

Measuring Behavior 2016

10th International Conference on Methods and Techniques in Behavioral Research
25-27 May 2016, Dublin, Ireland

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Proceedings



Linked Data Sharing to Foster Consumer Based Science Enabled by Richfields: A Research Infrastructure on Consumer Health and Food

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Abstract

There is growing interest in consumer health as related to food intake, other lifestyle behaviours and their determinants. However, data is fragmented, key information is lacking, and the resulting knowledge gap prohibits policy makers and companies to design effective public health nutrition strategies and reformulate food products. Making “the healthy choice the easy choice” requires knowledge on the context of personal lifestyle choices of citizens. To this end, technologies to measure and collect data (real-time and in situ), and methods and processes to align, link and share data on food-related behaviour and lifestyle are urgently needed to revolutionize research into the diversity of European consumers’ behaviour, covering the whole range from purchase (e.g. in-store), preparation (e.g. in the kitchen) and consumption of foods (e.g. in the dining room). This will overcome the status quo where food-related consumer behaviour and lifestyle trends are studied in isolation, in short time frames and in a relatively limited social and physical context.

The aim of this paper is to give an overview of the Horizon 2020 project RICHFIELDS, that has started last year. RICHFIELDS aims at designing a RI on consumer behaviour and food intake, with a Consumer Data Platform, that is to a large extent based on consumer-driven data collection on food behavior and lifestyle. Consumers are central to the design: they harbour crucial information, as they increasingly adopt mobile apps and sensors, get access to e-business data and even medical information. Collectively, such real time and in situ data create new opportunities for research by e.g. monitoring food-related behaviour and providing personalized feedback. The RI Consumer Data Platform will enable scientifically sound inference by connecting consumer-generated data (open, big data, web based, unstructured) with established observational and experimental data.

Introduction

The EU H2020 Programme addresses healthy diets for the ageing European population, as well as the increasing relevance of environmental and social sustainability of these diets [1]. The Strategic Research Agenda and the implementation plan of the Joint Programming Initiative Healthy Diet Healthy Life [2] prioritized determinants of diet and physical activity to align research on healthy diet (and physical activity as part of lifestyle) choices in an encouraging societal environment. Regarding dietary behaviour, social sciences have emphasized the importance of personal characteristics that interact with the social environment at specific times and places. In this respect, a sound scientific evidence-base on consumer behaviour and lifestyle is crucial for research, governments and industries to adequately respond to the urgent health and sustainability challenges in the health and food domain.

Food-related consumer behaviour and lifestyle trends are studied in isolation, in short time frames and in a relatively limited social and physical context. Current data collection methods are expensive and show only certain aspects of behaviour (e.g. food purchase or intake) as they are typically based on interviews or recordings in surveys that sample sub-populations. These datasets are not sufficient to understand food intake;

not for companies to develop products for personal nutrition nor for governments for policy evaluation. Without more integrated data it will be difficult to make the healthy choice the easy choice.

To fill these gaps and advance food- and health related consumer research, which is relevant to the daily life of the majority of apparently healthy EU-citizens, new technologies to collect, align and share (real-time) data on food-related behaviour and lifestyle are urgently needed to revolutionize research into the diversity of European consumer behaviour, covering the whole range from purchase (e.g. in-store), preparation (e.g. in the kitchen) and consumption of foods (e.g. in the dining room). Consumer driven, big data and new tools to measure food intake are important drivers to bring consumer insights to a next level.

The FP7 EuroDISH project (Grant no311788, www.eurodish.eu, [3]) has identified the need for research infrastructures (RIs) in the food and health domain that can advance research *within, among and over-arching* the so-called ‘DISH’ research domains: Determinants of dietary behaviour, Intake of foods and nutrients, Status and function of the body, and Health and disease prevention. The EuroDISH project’s initial findings confirm the current disparate and fragmented health and food RI. Advanced RIs have been identified as useful to help facilitate health and food research (e.g., BBMRI-ERIC, CESSDA, EATRIS, ECRIN-ERIC, ELIXIR, EBI, ESS, MetaboHUB and SHARE-ERIC). However, none of these RIs can be considered health and food specific. Those “potential” or “developing” RIs identified that are health and food specific predominantly reside within one of the DISH model defined research areas “Intake”, “Status” or “Health” as for the research area “Determinants” RIs are lacking [4]. Therefore the new H2020 project RICHFIELDS (Grant no 654280, [5]) aims to design a RI Consumer Data Platform with the focus on Food and Health Consumer Behaviour and Lifestyle. Based on all the data collected, the new RI will make it possible to create new knowledge in the ‘DISH-domains’ of Determinants and Intake, with close connections to the domains of Status and Health. In this way, the new RI will fill the present gap in the food and health domain and simultaneously connect consumer behaviour in the domains of Determinant and Intake to the largely disconnected research on Intake, Status and Health outcomes [3]. The RICHFIELDS project is a 3 million euro project that will last for three years (2015 -2018) and has 16 European partners.

