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# Experiential Manufacturing: The Earthquake Shelf

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**Abstract:** Experiential Manufacturing describes a design led investigation into uncovering the latent values that might exist in data that describes our experiences. By learning from the ways we engage with meaning and memory through material encounters, it aims to create more intrinsic, and aesthetic experiences of biographical data, and to provide meaning beyond the recall of information.

The Earthquake Shelf is a designed provocation that implements this approach. It monitors live data feeds for earthquakes at a specified location, and whenever one strikes, the shelf will shake. Depending on the earthquake's magnitude, the objects placed upon the shelf may fall, being damaged to leave behind material evidence of a remote event. This tangible rendition does not describe a person's previous earthquake experience, but by evoking it, seeks to allow for the reconstruction of memories, and for their association with 'new' objects through the action of the device.

This paper describes the design process behind the Earthquake shelf, and reflects upon the experiences of the research participant. From strong visceral connection to the past, to empathetic connections to remote locations, and eventually frustration, the Earthquake Shelf revealed the ways that design might engender a variety of emotions and responses.

**Keywords:** Design; Memory; Material; Data.



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## Context

As we continue to accumulate vast archives of primary and secondary biographical data, the scale and dispersal of these records demands that the technologies we have for navigating them prioritize efficient retrieval and organization of information. While clearly imperative, these utilitarian goals are not best suited to supporting the more emotional aspects of memory, and the great potential for more emotionally valuable remembering is neglected. Such systems impose structure on biographical data that may restrict our abilities to reflect freely, and reconstruct our memories according to our current needs (Middleton, 2005).

Meanwhile, our engagement with memory through meaningful objects is potentially quite different to that through digital content. The meanings of objects are predominantly implicit, and specific to our personal experiences. They are also in flux, and objects' lack of explicit description of the events to which they are associated allows us to reformulate and reconstruct memories over time, in line with our evolving needs and values [Kirk, 2010; Gaver 2003]. Digital records on the other hand are, at times, designed to provoke fixity (a state of permanence) in their interpretation (Harper et al., 2012).

Technologies such as the Internet of Things, and rapid prototyping have precipitated an increased interest in designing more meaningful interactions through the relationships between digital and physical things. However, the relationship between material and memory is complex, and many efforts in manifesting 'memory data' pay insufficient attention to the aesthetic and experiential dimensions through which objects support meaning (Ylirisku, 2013). Further, work exploring the relationship between data and memory commonly perpetuates assumptions that the data being stored is the memory, conflating digital storage with processes of human remembering (Harper et al 2008). We argue that like physical objects, data is rather an index to memory, and that its combination with physical systems, should more appropriately be used to evoke memory rather than describe it. Experiential Manufacturing is a design led approach to exploring how we might design relations between data, things and people that better support these characteristics of autobiographical memory.

## The Earthquake Shelf

The Earthquake Shelf is a designed prototype that monitors live data feeds for earthquakes and whenever one strikes a selected area, the shelf shakes. Depending on the earthquake's magnitude, the objects placed upon the shelf may fall. By reacting live to real earthquakes the shelf physically marks objects to leave behind a material memento of the event. This tangible rendition does not describe a person's previous experiences, but evokes it, aiming to associate former memories with 'new' objects through the action of the device. This represents an experiential and evocative approach to designing interactions with our digital data records, whereby less explicit, more intrinsic and aesthetic relationships are made between objects and data.

## Design Process

The process began by searching for experiences that were likely to be emotionally significant (and hence memorable), that would have an associated resource of data, and that had a clear affect on material things. After reading news stories about damage to property, disasters were chosen. Initial ideas concerned earthquakes and floods, but the former had more associated data, and a clearer set of material associations. For example, in reference to some earthquake safety procedures the initial idea was for an Earthquake Table that the person could hide under while it

shook, and the objects would fall from the top. However, the relationship between a table, and the value of things placed upon it is not so clear. Here, a shelf was seen to have more suitable associations of value and importance (actual or potential), and items falling from shelves are a familiar story in any report of an earthquake experience.

