gene expression profile of PTC-PKP2 lines compared to HL1-WT.

3. Methodology

sgRNA were designed to target different coding regions of the *pkp2* gene to further be cloned into px458-Cas9WT-GFP. These constructs were transiently transfected into HL1 cells to induce DSBs in target regions, introducing indels leading to a frameshift and finally to a PTC. After 48h of transfection, cells were diluted to generate isogenic colonies to expand and sequence separately. Edited clones containing a PTC were selected. Edited PTC-PKP2 will be characterised by real-time PCR to determine possible gene expression differences compared to HL1-WT.

CRISPR/Cas9 is an effective technique to edit a HL-1 cell line introducing PTCs. Our PTC-PKP2 cell lines are a good experimental design to study molecular mechanisms implicated in AC cellular phenotype.

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Keywords: Arrhythmogenic Cardiomyopathy (AC), Plakophilin 2 (PKP2), HL1 cell line. CRISPR/Cas9. Premature stop codon (PTC)

INTRACRANIAL SELF-STIMULATION INDUCES CHANGES IN KEY REGULATORS OF GENE EXPRESSION RELATED TO NEURAL PLASTICITY

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1. Hypothesis and objectives

Intracranial self-stimulation (ICSS) applied to the lateral hypothalamus (LH) has been found to improve learning and memory in rodents ^[1]. However, the molecular bases of ICSS are not clearly understood. MicroRNAs (miRNAs) have emerged as central regulators of gene expression that could have a key role in orchestrating neural plasticity ^[2]. With the aim of deciphering the molecular mechanisms of ICSS, we studied the changes that ICSS induces in these key regulatory molecules.

2. Methodology

Male Wistar rats were treated with 3 sessions of LH-ICSS or sham treatment. Brain tissue samples, including CA1, CA3 and DG hippocampal subfields, were obtained 90 minutes after the last ICSS session. Differentially expressed miRNAs between pooled ICSS and sham DG samples were studied using an OpenArray miRNA panel to select potentially-regulated miRNAs. We quantified the levels of the OpenArray-based selected miRNAs, together with 4 bibliographic-based selected miRNAs (i.e. miR-132-3p, miR-134-5p, miR-146a-5p and miR-181c-5p), in the CA1, CA3 and DG hippocampal subfields, by qRT-PCR.

3. Results

According to the OpenArray results, we presented a 14 miRNA candidate subset to be regulated by ICSS in DG, from which 6 were selected to be functionally interesting, including miR-495-3p. We validated that miR-495-3p was significantly upregulated in the DG region, but not in

other hippocampal subfields. We also found that miR-132-3p was significantly upregulated in CA1 and DG regions of ICSS-treated rats, but not in CA3.

4. Conclusions

These results confirm for the first time that hippocampal expression of specific cognitive-related miRNAs, including miR-132-3p and miR-495-3p, is induced by ICSS treatment. Their subregion-specific upregulation pattern suggests an important role of DG triggering ICSS effects. Interestingly, decreased levels of the two miRNAs are present in human brains with Alzheimer's disease (AD). Our results suggest that ICSS could reverse hippocampal levels of these synaptic plasticity-related expression regulators and this could serve as a therapy to fight AD cognitive deficits.

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A COMPREHENSIVE APPROACH TO MEETING THE NEEDS AND DEMANDS OF PEOPLE WITH MULTIPLE SCLEROSIS

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1. Introduction

Multiple sclerosis (MS) affects 47,000 people in Spain, so it is essential to implement health interventions that respond to their needs and demands (1,2). Identifying and resolving these needs and demands is directly related to well-being and self-perceived quality of life (3,4). In turn, the World Health Organisation (WHO) establishes health empowerment as the primary strategy of integrated people-centred health systems that places people, not diseases, at the centre of health systems, qualifying them to take charge of their own health (5). Expert Patient (EP) and Shared Decision Making (SDM) Programmes can facilitate this, but their particular features should be tailored to MS (6).

2. Hypothesis and objectives

The implementation of healthcare programmes to solve the self-perceived needs and demands of people with MS and their families will improve their healthcare and perceived well-being. Objective: Find out the needs and demands of people with MS in relation to management of MS with the aim of designing two specific programmes that will enable health empowerment.

3. Methodology

A phenomenological approach to a qualitative descriptive study using focus groups was performed in Girona (Spain). Data was gathered from semi-structured interviews with patients with MS, relatives and health professionals. These data were coded and grouped using thematic content analysis with independent peer review. 95 participants were selected and 73 agreed to participate.

4. Results and conclusions

According to participants, their needs and demands focused on improving knowledge of MS, the role of the person in SDM and on acquiring the skills to promote self-management and autonomy. In turn, the EP Programme must address the impact of MS, integrated treatment and health promotion, follow an open script with small groups and the support of healthcare professionals; participants should show the need for help and an absence of comorbidities that prevent interaction; EPs should have a positive vision of health, experience-based knowledge and leadership and communication skills; and the potential benefits were improved knowledge, quality of life and the normalization of the patient's health situation.

An SDM programme for MS that includes a website and a decision-aid was built up by codesign according to the key elements for selecting a treatment identified (route and frequency of administration, the effectiveness of the treatment, the side effects and the impact on the patient's life).

Conclusion. The aspects identified in this study will permit Spanish MS EP programme development. The SDM MS website and the decision-aid provide a multidisciplinary intervention to foster the shared decision-making process and role of people with MS in it.

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SEQUENTIAL PROCEDURES' USEFULNESS TO CLUSTER INVESTIGATION AND INTERPRETATION UPON SCARCE MORBIDITY SETTINGS

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1. Introduction

Preventive and precautionary dictates reveal a pressing need for procedures to detect increased morbidity rates in relatively small populations and genuine low-frequency clusters. Cost-effective, informative and real-time analyses must be able to provide guidance to concerned communities and stakeholders: Are cases causally related? What causal mechanisms are appearing? Is further investigation needed? When should an intervention be started in the pertinent community sector or area? When common trend statistics are analysed, genuine aggregates of non-recurring, infrequent diseases can go unnoticed by health authorities. However, simply monitoring a broad range of these conditions presents the drawback of finding huddles that have occurred by chance at the expense of costly procedures.

2. Hypothesis and Objectives

We aim to detect clustering upon sparse data settings comprising a population-based time series analysis of the four main categories of myeloid malignancies (MMs) from 1994 to 2008. Secondly, we wonder if the cases encompassed by the clustering could have been diagnosed from informative MM subtypes.

3. Methodology

We applied a sequential approach based on the relative interval (RI) statistic. This reflects the waiting time to the event. RI controls for size and profile differences between populations. Prime verification of rate ratios by standardized incidence ratios (SIR) – regardless of statistical significance – marshalled communities to investigate further. Analyses were performed on preselected municipalities in the Girona province (Spain).

4. Results

Sequential analyses based on the RI depict the temporal pattern of an excess of MM cases clustering over a multiyear period, whether or not the excess is significantly evinced by the SIR. Once we sense the extent of clustering, a focused analysis of morphological subtypes often demonstrates selective involvement by disease subtype.

5. Conclusions

In exploratory, non-post-hoc investigations of temporal clustering of malignancies, these sequential methods yield invaluable information and reassurance beyond the count-based point estimates. Unearthing the approximate start time of accelerated rate intensities facilitates a timely scrutiny of the exceeding morphological subtypes. Moreover, it provides enhanced insights in the epidemiological causation. High quality morbidity data derived from chronic disease population-based registries warrant selective assessments using these rather cost-effective strategies and methods for the analyses of chronic disease clusters.

**DOCTORAL PROGRAMME IN WATER
SCIENCE AND TECHNOLOGY**

ANALYSIS OF GENETIC VARIABILITY OF *ARISTEUS ANTENNATUS* ALONG THE SPANISH MEDITERRANEAN COAST EMPLOYING MICROSATELLITE MARKERS DURING TWO CONSECUTIVE WINTER SEASONS 2016-2017

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1. Introduction

The blue and red shrimp, *Aristeus antennatus* (Risso, 1816), is a highly abundant marine crustacean in the western basin of the Mediterranean Sea, and is highly exploited by the deep-water bottom trawl fisheries. Along the Spanish Mediterranean coast, it is usually caught at depths of 500 to 800 m, depending on the fishing ground (Fernández *et al.*, 2011).

2. Hypothesis and objectives

The main objectives of the work were to estimate the levels of genetic diversity within populations, the genetic divergence among populations and the temporal stability of the blue and red shrimp along the Spanish Mediterranean coast. Furthermore, we tried to determine the connectivity of the populations in the studied area.

3. Methodology

Seven locations were analysed (Port de la Selva, Roses, Palamós, Blanes, Vilanova i la Geltrú, Dénia and Santa Pola) during two consecutive winter seasons (2016 and 2017). In order to accomplish the objectives, we genotyped 12 microsatellite *loci* previously reported in Heras *et al.*, 2016 in a total of 1403 *A. antennatus* individuals.

4. Results

The number of alleles detected per *locus* ranged from 2 to 29 with a total mean of 9.09. The observed heterozygosity (H_o) for each location varied from 0.440 to 0.486 in 2016 and from 0.431 to 0.498 in 2017, while the expected heterozygosity (H_e) varied from 0.629 to 0.639 in 2016 and from 0.620 to 0.643 in 2017. Of a total of 168 comparisons between the observed and the expected genotypic proportions under the Hardy-Weinberg equilibrium, 95 were significant, which caused significant deviations from the Hardy-Weinberg equilibrium in the seven locations analysed in the two consecutive years. The AMOVA did not show significant differences among locations in 2016 ($F_{ST} = 0.00177$, $P = 0.270$), whereas they were pointed out in 2017 ($F_{ST} = 0.00249$, $P = 0.035$) due to the Blanes-Dénia pair ($F_{ST} = 0.00946$, $P = 0.0001$). We found temporal differentiation between the two temporal replicates ($F_{CT} = 0.0006$, $P = 0.027$), mainly due to Blanes (2016-2017). The Mantel test did not detect isolation by distance along the geographical region analysed in either the 2016 or the 2017 samples.

5. Conclusions

These results are consistent with a scenario of high connectivity along the studied locations, supported by the oceanographic characteristics of the North-Western Mediterranean coast and the biological characteristics of the species.

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INDIVIDUALISTIC AND ORGANISMIC COMMUNITIES IN THE PROCESS OF REOLIGOTROPHICATION OF A LAKE

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1. Introduction

Water bodies near urban areas are heavily impacted by receiving loads of Nitrogen and Phosphorus that alter the dynamics of the communities living there, in a process known as eutrophication. However, as wastewater treatment plants reduce the influx of these elements, the converse process of ‘reoligotrophication’ takes place. These processes are discontinuous and result in abrupt changes to composition and richness. This can give us information about the drivers of change in these communities and their ultimate nature: while some see ecological communities as statistical collections of ‘individual’ species, others understand them as ‘organisms’ whose components are interrelated and depend on each other.

2. Hypothesis and objectives

Using a longitudinal dataset comprising 35 years of monthly samplings of phytoplankton in lake Zürich (Switzerland), we aimed to study the process of reoligotrophication. Our objective was to develop a framework that would allow us to determine the extent to which phytoplankton communities respond to environmental change ‘individualistically’ or ‘organismically’.

3. Methodology

First, we had to establish that there was abrupt compositional change in these communities. Second, we needed to show that there was no abrupt environmental change. And finally we had to rule out the observed patterns being produced by a discrete distribution of the physiological responses of the species. In order to characterize the responses to environmental change of the species, we have used a stochastic dynamic model (Ontiveros *et al.* 2019) based on the classic Theory of Island Biogeography that estimates colonization and extinction processes.

4. Conclusions

We found that both views of ecological communities, as ‘organisms’ or ‘individual’ species, took place in the studied lake. Winter and summer communities responded differently to environmental variables (i.e. temperature), supporting the individualistic view. On the contrary, we saw abrupt community changes along a gradient of phosphorus availability not related to distinct physiological responses of the species, which supports a organismic conception of communities. The recovery of eutrophicated lakes may lead to unpredictable changes in their communities due to their ‘organismic’ nature, which may influence the outcome of remedial actions in these lakes.

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POWER TO C-NEUTRAL COMPOUNDS – ELECTRO BIOCO₂ RECYCLING TO ACETATE UNDER THERMOPHILIC CONDITIONS

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1. Introduction and Objectives

Modern life is sustained by an unremitting stream of increasing energy demand. This causes the depletion of fossil fuels and the consequent emission of high amounts of CO₂ to the atmosphere. On the other hand, bioelectrochemical systems (BESs) are capable of using this waste as a raw material to produce valuable compounds. Additionally, operations at high temperatures have been proven to enhance production rates, product specificity and recovery (Hussain et al., 2012), (Choi et al., 2004). Therefore, this study is aimed at unravelling the optimal variables at 50°C to steer electro bio-CO₂ recycling into acetate as a main precursor for chain elongation.

