Temperature-dependence of the single-cell variability in the kinetics of transcription activation in Escherichia coli

From in vivo single-cell, single-RNA measurements of the activation times and subsequent steady-state active transcription kinetics of a single-copy Lac-ara-1 promoter in Escherichia coli, we characterize the intake kinetics of the inducer (IPTG) from the media, following temperature shifts. For this, for temperature shifts of various degrees, we obtain the distributions of transcription activation times as well as the distributions of intervals between consecutive RNA productions following activation in individual cells. We then propose a novel methodology that makes use of deconvolution techniques to extract the mean and the variability of the distribution of intake times. We find that cells, following shifts to low temperatures have higher intake times, although, counter-intuitively, the cell-to-cell variability of these times is lower.

We validate the results using a new methodology for direct estimation of mean intake times from measurements of activation times at various inducer concentrations. The results confirm that E. coli's inducer intake times from the environment are significantly higher, following a shift to a sub-optimal temperature. Finally, we provide evidence that this is likely due to the emergence of additional rate-limiting steps in the intake process at low temperatures, explaining the reduced cell-to-cell variability in intake times.

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Authors: Goncalves, N., Startceva, S., Palma, C., Bahrudeen, M., Oliveira, S., Ribeiro, A. S.
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Ecosystem Approach on Medical Game Development: The Relevant Actors, Value Propositions and Innovation barriers

This paper explores the medical game ecosystem and reveals the reciprocal value propositions of the relevant actors of medical game ecosystems, as well as barriers that may be complicating or hindering realization of the value propositions. The case comprises an emerging medical game ecosystem in Finland in the traumatic brain injury (TBI) rehabilitation context. This study presents 12 actor groups, their value propositions, and the barriers between the actors. This paper gives a comprehensive view of the actual medical game ecosystem that is needed to utilize the full potential of gamification and serious games in the health care sector.

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Industrial and Information Management, Research group: Center for Innovation and Technology Research , University of Vaasa
Authors: Litovuo, L., Makkonen, H., Aarikka-Stenroos, L., Luhtala, L., Mäkinen, S.
Method for Evaluation of Surgical Wound Healing: A Case Study

We arranged a case study in order to examine whether tetrapolar bioimpedance measurement could be applied for evaluating the healing of a surgical wound. We measured the donor site surgical wound of a patient who had undergone a breast reconstruction surgery. The measurements were conducted three times in a nine days period, starting from the first postoperative day. As a reference, the impedance of an unaffected site was also measured. The electrodes were placed at equal distances, four centimetres apart in a parallel formation. The results show that, at low frequencies, the impedance of the wound increases with time. At higher frequencies, the situation is opposite; the impedance of the wound is initially higher than the reference and decreases with time. Both ends seem to approach the reference impedance as the healing proceeds. Our results are in accordance with the normal course of surgical wound healing and more specifically appear to be related to the diminishing swelling around the wound site. We conclude that the obtained results are interesting in a level that calls for further investigation.

Examining service experiences: comparing methods to capture children's experiences

Purpose – Recent discussion on the service-dominant logic (SDL) and interest of studying service experiences in different contexts have been increased. However, this has brought up a new methodological challenge for contemporary research. Research methods used, need to capture experiences in the contexts of value co-creation while taking dimensions affecting to experience co-creation into account. This challenges researchers to adapt their methodology to be suitable for the context of studied phenomenon. This paper will provide a set of methodological snapshots applicable for SDL and
service research in a context of healthcare services for children and their families.

Design/Methodology/approach – Study draws on selected literature from the fields of service research and healthcare services and tests new methods of capturing experiences in a special experience context of children’s healthcare. We analyze and report a set empirical studies applying of qualitative and quantitative approaches for investigating experience in a special research field of children's healthcare experience. These methodological approaches include probing, structured and unstructured interviews and surveys. We review and compare the key characteristics of the methods and their respective benefits for service experience research.

Findings – Key findings shows that some research methods are more appropriate capturing children’s experience data. Study also suggest that some methods are more appropriate for capturing data of co-creation in children’s social contexts.

Research implications – The paper builds contribution by increasing understanding on how different research methods capture dimensions of service experience co-creation and help researchers interested in studying children’s experiences to select an appropriate methodology for conducting their research.

Originality/value – Service experience research lacks paper that pieces together different methodology approaches capturing complex phenomenon of children’s experiences.