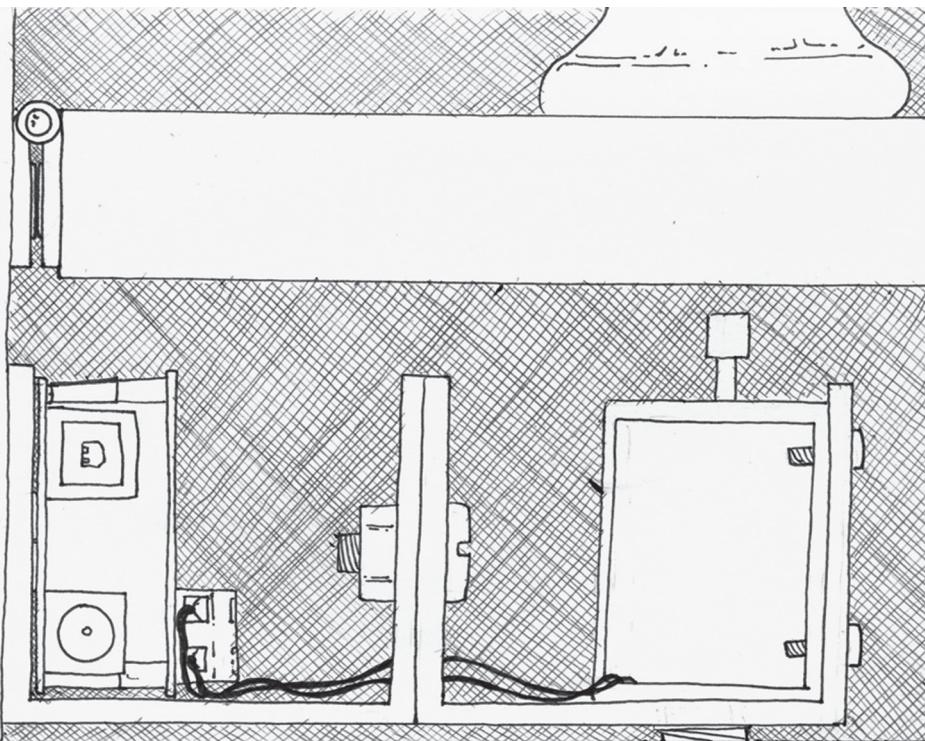


Figure 1. A sketch of the mechanism.



Figure 2 (top). The second iteration of the Earthquake Shelf

Figure 3 (bottom). Having fallen to the ground, the vase smashed upon the floor

The Earthquake Shelf was taken through three iterations, each of which tested and developed some aspect of the shelf's design.

The first was a 'quick and dirty' test to get a feel for the mechanism and software that would control the shelf's movement. The subsequent two prototypes will now be discussed in more detail.

## Iteration 2: Data, Damage, and Meaning

The second iteration of the Earthquake shelf (Figure 2), like the first, comprised of a wooden board attached to a wall with a hinge, and an Arduino<sup>1</sup> that drives a solenoid actuator to move the shelf up and down (Figure 1).

Rather than the random shaking of the previous iteration, this version experimented with recreating historic earthquakes. Based on eyewitness accounts, and more recent scientific estimates, the Arduino was programmed to recreate the great San Francisco Earthquake of 1906. The clock seen on the wall in Figure 2 indicates that the shelf starts shaking at the correct time, and it is programmed to shake for the reported duration of the 1906 earthquake.

