

meSch - material encounters with digital cultural heritage: Reusing existing digital resources in the creation of novel forms of visitor's experiences

Daniela Petrelli¹, Monika Lechner²

¹Art and Design Research Centre, Sheffield Hallam University;
Cantor Building, 153 Arundel Street, Sheffield, S1 2NU, UK

d.petrelli@shu.ac.uk

²DEN Dutch Digital Heritage Foundation
Prins Willem-Alexanderhof 5, 2595 BE Den Haag, The Netherlands

monika.lechner@den.nl

KEYWORDS: *Internet of Things, smart objects, tangible interaction, bridging the gap between digital and physical, co-design, post-digital, interaction design, reuse, contextualisation.*

ABSTRACT

A wealth of digital cultural heritage content is currently available in online repositories, portals or on museum servers. It is however accessed only in a limited way and utilised through rather static modes of delivery, missing the connection and interaction with the real objects and physical artefacts in the museum or heritage site. What is more, digital artefacts lack materiality, authenticity and "aura", which is crucial to the appreciation of cultural heritage.

The meSch project - Material EncounterS with digital Cultural Heritage - has the goal of bridging the gap between the cultural heritage experience on-site and online. meSch will enable cultural heritage professionals to create tangible smart exhibits, enriched by digital content, without the need for specialised technical knowledge. To achieve this goal a set of physical hardware and software components is being developed: the meSch platform. It consists of an authoring tool for the composition of physical/digital narratives that can be mapped to the interactive artefacts, and an embedded multi-sensor digital system platform for the construction of ad-hoc physical smart exhibits. The meSch approach is grounded on principles of co-design and on a Do-It-Yourself philosophy of making and experimentation. Co-design involves broad participation of designers, developers and cultural heritage stakeholders in the development and design process. Hands-on design and maker workshops are held throughout the project to shape the development of the meSch tools. The ultimate goal of the project is to support the creation of an open community of cultural heritage professionals driving and sharing a new generation of interactive physical/digital smart exhibits for the museum environment and heritage sites.

meSch receives funding from the European Community's Seventh Framework Programme 'ICT for access to cultural resources' and is currently in its second year. <http://www.mesch-project.eu>

INTRODUCTION

Heritage institutions can no longer avoid being involved in digitisation activities now or in the near future, nor can they escape from being confronted with digital born material.¹ A vast amount of money is flowing into digitisation activities and the maintenance of digital collections each year. Yet, we are nowhere near a completion of the task of digitising and providing online access to our heritage and only begin to understand the real potential of the wealth of digital heritage online. Whether it is in large repositories like Europeana, on cultural heritage institution's own websites or in the cloud as (linked) open data - digital artefacts online are no longer isolated from their original context, but can be enriched and enhanced with more meaning through other relevant sources.

However, a digital artefact lacks the materiality of the original object and materiality or the "aura" of an original object plays a great role in the appreciation of cultural heritage. The question is, can we possibly make digital artefacts tangible again in ways that transfer the feeling of materiality, authenticity, or "aura"?

The myth that the same sensorial experience can be realized in a digital environment has progressively diminished the value of the physical artefact resulting in the dominance of communication over emotion. There is even an apparent paradox in the materiality of heritage: "objects are seen [by some heritage scholars] as means to illustrate themes, ideas or stories rather than functioning as the primary carriers of information or creators of meaning within displays." (Wehner & Sear 2010). This extreme position of the material being in support of the digital is challenged by the view of other scholars that claim materiality complements and completes cognition with emotion, which is essential for understanding and appreciation, imagination and creativity (Dudley 2010, van Schijndel et al. 2010, Wehner & Sear 2010, Finnegan 2002, Antle 2009, Davidson et al. 1991, Wilson 1989).

meSch believes that a personally meaningful, sensory rich, and socially expanded user experience with digital content can bridge the gap between digital collections and the specific social and material contexts in which heritage comes to matter. Our aim is to make use of the wealth of digital heritage online in order to create new forms of visitor's interaction - beyond the mobile screen.

INTERACTION BEYOND SCREENS

Digital interaction in heritage institutions is mostly spans from mobile technology such as smartphones and tablets to large touchscreens. One still unexplored form of visitors interacting with digital content is that of a physical engagement with the exhibits.