2. Methodology

Four BESs were operated at the fixed cathode potential of -0.6 V vs. SHE (Standard Hydrogen Electrode). In each reactor, graphite rod was used as the anode, while plain carbon cloth (working area of 30 cm²) was used as the cathode, both placed in chambers separated by a cation exchange membrane (Figure 1).

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FOULING PROPENSITY OF NOVEL THIN-FILM COMPOSITE MEMBRANES WITH DIFFERENT DRIVING FORCES

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1. Hypothesis and Objectives

Forward Osmosis (FO) has been shown to be a promising technology for the treatment of wastewater, and could eventually replace reverse osmosis (RO) in the context of water reuse. Nonetheless, the efficiency of the FO process hinges on its low fouling propensity and the resulting cost-effective production of clean water (Klaysom et al., 2013). The objectives of this study were the following:

Investigate fouling propensity of two novel FO membranes under i) different driving forces (osmotic and hydraulic pressure) and ii) different draw solutions to improve the current understanding of FO fouling mechanisms.

Determine the reliability of the proposed model for quantifying fouling accumulation.

Relate the fouling propensity to the different membrane characteristics.

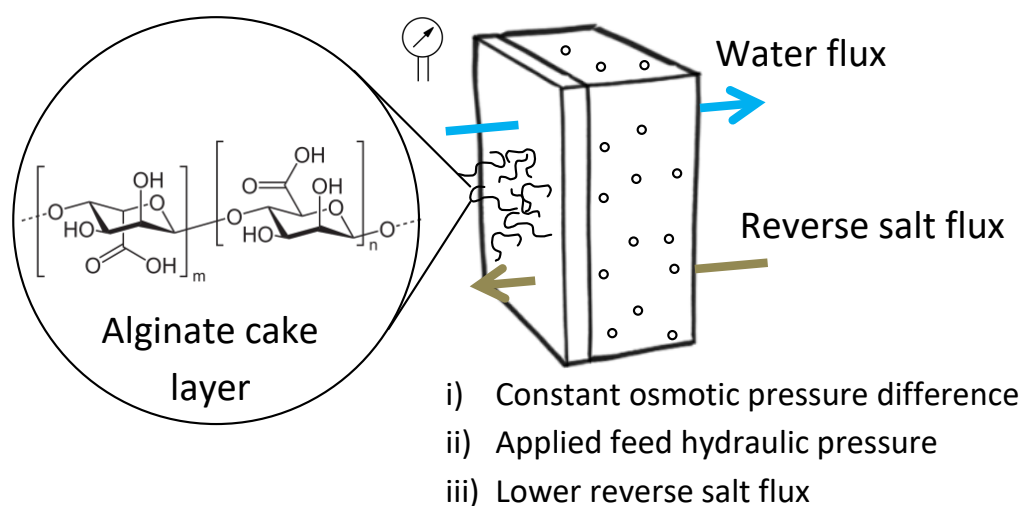


Figure 2. The three experimental conditions tested to achieve the objectives

2. Methodology

Two novel thin-film composite membranes were tested in a cross-flow filtration apparatus. Using different concentrations of NaCl and Na₂SO₄ as the draw solutions, the osmotic pressure difference was kept constant to represent large-scale FO systems. Next, 1 bar of hydraulic pressure was applied on the feed solution for comparison. After each experiment, the surface density of the deposited foulant was measured, and from the water flux decline, the effective driving force and the cake structural parameter were modelled. This was related to the foulant mass to draw conclusions on the different fouling behaviours in each case.

3. Conclusions

Water flux decline should not be used as a fouling indicator because it does not reflect all of the complex and unique processes in FO.

A constant osmotic pressure driving force resulted in significant fouling, contradicting the widely accepted notion of low fouling propensity in FO.

RSF-enhanced fouling and compression of the cake layer close to the active layer were identified as important FO fouling mechanisms for high-permeability membranes.

An applied hydraulic pressure in the feed solution introduces cake layer compaction even at low pressures.

A strong negative membrane surface charge improves resistance to alginate fouling, dominating over surface roughness and hydrophobic interactions as the main parameter determining fouling propensity.

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HOLISTIC EVALUATION OF PHAC DEGRADATION DURING UV SULFATE-BASED OXIDATION PROCESSES AS ADVANCED WASTEWATER TREATMENT

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1. Hypothesis

Pharmaceutical active compounds (PhACs) represent a class of emerging micropollutants which have been found in surface water, groundwater, wastewater and even in drinking water. Conventional wastewater treatment plants (WWTPs) are ineffective at dealing with these compounds [1]. Advanced oxidation processes (AOPs) have been proposed as tertiary treatments for municipal WWTP effluents due to their versatility and ability to detoxify effluent streams containing emerging contaminants [2]. The degradation efficiency of UV-activated peroxydisulfate (PDS) and peroxymonosulfate (PMS) has been proved at laboratory scale, but there are no studies focusing on the environmental performance of UV/PDS and UV/PMS as advanced wastewater treatment at pilot-scale treating real secondary WWTP effluent that contains PhACs.

2. Objectives

To this end, this work examines the feasibility of applying UV/PDS and UV/PMS technologies at pilot scale, assessing their energy requirement, and evaluating their environmental sustainability.

3. Methodology

Direct comparison of UV/PDS and UV/PMS has been conducted with pilot-scale experiments, assessing the removal of nine PhACs. Subsequently, the life cycle assessment (LCA) impacts associated with the treatment of 1 m³ of wastewater with an effective average PhAC removal of 80% were also evaluated.

4. Results and Conclusions

Photolysis alone was not able to degrade PhACs from WWTP secondary effluent to a significant extent. The addition of 0.4 mM of PDS or PMS, applying 416 mJ/cm² of UV fluence, resulted in average removals of 84% and 85% for UV/PDS and UV/PMS, respectively. The values of the fluence-based degradation constants (K_{obs}) are in general agreement with the removal values indeed being 8.7 cm²/J, 8.8 cm²/J and 8.2 cm²/J, respectively for UV/PDS and UV/PMS. The electrical energy (kWh) required to degrade the mix of PhACs by one order of magnitude in 1 m³ of contaminated water was calculated as 0.9 kWh/m³/order and 0.8 kWh/m³/order, for UV/PDS and UV/PMS respectively. With regard to the sustainability assessment, the two main factors with the greatest environmental footprint for the UV/PDS process were PDS production (52.9%) and electricity consumption (33.4%). On the other hand, PMS production accounted for 85% of the total environmental impact of the UV/PMS process, while the second factor, electricity, was only responsible for 11.2%. Finally, the normalized environmental impact analysis showed that UV/PDS was associated with an environmental footprint three times lower than UV/PMS.

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**DOCTORAL PROGRAMME IN
HUMANITIES, HERITAGE AND CULTURAL
STUDIES**

NEW SOCIAL MOVEMENTS AND BUILT HERITAGE. CASE STUDIES IN CATALONIA (1970-2018)

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1. Introduction

The villages, towns and cities in which we live and work and that we visit are places made for and by human activity and so are full of narratives, values and meaning. Streets, buildings and squares become a stratification of moments throughout time. The way in which we look at these material testimonies enables us to learn about our present, think about our relationship with the past and bring to light what the future may hold. The investigation I am conducting is focused on a specific type of buildings: those at risk of disappearing. There are some cases in which safeguarding architecture becomes the main objective of grassroots organisations, often named *Salvem* in Catalonia. Their ideas, the way they work and their values depict a heritagisation that distances itself from the authorised discourse (Smith, 2009).

2. Objectives and methods

The research investigates the conjunction of new social movements and built heritage. Some significant research has been published to contribute to the knowledge of heritage-safeguarding movements in Valencia, such as *Salvem El Cabanyal-Canyamelar*, and in Barcelona and its surrounding villages (*Salvem Can Ricart*, *Salvem les Tres Xemeneies*, etc.). Nevertheless, it seems that the rest of the country has not been thoroughly investigated, which is why the project I am presenting is innovative and will contribute to the expansion of knowledge of the phenomenon across Catalonia. The geographical and temporal range of research established is from Catalonia, excluding the Àrea Metropolitana de Barcelona, between 1970 and 2018. The chosen temporal range coincides with the emergence of a fresh understanding of heritage which supposed a new relationship with the past. The idea of the sacredness of cultural elements was gradually abandoned, due to its representative functionality of Nation-state identity. Existence value changed to recognise a Use value that could directly affect the socio-economic development of communities (Van Geert & Roigé, 2016). This new way of understanding heritage led to citizens becoming more aware of cultural property.

The first aim of the research plan proposes to create an inventory of all the *Salvem* cases, which will identify and geographically classify them. Currently 74 cases have been identified, one of them having been comprehensively studied as a pilot test. The research is being conducted using mixed methods, with a qualitative approach having more weight. An exhaustive analysis of primary and secondary sources, national and international indexed journals and local press is being carried out, alongside ethnographic fieldwork such as interviews.

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THE CATALAN SONGBOOK E: NOTES TOWARDS ITS AUTHORSHIP AND PLACE OF COMPILATION

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The Catalan songbook *E* —also known as the "Cançoner Estanislau Aguiló" due to the name of its former owner— is a very important witness to one of the main textual traditions in Catalonia during the Middle Ages (the genre known as "noves rimades" or "codolades") and its study may contribute to better understanding the features of narrative poetry.

The Aguiló codex, which is currently held at the Arxiu del Regne de Mallorca in Palma de Mallorca, was compiled at the end of the 14th century or the beginning of the 15th century. Its anonymous scribe, who might have copied the manuscript for his own personal use, transcribed Bernat de So's "Visió", all the narrative poems by the March brothers: Jaume and Pere (Ausiàs March's uncle and father, respectively), the anonymous "Fraire de Joi" and the "Déu d'amor caçador", Guillem de Torroella's "Faula", some troubadour lyric poems, a fragment of "Flamenca" and the anonymous *salut* "Senyora graciosa" (all added *a posteriori*), and Joan de Castellnou's treatise known as "Compendi".

The manuscript, which is written on paper, was fully restored in 1979. Its restorers reorganised the quires —previously, the current sixth quire was the fourth quire of the gathering— and replaced the old parchment binding with a similar one. The old parchment covers are a notarial document from Valencia dated February 1388, in which were mentioned, *inter alia*, the names of some Valencian notaries (Guillem Mir, Pere de Pina and Jaume Rossinyol) and a highly respectable jurist of Valencia (Arnau de Conques). All of them worked within a circle closely linked to the royal court or the royal duchy of Gandia, such as Pere d'Orriols and Guillem Martorell (Joanot's grandfather), who, like Pere March, spent most of their life serving Alfonso of Aragón, Marquis of Villena and Duke of Gandia. This information raises some interesting questions about the profile of the compiler and the place of compilation. For example, was the compiler (maybe a notary) from Valencia? Was he linked in some way to the royal court or to the royal duchy of Gandia? Was the manuscript copied to be stored in a Valencian notary's private library?



Figure 1. Detail of folio 23v: scribe's drawings



Figure 2. The twentieth-century manuscript's binding (1979)

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AGRARIAN WAGES IN CATALONIA (1850-1890)

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Research on living standards is a matter of classical analysis in social and economic history studies. However, research has revealed issues with inferring the living standards of past societies, given the documentary limitations and the complexities of calculating total personal or family income. This is more difficult in farming because the structure of the property is a determining factor in family income.

Despite the significant challenges for the analysis of living standards, studies on wage dynamics are still valid to improve our knowledge of past societies. This article, defined by Catalan geography, investigates agricultural wages during the second half of the nineteenth century. Differences in agrarian wages in Catalan regions can be quantified using information contained in the *cartilles avaluatòries*, documentation associated with the *amillament* system. First, according to the tasks carried out, data are described and distributed by regions. Exposing income detects geographical differences and divergences between areas to be quantified. After noting discrepancies in wages, the article explores several ways to analyse disparity in husbandry wages. First, a comparison is made of income using a set of the main agrarian wages of the nineteenth century (Garrabou, Pujol and Colomé, 1991; Garrabou and Tello, 2002). This exercise enriches the central hypothesis of the dynamics of Catalan agricultural labour. Garrabou, Pujol and Colomé (1991) noted a coexistence of two differentiated wage patterns: coastal and interior. Second, the data obtained from the *cartilles* is compared with the set of industrial wages (Enrech, 2006; Nadal, Benaül and Sudrià, 2012). The comparison between industrial and agricultural wages makes it possible to detect the influence of the demand for an industrial workforce. Based on the regional diversity of the sample, the article highlights theories on the convergence of agricultural wages in nineteenth-century Catalonia.

Indeed, the results confirm the existence of a wide disparity in wages in Catalan territory, but the coastal-inland duality does not entirely explain the variety of types of salaries. The coastal regions of Girona and Terres de l'Ebre register substantially lower wages compared to Barcelona villages on the coast. The primary influence on wages, then, would be the demand generated by consolidation of the industrial sector.