To create various strengths of movement, the magnitude of the earthquake was translated from a range of 2.0-8.0M<sup>2</sup>, to the minimum effective<sup>3</sup> and

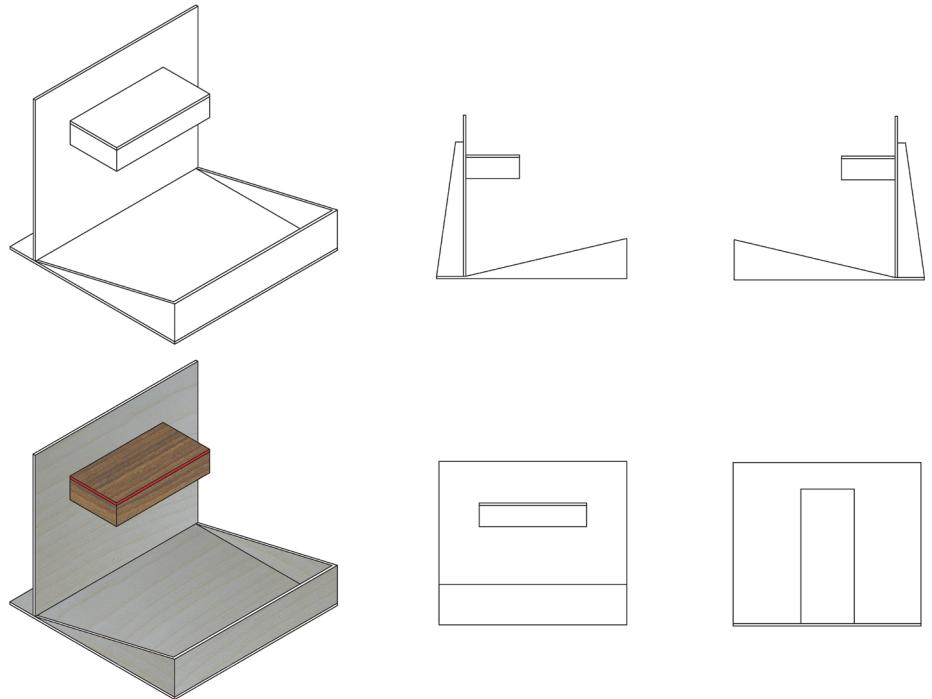


Figure 4 (top left). The reassembled vase bears the material scars of the remote earthquake

Figure 5 (left). Illustration of the Earthquake Shelf's form for deployment

Figure 6 (top). The participants photographs of the Earthquake's aftermath

maximum power outputs of the solenoid. However, translating earthquake magnitude to the movement of a shelf is extremely arbitrary, and in any case, the limited range of the shelf's movement makes it extremely difficult to read all but significant variations of magnitude.

During this experiment, the vase placed on the shelf was allowed to fall and smash (Figure 3). Once reassembled (Figure 4), it bore the material scars of an event. This raised the question, if this damage was caused by data from a real Earthquake, is this a memento of that event? However, this began to feel like an attempt to literally (and impossibly) recreate a past event.

## Final Prototype

Learning from the previous iteration, the final version of the shelf switched to live data. This helped avoid being too descriptive of previous experiences, in order to allow for a more evocative connection to the past. Fundamental to this approach though, was the need for the Earthquake Shelf to be designed for a specific individual's experience. This is ethically difficult, so an expert in disaster recovery was consulted to advise on the research. Following an advert, a participant was found who had lived in New Zealand during the 2010 earthquakes, and who now lived in the UK.

In initial interviews he described his earthquake experience (see photos in Figure 6), describing how objects would fall from shelves and the sound of wooden slats banging together. Focusing on these evocative but generic experiences helped avoid being too descriptive (literal), which fitted well with the Experiential Manufacturing concept.