Screen-based technology acts as 'attention grabber' capturing the visitors to the point of ignoring the presence of valuable originals and ignoring other exhibits they could actually enjoy more (vom Lehn and Heath 2003, Schwarzer 2001, Martin 2000). Visitors who come in groups can only rarely enjoy their visit as a group because mobile guides, games, virtual reality or augmented reality tend to be designed for a single user. Large screens support sharing but they do not move the attention back to the exhibits or the space (vom Lehn and Heath 2003, vom

¹ According to the ENUMERATE Core Survey 87% of heritage institutions have a digital collection (83% in Core Survey 1). See: [Survey Report on Digitisation in European Cultural Heritage Institutions 2014](http://www.enumerate.eu/en/surveys/core_survey_2/), http://www.enumerate.eu/en/surveys/core_survey_2/ Accessed May 29th, 2014.

Lehn et al. 2007, Kelly 2000). A multi sensorial experience, particularly touch, increases the appreciation and understanding of cultural heritage (Dudley 2010). Previous experiments have shown that tangible interaction can reach across different groups of users, including those with no previous knowledge or limited interest (Hornecker and Stifter 2006; Ciolfi and McLoughlin 2011). Indeed, museum exploration and learning are more effective when a number of visitors simultaneously engage in interdependent activities (Falk and Dierking 2002, Perloy 2011), a theory confirmed by specific studies that show how the social interaction and active participation around interactives makes the experience more meaningful and memorable (Heath et al. 2002, Hornecker 2010, Hornecker and Stifter 2006, Ciolfi, Bannon & Fernström 2008).

VISION AND GOAL

The technological means are now available to join benefits of physical and digital together and reunite what has been separated: it is possible to tear down the borders between the digital and physical: to still experiencing a physical sensation with the real object when interacting with the digital artefact. The meSch project wants to put the physical back at the centre of the cultural heritage experience by enabling curators, artists and designers to create networks smart exhibits that let the visitors literally "touch the story". Smart exhibits, also called smart objects, are physical objects equipped with sensors to gain smart device functionalities so that they can interact with and 'sense' their environment. It is possible to embedded 'stories', thus digital content, in smart objects, that will be revealed if and when the conditions are right: e.g. when visitors have reached the right time in the storyline, or a group of visitors is acting in a certain way, or when the proximity of another smart object or hotspot is reached. By being connected to each other, their environment and their digital representation online, smart objects belong to the era of the Internet of Things. The meSch project will exploit and expand these emerging technologies for the heritage sector and make them available for even non-technical users. The aim is to empower cultural heritage professionals to become designers and makers² themselves, by offering a meSch platform that will be easy to use at all levels and that will support the design, the content composition, the use of adaptable templates, their linking with the object's behaviour description and the final making of the physical form of the smart object. The entire life cycle of the adaptive smart objects will be supported by the meSch platform, from the conception, to the development, deployment, their use by visitors, the logging of the visit and its representation online, that can lead to personalized post-visit content online.

ENVISIONED WORKFLOW

The envisioned meSch workflow consists of different phases in the creation of adaptive smart objects for an interactive exhibition. The digital and the material collections are making a full cycle from digital to physical and back to digital.

² Maker movement is a contemporary subculture that started as an extension of the DIY culture toward digital technology and digital fabrication and now encompasses both technology and traditional craft. The Maker magazine and the international Maker Fair are points of reference for this community.