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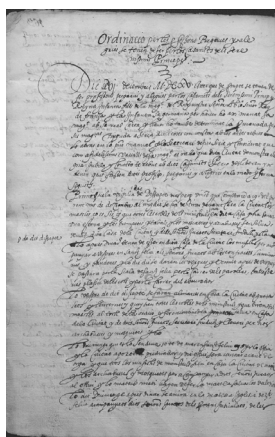
MUSIC AND CEREMONY AT THE DOUBLE MARRIAGE OF ANNE OF AUSTRIA TO LOUIS XIII OF FRANCE AND PHILIP IV TO ELIZABETH OF FRANCE

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Events related to aspects of the life of the royal family entailed a series of important celebrations. The *Manual d'Acords* of 1615 includes the ceremonies held in Girona, as one of the main cities of the Principality of Catalonia, in the double marriage of the Anne of Austria and Louis XIII of France and Philip IV and Elizabeth of France. The king reported the news by means of a letter and through a public call with music on the tuba and medieval trumpet, or *anafils*, and the preparations were set. The spaces through which the procession passed had to be presented in a certain way, and anyone who did not keep them clean and well decorated was sanctioned. The city prepared for a three-day celebration. Businesses had to close their doors; people came out of mourning and dressed in with their best clothes. Citizens were allowed to dress up and make masks. There were dances, “solaços”, lights and flashlights. Likewise, during the celebration, poor people were given some bread. A procession as dazzling as that seen during Corpus Christi was organized. There were also “jurats” and brotherhoods, with their lights and flags. There was the dragon, the little dragon, the giant, the “gegantessa”, the eagle, and the “mulassa”. All this was enlivened by music from minstrels, deaf music, trumpets and drums. Everyone, no matter their class, status or condition, was called to attend the church of Saint Feliu to hear the *Te Deum Laudamus*.

Figure 1. AMGi, *Manual d'Acords*, 1615, f. 163^v.
Casament d'Anna d'Àustria amb Lluís XIII de França
i Felip IV amb Isabel de Borbón, 16 desembre de 1615.



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THE MODERN AGE SILVERWARE IN GIRONA

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The present communication is framed within the study of the art of silverware in modern times in Girona, focusing on the institutional organization, of both the guild (and the school) and the brotherhood. The main objective is to study the institutional framework of Girona's silversmiths to establish not only the organization of the guild –structure, regulations, charges and access conditions – but also that of the associated Brotherhood of Saint Eloi, which served the devout and the social dimension of the trade. It should be noted that the Brotherhood of Saint Eloi not only grouped silversmiths, it also brought together members of other metallurgical trades such as blacksmiths, locksmiths, coppersmiths, tinsmiths, etc. We propose to build a historical discourse around the artistic and social reality of silverware.

Our chronological framework is the 17th and 18th centuries, one of the most dynamic periods in Catalonia's art history. Although the study of this period is in the process of standardization, silverware is one of the most cryptic and needed subjects in research, despite investigations and publications such as the ones by Núria de Dalmases (1979; 1985), or the studies of José Manuel Cruz Valdovinos (1982). We also have specific studies that show the group in the different organizational structures, as a guild (M. Jesús Sanz, 1991), as a school (Antonio Martínez Subías, 2008) and as a brotherhood (M. Jesús Sanz, 1996) .

Through the study of theoretical foundations, the systematic emptying of archives and field work, we are trying to define a solid framework for the reconstruction of the image of this group in the Modern Age, from artistic, historical, social, religious and cultural points of view. Our archivist research focuses mainly on legal sources (normative or state regulations), municipal sources (cadastral books or municipal resolutions and acts), notarial funds (inventories and wills) and documents referring to the Brotherhood of Saint Eloi.

We believe that the proposed investigation guarantees that the research will make a solid and positive contribution to the knowledge of the world of silverware of the 17th and 18th centuries in Girona's bishopric field. So we intend to substantially enrich our knowledge of silverware in the Modern Age and to increase the comprehension of our heritage, convinced that the result is an interesting patrimonial sector that is waiting to be rediscovered.

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DOCTORAL PROGRAMME IN EDUCATION

ADVANCING TOWARDS KNOWLEDGE OF MATHEMATICAL REPRESENTATION IN EARLY CHILDHOOD EDUCATION: THE CASE OF PATTERNS

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1. Introduction

The National Council of Teachers of Mathematics [NCTM] (2003) defines mathematical representation as a process that allows the ordering, recording and communicating of mathematical ideas. In addition, this prestigious organization of mathematics teachers holds that representations assist recognition of the common mathematical nature of different situations. Rico (2009) adds that representation includes a set of tools, both signs and graphics, that show the presence of concepts and mathematical procedures with which mathematical knowledge is addressed and captured. For this author, two major types of representational systems are distinguished: symbolic and graphic. While the first type of representations are alphanumeric characters, the second type are figurative.

2. Objective

On this basis, the objective of this study, which is part of a larger investigation, is to make a first approach to the representation of patterns at early ages, since it is indispensable knowledge for the formalization of algebraic thinking (Mason, Stephens and Watson, 2009).

3. Methodology

In this sense, through design-based research [DBR], a study was conducted with 23 children from 4 to 5 years old to analyze if they can represent patterns and, if so, determine what type of representations they use.

4. Results and Conclusions

The first results show that: 1) globally, more than half of the participants correctly represented the patterns; 2) Basically, they use two systems of representation, graphic and symbolic, but

with a clear predominance of the first type (more than 70%). From this perspective, we agree with Bjorklund (1995) when he states that children represent the world in a manner conditioned to what they perceive, to what they remember and to the way they solve certain problems.

It is concluded that through exposure to a variety of patterns in different educational contexts, from the interactions with the different systems of representations, with the teacher and with the rest of the students, mental images are developed that allow us to advance in learning, understanding and formalizing mathematical ideas.

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REFLECTIVE THINKING CONSIDERED AN ESSENTIAL COMPETENCE IN INITIAL TEACHER TRAINING. EVIDENCE FROM AN ACTION RESEARCH STUDY

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This research shows the stages developed during the four years that this study lasted, giving an account of a process of Initial Teacher Training (FIT). A process in which all the participants experienced professional growth by developing the Teachers' Reflective Thinking (PRT) competency. The students were scaffolded in the development of this competency, as stipulated in the hypothesis:

Teaching reflective thinking will be developed during the initial training process through methodological strategies of continuous support, therefore the greater the guided methodological practice, the greater the reflective capacity developed by the pedagogy students.

Reflective thinking consists of many stages and represents a challenge in terms of planning and implementation due to the different variables that arise during the scaffolded process. For this reason, the selected research paradigm was qualitative with a descriptive perspective (Hernández, 2010, Quiroz, Merino & Stronguiló, 2004) based on the stages of participatory action research (Noffke & Somekh, 2009); since the programs, teaching strategies and the pedagogical activities that were proposed to promote reflective teaching thinking were all constructed in addition to information being collected semester to semester. Consequently, the data was collected through the reflective diary of the population under study and by means of a perception survey about the development of the competency.

Therefore, the research question is *what methodological strategies efficiently promote the development of reflective teaching thinking in UPLA students of English pedagogy?* To answer this question, the general objective proposes *to elaborate a methodological and evaluative proposal to develop reflective teaching thinking in UPLA students of English Pedagogy within the context of curricular innovation.*

Finally, it can be concluded that this research was aimed at achieving the objective, since the series of actions that were planned and executed to collect the information fostered the

development of reflective thinking in students progressively, through the action-research cycle designed. As a consequence, the findings were grouped into four categories:

- 1) Achievement of reflective thinking
- 2) Reflection process that contrasts practice with theory
- 3) Application of reflection through the action-research cycle
- 4) Ongoing feedback between the actors of the research process

In conclusion, reflective thinking is a competency that every pedagogical degree must develop in future teachers, since early acquisition allows pre-service teachers to display different skills linked to their professional environment.

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INDEPENDENT LIVING FOR PEOPLE WITH INTELLECTUAL DISABILITIES IN CATALONIA. THE PERSPECTIVES OF PROFESSIONALS.

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1. Introduction

Article 19 of the Convention on the Rights of Persons with Disabilities, ratified in Spain in 2007, specifies the right to independent living; something increasingly desired by people with intellectual disability (ID). A program supporting home-based autonomy (PAAPH) has been in place in Catalonia since 2002. It is offered by several organizations and provides personalized home support to people with disabilities who live alone or in groups of up to four, the aim being to guarantee said right through personalized support and thus favor this group's emancipation and participation in the community.

2. Objectives

In order to determine the opinions of professionals involved in providing this support for independent living for people with ID, 29 interviews were conducted with 35 professionals working in services located in different regions of Catalonia.

3. Methodology

The aim was to obtain information regarding the professionals' perspectives on the model of support for independent living in our context, the barriers faced by people with ID when it comes to progressing in their life projects, and the opportunities and limitations inherent in the PAAPH. A qualitative approach was taken to this research in order to be able to interpret and identify the views of different professionals by means of an analysis of thematic content. The results of the research highlight the strengths and weaknesses of the program according to the professionals, as well as their proposals for its improvement. The possibility of individualized user support particularly stands out. At the same time, aspects related to the conditions for accessing the program and the distribution of support are criticized, access being limited to people with extensive or generalized support needs.

4. Conclusions

By way of conclusion, recommendations are made for improving the program and introducing innovation, the most notable of these being the provision of personalized quality support and the introduction of training and awareness-raising actions that are adapted to new theories in intellectual disability for professionals, among other agents.

SHOULD MOTHERS BE INCLUDED IN SOCIAL MOBILITY MODELS FOR SPAIN?

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1. Hypothesis and Objective

This research analyses whether the explicative capacity of models of intergenerational social mobility for Spain increases when the socio-economic position of the mother is included as an independent variable.

Traditionally, social mobility research has used the Conventional Model (Goldthorpe, 1983), according to which the best way to define the socio-economic position of the family of origin is exclusively the father's socio-economic position. Nevertheless, economic and social changes over recent decades have led several authors to question whether this approach is still valid.

Despite Recent research has included the effect of mothers on the socio-economic position of their offspring. Fachelly et al. (2015) tested whether the social mobility patterns previously described for Spain yield the same results when the mothers are considered. However, analysis has yet to consider whether the fit of the social mobility actually improves when mothers are included.

The hypothesis of this research is that the Conventional approach is no longer valid to conceptualize patterns of social mobility for Spain.

2. Methodology

To test the hypothesis, I compare the explicative capacity of the Conventional Model to that of the models gathered by Korupp et al. (2002) – namely, the Dominance Model, the Modified Dominance Model, the Joined Model, the Sex-Role Model and the Individual Model – as well as two other models that I add to the analysis.

The statistical operationalization of these models is developed using data from rounds 1 to 8 of the European Social Survey.

3. Conclusions

According to the first results of the analysis, it can be concluded that the Conventional Model has less explicative capacity than other models and, therefore, it is not the best way to conceptualize social mobility patterns for Spain.

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ASSESSMENT OF THE TEACHING OF ALGEBRA IN PRIMARY EDUCATION TEACHERS

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This investigation offers as a hypothesis the idea that many teachers in Chile have an insufficient level of didactic-mathematical knowledge for the teaching of algebra. This implies that they do not have the mastery of knowledge to allow them to conduct their classes properly. The purpose of this research is to assess the early algebra didactic-mathematical knowledge of primary school teachers. Its content has been introduced into the school curriculum of the National Council of Teachers of Mathematics (NCTM, 1989 and 2000) and the Common Core State Standards Initiative (CCSSI, 2010), and has also been included in the Chilean curriculum from the first year of primary school since 2012 (MEC, 2007; MINEDUC, 2012).

Methodologically, this is exploratory research, since we have verified that there are insufficient investigations of algebraization in the Chilean curriculum, and in addition presents a mixed approach.

This work is based on the contributions of the Onto-Semiotic Approach (OSA) to Mathematical Knowledge and Instruction by Godino et al., and on the professional knowledge of teachers (Shulman, 1986). Using several models, Godino (2009) proposed his didactic-mathematical knowledge model which comprises six dimensions for didactic-mathematical knowledge.

Considering the studies carried out by the author of the aforementioned investigation, we have designed an instrument to allow the didactic-mathematical knowledge of teachers working in primary education to be measured. Upon completion, the instrument was tested by ten mathematical education experts. To reinforce our instrument, we chose to include two questions that are part of an instrument that was developed to analyze the knowledge of future algebra teachers (Godino et al., 2005). Subsequently, 8 primary school teachers carried out the pilot version. The final version of 8 items was applied to 121 primary education teachers in Chile.

The results indicated that teachers have an insufficient level of didactic-mathematical knowledge for teaching algebra. This implies that teachers have no mastery of the understanding necessary for adequate execution of their pedagogical practice.

Finally, we can conclude that it is imperative to implement a program to upgrade primary education teachers' level of didactic-mathematical knowledge, to improve the treatment of algebra as a mathematical object in textbooks for primary schools in Chile, and to reformulate

the curricular structures in the training of primary education teachers, considering the need to extend the algebraic content and algebra-related dialectics.

