Chartered Institute of Ergonomics & Human Factors

Designing an information, communication and entertainment interface for SMART retirement living

Garth Ledingham[1], Ella Cotterill[2] & Huseyin Hogan[3]

[1, 2, 3] Bournemouth University, UK

ABSTRACT

COVID-19 has left society and adults over the age of 65 needing to redefine daily life, to overcome deteriorating physical and mental wellbeing. Social distancing requirements in retirement communities have left residents feeling alienated, which has accelerated the need to acquire more unfamiliar technology in order to resume as near a normal life as possible. Two retirement community studies in Florida USA and Scotland UK, were undertaken to determine if an information, communication and entertainment technology interface could overcome accessibility and parsimonious factors to become a viable precursor to next generation SMART retirement living. Thirty-six respondents in an online survey indicated notable SMART phone, laptop and tablet use; however perceived usefulness of social media and video telephony varied. These would all be key elements of any digital retirement community. Semi-structured interviews illustrated increased narrow technology use of heterogeneous online services but posed ergonomic and pedagogical questions. A purpose-built low fidelity prototype was proposed and tested using a Cognitive Walk Through and Concurrent Think Aloud. It may have indicated an attractive solution, but concerns around residents' privacy, security and the perceived freedom of choice would need further exploration. User experience (UX) designers and retirement operators will need to consider these influencing factors within future studies if they are to create a SMART living interface which builds self-efficacy and strengthens social connectedness over time.

KEYWORDS

SMART Retirement Living, Infrastructure and Cities, User Experience

Introduction

On and offline convergence of a retirement eco-system

Retirement communities in the United States, established over 90 years ago, attract residents based on perceived safety, security and connectedness (Roy et al 2018). These living constructs in the UK are less than 20 years old but are expected to grow, with 135,000 dedicated retirement homes expected to be developed in the next four years (Scaife 2018). Residents' quality of life was traditionally based on a physical connected living construct, but due to COVID-19 this operator model may be lacking, leading residents to seek a proxy digital eco-system. This may encourage community operators to evolve and commoditise their architecture and services, thereby assuring social connectedness and on demand digital living. A rapid prototyping approach using the cost benefit of a web-based Information, Communication, and Entertainment Technology interface could provide a sandbox to review residents' user trends. However, this proposition may need to address

the following: (i) retirement community organisations have built their operating models on physical connectedness and dedicated service amenities and may not yet have adapted (ii) information, communication and entertainment multimedia for retirement community residents may reflect heterogenous digital services based on a common user persona, which ignores the particular needs of residents and their acceptance model for quality of life.

The authors structured their study to create an artefact that integrated the requirements of retirement residents based in the UK and US. The study had three aims:

1. To develop a set of user requirements for an integrated Information, Communication and Entertainment Technology interface to improve quality of life.
2. To produce an integrated Information, Communication and Entertainment Technology interface prototype that effectively incorporated key user requirements to achieve self-efficacy.
3. To identify interface design gaps and further lines of inquiry, which may enable the further development of an integrated Information, Communication and Entertainment interface in retirement communities in the future.

SMART Retirement Living

SMART retirement living remains an experimental construct based on limited health care research (Sharma et al 2016). With residents aged between 55 to 90 years, careful consideration may be required to avoid broad and unhelpful assumptions when reviewing requirements for a SMART Information, Communication, Entertainment and Technology interface (ICET). Technology parameters around usability, security and privacy may be based on past experiences, current self-efficacy and internal locus of control to succeed (Zheng 2013).

Digital Exclusion: Learning

Digital exclusion is a key consideration for user experience (UX) designers; barriers may include cost and training. Relatable training may become part of the resident's acceptance model with support from digitally adept residents or acceptable faces in order to avoid intimidation. Basic steps to build relatable learning may cover: communicating, handling information, transacting, problem solving, and being safe and legal online (Davidson 2018). The layout of a controllable SMART Living interface may also enable easier browsing and support elaborative content based on prominence. Structuring thought process and decisions to achieve task outcomes may be supported by offering a limited number of sub structured hierarchies if information scent can be retained to achieve overall task completion (Koretsky 2018). Intuitive design may consider the ergonomic design of content layout on a tablet or smartphone where users tap or swipe for information. This may be challenging depending on how it is held, or if the user has a motor control impairment (Vaportzis et al 2018). UX designers may need to consider Fitt's law (Mockler 2014) where the size of icons on which to tap on may seem closer than icons that are smaller, this can encourage longer periods of daily use with an interface.