Aim

The aim of the RICHFIELDS project is to design a RI Consumer Data Platform which serves as an open access, distributed data-platform to collate and connect, and align and share innovative and existing data in order to enable researchers, policymakers and other stakeholders to develop, evaluate and implement effective food and health strategies both at the level of individuals and populations. The design of the RI Consumer Data Platform will function as a data platform that harbours a growing and flexible scientific evidence base for food and health behaviour and lifestyle of European Citizens considering state-of-the-art information and communication technologies for collecting big and open data created by consumers and researchers. It will integrate a large diversity of data that describes the interactions of time, place and individuals’ behaviour, generated by machines, such as sensors gathering information, digital pictures and videos, purchase transaction records, GPS signals, etc. RICHFIELDS will design models to describe the provenance of data and explore mechanisms (like triple-level security, digital signatures etc.) to provide the security, the origin and the ownership of linked data.

Approach

The RI Consumer Data Platform will be achieved by integrating food and nutrient related data generated either for research purposes or for purposes other than research (e.g. commerce); either directly provided by consumers (e.g. uploading invoices, medical data) or indirectly by technology (e.g. apps, sensors) or information systems/processes (e.g. medical data, sales data, surveillance data). The combination of the dimensions of time (e.g. real-time, longitudinal data) and place (e.g., GPS, in situ data) will enable detailed description of the context and environments in which the behaviour is taking place, with a focus on three domains: purchase, preparation and consumption. The RI Consumer Data Platform will enable scientifically sound inference by connecting data and methods from consumer-generated data with established observational (epidemiology,

surveillance, purchase) and experimental data (experimental kitchen, buffet, restaurant). The interaction with new technologies in combination with big data will bring food and health research and dietary surveillance to the next level. The RI Consumer Data Platform will be a network of data resources and services, distributed laboratories and experimental facilities, of participating legally autonomous organisations that will be working together. That sets all kind of requirements and preferences with regard to the ICT, business model, governance, legal and ethics issues.

The design of the RI Consumer Data Platform and its interfaces will address both functionality of food-related consumer behaviour and lifestyle as such as well as its viability and sustainability.

- At the data-level of the RI, the design will (1) provide the architecture based on 4 building blocks: data quality and assessment, meta data, standardization and linking) for a “big food related data” level, a platform of exchangeable consumer- and research-generated data that enables to extract and combine information on food-related consumer behaviour, and (2) develop and maintain standards for high quality data collection, either directly from consumers or indirectly by enrichment with existing available and unlocking new data sources.
- At the level of the viability and sustainability of the RI, the design will account for (1) flexible technical architecture to link individual and experimental data; (2) governance and ethical issues to support supply and use of data both in the development and maintenance phase; (3) a business model to underpin the feasibility of the RI (a service to stakeholders at government, SME & industry, research institutes, but also to consumers to manage their food and health data).

Gaps and needs

Within DISH (Determinants, Intake, Status and Health) areas, the research facilities, resources and services related to the *Determinants* area appear to be the most fragmented perhaps due to the less defined boundaries of discipline, paradigm, data source and methods of study [4]. Therefore, the RICHFIELDS project will be a step on the way to explore the sustainability and practicality of designing the RI Consumer Data Platform to specifically aid the study of the link between determinants and intake of diet-related lifestyle behaviours [6]. This includes exploring the collection of new data, re-using/collecting secondary data and investigating how determinants of diet-related lifestyle behaviour can be integrated into or extracted from existing health and food RIs. Research challenges and problems are listed in table 1 as well as possible contributions of the RICHFIELDS project. Corresponding requirements and preferences towards the design of the RI Consumer Data Platform are formulated.