Keywords: Didactic-mathematical knowledge; algebra; primary education teachers; instrument

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THE EMPOWERMENT PROCESS IN RELATION TO THE CAPITAL OF YOUNG PEOPLE FROM THE SOUTHERN CONE OF LATIN AMERICA LIVING IN CATALONIA AFTER A MIGRATION EXPERIENCE¹

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This study explores the empowerment process of young people between 20 and 34 from the Southern Cone region of Latin America (Argentina, Chile and Uruguay) who, after a migratory experience, are living in Catalonia. Specifically, it inquires into the relationship between the social, cultural, economic and symbolic capital of these young people and their opportunities for empowerment (Bourdieu & Ruiz de Elvira Hidalgo, 1998; Úcar Martínez, Jiménez-Morales, Soler-Masó & Trilla-Bernet, 2016; Soler, Trilla, Jiménez-Morales & Úcar, 2017).

The hypothesis holds that during youth, migration can be considered a process of empowerment; it is an opportunity to increase the individual's capabilities, and to develop self-confidence and a wide range of social skills. From a total of 50 "Biograms A", 24 participants were selected to apply a "Biogram B" (Abel, 1947). An intentional sample of 12 young people was formed with the collected data, and in-depth interviews were conducted with them (Páez de la Torre, 2017). Each interview concluded with a graphical representation of their life itinerary (Barbour, 2013; Esteban-Guitart, Pallisera, Follana & Gifre, 2017).

The aim of this paper is to present the results obtained from a discursive analysis of the in-depth interviews. A battery of youth empowerment with 9 dimensions and 29 indicators, developed by the Hebe Research Group to measure youth empowerment (2014-2017)² (Úcar, Planas, Novella & Rodrigo, 2017; Llena Agud-Morell, Páez de la Torre & Vila Mumburú, 2017) and 10 thematic categories bridging Bourdieu's capital theory and the empowering processes of these young people (discovered in a previous work, Páez de la Torre, 2018) were the instruments used for this task. A double categorization was carried out. Self-esteem, critical

¹This study was carried out with the support of the Universities and Research Secretariat of the Ministry of Business and Knowledge of the Government of Catalonia, and also with the European Social Fund from the European Union. It is linked to the HEBE Project IDENTIFICATION OF POTENTIATING AND LIMITING FACTORS OF YOUTH EMPOWERMENT: ANALYSIS OF SPEECHES AND PRACTICES OF EDUCATORS. MINECO (National Programme of Research Aimed at the Challenges of Society) (EDU2017-83249-R)

² Project on youth empowerment and the moments, spaces and processes that contribute to it. MINECO (National Programme of Research Aimed at the Challenges of Society) 2013. Ref.: EDU2013-42979-R. Dr Pere Soler Masó (IP). <http://www.projecteheber.com/es/>

capacity and autonomy are the most relevant dimensions in which these young people located their empowerment experiences, related specially to immigration experiences, labour paths, and educational and formative background.

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PRE-SERVICE HIGH SCHOOL TEACHERS' KNOWLEDGE OF MODELING APPLIED TO THE TEACHING OF STATISTICS AND PROBABILITY

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1. Introduction

In recent years, both the teaching of statistics and probability and mathematical modeling are issues that have played a leading role in the curricula of different countries, as seen for example in the Principles and Standards for School Mathematics (National Council of Teachers of Mathematics [NCTM], 2000). In this context, this research seeks answers to the following two research questions to propose actions to improve professional development. *What didactic-mathematical knowledge do Ecuadorian pre-service high school teachers have about mathematical modeling? Moreover, how do they understand the connection between mathematical modeling and the teaching of statistics and probability?*

2. Methodology

This study is guided by the interpretive paradigm, with a mixed methodological approach and an exploratory character. Theoretical approaches to research are guided by the Didactic-Mathematical Knowledge Model (Godino, 2014; Godino, Batanero & Font, 2007) with their respective categories of analysis, as well as the educational perspective of mathematical modeling, which considers it as a didactic strategy (Kaiser, Blomøj & Sriraman, 2006; Lesh & Doerr, 2003; Maaß, 2006).

The "CDM-MEP 12-14" questionnaire was designed to analyze pre-service high school teachers' knowledge. It was validated by experts from different countries and, subsequently, a pilot test was carried out to refine the situations for data collection. The final version of the questionnaire was made available at the two main universities training pre-service high school teachers in Ecuador. Responses from a total of 100 questionnaires, corresponding to 70% of the total population, were obtained.

In turn, document analysis research techniques were used to identify the importance placed on mathematical modeling in the curricula of Ecuador, Spain and the United States.

3. Results

Although these countries incorporate modeling in their curricula, the results show a clear disproportion in the different educational levels. In addition, the treatment of mathematical modeling is disjointed.

We are now in the data processing phase, which will allow us to interpret the data and answer the research questions.

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EXPLORING YOUTH EMPOWERMENT IN THE FIELD OF JUVENILE JUSTICE

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1. Current status

Empowerment is the development of two different but successive abilities: that of deciding and that of acting on what has been decided (Soler, Trilla, Jiménez-Morales & Úcar, 2017). Its social and educational perspective contemplates conscience, belief in oneself and the independence to decide and act in life (Gill, Aftab, Rehman & Javaid, 2019).

2. Hypothesis and objectives

The research presented (Ref.: 2018 Fi_B 00316) starts from the following hypothesis: Intervention based on the rehabilitation and reintegration of young people who have committed a crime allows youth empowerment to be worked on in a comprehensive manner. The *Medida de Convivencia en Grupo Educativo* is a system of juvenile justice in Catalonia in which young people are temporarily separated from their family unit to live in an educational group. To evaluate the impact of the socio-educational tasks assumed by the professional team linked to the measure, we propose to design and apply instruments that analyse the dimensions and indicators of youth empowerment of the HEBE Project (www.proyecteheber.com).

3. Methodology

The design of each of the instruments used comes from the series of questions and indicators of the HEBE Project (Planas, Trilla, Garriga, Alonso & Monseny, 2016).

A questionnaire and life stories were used to obtain the young people's perspective. The questionnaire was given to all the young people who had spent time living in the educational group, while the life stories were obtained through contact with six youths who were currently serving this judicial sentence. Experts validated both instruments, and the questionnaire also consists of a pilot test.

Interviews with family members from the young people's life stories were also held. A rubric was used by professionals of the educational groups to assess the actions and the youth empowerment projects. These were also validated.

4. Conclusions

The reliability and validity of the instruments makes the process stringent and guarantees the relevance of the data obtained. In this case, the variety of instruments applied are standardised with the same dimensions and indicators of youth empowerment, allowing, in this way, complementary and triangular work. The first results will be presented at the III Conference of Predoctoral Researchers of the University of Girona. There will be an initial estimate of the dimensions of empowerment presented in this youth profile.

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**DOCTORAL PROGRAMME IN THE
ENVIRONMENT**

CATEGORY-BASED ALLOCATION PROCEDURE: A NEW WAY TO ACCOUNT FOR ENVIRONMENTAL IMPACTS. THE CASE OF CITIES.

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1. Hypothesis

Allocation procedures determine the method used to distribute responsibility and accountability for the environmental impacts generated by a certain activity. The environmental impact assessment methods which consider the whole supply chain of a good or service account for the impacts along the supply chain to that product or service. However, cities are not products and they may need to use a different concept to allocate impacts. This new allocation concept has been suggested in the literature as being the category-based allocation procedure. Although current allocation procedures such as those that are producer-, consumer-, or monetary-based may be used in this conception, they may not be the fairest approach.

2. Methods

The chosen allocation procedure should follow the principle of causality between the impact and the activity performed. There are three existing allocation procedures used in PAS2070 and in the Global Protocol for Community-scale greenhouse gas emission inventories. *Producer-based* allocation assigns environmental impacts to the location where the activities that produce such impacts take place. *Consumer-based* allocation assigns the environmental impacts associated with the provision of products and services to the city where consumption takes place. *Monetary-based* allocation distributes a share of environmental impacts to each stage of the supply chain depending on the added value generated at each of these stages in the life cycle of products or services.

The *category-based* allocation procedure proposed in this communication assigns impacts to the producer or the consumer, depending on whether the impact category under consideration is local (producer) or global (consumer). The rationale behind the suggested *category-based* allocation is to foster action from public bodies so as to reduce the impact where it is caused

and to simultaneously make the consumer responsible for global impacts. The *category-based* allocation procedure has been found, through a survey, to be the preferred way to share responsibilities along the supply chain.

3. Results and Conclusions

The existence of situations in which impacts may be ambiguously attributable to a city under study or otherwise demands fair allocation procedures. Assigning Greenhouse Gases, which cause Global Warming, to the cities where consumption takes place would increase the GHG inventory of developed countries. Similarly, assigning local impacts, such as Water Use, to the producer would increase the sustainability of the supply chain, as they are assigned to the actor that should improve the current situation.

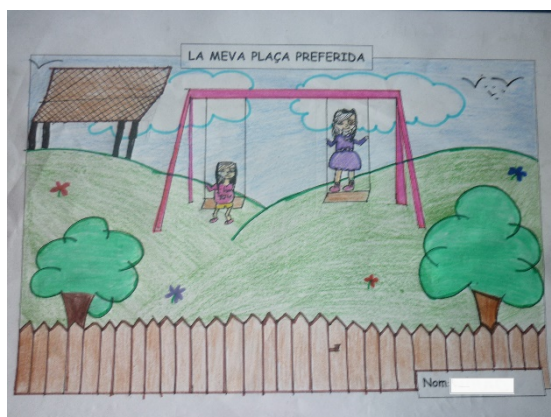
Keywords: environmental assessments, city LCA, national inventories, GHG, NDC, supply chain, life cycle perspective, impact category.

ARE BOYS AND GIRLS EXPERIENCING AND PERCEIVING PUBLIC SPACE DIFFERENTLY?

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As configured, cities condition the relationships that children establish with the world. Space either makes possible or prevents playing, learning, meeting friends, walking alone to school; in other words, it forges children's experiences in relation to the moment and the place. Within the framework of a doctoral thesis aiming to geographically analyse and explore the interaction bridges between urban projects in the public space and the dynamics of people's daily use of them from a gender perspective, this study has an explicitly intersectional and cross-generational approach. Although many different groups were considered while preparing this thesis, this article reflects on children's perceptions of and experiences with public spaces, paying special attention to differences in gender. To get closer to children's urban experiences, different research methods and techniques were used: drawings of the ideal square (for example, *Figure 1*), identification of photographs of different public spaces in the neighbourhood, completion of short questionnaires and writing letters describing the neighbourhood. Active listening to the children's experience occurred within the framework of the school. Children were also directly observed in the squares. The geographical context of this study consists of two areas in the city of Girona: Santa Eugenia de Ter-Can Gibert del Pla and Germans Sabat-Taiala-Domeny Nord. The research shows that children prefer to play with other children during their free time. These activities, however, differ considerably according to gender and the choice of space in which they occur. Adults' views of the treatment of children also differs according to the gender perspective. This undoubtedly conditions the children's perceptions of themselves and of the spaces in which they move about. It seems clear that different types of exclusion on the grounds of gender still exist. This points to a clear need to build cities that allow children to grow up without gender inequalities.



**DOCTORAL PROGRAMME IN PSYCHOLOGY,
HEALTH AND QUALITY OF LIFE**

QUALITY OF LIFE OF PEOPLE AFFECTED BY CHRONIC LUMBAR PAIN AND ASSOCIATED FACTORS

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1. Introduction

Chronic lumbar pain (CLP) is a complex skeletal muscle disease of diffuse pain in the lumbar region. It is the principal health problem among the Catalan population over 15 years of age, with a prevalence of 39.1% among women.

It has a strong impact on a person's daily activities and causes a health-related decrease in quality of life (QoL). It causes physical, psychic and social suffering and requires bio-psychosocial treatment and a multidimensional approach to treatment (Kamper et al., 2014).

2. Hypothesis and objectives

People with CLP who have a greater ability to adapt positively to life's adverse situations will have a better perceived QoL, meaning patients with CLP will have a better health perception. The main objectives of this research project are to describe and relate socio-demographic variables, medical history, QoL, state of health, disability, coping styles and perceived resilience in activities during different aspects of the day.

3. Methodology

The design of the research study will be longitudinal, observational and prospective. The study sample will be formed by all those patients who have CLP with or without radiculopathy and who want to participate in the study. The first data will be collected during 2019 from people during their the first visit to the pain unit and then again after 3 months.

The data collection questionnaire will include socio-demographic variables in order to gain knowledge of aspects related to personal, family, work and social life. In addition, risk factors related to their CLP will be evaluated together with the BPI, EQ-5D, VPMI, CD-RISC-10 questionnaires and the Oswestry Disability Index.