SMART Devices and Internet Use

Ofcom (2018) data indicates that SMART phones, computers and tablets are used by the retirement resident profile, but SMART phone use decline in those aged 65-75. This could be due to age-related deterioration in vision, mobility or cognitive capability (Bray et al 2020). Computer and tablet use also dropped for those aged 65-74, which may also indicate unknown influences around digital exclusion (Age UK 2020). Rohwedder and Willis's (2010) research infers that US retirees may demonstrate greater mental acuity later in life than UK retirees since they typically stay in employment longer, this may lead to greater subjective technical confidence.

Self-efficacy is the belief in one's ability to successfully adopt unfamiliar technology (Akhatar et al 2012). Perceived ease of use describes the extent to which a user may believe a technology could improve their task performance in the context of their living (Davis 1989). The Unified Theory of Acceptance and Use of Technology (UTAUT and UTAUT2) posited by Venkatesh et al (2011) adds individual and environmental influences on use to this acceptance model but may be over-simplified by reasoned behaviour. Research on information, communication and entertaiment technology use for those over 75 years appears to be limited, and between 70-75 use noticeably narrows (Age UK 2020).

SMART Retirement Communities

Ongoing support for residents may be based on a tiered level of physical rather than digital support (Weisman 1999):

- Independent living- residents have their own property and access to a wide variety of dedicated services;
- Assisted living where residents have more support for daily tasks such as washing; or
- 24 hour dedicated nursing home care.

Privacy concerns, and lack of understanding of the digital providers' terms and conditions can prevent residents embracing digital retirement communities (Norval et al 2014). The information causing this reluctance may only have come from family, friends and the media. These security and privacy fears can be overcome if residents understand the benefits of technology to their quality of living and ability to live independently.

SMART Eco-Systems precursors to SMART Cities: Multimedia & digital service content

Privacy concerns may reduce the longer a service provider can retain a user within its dynamic interconnected network (Coelho and Duarte 2016). This network model may pose ethical challenges if the artificial intelligence (AI) used to enable the experience leads to perceived misuse. An Ofcom (2018) study reported 45% of those aged 75+ were likely to feel confident in managing access to their personal data online compared to 80% of those aged 16 to 24. Eco-systems can be perceived as precursors to intelligent city infrastructure but may be owned by concerning monopolies or have start-ups plugged in with weaker security protocols. Studies of the elderly's use of online digital eco-systems were not prominent within the literary research available and lacked longitudinal merit; this can be down to acceptance or being known by a broader spectrum of elderly users. SMART cities can exemplify a wide, cooperative ecosystem between private and public infrastructure that transforms retirement communities into digitally gated social communities. These may gather big data from existing eco-systems and use behavioural modelling based on telemetry in SMART wearables or other health products (Cugurullo 2018).

Method

The authors used a mixed methods design with three phases: an online survey, a semi-structured interview, and a purpose-built low fidelity prototype, proposed and tested using a Cognitive Walk Through and Concurrent Think Aloud. These human centred design methods were used due to the conceptual phase of the prototype and the limitations of testing the study group remotely; their narrow use would not afford more attentional or highly formalised methods such as NASA TLX or the System Usability Scale (Whittington et al 2015). 36 participants were surveyed, 16 in the US and 20 in the UK. Their ages ranged between 55 to 80 (a standard deviation of 5.48) and mean age was 71.25. 10 of these participants then took part in the interview stage. Their ages ranged between 66-78 (a standard deviation of 3.63) and mean age was 71.8. The participants for the Concurrent Think Aloud included 7 from the previous study and 3 new participants. Their age range was 63-74 (a standard deviation of 4.4) and mean age was 70.4. The Cognitive Walkthrough was conducted by two researchers who have a background in Human Factors.