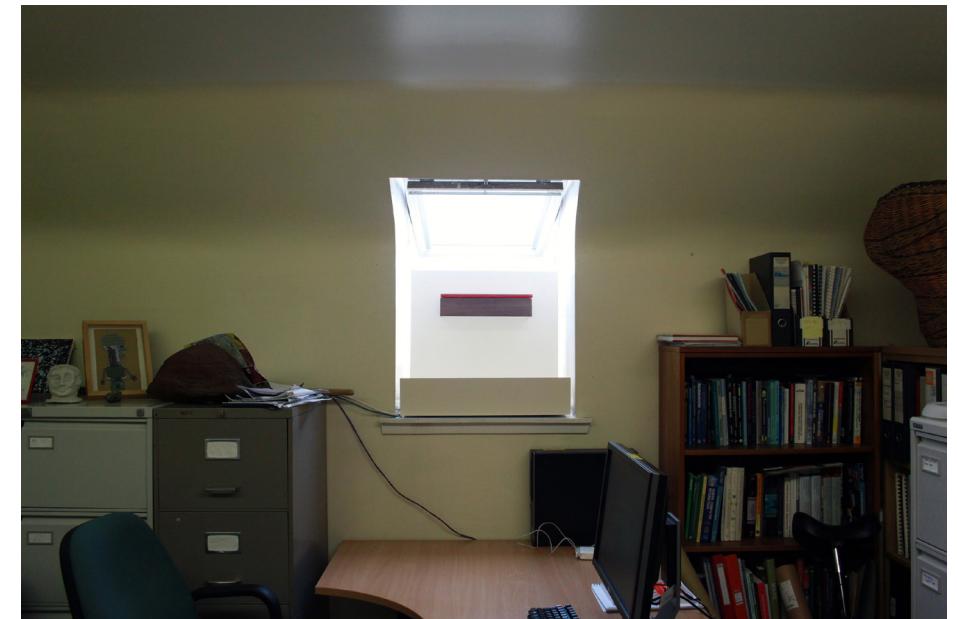


Figure 7. The final version of the shelf in its deployment location next to the participant's desk

The shelf was originally intended to be deployed in the participant's home, however during the interview they requested that it be installed in their office instead, and a suitable place was agreed upon (Figure 7). It was not permitted to attach anything to the walls inside the office, so a stand was made on which the shelf could sit within the recess of a window ledge. This was very close to the participant's desk and so the base of the stand included a barrier to prevent items from falling onto it. This was also painted the same colour as the walls so the shelf itself took visual prominence.



Figure 8. The vibrating mechanism inside the shelf. The top surface of the shelf bolts onto the aluminium rectangle, which is attached to the sides by 4 springs., When the large vibration motor mounted in the center at 45 degrees is activated, the shelf top surface shakes both vertically and horizontally.

The previous versions of the shelf only moved up and down, but earthquakes can move horizontally and vertically. A new mechanism was designed to allow the shelf multiple planes of movement (Figure 8) in the hope that this would allow for more realistic movement of the objects placed upon it. This time, the motor and mechanism were hidden within the shelf, so that it felt more like a regular piece of furniture rather than an overtly technological or mechanical one.

The body and lid of the shelf were now made entirely out of wood (Figure 8) so that the wooden sections would knock together, in reference to the sounds made by wooden house slats mentioned in the initial interview.

Finally, whilst previous versions focused on the ways that the shelf, and earthquake data might affect an unassociated object, in this study the participant was asked to personalize the experience by choosing what to put on the shelf. This required them to deliberately select something to be affected by the data, and take on its meaning.

## Deployment

The Earthquake Shelf was deployed with the participant for 6 weeks; enough time for them to experience the device given its anticipated slow frequency of action. During this time they were asked to make blog posts on the project website, recording and reflecting on their experiences. The blog was hidden from public view and only accessible when logged into the site.

A closing interview was conducted at the end of the deployment, and used themes from the participant's blog posts as talking points for further discussion and reflection.

## Reflections

The deployment can be divided into three distinct phases in which the participant's relationship to the shelf changed significantly. This ranged from an emotional connection to their own experience, to an empathetic connection to others, before the shelf's effects finally 'wore off'. These phases are discussed below in relation to the design of the shelf, but first we address the question of the shelf's ability to embed meaning into the objects placed upon it.



Figure 9: Before and after. The image on the left shows the books placed on the shelf by the participant, while the right shows them having fallen after an earthquake. [Images courtesy of participant].