4. Conclusions

Considerable scientific evidence describes CLP as causing functional disability and affecting practically all areas of daily activities (Lawford, Walters & Ferrar, 2016). Passive or maladaptive coping strategies are the best predictors of poor adaptation and may distort therapeutic benefits, increasing the intensity of pain and further deteriorating the patient's QoL (Løchting, Garratt, Storheim, Werner & Grotle, 2017). Resilience will provide strength and virtues while cognitive and behavioural skills will improve adaptation (Elliott, Burton & Hannaford, 2014). Catastrophism predicts the intensity of pain and disability (Wertli et al., 2014).

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PSYCHOLOGICAL FLEXIBILITY IN ECUADORIAN UNIVERSITY STUDENTS: ANALYSIS BASED ON THE ACCEPTANCE AND ACTION QUESTIONNAIRE (AAQ - II)

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1. Introduction and objective

Psychological flexibility is the ability to contact the present moment and thoughts and feelings without having to "defend" it. (Hayes, Luoma, Bond, Masuda & Lillis, 2006). Low levels in this skill may have a negative influence on academic work and personal well-being, due to the series of stressful events to which university students are exposed, e.g. excess of academic activities, examination periods, excessive work-related responsibilities, success or even professional failure (Martín, 2007).

The research aims to analyze whether there are statistically significant differences in psychological flexibility in terms of sociodemographic (sex and working status), academic (degree and course) and personal (lifetime) variables in a sample of university students.

2. Methodology

The sample involved 6230 undergraduate students from an Ecuadorian university (64.3% of the 9689 students enrolled), with an average age of 22.44 years old (52.3% women).

We used the Spanish version of the Acceptance and Action Questionnaire-II (AAQ II) by Ruiz, Langer, Luciano, Cangas and Beltrán (2013).

Statistical analysis was carried out through the analysis of variance (ANOVA) and the Student's t-test. We used SPSS v25 software.

3. Results

Regarding sociodemographic variables, women obtained significantly higher scores of psychological inflexibility ($M=24.45$, $SD=10.53$) than men ($M=23.74$, $SD=10.76$) ($p=.009$). On the contrary, no statistically significant differences were observed depending on working status.

With respect to the academic variables, the results showed statistically significant differences according to the degree ($F(4,6225)=2.39$, $p=.049$, $\eta^2=.002$) and the course ($F(4,6225)=3.57$,

$p=.007$, $\eta^2=.002$). There were lower levels of psychological inflexibility among students of Education Sciences and in fourth and fifth year students.

Students who claimed to be in an "especially difficult" situation showed greater rigidity at the time of the test compared to those who answered negatively to this question ($t(6228)=21.14$, $p<.001$); Likewise, students who claimed to be in an "especially happy" situation reflected lower levels of psychological inflexibility ($t(6228)=-10.81$, $p<.001$).

4. Conclusions

The results of the research reflected lower levels of psychological inflexibility among men and among students in the final years of study. On the other hand, the fact of being in an "especially happy" or "especially difficult" situation showed a statistically significant relationship with the scores obtained in psychological inflexibility, whilst not enabling the causal direction of the relationship to be determined given the cross-sectional nature of the study.

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DOCTORAL PROGRAMME IN CHEMISTRY

CHANGING CHEMICAL REACTIVITY AND SELECTIVITY USING ELECTRIC FIELDS AS SMART CATALYSTS: A COMPUTATIONAL STUDY

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1. Hypothesis

A typical approach to increase the rates and control the selectivity of a chemical reaction is to add a catalyst to the reaction mixture. However, there are other ways to control the same features of a reaction, such as the application of oriented external electric fields (OEEF), an approach that has been studied both experimentally^[1] and theoretically.^[2,3]

The simulation of the reaction energy barriers under OEEFs is computationally very demanding since it requires the geometries and vibrational frequencies of the reactants and transition states (TS) at several strengths of the OEEF to be determined. For this reason, an approximation was suggested to compute the energy barriers in terms of the dipole moments of the reactants and TS and the strength of the electric field (Eq. 1).^[4] Although this approximation is computationally very efficient, unfortunately its accuracy is sometimes not good enough. Thus, we propose to generalize Eq. 1 also including the polarizability or even higher order terms in a Taylor expansion manner (Eq. 2) to gain chemical accuracy.

$$\Delta E^\ddagger(F) = E(0) - \bar{\mu}F \quad \text{Eq 1.} \quad \Delta E^\ddagger(F) = E(0) - \bar{\mu}F - \frac{1}{2}\bar{\alpha}F^2 - \frac{1}{6}\bar{\beta}F^3 \quad \text{Eq 2.}$$

$$\bar{X} \equiv -(X_{TS} - X_S), \forall X \in \{\mu, \alpha, \beta\}$$

Equations 3 and 2. Approximations for the fast evaluation of $\Delta E^\ddagger(F)$.

2. Objectives

Our goal is to generalize Eq. 1 by including in the Taylor expansion the linear polarizabilities of the reactants and TS or even higher order terms (Eq. 2) that will properly describe the curvature of $E(F)$.

We also want to check whether our approximation (Eq. 2) is better than those that already exist at predicting reactivity either qualitatively or semiquantitatively.

3. Methodology

All the geometry optimizations were performed using the hybrid B3LYP-D3BJ DFT functional as implemented in the Gaussian16 package. The 6-31+G(d,p) basis set was used to build up the molecular orbitals during optimizations. Energies, dipole moments and polarizabilities were refined at the 6-311+G(2d,2p) level. An in-house code was developed to keep the geometry properly oriented with respect to the OEEF during the optimization.

4. Conclusions

Once our methodology was implemented, we studied the electric field induced reactivity of several systems. In some cases, the discrete-dipole approximation leads to reaction barriers with deviations larger than 5 kcal/mol with respect to exact values. On the other hand, the errors in the barriers obtained with our proposed approach are in the range of 0.1-1 kcal/mol. Therefore, our approach is far more reliable and still computationally very cheap.

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CHEMOSELECTIVE ALIPHATIC C-H BOND OXIDATION ENABLED BY POLARITY REVERSAL

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1. Introduction

Selective oxidation of unactivated aliphatic C-H bonds constitutes a potentially useful reaction because it introduces functionality into otherwise inert aliphatic skeletons.¹⁻⁴ However, the differentiation among multiple C-H bonds with powerful oxidizing agents and predictability in site selectivity are often insurmountable problems that prevent the widespread incorporation of these reactions in synthetic planning. Another critical issue is represented by product chemoselectivity because the first formed products are generally more susceptible to oxidation than the starting substrate.

2. Objectives

In this work⁵ we want to develop a general procedure to attain chemoselective and regioselective oxidation of unactivated C-H bonds catalyzed by bioinspired iron and manganese complexes (Figure 1).

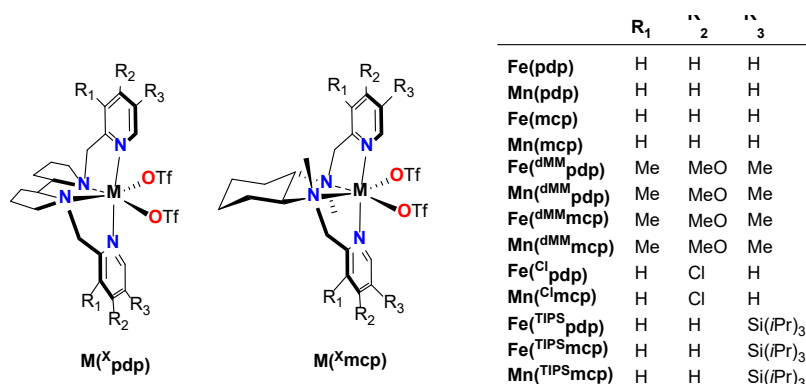


Figure 1. Complexes used in this work

3. Methodology

The effect of establishing hydrogen bonding between the solvent and the first formed hydroxylated product or the functional group installed on the substrates has been investigated by using fluorinated alcohols as solvents.

4. Conclusion

Fluorinated alcohols exert a polarity reversal effect on electron-rich functional groups, directing iron and manganese catalyzed oxidations towards a priori stronger and unactivated C-H bonds. As a result, selective hydroxylation of methylenic sites in hydrocarbons and remote aliphatic C-H oxidation of otherwise sensitive alcohol, amide and amine substrates is achieved by employing aqueous hydrogen peroxide as oxidant (Figure 2).

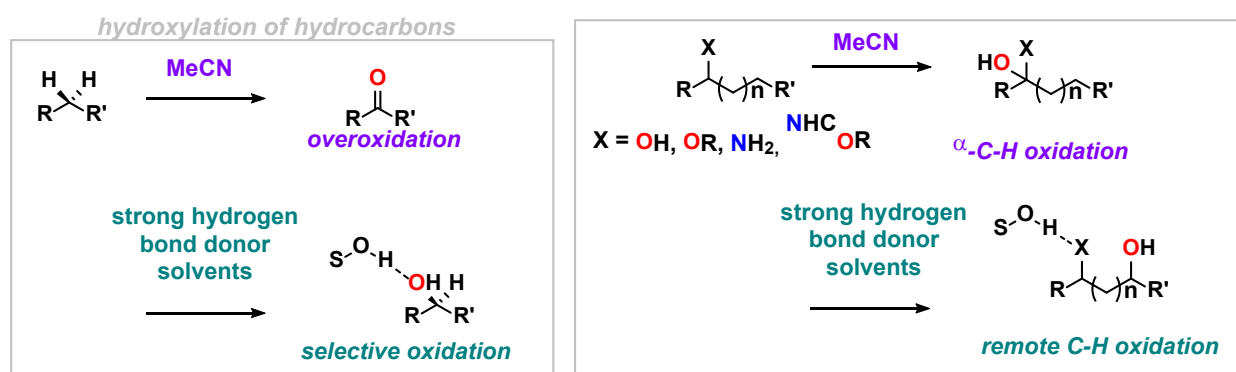


Figure 2. Effect of fluorinated alcohols

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FROM LINEAR TO CIRCULAR POLYCYCLIC COMPOUNDS: AROMATICITY STUDY ON SINGLET AND TRIPLET STATES

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1. Introduction

The term aromaticity is associated with cyclic molecular systems with a certain spatial and electronic structure that causes electron delocalization, providing enhanced stability. There are plenty of interesting examples, with a large variety of aromaticity types and shapes. Some particular examples are; Chichibabin's oligo-p-phenylenes, their cyclic version cyclo-p-phenylenes (CPPs), and different types of porphyrins.^[1,2]

2. Hypothesis and objectives

Some derivatives of the three examples given above may be stable in radical and/or cationic forms with small singlet-triplet energy gaps. This stability may be due to the aromaticity of the species. Therefore, our aim is to determine the role of aromaticity in the stability and the properties of the system.

3. Methodology

The geometries of the systems were optimized at the density functional theory (DFT) level and the aromaticity of the resulting structures was analyzed *a posteriori* by means of several aromaticity descriptors including NICS, FLU, AVmin, AV1245 and EDDB, among others.^[3,4]

4. Conclusions

In general, the Chichibabin and CPP systems present small singlet-triplet energy gaps. Our results also allowed us to determine the role of the aromaticity on the stability of the systems and to characterize the different aromatic pathways present in the molecules.

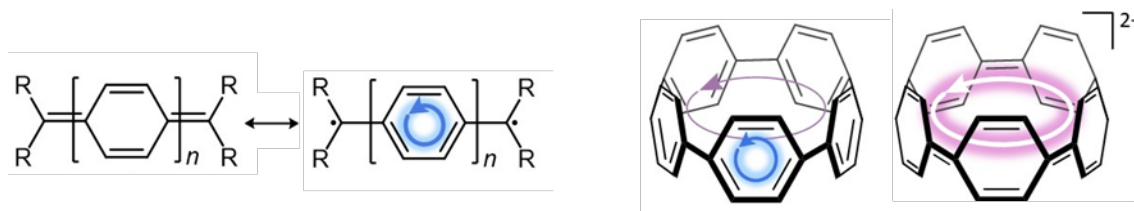


Figure 4. Quinoid and benzenoid resonance forms of Chichibabin and CPP compounds.

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IDENTIFICATION OF MAJOR PROSTATE SPECIFIC ANTIGEN (PSA) GLYCOFORMS FROM AGGRESSIVE PROSTATE CANCER (PCA) PATIENTS

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1. Introduction

Prostate Cancer (PCa) is the most common cancer and the second cause of death from cancer in men (1). The biomarker used nowadays is Prostate Specific Antigen (PSA), a glycoprotein synthesized by the prostate. However, PSA levels are neither specific enough to distinguish between benign prostate pathologies and PCa, nor between low and high-risk PCa. Therefore, the development of non-invasive biomarkers is required in order to reduce PCa overdiagnosis. Glycosylation of PSA is altered in PCa. In particular, an increase in the percentage of α 2,3-sialic acid and a decrease of core fucosylation of PSA determinants are indicative of aggressive PCa (2). Nonetheless, specific PSA glycoform structures that are either increased or decreased in aggressive PCa have not been described yet.