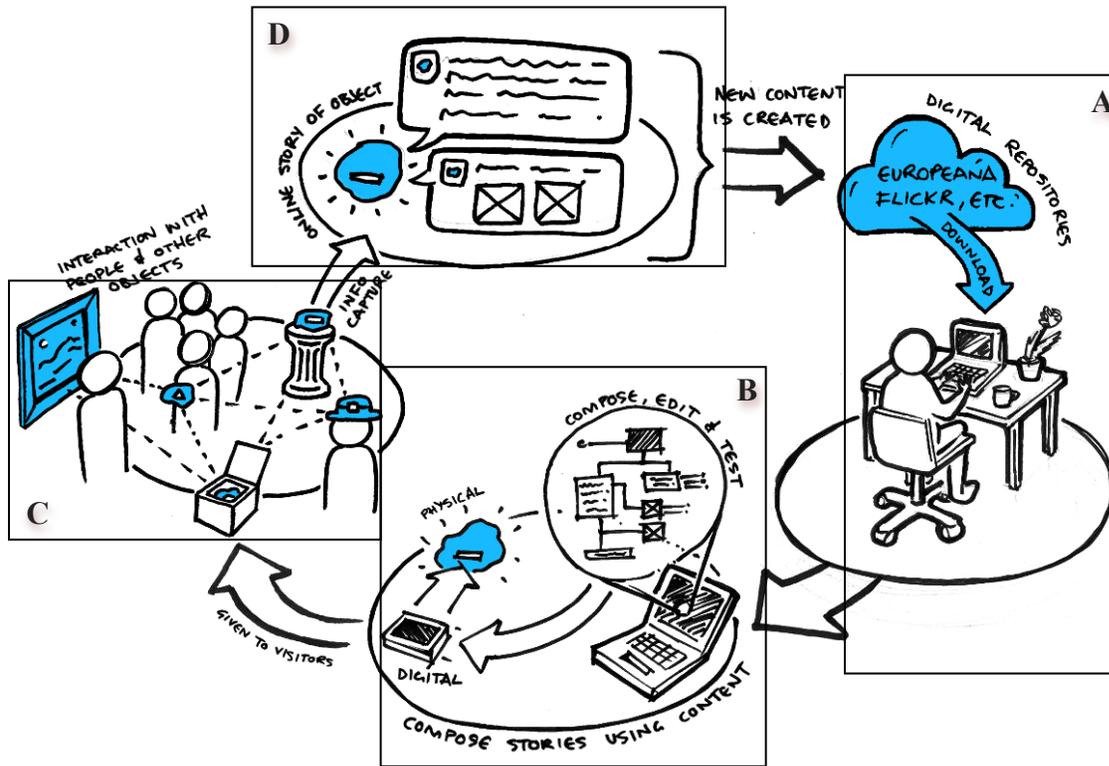


Fig. 1: The envisioned meSch workflow, clockwise from right to left.

- (A) The online meSch portal, where a community is sharing their experience in designing and making smart objects for interactive exhibitions, is a good source of inspiration and starting point. Digital content repositories of the institution in question have already been connected to the part of the meSch platform that is also able to browse content in other content repositories such as Europeana, Wikimedia or Flickr. A recommender system suggests material that could be relevant for the task at hand, using different recommendation strategies: e.g. suggest similar content and similar media (more text or images), or similar content but different media (if the loaded material is text, it looks for images or videos), or complementary content (if the piece is about nature the recommender looks for the same topic but from a different perspective, for example cultural understandings of nature). Specifically created content (e.g. from a museum publication) can also be added during the editing process to assure a maximum of suitable material. In an iterative process of browsing, searching, selecting and saving the heritage professional collects material for composing one or multiple narratives, or different perspectives on the same topic depending on the amount of different visitor groups that the content will have to adapt to.
- (B) Once the selection of the extra content has reached a satisfactory level it is time to select an activity template. Different activity templates fit specific types of visitors, for example a quest could fit to a family with young children, or the type of heritage (for example a sound-scape may be the best solution for an outdoor archaeological site while playing sound would ill fit a traditional museum indoors). The selected activity template is then filled in with the content and taken to production to create the final interactive

smart exhibit or space. Depending on the facilities available, this final step may be carried out with the help of a digital fabrication lab such as a FabLab³, including the selection and composition of the digital technology (sensors, actuators, microprocessors) and the making of the encasing (possibly using 3D printing or laser cutting to keep the costs as low as possible and allow reuse in other occasions).

- (C) A narrative template is independent from the actual content and is used to structure it, for example in terms of what comes before and after or which conditions release what portion of information or which kind of interactive behaviour. The narrative is represented as a network: each node contains a snippet of content and is controlled through a set of activation rules that, at run time, will determine if and how the content should be delivered. The set of activation rules on the nodes represents in abstract terms the behaviour of the smart object: by annotating the nodes with the behaviour (the activation rules) the museum professional specifies how each object will behave when the visitors encounter it.
- (D) The smart objects have an online shadow that logs each visit. This log is used to personalise the visitor's online exploration after the visit. The curator can use the log to monitor how the exhibition is going, analyse the visiting patterns and improve it.