Results

Survey findings identified several trends which could inform how a community could be extended digitally. Laptop, SMART phone and then tablets were most used by respondents, with less confidence in using desktop computers and virtual assistants. US participants indicated a higher level of confidence overall in using technology compared to their UK counterparts; this was indicated by greater ownership of technology products. UK participants also indicated higher levels of frustration when using technology. Correlations indicated that frustrations could be reduced by increasing the number of internet activities undertaken by respondents. However, the results indicated that such technical confidence reduced with age. The top video communications platforms for participants were Apple, FaceTime and WhatsApp video chat. The top social media sites were slightly different, WhatsApp then Facebook. US respondents also showed a greater preference for Pinterest and Instagram compared to UK participants.

US respondents further indicated their technical confidence by more varied internet use, including social media, banking, researching deals, and booking travel. The UK had slightly more respondents indicating narrower use, mainly emailing and buying goods. For entertainment preferences Netflix was the most trusted brand, then Amazon, Apple and Google. All known eco-systems indicated they were incidentally already part of the user's technology acceptance model. Secure and encrypted payment options, HTTPS padlock, and automatic sign out of websites were the most popular features when deciding to trust a website. US respondents indicated a preference more for automatic sign out features, customer service help and user testimonials based on a typical consumer experience model as opposed to UK participants who preferred the characteristics such as https padlock, encrypted payment options for shopping and layout.

Survey results helped to elicit a CATWOE pneumonic Soft Systems framework (table 1) to define the complex problem space for an ICET, enabling the authors to further understand constraints between the different influencing factors (Bergvall-Kåreborn 2004). This may also be useful for stakeholders testing assumptions and assertions related to this problem space.Table 1: CATWOE

Customer	Resident of Private Retirement Community
Actor	Private Retirement Community operator/concierge/carer/AI
Transformation	Enable residents to experience a similar quality of life online as they experience offline in a private retirement community
Worldview	COVID-19 is leading to social isolation curtailing their ability to maintain independent living
Owner	Private Retirement Community operators
Environment	Responsible for own daily tasks and technology unless they seek assisted support

for an ICET interface

Research from the literature review and survey is summarised in the Rich Picture in figure 1 below. It illustrates the proposed information, communication, entertainment and technology interface and maps the pedagogical and ergonomic needs of the user to immediate and evolving technological and digital resources which retirement operators or public services may want to consider.

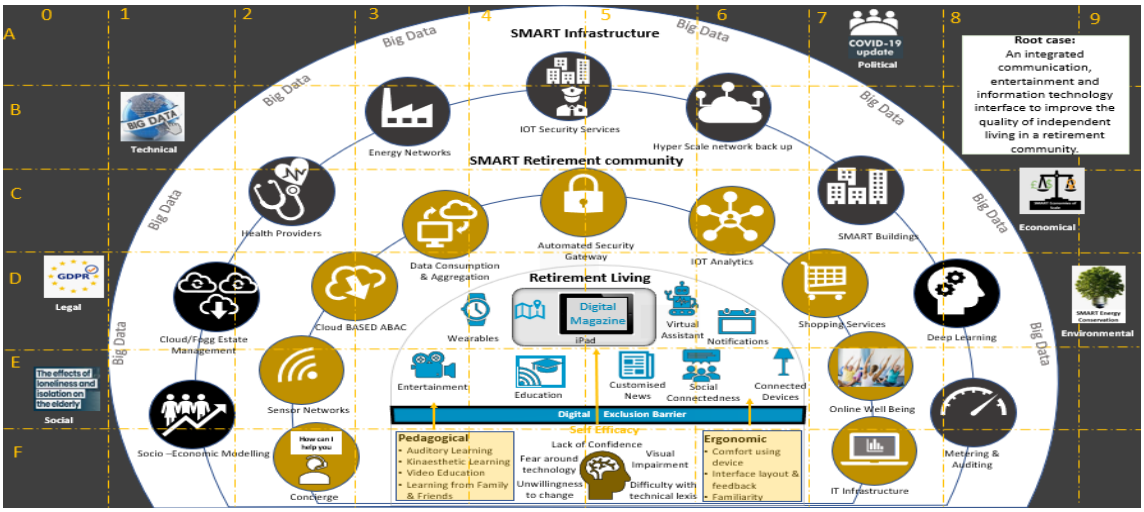

Figure 1: Rich Picture of SMART Retirement Living, Community and Infrastructure themes.