2. Hypothesis and objectives

The identification of the main changes in PSA glycan structures in aggressive PCa patients could facilitate the development of methods to differentiate between high-risk PCa and benign prostate hyperplasia, prostatitis and low-risk PCa. We aim to purify the serum PSA from aggressive PCa patients and perform PSA N-glycan sequencing in order to identify the main PSA glycan structures of high-risk PCa patients.

3. Methodology

Serum samples were obtained from Dr. Josep Trueta Hospital. PCa patients with high levels of PSA (>450 ng/ml) were analyzed. PSA purified from healthy individuals' seminal plasma was used as a control. PSA was immunoprecipitated and α 2,3/ α 2,6-sialic acid glycoforms were separated by SNA-agarose chromatography. The PSA fractions collected were

immunoprecipitated and resolved on SDS-PAGE. PSA bands were excised and digested with PNGaseF. The obtained N-glycans were analyzed by Hydrophilic Liquid Chromatography combined with exoglycosidase digestions.

4. Results and conclusions

Glycan differences between healthy and aggressive PCa patients were determined. A major glycoform containing α 2,6-sialic acid, not fully identified yet, was increased in aggressive PCa, whereas the biantennary core fucosylated α -2,6 disialylated PSA was significantly reduced. These results show changes in specific glycoform structures associated to aggressive PCa, which could be used as templates to develop specific methodologies for their detection.

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MECHANISM OF THE MANGANESE-PINCER CATALYZED ACCEPTORLESS DEHYDROGENATIVE COUPLING OF NITRILES AND ALCOHOLS

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1. Hypothesis and objectives

One of the main problems nowadays is the emission of noxious gases such as CO₂ and N₂O to the atmosphere. It is therefore crucial to develop new reactions towards green chemistry.^[1] One way of approaching green chemistry is to reduce waste and produce H₂ as a renewable and clean energy source.

A recent study showed that a Mn-pincer complex (Figure 1) could catalyze the acceptorless dehydrogenative coupling (ADC) of nitriles and alcohols to yield acrylonitriles (Figure 2).^[2] The reaction mechanism proposed in that work contained some intermediates that were not characterized in most of the cases. Moreover, one of the intermediates involved a charged separation, which is unlikely in apolar solvents.

Our work focuses on the clarification of the entire mechanism through computer simulations, as there are knowledge gaps in the described mechanism, as well as on analysis of the kinetics of the process. Unravelling the mechanism will allow further research into this novel catalyst.

2. Methodology

To clarify the reaction mechanism of this critical reaction, we decided to perform a DFT study using Gaussian09. The gas optimization was performed at BP86/TZVP level of theory and single point solvent corrections at M06/cc-PVTZ level, with the SMD solvation model for toluene as solvent.^[3]

3. Results and Conclusion

Our results prove the existence of a cooperative effect of the metal and the ligand in several steps of the catalytic cycle. We also find the presence of several equilibria between isomeric intermediates where water, or the same alcohol reagent, takes part in assisting the proton

transfer. Furthermore, we have analyzed the charge separated structure proposed experimentally and have found a nearly pure covalent bond between the two expected charged moieties. Finally, the Knoevenagel condensation step that generates the acrylonitrile is found to be the rate-determining step.

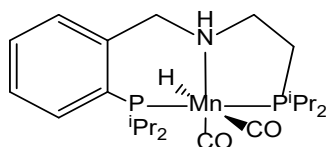


Figure 1. Mn catalyst for ADC as reported by Milstein and co-workers.[2]

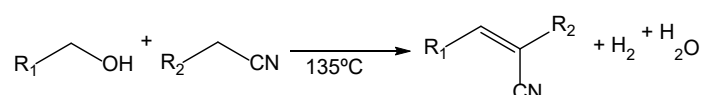


Figure 1. The acceptorless dehydrogenative coupling reaction catalyzed by the Mn catalyst in Figure 1.

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SYNTHESIS AND CHARACTERIZATION OF ORGANOMETALLIC IRON COMPLEXES

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1. Introduction

The use of iron as a catalyst for cross-coupling reactions is a field that has been exploited with successful results in recent years. In most cases, the involvement of an organometallic iron-carbon species as the key reaction intermediate in the catalytic cycle has been postulated. However, the detection of such compounds has remained elusive [1].

2. Objectives

The main goal of this work is to synthesize and characterize organometallic iron complexes in order to gain more insight into the mechanism of cross-coupling reactions catalysed by iron-based systems.

3. Methodology

This series of organometallic aryl-iron(II) complexes are prepared through a C(sp²)-Br activation using model macrocyclic arene substrates previously used in our group [2] and an iron(0) pentacarbonyl precursor. The use of model macrocyclic ligands is key for the stabilization, isolation and characterization of these reactive intermediates. Once isolated, these complexes will be characterized by different spectroscopic and spectrometric techniques such as high-resolution electrospray ionization mass spectrometry, nuclear magnetic resonance, infrared spectroscopy, X-ray diffraction and DFT calculations. Furthermore, studies on the reactivity of the different organoiron(II) complexes prepared will be performed.

4. Conclusion

A new family of aryl-iron(II) complexes has been synthesized and characterized by different spectroscopic and spectrometric techniques. Unprecedented reactivity has been observed

upon changing the amine substituents on the macrocyclic ligand; CO insertion and formation of a tertiary amide takes place.

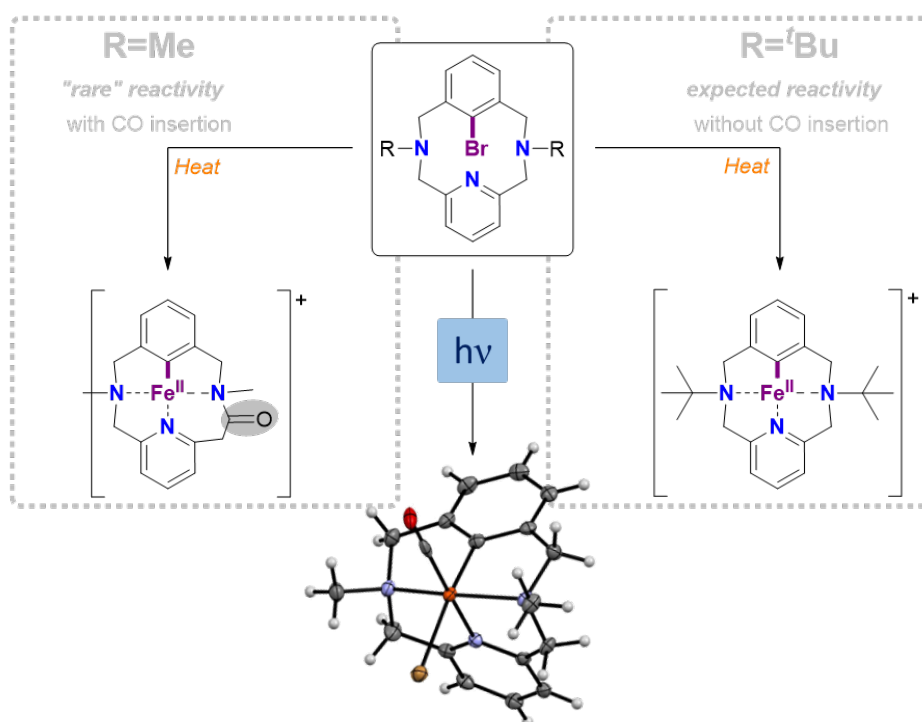


Figure 5. Reaction of aryl-bromide macrocyclic ligand with iron(0) under different conditions giving different organometallic iron(II) complexes.

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A BOTTOM-UP APPROACH TO ARTIFICIAL OXYGENASES: THE COMBINATION OF IRON COORDINATION COMPOUNDS AND PEPTIDES

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1. Introduction

The asymmetric oxidation of hydrocarbons remains a challenge for synthetic chemists, but it commonly occurs in nature among metalloenzymes [1]. The metal centre in their active site has an important influence on the reactivity of the enzymes. Moreover, the secondary coordination sphere around the metal defines a well-organized cavity that favours high selectivities.

2. Hypothesis and objectives

A possible approach to mimic the selectivity obtained by metalloenzymes is the use of bioinspired catalysts in combination with peptides. The high reactivity of metal catalysts and the structural versatility of peptides may result in efficient and selective catalysts. Despite the advantages of this approach, the use of metallopeptides in oxidation reactions is still an unexplored field, and examples in the literature are scarce [2]. Recently Cussó *et al.* demonstrated that the combination of peptides and a metal catalyst allows the enantioselective oxidation of challenging substrates (Figure 1) [3].

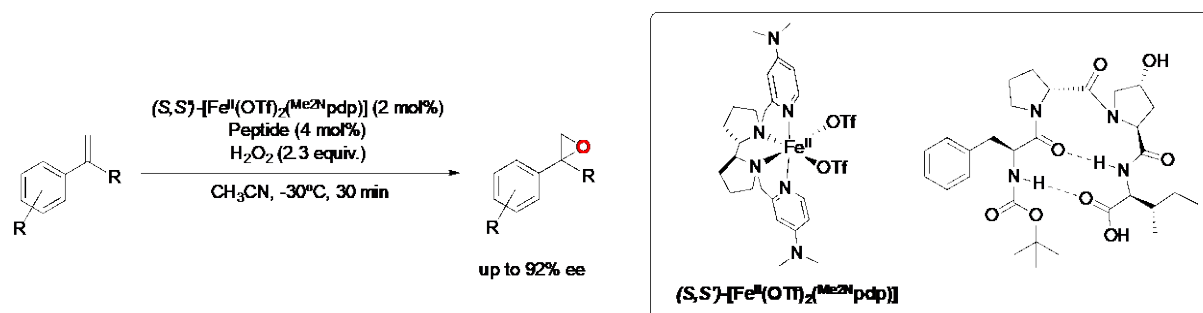


Figure 6. Catalytic system reported by Cussó *et al.*

Our hypothesis is that the flexibility of the system reported by Cussó represents a drawback in favouring high selectivities and we suppose that the introduction of rigidity in the hybrid metal catalyst-peptide will result in a more efficient and enantioselective catalytic system. The objective of this work is to anchor the peptide in the structure of the ligand in a covalent manner to achieve a more rigid and structured catalyst.



^d coordination sphere.
The covalent attachment reduces the flexibility of the system

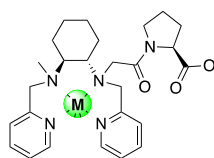
Figure 7. Schematic representation of the objective of our work

3. Methodology

A synthetic route for the covalent anchor of amino acids in the structure of the ligand has been designed and successfully applied with traditional organic synthesis techniques. The corresponding iron and manganese complexes have been prepared under inert conditions and were tested in epoxidation reactions.

4. Conclusions

The complexes containing an amino acid covalently attached in the ligand structure resulted in non-active catalysts for the epoxidation of model substrates. At this point, we decided to search for another strategy. We have designed a system based on the supramolecular interaction of the peptide and the metal catalyst. Preliminary studies show highly efficient epoxidation of a wide range of substrates but further explorations are still needed to optimize this system. These latest results suggest that metallopeptides can be used as catalysts in oxidation reactions.



ALYST

ACTIVE
CATALYST

Figure 8. Catalytic systems prepared in this work and tested in the asymmetric epoxidation of olefins

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**DOCTORAL PROGRAMME IN
TECHNOLOGY**

RESILIENT ARCHITECTURE: WHAT ABOUT GLOBALIZATION?

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EPS UdG / Universitat de Girona

1. Hypothesis and objectives:

The purpose of this thesis is to investigate a way of designing architecture. We should reconsider the way we live and foster analysis and critical thinking when considering and planning architecture. This hypothesis is based on proposing a new approach to architecture that includes defining guidelines for the relationships between places and globalization. Places are identified with people: individuals with a specific culture who claim subjectivity and all that is local. Globalization is understood as any flow of information and homogenization of space, mainly led by capitalism. The objective of this thesis is to focus on globalization and its consequences – the emergence of global cultures, globalized ideology and technology – and to identify negative and positive elements it brings to society.

2. Methodology:

We have used theorists' documentary research about globalization as our basis. The terms of each theorist's discourse will be objectively analysed and conclusions drawn about the phenomena studied in each one. We have considered the specific situation of analysis in global cities, where globalization concepts have the greatest influence on society, on architecture and on the urban system. We will judge to what extent aspects brought about by globalization are characteristics not focused on society and an architecture for it, or if, on the contrary, it has qualities that can serve to define some essential points for resilient architecture.