Key words methodology, children’s experiences, service experience, healthcare

Paper type – Research paper

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Authors: Litovuo, L., Aarikka-Stenroos, L., Kaipio, J., Karisalmi, N.
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Editors: Gummesson, E., Mele, C., Polese, F.
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Keywords: methodology, children's experiences, service experience, healthcare, experience
Links:

Research output: Scientific - peer-review › Conference contribution

Foundational eHealth Curricula for the health care workforce
The European Union supported project EU*US eHealth work aims at developing the eHealth skills and competencies of the people working in health care. A part of this work is to develop curricula describing what the personnel should learn about the various aspects of eHealth.

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Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Sleep and Sensory Signal Analysis Group-SSSAG, Research group: Personal Health Informatics-PHI
Authors: Värri, A., Tolonen, J.
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Links:
http://urn.fi/URN:NBN:fi:tty-201710122007
Research output: Professional › Paper, poster or abstract
EU*US eHealth Works to Improve Global Workforce Development

For the past several decades, healthcare organizations and providers in the United States, the European Union and other countries around the globe, have advanced the digital transformation of healthcare to help increase quality, safety and efficiency. Health information technology/eHealth enables healthcare workers and providers the opportunity to maximize their care delivery, ultimately resulting in better outcomes for patients, consumers and society.

The core of any healthcare system is its workforce. Therefore, healthcare systems require a robust supply of highly skilled professionals who are proficient in eHealth/health IT to use, operate and maintain the digital services, which are an increasingly essential part of their infrastructure. Some of these professionals are front-facing care providers such as doctors, nurses, pharmacists and other caregivers and need "eSkills" to achieve and sustain success in their work. Others are on the extended healthcare team, such as clinical informaticists, health information sta?, biomedical engineers and researchers, employ eHealth on a daily basis where the use of ICT (information and communications technology) is critical. Furthermore, some healthcare sta? that may not be traditionally thought of as using ICT in their work, such as pastoral care workers (clergy), environmental workers, or nutritional sta?, who are also more frequently relying on digital services and technology to manage their daily tasks.

To take on these expanded duties, all workers within the healthcare environment must be trained in eHealth, preferably before they even receive their first job. Therefore, the development and advancement of a healthcare workforce equipped with eHealth skills is vital to the present and future state of healthcare. This eHealth enabled workforce will assure that systems keep working functionally, that clinical workflows are incorporated into technology, and that healthcare is delivered in a manner that is safe, secure and quality-infused.

This paper will discuss the ways in which the EU*US eHealth Project, in cooperation with its Consortium members and a large stakeholder community, will work to measure, inform, educate and advance development of a skilled eHealth workforce throughout the European Union, United States and globally, with the goal of creating a legacy of digitally empowered health care professionals now and in the future.

General information
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Ministry of Education publication type: D2 Article in professional manuals or guides or professional information systems or text book material
Authors: Blake, R., Shaw, T., Blake, A., Hübner, U., Kaye, R., Schug, S., Thye, J., Värrri, A.
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ASJC Scopus subject areas: Computer Science (miscellaneous), Health Professions(all)
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Association of exercise loading history with fall-induced hip fracture risk.

General information
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Organisations: Civil Engineering, Faculty of Biomedical Sciences and Engineering, Research group: Computational Biophysics and Imaging Group, UKK Institute for Health Promotion Research
Authors: Abe, S., Narra , N., Nikander, R., Hyttinen, J., Kouhia, R., Sievänen, H.
Publication date: 2017
Peer-reviewed: Unknown
Influence of exercise history on fall-induced hip fracture risk.

Hip fracture is a major public health problem. Thin superolateral cortex of the femoral neck experiences unusually high stress in a sideway fall, contributing to hip fracture risk. The aim of this study is to examine how exercise based loading history, known to affect the femoral neck cortical structure, influences fall-induced fracture risk. For this purpose, finite element models were created from the proximal femur MRI of 91 young athletic and 20 control females. Fall-induced superolateral cortical safety factors (SF) were estimated in the distal volume of femoral neck. Significantly higher (p < 0.05) SFs were observed from femoral necks with high impact (H-I), odd impact (O-I), and repetitive impact (R-I) exercise history, indicating lower fracture risk. The results indicate that it is advisable to include some impact exercise in a fracture preventive exercise program.
Biomaterials for Electronics

Challenges of climate change, ecological scarcity and depletion of natural resources form a global push towards a bioeconomy, which means shifting from fossil to renewable raw materials. Wood biomass will likely get a significant role in the Finnish bioeconomy. Finnish economy has conventionally focused on bulk products, while the challenge in the future is to bring high added value to the fibre based components and products. Cellulose based nanomaterials are low-cost, strong, porous, lightweight, solution processable, biocompatible, biodegradable and piezoelectric biomaterials, which have obvious applications for example in biomedical and electronic applications.