## Making Meaningful Objects

The Earthquake Shelf was unsuccessful in using data to embed meaning into the objects placed on the shelf, which we attribute primarily to the participant's choice of objects. He related his choice to those things that fell from his shelves during the 2010 earthquake:

*Other things on shelves were really CD's and books. So I just thought why not get books because they are easy to re-stack and they don't get broken. They're just old, scuffed books.*

The books were useful in signifying that the shelf had shook, whilst the participant was absent (Figure 9), but their lack of value may have obstructed the attribution of a new meaning. As the books were old and scuffed already, any new marks made falling from the shelf were not apparent (unlike the vase in the previous iteration). Material changes could not therefore be ascribed to a specific event, which prevented data from marking experience upon the objects.

## Phase 1: Emotional Connection to Experience

In the first three weeks of the deployment, the Earthquake Shelf itself provoked strong emotional responses by evoking memories of the participant's original experience. This was the result of three main characteristics: the physicality of the interaction, its singular function, and response to live events.

The physical manifestation of online earthquake data created a visceral and 'real' connection to the participant's past experiences:

*I felt actually there was an emotional link. It felt like this is a real thing in the office that's vibrating because something real is happening on the other side of the world, and that whole reality was quite different to what I expected. Because looking at quake net [website], or whatever and looking at graphs, just becomes somehow scientific study of it rather than the real thing.*

*I think making it a real object does definitely create a stronger link to New Zealand... and it seems much stronger than just looking at a chart.*

The shelf's physicality provided no real information about the events it was responding to. As a result the participant engaged with it in terms of his own experience, rather than the 'scientific study' of current events. This reminiscent experience however, was somewhat skewed. The participant reflected that whilst the shaking was ambiguous enough to trigger memories of his specific event, it drew focus on the purely negative aspects, eschewing the more positive features, such as closer community relationships, and the ad-hoc social initiatives that followed in the aftermath.

The participant particularly valued the Earthquake shelf's singular function:

*It only has one function doesn't it? It's a shelf that vibrates when there's an earthquake, and that's it. It's a very simple function... So I think the fact that it was just one function, makes a more direct link and a much simpler link.*

Here, there is no need to interpret what the shelf is doing, or signifying when it shakes, and nothing to interrupt, disrupt, or distract from its meaning. As a result the participant's response to the shaking, and the meaning of that interaction is clear, contributing to the real and visceral engagement.

Finally, the use of live data, and the knowledge that they were remotely experiencing these events more-or-less as they happened was vital to the participant's engagement with the prototype, but also in encouraging them to reflect upon their own experiences.

As other researchers have found [Jacobs, 2013], this live-ness connects people to an event very directly and, by effectively allowing them to share an experience remotely, encourages deeper reflection.

*So I know there have been earthquakes, what's the reason to have something that's vibrating now from some historic event but I don't know where or when it was. So I think it being live was actually a critical part of the whole thing.*

As well as affecting the participant's interest in, and value of the shelf, live-ness was extremely important in avoiding directly recreating the participant's experience. Liveness helped to mediate the tension between trauma and memory by abstracting the shelf from the past experience, and instead evoking it through the use of familiar actions.

## Empathy for Others

After three weeks the participant was concerned they'd had insufficient opportunity to engage with the shelf. This was due to a combination of being away from the office, and a lower frequency of earthquake events than usual. To increase the frequency with which the shelf shook, it was reprogrammed to respond to earthquakes throughout the whole of New Zealand, rather than just Christchurch. This change effectively created a second phase of the deployment:

*I think it was necessary to change it otherwise I think there would have been very little to talk about. But I think it was interesting to change it after a couple of weeks because the first bit was much more about the links to our experience, and the second bit was much more about New Zealand as a whole and that people were going through something similar to what we had been through.*

So, whilst the participant's experience was initially one of reminiscent reflection, in breaking the explicit link to the location of that experience,

his engagement with the shelf became more about empathy for the current experiences of others.

This highlighted an interesting aspect of the relationship between the function of the shelf and its interaction. The lack of information available in the physicality of the shelf's shaking had previously helped connect the participant to their memories. Now though, he became much more interested in detailed information about the Wellington earthquakes, and often sought out supplementary data.