EMBEDDING DIGITAL CONTENT INTO PHYSICAL OBJECTS

This section introduces some of the prototypes that have been developed in meSch in its first year of activity. Cultural heritage professionals, designers, computer scientists and engineers have been working together in co-design workshops to imagine, design and shape the prototypes. The co-design approach helps us to solutions that are more likely to be useful, usable and ultimately adopted by the cultural heritage community. In co-design practice all stakeholders collaborate and share responsibilities and decisions at every stage of the process. The three prototypes chosen below illustrate how digital content can be used to generate visitors experiences that are radically different from what has been seen in museums so far.

The Loupe - to explore

The loupe is a magnifying-glass-like device (Fig. 2) that reveals different layers of digital content when it is held over specific museum objects. The technology used is Augmented Reality, by means of a smart phone embedded within the loupe, but the experience of using it is very different from holding a smartphone or tablet. The visitor engages in an exploration to first find the object profiled on the loupe screen, then reveals multiple layers of content by holding the loupe in different positions before moving to the next object on the trail. To the user it is not even evident that there is an actual smartphone inside the loupe. The loupe uses of the optical zoom feature of the smart phone to display details that the visitor could not see with the naked eye. The content used in this prototype was taken from the database of the Allard Pierson Museum and customized to fit this specific purpose. Obviously, the focus in this prototype is on exploring different layers of the original object (e.g. hovering the loupe over a mummy that

³ Fab labs, or Fabrication Labs, are workshops for digital fabrication open to the public. The movement is quickly growing and new labs open around the world continuously taking the power of digital fabrication to anyone interested.

reveals its content or zooming in on decorations on a Greek vase that suddenly start to move in the loupe due to an animation being activated). Seamless interaction between the physical object and digital content is realized with a device that feels natural to use.



Fig. 2 The Loupe in use at the Allard Pierson Museum, unveiling hidden stories of objects in a non-intrusive, intuitive way. The visitor does not even realize he is using a hidden smart-phone.

Interactive display cases – objects tell their story

This series of augmented, networked display cases was created to trigger interaction with the object on display. Each object can receive and generated tweets via its own hashtag on the @meschcases twitter account. Visitors curate the exhibition with their behaviour.

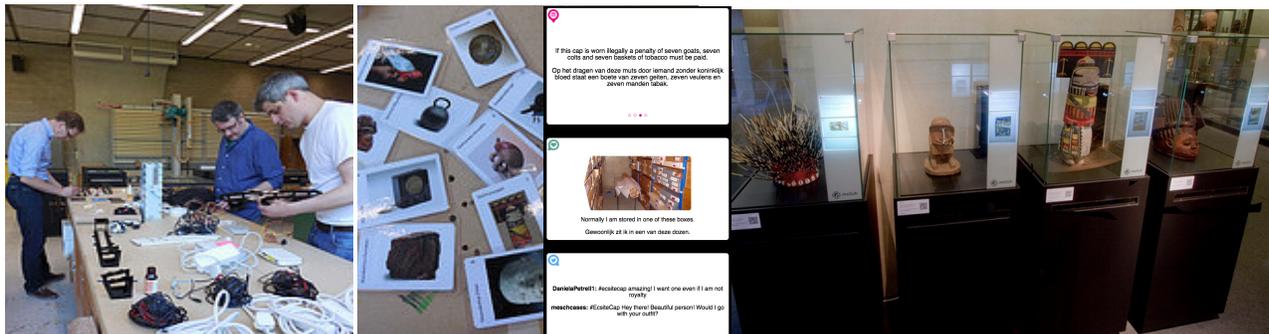


Fig. 3: The meSch cases were designed and first tested at the MUSEON. Laminated cards with an NFC tags link each object to the digital content that gets dynamically displayed with it.

The cases measure the ‘interest’ or rather ‘attention’ of visitors by combining the amount of people in front of the case, the time they spent standing there and the number of twitter messages each object receives. This information was used to create a competition between the object and decide which one is the least “popular” that should be replaced by another object.

To allow a quick change of objects and to ensure the correct content is displayed, NFC technology⁴ was used. Each object got its own laminated card that contained an NFC tag with the

⁴ A small projector within each case displays the information dynamically, which also allows to project content in different languages. The content, consisting of information taken from the museum’s database, a book recently published by the museum and a flow of twitter messages. Additional content was taken from already existing digital resources, such as YouTube or Flickr.

object ID. When one object is replaced with another, the card has to be replaced as well so that Raspberry Pi with integrated NFC tag reader will detect what kind of object the case is contains. A small projector within each case then displays the information linked to the object in it dynamically, which also allows to project content in different languages. The content consists of information taken from the museum's database, a book recently published by the museum and a flow of twitter messages. Additional content was taken from already existing digital resources, such as YouTube or Flickr.