3. Conclusions:

Globalization itself provides some positive aspects for designing this resilient architecture, such as flexibility, efficiency in materials and structure through technology, and empty space. On the other hand, globalization intrinsically brings with it aspects based on consumerism and a belief in constant technological improvement for a better quality of life, encouraged by capitalism. This has brought about an architecture that is purely functional or only for mass consumption, which is directly focused on satisfying some very specific aspects and not responding to the qualities of the individual. This has resulted in the deterioration of urbanism,

architecture and space. We can see it in Rem Koolhaas's concepts in Generic City or Junkspace, Roger Connah's Pulp Architecture and the non-place of Marc Augé. Finally, the real contribution is to take advantage of the positive aspects of globalization in the economic, political and cultural spheres to design architecture capable of adapting to social tensions and improving the quality of life in cities.



Figure 9. Resilient architecture scheme

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MOTIV-ARCH: A CULTURAL HERITAGE CO-CREATION SYSTEM TO MOTIVATE GIFTED STUDENTS

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1. Introduction

Education is considered an essential factor in society, but some problems remain with developing quality education. For that reason, educational institutions and official organizations, such as the UN, are constantly trying to find ways to improve conditions in educational systems through the use of technological tools in schools (Regional, 2013).

Examples of these technological tools improving education include augmented reality (AR) (Azuma, 1997), virtual reality (VR) (Wojciechowski, Walczak, White & Cellary, 2004) and game-based learning (GBL) (Garris, Ahlers & Driskell, 2002). These kinds of technologies can improve students' motivation and interest in their learning process, such as in the case of AR (Bacca, Baldiris, Fabregat, Graf, & Kinshuk, 2014). In addition, it is important to consider students' personal attributes such as interest, motivations, abilities, and so forth (Regional, 2013).

In the case of gifted students, if their learning process is equal to the other students with no differentiation between activities, they may feel demotivated and bored in the classroom (Pomar & Díaz, 1998).

2. Hypothesis and Objectives

Taking into account the aforementioned problem, the hypothesis of the investigation is to find out whether the co-creation of adaptive content for learning about cultural heritage and the use of immersive technological tools might improve gifted students' motivation in their learning process. To verify this hypothesis, I propose the following objectives:

The use of immersive technological tools in the process of co-creating material relating to cultural heritage to improve gifted students' motivation taking into account their characteristics and needs.

Identify students' characteristics to determine the type of material should be co-created.

Evaluate the learning methods that could be adapted considering students' characteristics and needs.

Create the relationship between learning methods and students' characteristics for co-creation of educational resources.

Implement a prototype with immersive technologies to enhance students' motivation in the learning process.

3. Methodology

The methodology used for this investigation is the qualitative approach proposed (Hernández Sampieri, Fernández Collado & Baptista Lucio, 2014) divided into different phases (initial, production, implementation and construction, validation).

4. Conclusions

The research concludes that knowing how to use immersive technologies in educational environments supports gifted students' motivation to learn cultural heritage and validates that conclusion using a prototype that implements these technologies in the educational area.

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FAULT DETECTION WITH PRINCIPAL COMPONENT ANALYSIS IN POWER DISTRIBUTION NETWORKS WITH DISTRIBUTED GENERATION

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1. Hypothesis and objectives

This work presents an automated fault detection strategy based on principal component analysis (PCA) for low voltage distribution networks with the presence of distributed generation (DG) and phasor measurement units (PMUs). The proposed technique is aimed at triggering automatic responses to provide grid reconfiguration and help to reduce interruption times, improve quality of supply, and optimize asset utilization in low voltage power distribution networks.

2. Methodology

The proposed methodology consists of a PCA algorithm that statistically analyses the PMU data recorded at different buses of the power distribution network. First, it computes a statistical model of normal operating conditions (NOC) with dimensionality reduction, and then it detects abnormal operating conditions (AOC) by projecting the subsequent observations onto the modelled space and evaluating the consistency of the results by using two statistical indexes: Hotelling's T^2 and square prediction error. As a result, it is capable of correctly identifying and distinguishing AOC from NOC without requesting any information about the network topology, configuration or electrical parameters.

3. Results

Testing and validation were conducted based on a real power distribution network simulated in MATLAB under short circuits. The statistical indexes calculated under AOC violate the statistical thresholds and allow for correct fault detection.

4. Conclusions

The automated PCA-based strategy is able to detect faults correctly in low voltage distribution grids with DGs and PMUs. The statistically calculated results allow for correct distinction between NOC and AOC in PMU data without requesting any further information about the network topology, configuration, or electrical parameters.

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EFFECTS OF PALLADIUM ADDITION ON THE MAGNETO-STRUCTURAL AND MAGNETIC PHASE TRANSFORMATIONS OF NI-MN-SN SHAPE MEMORY ALLOYS

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1. Hypothesis and objectives

In recent years, a new type of ferromagnetic shape memory alloys (FSMA) have become of increasing interest as sensor and actuator materials due to their large magnetic-field-induced strain and shape memory effects. The aim of this research work is the obtention and thermal, structural and thermomagnetic analysis of ferromagnetic Heusler-type alloys (based on Ni-Mn-Sn-Pd quaternary systems) and the study of several of their relevant functional properties: shape memory, magnetoelasticity, magnetoimpedance, magnetocaloric effect, exchange-bias and magnetoresistance.

2. Methodology

Preparation of master alloys: fusion by electric arc in controlled Argon atmosphere (and addition of a fourth element to the Ni-Mn-Sn system). Preparation of ribbons by “melt spinning” technique. The alloys will be structurally and magnetically characterized after their fabrication as well as after the thermal treatments that will be performed in order to change or optimize their microstructural, structural and magnetic properties. The crystalline structures of the spun ribbons were determined by X-ray diffraction technique (XRD). The characteristic transformation temperatures and the thermodynamic parameters of the samples were determined by differential scanning calorimetry measurements (DSC). The magnetic measurements (hysteresis loop and magnetization) were performed by a vibrating-sample magnetometer (VSM) in the temperature range 10–400 K.

3. Results and Conclusions

Besides the first order martensitic structural transition (induced by change of temperature and/or magnetic field), the Heusler ferromagnetic alloys here analyzed exhibit magnetic transitions associated to austenite and martensite phases. The transition temperatures vary

noticeably with small changes of concentration of valence electron per atom, e/a , which allows adjustment or “tuning” of certain functional properties in a wide temperature range, including the room temperature (for applications such as magnetic refrigeration). Likewise, the minor addition of a fourth X element can drastically modify both microstructure and functional behavior. It was found that the addition of 2 at.% of Ti inhibits structural transformation when no external magnetic field is applied. The applicability of these materials is based in the cyclic response under the application of an external magnetic field, pressure and/or heat exchange. It is important to check the stability of the microstructure as well as the magnetic and the thermal response after cycling. Therefore, cyclic experiments (100 cooling-heating experiments working with liquid nitrogen) have been performed. It was found that thermal behavior and microstructure was usually unchanged, with the exception of the alloy with 1 at.% of Ti (after cyclic treatment, a premartensitic phase appears).

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**INTERUNIVERSITY DOCTORAL
PROGRAMME IN ARTS AND EDUCATION**

MODEL CATALAN LYRIC SINGERS

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University of Girona

1. Hypothesis and objectives

During the 20th Century, a few internationally famous lyric singers emerged in Catalonia. Singers such as Victoria de los Ángeles, Montserrat Caballé, Enriqueta Tarrés, Josep Carreras and Jaume Aragall have exported their art throughout the world. They all share a common origin and possibly the same singing technique learnt at Catalan schools.

We aim to find the link between them and whether there are any common characteristics in this artistic and human phenomenon. We also aim to find out whether there is a Catalan school of singing.

2. Methodology

We have tried to discover if these singers share a common singing technique through bibliographic research and expert questionnaires. Moreover, we have tried to find physical similarities and to determine if their mother tongue or Barcelona's opera singing tradition was decisive or merely a coincidence.

3. Conclusions

According to the object of our study, the main conclusions so far are the following.

The object of study has been transformed along with the research. There was insufficient evidence for the existence of a Catalan school of singing. In the end, similarities based on a shared singing techniques belonging to a Catalan school were just physical similarities due, perhaps, to the climate, the Mediterranean singing tradition, and the interest that exists in Barcelona and its Gran Teatre del Liceu.

Furthermore, the most valuable finding, thanks to different surveys conducted among singing teachers, is that the mother tongue was decisive in this phenomenon.

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**INTERUNIVERSITY DOCTORAL
PROGRAMME IN BIOINFORMATICS IN
LAW, ECONOMY AND BUSINESS**

CONTROL OF LEGALITY IN THE PUBLIC ADMINISTRATION

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1. Hypothesis and Objectives

The principle of legality characterizes administrative law, since it grants prior authority to public administrations that enable their management to be activated.

One of the assumptions in a constitutional state is that constitutional norms protect and govern the principle of legality; that is, if it were out of their scope, it would lack legal value. Nevertheless, in the legal system it is possible to find public administration authority that is opposed to the supreme law. A controversial scenario is the result of this possibility, as is the need for constitutional control of any principle of legality that departs from the protection of human rights.

2. Methodology

This study is part of a bibliographic investigation, both in terms of the doctrinal literature and the legal order that contains the principle of legality, examined through the paradigm of positivist research. We have tried to select legal forms that determine the functioning of the public administration in contrast to constitutional law. During the information collection and data analysis, focal normative groups were observed from the perspective of effective human rights protection and specialized literature, which seek to sustain the variables presented.

3. Conclusions

The research, which began in 2016, presents a topic of legal relevance that questions the very structure of administrative law. To date, partial results have been published in various international academic forums and publications in Ecuador and Spain. A legal discussion contradicts the attributions of public administrations, which despite being found in the law, do not seek the protection of people's rights. The contradictory scenario of public administration attributions has been revealed and the case for control has been made. The lack of mechanisms to control state attributions causes the activity to become arbitrary, discretionary and unjust.

It is essential to control the legal activity of public administrations, to identify management compliance with constitutional norms and, most of all, to redirect public service to guarantee the ideal of any republic: the freedom of its citizens.

Keywords: Administrative law; public administration; control of law; principle of legality; human rights.

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THE LIMITS OF LEGAL PLURALISM. A REVIEW OF THE CASE OF VENEZUELA: A BREAK OR AN APORIA?

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It is possible to rebuild a legal and social order in Venezuela in the form of a plurinational, multiethnic and intercultural State, where State and indigenous legal systems are coherently articulated on the basis of respect towards native ancestral worldviews and there is coordination between the indigenous judicial system and the national judiciary. The new legal order should be understood as the democratic path leading to the reinforcement of the principles of pluralism and interculturality in Venezuela.

The methodology is focused on the critical analysis and study of the bibliography and works constituting the contemporary doctrine of the Theory of Law, Legal Sociology and Critical Political and Legal Philosophy. As desk research, the methodology will consist of comparing different sources of information - such as selected texts, data compilation works, papers and positive legal documents, among others - and the application of the body of theoretical foundations studied on the issue of the limits of legal pluralism in Venezuela. Besides this, dialogues and exchanges of views with experts from different universities will be undertaken through interviews and participation in seminars and conferences on this field. The research will implement the historical and comparative method as well as the rules of legal hermeneutics.

There is a gap between the legal and constitutional framework with regard to legal pluralism in Venezuela, which is strongly connected with the structure of an extractivist State and a social and political process which still has considerable public support but which is facing a serious ongoing crisis.

Bearing in mind the multiple interpretations concerning the notion of legal pluralism, both as an epistemological, political and legal category and as a tool for social change, this work reaches the conclusion that legal pluralism in Venezuela is constrained by various conditioning factors, such as the persistence of extractivism -which is the foundation of the national economy, the lack of enforcement of the Organic Law of Indigenous Peoples and Communities, and the highly insufficient boundary delimitation of the territory of native peoples constitutionally recognized in Venezuela since 1999.

A ROBOT HAS REPLACED YOU. SO WHAT?

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1. Introduction

Robots and automation processes represent a serious danger to the preservation of current employment levels. For decades, the dominant economic thesis has been that after a period of decline in labour demand, job opportunities would emerge in new or more innovative sectors, thus contributing to generalised social progress. Now our societies face the challenges of the widespread use of robots and artificial intelligence, which, in an interconnected world, become a threat to non-qualified, and even highly skilled, workers.

2. Hypothesis and objectives

In the face of a hypothetically critical unemployment levels in the future caused by the technologies mentioned, it is fundamental to consider citizens' preferences when it comes to public policies implemented in developed countries. They include the following:

Basic income. A guaranteed payment could be useful to maintain citizens' ability to consume by redistributing wealth.

Public employment. The aforementioned income would be conditional on carrying out tasks designed for general social welfare instead of being a right with no obligations.

Redistribution of labour time. Increased productivity allows employers to hire fewer workers. In this sense, a progressive reduction of the maximum working hours, while increasing the legal minimum wage, could maintain employment rates and citizens' purchasing power.

Free education. If knowledge is more accessible to all, an educated society will be better able to adapt to the technological transition.

3. Methodology

Between December 2018 and April 2019, a survey was conducted in the provinces of Barcelona and Girona, asking, among other questions: "What would be your priority if you were unemployed because of technological changes?" Taking part in the survey were 1,405 people with permanent residence in 218 Catalan municipalities. The participants were consulted in public spaces and in several adult education centres.