To further align the literary and survey theme findings indicated in figure 1, an empathy map was created in figure 2 to understand and narrow the interview findings into core usability requirements for the interface. Personas were created to further illuminate typical daily routines and *ideal technology experiences of users*. The themes and comments attained from the semi-structured interview transcripts helped the researchers to understand the problem space and users' anxieties around technology. The empathy map quadrant labelled **says** showed participants' verbal comments (Gibbons 2018). The **think** quadrant captured what recurring thoughts, including concerns, were shared by the respondents (ibid). The **does** quadrant identified activities or actions related to their daily routine when using technology (ibid). The **feels** quadrant indicated the resident's emotional state related to perceived usefulness of technology and concerns (ibid).

Figure 2. Empathy Map aggregating insights and comments from semi structured interviews.

The synthesis of qualitative information, including who influences their use, may assist when considering the prototype's possible functions and types of content. The MoSCoW technique, a dynamic software development method, was used to narrow the key technical and usability requirements, to create a minimum viable proposition (Hatton 2007). To rationalise requirements they were assigned certain categories from *Must Have*; essential to the minimum proposition,

Should Have; a high prioritisation but not absolutely critical, *Could Have*; that could be desirable but not essential to *Won't Have*; but may be considered as a later iteration (Tudor and Walter 2006).

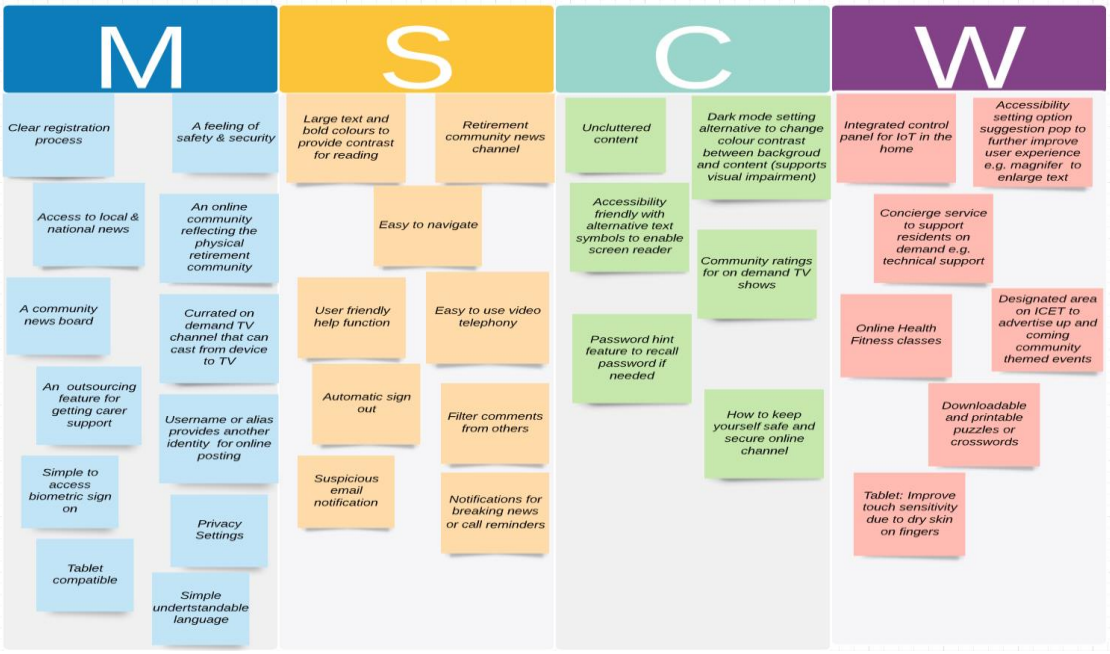

Figure 3: MoSCoW requirements elicited from the research.

Respondent themes clustered around the anxiety of coming up with passwords and then having to remember them as they attempted to acquire further digital solutions to stay connected with family and friends due to COVID-19 induced social isolation. Many had created simple workarounds to help them recall their passwords as indicated by the MoSCoW requirements preferred biometric sign on. Respondents were clearly attempting to redefine their quality of living through digital measures not afforded to them by their community operators. This included: attempting to set up online book clubs, increasing their online shopping, sharing COVID jokes, passively reviewing social media and watching online TV streaming sites. In recreating a familiar but digitally based quality of life, navigation of new sites posed a digital barrier for some based on how cluttered their content was, font size, colour of background or position of buttons. The latter annoyed users when accidentally pressing on them and subscribing to paid services such as Amazon Prime.