Piezoelectric sensors are widely applicable for various healthcare and well-being applications. We have recently studied flexible piezoelectric sensors made from commercial PVDF films and printable PVDF-TrFE ink, as well as biodegradable films from wood-based cellulose nanofibrils (CNF) [1] and bacterial cellulose (BC).

The high porosity of CNF makes it also a promising material for supercapacitors, also known as electrochemical double-layer capacitors (EDLC). We have recently demonstrated the fabrication of supercapacitor electrodes from a mixture of CNF and dandelion using high temperature pyrolysis.

References:

The impact of acquisition dose on quantitative breast density estimation with digital mammography: results from ACRIN PA 4006

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Scopus rating (2013): SJR 3.21 SNIP 2.953 CiteScore 5.4
Scopus rating (2012): SJR 3.279 SNIP 2.855 CiteScore 5.27
Scopus rating (2011): SJR 3.129 SNIP 2.696 CiteScore 4.93
Scopus rating (2010): SJR 3.226 SNIP 2.667
Scopus rating (2009): SJR 3.121 SNIP 2.76
Scopus rating (2008): SJR 3.051 SNIP 2.664
Records, self-tracking devices and mobile applications provide a rich variety of data but it often becomes difficult to understand. We implemented the hFigures library inspired on the hGraph visualization with additional improvements. The purpose of the library is to provide a visual representation of the evolution of health measurements in a complete and useful manner.

Results
We researched the usefulness and usability of the library by building an application for health data visualization in a health coaching program. We performed a user evaluation with Heuristic Evaluation, Controlled User Testing and Usability Questionnaires. In the Heuristics Evaluation the average response was 6.3 out of 7 points and the Cognitive Walkthrough done by usability experts indicated no design or mismatch errors. In the CSUQ usability test the system obtained an average score of 6.13 out of 7, and in the ASQ usability test the overall satisfaction score was 6.84 out of 7.

Conclusions
We developed hFigures, an open source library for visualizing a complete, accurate and normalized graphical representation of health data. The idea is based on the concept of the hGraph but it provides additional key features, including a comparison of multiple health measurements over time. We conducted a usability evaluation of the library as a key component of an application for health and wellness monitoring. The results indicate that the data visualization library was helpful in assisting users in understanding health data and its evolution over time.
Background and Aims: The coverage of the official statistics is poor in motorcycle and moped accidents. The aim of this study was to analyze the severity of motorcycle and moped crashes, and to define the degree of under-reporting in official statistics. Material and Methods: All first attendances due to an acute motorcyclist or moped driver injury registered in the emergency department between June 2004 and May 2006 were analyzed. The severity of the injuries was classified using the Abbreviated Injury Scale score and the New Injury Severity Score. The hospital injury data were compared to the traffic accident statistics reported by the police and compiled and maintained by Statistics Finland. Results: A total of 49 motorcyclists and 61 moped drivers were involved in crashes, leading to a total of 94 and 109 injuries, respectively. There were slightly more vertebral and midfoot fractures among motorcyclists than among moped drivers (p = 0.038 and 0.016, respectively). No significant differences were found between the severity (maximum Abbreviated Injury Scale and median New Injury Severity Scores) of the motorcycle and moped crashes. There was no in-hospital mortality. The degree of agreement (overlap) between the hospital dataset and the official statistics was 32%. The rate of under-reporting was 68%. Conclusions: According to the maximum Abbreviated Injury Scale and New Injury Severity Scores, the injury severity was equal for motorcycle and moped crashes. The degree of agreement between the hospital dataset and the official statistics was 32%.
Implementation and User Testing of a System for Visualizing Continuous Health Data and Events
Efficient ways are needed to visualize the health status of a person and how the lifestyle, daily choices and health care actions are affecting it. Current systems lack a comprehensive interface for interaction and exploration of large and complex data and events affecting the data. Based on state-of-the-art data visualization techniques, we implemented and user tested a system that visualizes health data holistically over time. The system focuses on the dynamic changes by using a timeline of events affecting the overall health status. We conducted an extensive user testing process involving surveys, heuristics and observations in order to evaluate our system. The results show that our system has a high level of User Satisfaction while providing an adequate understanding, interaction and navigation of the data.