4. Conclusions

The following figure illustrates the distribution of preferences indicated by citizens. The two most popular options are notable: free education (28.11%) and redistribution of working hours (27.11%). Next in popularity came public employment (22.49%) followed by basic income (14.73%), unemployment benefit (4.55%) and other options (2.99%). In this sense, a basic income is not a measure that the population broadly supports, considering there are other options with less impact on public finances.

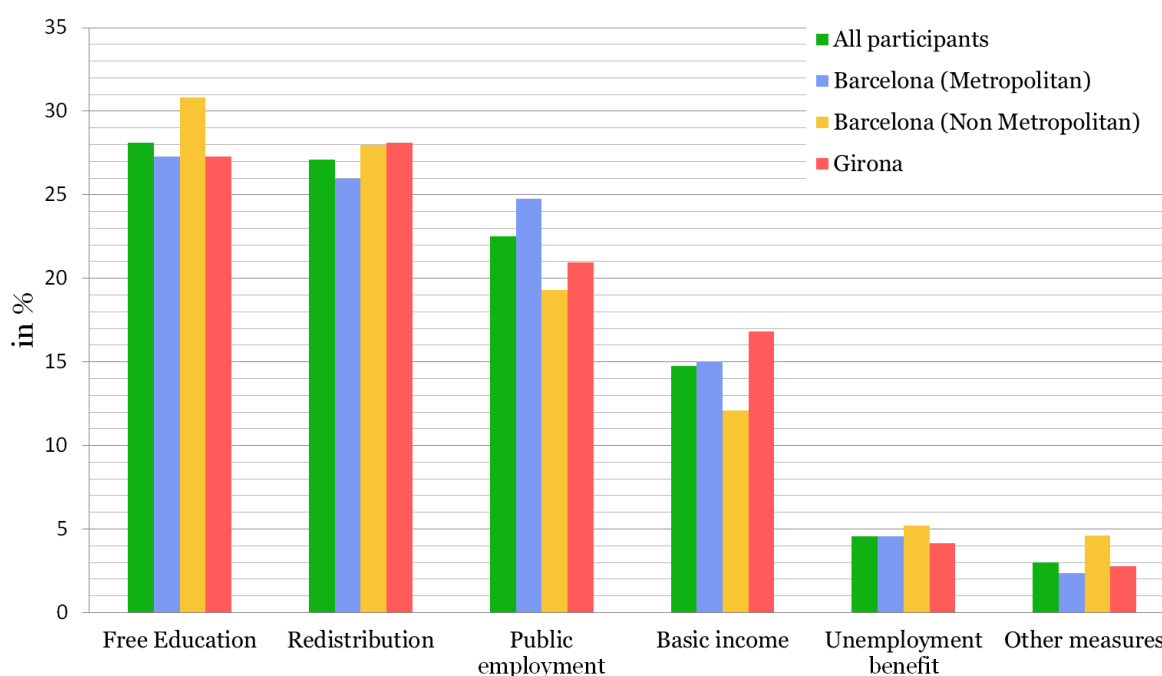


Figure 10. Preferences regarding assistance measures in the event of redundancy.

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(CYBER) FRAUD AND THE PROPERTY CRIME RISE. EVIDENCE FROM SPAIN AND EUROPE.

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1. Introduction

In recent years, a reduction in property crime has been identified throughout the western world (Aebi and Linde, 2010; Fernandez-Molina and Bartolomé-Gutiérrez, 2018; Tonry, 2014; Tseloni et al., 2010). However, fraud has not been considered in the analysis, which is surprising given that the Internet has greatly increased fraud opportunities (Clough, 2015, Miró, 2013) and that it is considered Europe's most widespread property crime (Williams, 2015). The Spanish National Police have also applauded a crime drop in Spain, which they put down to increased police efficiency (MIR, 2016), yet cybercrime has particularly low reporting levels (Caneppele and Aebi, 2017) and, in fact, the Internet may be hiding a property crime wave (Tcherni et al. 2016).

2. Hypothesis and objectives

The aim of this paper is to analyse the nature, prevalence and evolution of fraud as well as its role in the overall panorama of delinquency. Furthermore, this study examines the extent to which we are witnessing a fraud 'police recording flop' (Caneppele and Aebi, 2017) rather than a crime drop, and whether this exemplifies the new multi-agency approach to crime prevention (Holt and Bossler, 2015).

In this sense, the two main hypotheses are:

Fraud reporting to the police is considerably lower than other property crimes.

If fraud is included in the trend analysis, a Spanish property crime drop cannot be identified.

3. Methodology

The study analyses crime trends in Spanish police statistics, fraud data from the Bank of Spain and the European Central Bank as well as the results of national victimisation surveys from a number of European countries.

4. Conclusions

The results show fraud to be extremely prevalent, rising rapidly and likely to continue increasing. The overall rise in fraud is the result of huge increases in cyber fraud. Underreporting appears to be considerably higher than for other property crimes; therefore, it appears there has not been a Spanish crime drop and the real crime rate is much greater than the official.

The first step in effective crime prevention is an accurate picture of crime. This study therefore highlights the fundamental challenge faced by public police forces as a consequence of fraud underreporting. Spanish police forces have attributed recent drops in official crime rates to improved police efficiency yet, in reality, they may be significantly underprepared to deal with widespread cyber fraud.

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INFRACTIONS IN THE PUBLIC ADMINISTRATION BY ACT OR OMISSION AND THEIR INCIDENCE IN COMPUTER CRIME

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1. Hypothesis and objectives

After a review of the literature, this study aims primarily to use management systems and information security based on the balanced scorecard to create an innovative strategy that will allow mitigation of crimes and infractions that arise in public administration because of action or omission on the part of those responsible.

2. Methodology

This is an empirical study through the paradigm of positivist research, with qualitative and quantitative techniques to collect information and analyse data from the perspective of organizational management and government auditing. It uses different instruments, (focus groups audited in public administration, observation, and specialized literature) that sustain the variables presented. For this reason, the phases are stratified, beginning with the information input, the transformation variables and that output that give structure to the management system and information security.

3. Results and Conclusions

The investigations carried out for 2016, 2017 and 2018 – the results of which were published and presented at different international events – generated scientific academic debate with respect to the impact of the absence of internal control and risk management in public and private management from the point of view of the organization and government auditing. In addition, this starting point identified factors that affect the implementation of administrative and financial infractions resulting from action or omission by those responsible, which in many cases gives rise to various types of crime. The most representative of these is computer crime. Among the most common reasons are a lack of transparency in processes, little scientific and technological development, a lack of strategies to safeguard information, the poor socialization

of knowledge management, the incompetence of human capital, and obsolete legislation in relation to technological development that would otherwise punish these crimes. The effect is to highlight the viability of the design and implementation of management systems and information security based on artificial intelligence. On one hand, this would help identify the causes and the effects of past events to evaluate them and seek improvement. On the other hand, they might be part of a measuring strategy and for proactive transformation. In other words, they could help re-engineer processes based on successful tests and errors ranging from the reformulation of organizational philosophy, objectives and strategic planning to computer systems, with the balanced scorecard as a determining factor intended to provide information security, efficiency and effectiveness in management.

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ANALYSIS OF THE HIERARCHY AND OPPRESSION OF HUMAN RIGHTS IN THE IBERIAN PENINSULA UNDER ROYAL POWER AND RELIGIOUS CONTROL DURING THE MIDDLE AGES AND RELATED COMPARATIVE STUDIES ON CHINA

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The most significant reflection of hierarchy and the oppression of human rights on the Iberian Peninsula under royal power and religious control during the Middle Ages was the inquisition. At the ear of European religious reform from the 15th to the 16th century, the Roman Catholic Church tried to resist the expansion of Protestantism by strengthening the power of the inquisition. Meanwhile, the inquisition also played a significant role in the unification processes of Spain and Portugal and subsequent overseas expansions.

As to contemporary China, the Confucian patriarchal and ethical system nominally advocates that people act in harmony with the law of heaven, while in reality subjecting them to imperial power and the system of monarchy. "The three cardinal guides and the five constant virtues" is the most important principle of the Confucian patriarchal and ethical system, essentially demanding subjects pledge loyalty to the monarchy.

This project will use a variety of methods, including both qualitative and quantitative. The reason for this is that different research methods can help to collect disparate types of data, thereby achieving various research objectives. Qualitative methods will be used to compare Spain and China. Firstly, their key differences will be summarized and illustrated, then new concepts and ideas will be proposed, and a design for future research questions suggested.

As distinct from inquisitions in other European regions in the Middle Ages, the basis of the inquisition on the Iberian Peninsula is particularly closely related to the "Jewish issue". Furthermore, the "Jewish issue" is complicated by the issue of the Jewish-converso, or Marrano, population. Previous research on this topic has shown one of the most significant controversies to be the role of the inquisition. The status of Marrano typically reflects the oppression of human rights by political and religious powers during the Middle Ages.

According to Vitoria's theory, royal power and ecclesiastical power should be separated. The purpose of legislation based on royal power is to identify actions as being in accordance with the law or against the law. However, the purpose of legislation based on ecclesiastical power is primarily to identify actions as being in accordance with morality or against morality. Moreover, the legitimate relationship between a Christian nation and a non-Christian nation

should follow two principles. On the one hand, any action taken by one party which might influence the other party requires a reasonable negotiation procedure. On the other, if the result of negotiation shows the action to be against the law, the law does not protect the person who despises the result. ^[1]

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**INTERUNIVERSITY DOCTORAL
PROGRAMME IN TOURISM**

MAPPING A HUMANISTIC VIEW OF TOURISM

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1. Hypothesis and objectives

Tourism was the most significant social, cultural and economic activity of the 20th century. In the 21st century, its worldwide evolution is rapidly growing in virtually all parts of the world, reaching 1,322 million international tourists.

Quantitative figures, especially with regard to the number of international travellers and income generated, tend to overshadow one of the main characteristics of travel: the condition of being a human experience, and expanding possibilities for personal development.

Based on this hypothesis, we want to evaluate the relationship, in the field of academic research, between travel and humanistic disciplines.

2. Methodology

A bibliometric study of the main databases of academic texts has taken into account texts from the areas of knowledge of both tourism and the humanities and combining keywords in the semantic field of travel (tourism, itinerary, and so on) with the humanistic disciplines (literature, humanities, etc.).

3. Results

A first quantitative analysis established the frequency with which these two subjects are jointly studied. In addition, it identified the most closely related areas and, significantly, where the gap occurs.

With these data, we dispel the notion of travel as an individual transformative experience and identify the elementary components in order to characterize them later.

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COMMUNITY-BASED TOURISM: A STUDY OF STRENGTHENING FOR POST-DISASTER DESTINATIONS. CASA: ECATZINGO MEXICO

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1. Introduction

On Tuesday, 19 September 2017, Mexico was affected by an earthquake of 7.1 on the Richter scale. Although the epicentre was located in the state of Puebla, the quake had a direct impact on eight states in the country. Ecatzingo de Hidalgo, a municipality in the south of the state of Mexico, was among the worst affected in terms of infrastructure. With a population of 9,500, almost 80% of the homes were destroyed, nine of the 16 educational institutions suffered partial damage and three were completely demolished.

With the support of social organizations such as Telar Social and América Solidaria, this research aims to present a methodology that uses community-based tourism to foster sustainable human development in communities affected by natural disasters.

The study focuses on changes in perception and the negative impact on the image of the destination after the 2017 Ecatzingo earthquake. It also proposes mechanisms to develop community-based tourism strategies taking into account the internal and external environment of Ecatzingo.

In addition, the keys to success are linked to community participation in the area's recovery. This is essential in the planning process; culture is the basis of tourist appeal, so the culture becomes a driver for development. There are also several difficulties that must be overcome in order to implement sustainable indicators.

2. Hypothesis

Community-based tourism can better promote sustainable development in a community post-disaster situation thanks to collaborative work by its members. The following questions were developed in relation to community-based tourism. Is community-based tourism the solution for post-disaster communities? Are sustainable tourism indicators a viable method for the evaluation of post-disaster communities? How can gastronomic tourism help develop a region and promote local products, and thus maintain the landscape? What is rural community

tourism and how is it positioned compared to other destinations? Are there any experiences of this kind in Mexico?

3. Methodology

To carry out the study, we conducted and then analysed a territorial diagnostic in the town of Ecatzingo, Mexico. We recorded information about the context of the region, the demography and their gastronomic and local experiences. We also conducted interviews about the population's post-disaster experience and a focus group with the leading figures in the community. The study was supported by references from Telar Social, América Solidaria, UNESCO sustainable indicators, and case studies from the Mexican Secretary of Tourism, SECTUR.

4. Conclusions

In conclusion, the study presents the perception of the Ecatzingo community, showing the resilience of the locals, their post-disaster feelings and the goals for the rehabilitation and reconstruction of the image of their town.

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