Table 2: Summary scores from Likert scale of 1 to 4 from Concurrent Think Aloud summary rating

Participants	Perceived Usefulness	Perceived Ease of Use	Attractiveness	Overall Score
Overall Mean: 10	3	2.9	2.95	2.95
Overall Mean: 10	3	2.9	2.95	2.95

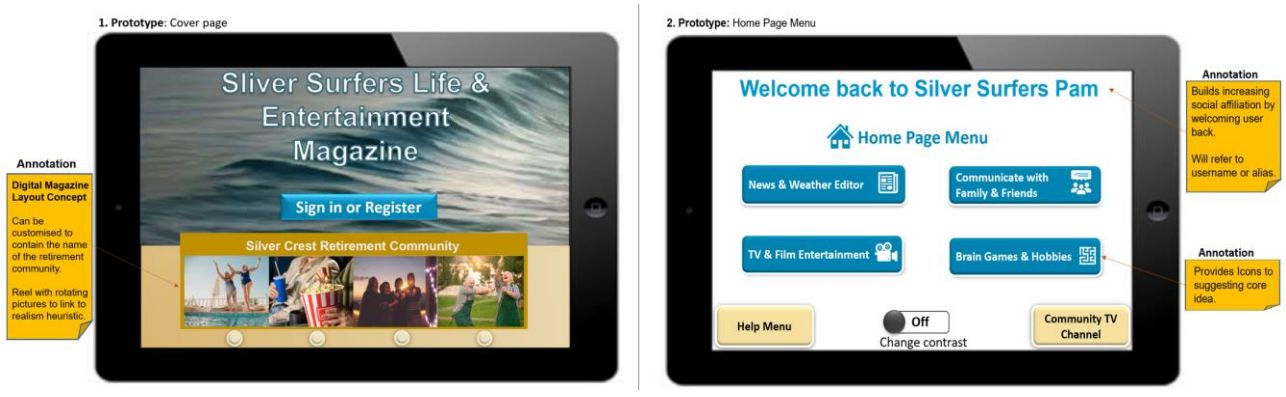

Figure 4. Illustrating the finalised low fidelity prototype landing page and home page menu

Table 3. Justifying changes of the Prototype based on Concurrent Think Aloud Feedback.

Change recommended	Justification	Severity
A. Clarify password strength requirements	Users wanted assurance of online security when adopting new technology. Their narrow use demanded guidance and assurance to achieve a password strength of at least 8 characters (NIST 2020).	High
B. Use universal language in Security Settings	Users needed simple jargon free language. Inserting recognisable icons could improve universal understanding.	High
C. Landing page required multi-media to encourage continued use	The landing page could utilise multi-media to create recognition and realism heuristics which provide a familiar or aspirational cue to suggest how social connectedness can also be supported online.	Medium to High
D. Help section offering a phone support	Participants reported lapsing use of new technology unless they could speak to technical support.	Medium to High

Conclusion

Ergonomic and pedagogical considerations: Respondent satisfaction varies around ergonomics and pedagogy, but the survey results and interviews indicated that UK respondents over US respondents preferred to use older, familiar devices for tasks online. Those aged 75+ showed anxiety with learning technology. Having in the moment, re-assuring, summarised, non-patronising feedback may help to extend use. The research may suggest that daily routines form passively around technology, providing confidence and purpose. UX designers and content providers could consider the delicate balance around this interaction to avoid upsetting residents with technical jargon and button layout. Software engineers may need to consider the arising risk aversion themes associated with cybersecurity and data privacy as part of overall interface prototype design. Leasing ICET devices as part of the retirement operator's service model may help residents to accept the cost and enjoy greater online community affinity.

Limitations: The online survey used snowball sampling which reinforced a homogeneous resident sample; a stratified sample may have attempted to find greater diversification (Biernacki 1981).

Impact: Future research for an integrated ICET interface may need to consider community participants between a 50- and 90-year age range, which can moderate the relationship between technical performance and acceptance. The requirements elicited and prototype design need to be further validated by ongoing research but may provide a frame of reference when walking through in detail user features that afford perceived ease of use over heterogeneous digital service providers.

References

Age UK. (2020). Not Like Riding A Bike: Why Some Elderly Stop Using the Internet. [online].