General information
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Organisations: Department of Signal Processing, Research group: Personal Health Informatics-PHI
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Research output: Scientific - peer-review › Conference contribution

Feature-based analysis of mouse prostatic intraepithelial neoplasia in histological tissue sections
Prostatic intraepithelial neoplasia (PIN) represents premalignant tissue involving epithelial growth confined in the lumen of prostatic acini. In the attempts to understand oncogenesis in the human prostate, early neoplastic changes can be modeled in the mouse with genetic manipulation of certain tumor suppressor genes or oncogenes. As with many early pathological changes, the PIN lesions in the mouse prostate are macroscopically small, but microscopically spanning areas often larger than single high magnification focus fields in microscopy. This poses a challenge to utilize full potential of the data acquired in histological specimens. We use whole prostates fixed in molecular fixative PAXgene™, embedded in paraffin, sectioned through and stained with H&E. To visualize and analyze the microscopic information spanning whole mouse PIN (mPIN) lesions, we utilize automated whole slide scanning and stacked sections through the tissue. The region of interests is masked, and the masked areas are processed using a cascade of automated image analysis steps. The images are normalized in color space, after which exclusion of secretion areas and feature extraction is performed. Machine learning is utilized to build a model of early PIN lesions for determining the probability for histological changes based on the calculated features. We performed a feature-based analysis to mPIN lesions. First, a quantitative representation of over 100 features was built, including several features representing pathological changes in PIN, especially describing the spatial growth pattern of lesions in the prostate tissue. Furthermore, we built a classification model, which is able to align PIN lesions corresponding to grading by visual inspection to more advanced and mild lesions. The classifier allowed both determining the probability of early histological changes for uncategorized tissue samples and interpretation of the model parameters. Here, we develop quantitative image analysis pipeline to describe morphological changes in histological images. Even subtle changes in mPIN lesion characteristics can be described with feature analysis and machine learning. Constructing and using multidimensional feature data to represent histological changes enables richer analysis and interpretation of early pathological lesions.

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Organisations: Pori Department, Research group: Data-analytics and Optimization, Research group: Computational Systems Biology, BioMediTech, BioMediTech, University of Tampere
Authors: Ruusuvuori, P., Valkonen, M., Nykter, M., Visakorpi, T., Latonen, L.
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Publication information
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Volume: 7
Levosimendan alone and in combination with valsartan prevents stroke in Dahl salt-sensitive rats

The effects of levosimendan on cerebrovascular lesions and mortality were investigated in models of primary and secondary stroke. We aimed to determine whether the effects of levosimendan are comparable to and/or cumulative with those of valsartan, and to investigate whether levosimendan-induced vasodilation has a role in its effects on stroke. In a primary stroke Dahl/Rapp rat model, mortality rates were 70% and 5% for vehicle and levosimendan, respectively. Both stroke incidence (85% vs. 10%, P<0.001) and stroke-associated behavioral deficits (7-point neuroscore: 4.59 vs. 5.96, P<0.001) were worse for vehicle compared to levosimendan. In a secondary stroke model in which levosimendan treatment was started after cerebrovascular incidences were already detected, mean survival times were 15 days with vehicle, 20 days with levosimendan (P=0.025, vs. vehicle), 22 days with valsartan (P=0.001, vs. vehicle), and 31 days with levosimendan plus valsartan (P<0.001, vs. vehicle). The respective survivals were 0%, 16%, 20% and 59%, and the respective incidences of severe lesions were 50%, 67%, 50% and 11%. In this rat model, levosimendan increased blood volume of the cerebral vessels, with significant effects in the microvessels of the cortex (∆R=3.5±0.15 vs. 2.7±0.17ml for vehicle; P=0.001) and hemisphere (∆R=3.2±0.23 vs. 2.6±0.14ml for vehicle; P=0.018). Overall, levosimendan significantly reduced stroke-induced mortality and morbidity, both alone and with valsartan, with apparent cumulative effects, an activity in which the vasodilatory effects of levosimendan have a role.