The interactive belt - to personalise a soundscape in outdoor heritage sites

Outdoor heritage may pose some striking challenges, e.g. no power supply or mobile phone network. But, it offers the opportunity to experiment with media that would not be suitable for indoor museums such as playing audio. To support the visit of the archaeological remains of the trenches of WWI located on the Alps in the north of Italy, we designed a belt that allows visitors to select the type of story they want to listen to by placing an illustrated card into a slit in one of the pockets hanging from the belt. Their presence in specific points of interest triggers evocative stories from the war, such as diaries, poems, military orders and tales from the life of the women left behind. The content comes from the archives of the Museo Storico Italiano della Guerra and was prepared as oral narratives and evocative sounds. The visitor walks the vast outdoor area freely and has his hands free. When in proximity of a point of interest, a sound lantern picks up the signal (via Bluetooth) and starts telling the story that is linked to this place.



Fig. 4: The Interactive Belt was first used to augment the trenches of WWI in the North of Italy, belonging to the Museo Storico Italiano della Guerra. Beautiful designed cards are linked to different topics and activate the audio files in the hanging sound lanterns that contain a Bluetooth receiver and the loudspeaker to play the content.

THE PRACTISE OF REUSING DIGITAL SOURCES

In realising our goal of reusing the available digital resources through the meSch platform, we started off analysing the digital collections of the consortium member museums have in house.

The focus was on three aspects: a) interoperability (technical specifications), b) rights and licenses and c) metadata and content. The analysis framework has been used to assess existing digital sources of the three museums in the consortium: the MUSEON (The Netherlands), the Museo Storico Italiano della Guerra (Italy) and the Allard Pierson Museum (The Netherlands). This resulted in a list of implications and recommendations concerning the integration of the internal sources into the meSch platform. Through desk research and a survey among project partners, an inventory of possibly interesting external sources and services has been compiled. This list includes both generic sources (such as Europeana, Flickr, DBpedia), which are useful

for all potential users of the meSch platform, and sources that are typically of interest for the three museums in the consortium. As expected, the analysis showed that the potentially relevant existing sources and services are very diverse.

It became clear that the ready available and highly structured sources that we analysed so far were not the only resources museum professionals envisage using when creating smart exhibitions with the meSch platform. In the three examples of prototypes that we discussed above for example, digital resources as well as paper ones have been searched and customized in order to identify suitable content. This content then went through a, sometimes rather extensive, sometimes only short, media production. The result was high quality material that was suitable to be used in the intended interactive public delivery modes.

Thus, so far, the integration of existing resources with the meSch platform, that is still in development, was not a straightforward process. There were a lot of technical issues and issues regarding rights and licences that have to be taken into account.

What is clear though, is that the preferred methods for accessing and reusing existing data will most likely be OAI-PMH, search and RESTful APIs and data that is available as Linked Open Data. Integration of internal museum content sources that do not provide these reuse mechanisms might still need a separate approach in the future.

Most of the data in the cultural heritage domain is Dublin Core compatible, which increases interoperability, but decreases data richness. The Europeana metadata format (EDM) is most likely the best standard to adopt, since it is compatible to most cultural heritage metadata schemes. However, external sources from other domains, e.g. YouTube, Flickr and Wikimedia often use custom-made schemes to identify and provide their content. Still, these other domains will have to be combined with heritage resources in the meSch platform.

Licenses however, are easier to identify in resources from YouTube, Flickr and Wikimedia, since they most of the time use Creative Commons licenses. Material from cultural heritage sector is most of the time not accompanied by a license, which makes it difficult to reuse. Clearly, the rights issues are problematic for at least some data of cultural heritage institutions, which will make it difficult for the meSch system to automatically handle the different licences and rights. The lesson learned here for heritage sector is that, even if there are no plans to publish collection data or assets online in the near future, it is important to provide appropriate licenses and rights information with each record, object or asset. There might just be a collaborative project or piece of technology that allows you to create things that were not possible before, reusing and combining your own data and content with the wealth of digital heritage resources online.