Table 1: Contributions of RICHFIELDS

Research challenges and needs	How RICHFIELDS project goes beyond the challenges and needs	Requirements & preferences for the design of the RI Consumer Data Platform
None of existing RIs can be considered food and health specific. There is a need for RIs in the food and health domain that advance research within, among and over-arching the DISH research domains. Current RIs on food-related consumer behaviour and lifestyle are adjudged to be in their infancy.	Greater co-ordination and support of food and health research. Using the enormous potential to create a RI to stimulate high-quality food and health research. Strengthen analytical capacity on food-related consumer behaviour and lifestyle.	The RI Consumer Data Platform serves as a data-platform, fills the present gap in the food and health domain, and connects consumer behaviour in the D-I domain to the largely disconnected research on I, S and H-outcomes.
The scientific community needs an advanced RI, relevant to the daily life of the majority of apparently healthy EU-citizens, industry and the scientific community needs.	An advanced RI that stimulates the development of unique services of added value to connect real- time in-situ data of the consumer to data of other RI's and experimental facilities.	Development of unique services for collecting, aligning and sharing innovative data types. Connections between consumer data with business and research generated consumer data.
Sound scientific evidence-based information on food-related consumer behaviour and lifestyle is crucial for research, governments and industries.	A RI that serves as a data-platform which performs the functions of a RI for researchers, industry and policymakers. The emerging knowledge will be accessible for public and private stakeholders.	Aspects as ICT solutions regarding data collection, big data storage, data standardisation (e.g., operating procedures, technical language and/or reporting of research/meta-data) and/or harmonisation (e.g., between MS) and data sharing, privacy, governance (e.g., management structure), sustainable funding, ethical/legal procedures), accessibility (e.g., to data, methodology, knowledge/expertise) and other relevant issues will be analysed and discussed.
Technologies to collect, align and share data on food-related behaviour and lifestyle are urgently needed. The current food and health research infrastructure is disparate and fragmented.	An architecture for a big data solution. The design will account for a flexible technical architecture.	The RI Consumer Data Platform will be designed by exploring concepts and tools for creating a semantic data model for linked (virtually integrated) structured, semi-structured, unstructured, big and open data, based on existing (standard) ontologies and incorporating aspects of research and business generated data as data provenance Cloud-based solution.
The status quo is that food-related consumer behaviour and lifestyle trends are studied in isolation, in short time frames and in a relatively limited social and physical context.	The RI will integrate a large diversity of data describing individual behaviour.	Integrating food and nutrient related data generated either directly by consumers e.g. apps or indirectly by technology (e.g., sensors) or information systems/processes (e.g. medical data, sales data, surveillance data).

Future perspective

Food and health are important issues for consumers (including patients). Developments in ICT (e.g., smart phones and cloud technology) help consumers to be more informed and manage their quality-of-life. These factors lead to more demand for science-based dietary advice. This trend will grow with more product reformulations (thanks to new options in plant production and food technology), more knowledge about the human body and brain (thanks to genetics, neuro-science etc.), and greater insights into the association between determinants and intake in relationship to food and health. The future perspective is to exploit this development by engaging with consumers and giving them an option to make data available to science, e.g. push the “blue button” or tie a “RICHFIELDS”-box in an app). Current data collection methods are expensive and show only certain aspects of behaviour (e.g. food purchases or intake) as they are typically based on interviews or recordings in surveys that sample sub-populations. These datasets are not sufficient to understand consumer behaviour; not for companies to develop products for personal nutrition nor for governments for policy evaluation. Without better data linkage it will be difficult to make the healthy choice the easy choice. Understanding of food-related consumer behaviour is crucial for preventive and health-promoting measures. The consumer-generated data (apps and sensors) provide the basis for development and evaluation of relevant behavioural feedback to consumers. Here, approaches jointly addressing the individual (health status, or from behaviourally or medically defined risk group) and his/her daily context (work, home, health, social, etc.) interact at the level of food purchase, preparation and consumption in the (super)market, the kitchen and during in/out of home consumption occasions. By giving consumers a platform through which they can manage their food and health data (of which they are increasingly the owner) RI Consumer Data Platform will make available data for researchers interested in studying food and health-related consumer behaviour. This data can be analysed using big data techniques [7] and be enriched through links with (open) datasets (The EU Open Data Portal <https://open-data.europa.eu/>). ICT technology can be applied that recognizes consumers as their own rich data source and create a possibility to manage it first of all for their own benefit but also to engage in (trans-disciplinary) science. Researchers using the RI Consumer Data Platform can as well use the data (subject to consumer consent), and can also ask the ‘connected’ consumers to test e.g., new ICT-apps for data collection. In addition, links will be created with experimental settings in kitchens, supermarkets and restaurants. This will focus particularly on the data and information management in such settings and the role of instant feedback from dietary and lifestyle advice on consumer behaviour.

Impact

Consumers share their individual data with the RI Consumer Data Platform on a voluntary basis although the EU Commission is currently reviewing its current legal framework on protection of personal data. The objectives behind this are to meet the challenges resulting from the use of new technologies and improve clarity and coherence of the EU rules for protection of personal data. Overlooking the privacy concerns, consumers’ individual data create evidence-based and on-the-spot feedback loops on behaviour regarding purchasing, preparation and consumption. Also, data on the situation and consumption moment, location/GPS information, can be linked and becomes available on an individual level. The consumer will benefit from the platform by receiving individualized feedback on his provided data. Thus the RI Consumer Data Platform can contribute, in a scientifically and evidence based way, to trans-national and cross cultural consumer insights and feedback systems to represent food-related consumer behaviour and lifestyle more accurately in Europe.

Furthermore, the RI Consumer Data Platform will: (a) enable the research community to advance and innovate high quality and impactful research by means of a RI, and thereby, (b) enable the European research community to study food and health consumer behaviour and lifestyle in relation to purchase, preparation and consumption, both in real life, and in (semi-)controlled research settings and therefore support policy makers in private and public environments. In conclusion, the RICHFIELDS project aims to design a RI Consumer Data Platform for consumer behaviour and lifestyle, which performs the functions of RI for consumers, researchers, industry and policy makers in the domain of food and health.

Acknowledgements

The present paper is one of the results of the RICHFIELDS project Grant Agreement no 654280.

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