Akhtar, S., Ghayas, S., & Adnan, A. (2012). Self-efficacy & optimism as predictors of organizational commitment among bank employees. *International Journal of Research Studies in Psychology.*

Bergvall-Kåreborn, B., Mirijamdotter, A., & Basden, A. (2004). Basic Principles of SSM Modeling: An Examination of CATWOE from a Soft Perspective. *Systemic Practice & Action Research.*

Biernacki, P., & Waldorf, D. (1981). Snowball Sampling: Problems and Techniques of Chain Referral Sampling. Sociological Methods & Research.

Bray, N., Spencer, L.H., Tuersley, L. & Edwards, R.T. (2020). Development of the MobQoL patient reported outcome measure for mobility-related quality of life, Disability & Rehabilitation.

Coelho, J., & Duarte, C. (2016). A literature survey on older adults' use of social network services and social applications, Computers in Human Behavior. [online], 58, 187-20.

Cugurullo, F. (2018). Exposing smart cities & eco-cities: Frankenstein urbanism and sustainability challenges of the experimental city. Environment & Planning A: Economy & Space.

Davidson, S. (2018). Digital Inclusion Evidence Review. *AGE UK* [online]

Davis, F.D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly* [online]. doi:10.2307/249008

Gibbons, S. (2018). Empathy Mapping: The first Step in Design Thinking. *Nielsen Norman Group* [online], https://www.nngroup.com/articles/empathy-mapping/.

Hatton, S. (2007). Early Prioritisation of Goals. In: Hainaut JL. et al. Advances in Conceptual Modelling: Foundation & Applications. *Computer Science*, Springer Berlin.

Koretsky, M., Keeler, J., Ivanovitch, J., & Cao, Y. (2018). The role of pedagogical tools in active learning: a case for sense-making. International Journal of STEM Education.

Mockler, J. (2014). UX suite: touch sensor evaluation platform. In: Processing of the 16th International conference in Human Computer Interaction with mobile devices and services (MobileHCI'14). Association for Computing Machinery, NY, USA.

NIST. (2020). Digital Identify Guidelines Authentication and Lifecycle Management [online]

Norval, C., Arnot, A. L., & Hanson. (2014). What's on your mind? Investigating recommendations for inclusive social networking & older adults. In: proceedings of SIGCHI conference on Human Factors in Computing Systems (CHI '14). Assoc. Computing Machinery, NY. USA.

Ofcom. (2018). Adults' Media Use and Attitudes Report [online] https://www.ofcom.org.uk

Rohwedder, S. and Willis, R.J., 2010. Mental Retirement. *Journal of Economic Perspectives.*

Roy, N., Dube', R., Després,, C., Freitas, A., & Légaré, F. (2018). Choosing between staying at home or moving: A systematic review of factors influencing housing decisions among frail older adults. *PLoS One.*

Scaife, T. (2018). The case for Retirement Housing. *Housing Insight Series 2018* Frank Knight

Sharma, R., Nah, F.F.-H., Sharma, K., Katta, T.S., Pang, N., Yong, A. (2016). Smart Living for Elderly: Design and Human-Computer Interaction Considerations, in: *Information Security and Privacy. Information Security and Privacy.*

Tudor, D. & Walter, G. A. (2006). Using an agile approach in a large, traditional organisation. *Proceedings of AGILE 2006 Conference AGILE'06.*

Vaportzis, E., Giatsi Clausen, M., & Gow, A. J. (2018). Older Adults Experiences of Learning to Use Tablet Computers: A Mixed Methods Study. *Frontiers in psychology*.

Venkatesh, V., Thong, J.Y.L., Chan, F.K.Y., Hu, P.J.-H., & Brown, S.A.. (2011). Extending the two-stage information systems continuance model: incorporating UTAUT predictors and the role of context. *Information Systems Journal*.

Zheng, R.Z. (2013). Effective Online Learning for Older People. *IGI Global* [online].

Weisman, M-L. (1999). This History of Retirement, From Early Man to A.A.RP. *New York Times*

Whittington, P., Dogan, H. and Phalp, K., 2015. Evaluating the usability of an Automated Transport and Retrieval System. In: International Conference on Pervasive and Embedded Computing and Communication Systems (PECCS) 11-13 February 2015 Angers, France.