NEXT STEPS

meSch is a 4-years EU funded project (2013-2017) aiming at developing technology for the heritage professionals to create interactives that integrate digital content into physical experiences for the different kinds of consumers of heritage today. Now concluding its first phase, meSch has so far explored the potentials of the most recent technology for pervasive and embedded computing holds for cultural heritage, trying to lower the technological barrier. Co-design workshops, exploratory labs and prototypes allowed the multidisciplinary team to share experiences and create a common understanding on what needs to be done. This was instrumental to lay a solid foundation for the following phase when the meSch platform is fully designed and implemented. Currently, the integration of some digital resources into a single

access point is being carried out with the aim of achieving a first preliminary prototype of the platform at the end of the second year (in the beginning of 2015).

During the whole life of the project, effort is put in creating awareness about meSch in the cultural heritage sector to kick-start a community that could try some of our prototypes as beta-testers and contribute ideas and examples to the project. On-going work and early results are published on the project website <http://www.mesch-project.eu>

REFERENCES

Antle, A.N. Embodied child computer interaction -- Why embodiment matters, ACM Interactions, March+April Issue (2009), 27-30.

Ciolfi, L., Bannon, L.J. and Fernström, M. (2008), "Including visitor contributions in cultural heritage installations: Designing for participation", "Museum Management and Curatorship", Vol. 23, Issue 4, pp 353-365.

McLoughlin, M. and Ciolfi, L. (2011), "Design Interventions for Open-Air Museums: Applying and Extending the Principles of "Assembly" ", *Proceedings of CHI 2011 - Human Factors in Computing Systems*, Vancouver May 2011, ACM, pp 553-556.

Davidson, B., Lee Heald, C., Hein, G. (1991) Increased exhibit accessibility through multisensory interaction. *Curator*, 34 (4) 273-290.

Dudley, S. (ed.) (2010) *Museum materialities: objects, engagements, interpretations*. Routledge.

Falk, J., Dierking, D. (2002) *Lessons without limit: how free-choice learning is transforming education*. Alta Mira Press.

Finnegan, R. *Communicating. The Multiple Modes of Human Interconnection*. Routledge 2002.

Heath, C., Luff, P., vom Lehn, D., Hindmarsh, J., Cleverly, J. (2002) Crafting participation: designing ecologies, configuring experiences. *Visual Communication*, 1 (1), 9-33.

Hornecker, E., Stifter, M.. *Learning from Interactive Museum Installations About Interaction Design for Public Settings*. Proceedings of OzCHI 2006. Sydney. ACM, 135-142.

Hornecker, E. , Stifter, M. Digital Backpacking in the Museum with a SmartCard. Proc. of CHINZ 2006. ACM Press, 99-107.

Hornecker, E. . Interactions Around a Contextually Embedded System. Proc. of TEI 2010. ACM 169-176.

Kelly, L. (2000). Use of Computer Interactives in Museum Exhibitions: Literature Review. AMARC - Australian Museum Audience Research Centre.

Martin, D. Audio Guides. *Museum Practice*, 5 (1). 2000. 71-81.

Perloy, L.M. (2011) Improving educational museum experience using a multi-touch table, master thesis. Enschede 2011, p. 55.

Schwarzer, M. (2001). Art & Gadgetry – The Future of the Museum Visit. Museum News, July/August 2001 American Association of Museums.

van Schijndel, T., Franse, R., Raijmakers, M. (2010) The exploratory behaviour scale: assessing young visitors' hands-on behaviour in science museums. Science Education, 94 (5), 794 – 809

vom Lehn, D. and Heath, C. (2003) Displacing the object: mobile technology and interpretive resources. ICHIM - International Cultural Heritage Informatics Meeting.

vom Lehn, D., Hindmarsh, J., Luff, P., Heath, C. (2007) Engaging Constable: Revealing art with new technology. CHI 2007 International Conference on Human Factors in Computing Systems, 1485-1494.

Wehner, K. and Sear, M. (2010) Engaging the material world: object knowledge and Australian Journeys. In Dudley, S. (ed.) Museum Materialities: Objects, Engagements, Interpretations. Routledge.

Wilson, F.R. The Hand. How its use shapes the brain, language, and human culture. Vintage books 1989.