Shortly after this, a large earthquake with an epicenter in Wellington, and a strong aftershock sequence meant that the frequency of the shelf's shaking increased from a couple of times a week, to several times a day. This 'violent' mode of interaction was intended to suit very infrequent actions, but with this increased activity, the shelf quickly became a nuisance, and the deployment was ended.

## Conclusion

In this paper we present the Earthquake Shelf, a design provocation that responds to live earthquakes in remote locations to investigate the ideas of Experiential Manufacturing. From a strong emotional response through evoking memories of personal experiences, to empathy for others, the

Earthquake Shelf took on different meanings during the deployment. This change was induced by manipulation of the Earthquake Shelf's functional behavior. Breaking associations between data and activity altered meaning but fostered deeper reflection by the participant through an evolving relationship with the artifact.

We also saw that the role of visible physical damage may have been an extremely important element of an object's ability to take on meaning through the shelf. While the vase used in the development of the prototype showed very clearly that the shelf had altered its materiality, the books the participant chose did not. Similarly, the books were preconceived as meaningless objects, while a new, unfamiliar object may not have carried preconceptions that obstructed the attribution of meaning. We speculate that a more easily, or visibly damageable object, such as a vase may have been able to take on associations of earthquakes, but this is a matter for further research.

However, this also points to another observation that concerns the transition from a concept, to a bespoke research prototype. In tailoring the shelf to the needs of the participant, various compromises were made to its design. For example, we decided to avoid the use of potentially dangerous objects (vases), and installed the shelf in the participant's office,

rather than their home. With these changes significant aspects of the prototype's intended interaction were lost, and the potency of its affect diluted. Further research might pursue ways of maintaining the criticality of the design, whilst still supporting the depth of engagement that comes from longer-term field deployments.

It is also worth reflecting upon the fact that whilst the shelf was designed, in part, to be a piece of furniture, it has no place in the home or the workplace (it is clearly sub-optimal in its duty as a shelf). Neither however, is it a gallery piece. It is a curious kind of object, a research vehicle designed to be lived with for a short period of time, as a provocation to develop understanding of how experience can be supported through a relationship to data.

## Endnotes

<sup>1</sup> <http://www.arduino.cc/>

<sup>2</sup> According to <http://www.usgs.gov/> a magnitude of 2.0 is the approximate minimum magnitude of earthquakes that are commonly felt by people, whereas earthquakes of 8.0 or above are relatively rare.

<sup>3</sup> I.e the minimum power at which it was able to physically move the shelf.

## References

- Gaver, W., Beaver, J., and Benford, S. (2003). Ambiguity as a resource for design. *Proc. CHI'03*, Ft. Lauderdale. New York: ACM Press.
- Harper, R, Whitworth, E., & Page, R. *Fixity: Identity, time and durée on Facebook*. Proc. IR 13 (2012).
- Harper, R., Randall, D., Smyth, N., Evans, C., Heledd, L., Moore, R. 2008. The past is a different place: they do things differently there, *Proceedings of the 7th ACM conference on Designing interactive systems*, p.271-280, February 25-27, 2008, Cape Town, South Africa
- Jacobs, R., Benford, S., Selby, M., Golembewski, M., Price, D., Giannachi, G. (2013) A Conversation Between Trees: What Data Feels Like In The Forest. In *Proceedings of the 2013 SIGCHI conference on Human Factors in computing systems (CHI 2013)*, ACM, April 2013.
- Kirk, D.,Sellen, A. (2010) On Human Remains: Values and Practice in the Home Archiving of Cherished Objects. *Transactions on Human-Computer Interaction (TOCHI)*, 17, 3, 1-43
- Middleton, D. & Brown, S, D. 2005. *The Social Psychology of Experience: Studies in Remembering and Forgetting*. Sage Publications, London
- Ylirisku, S., Lindley, S., Jacucci, G., Banks, R., Stewart, C., Sellen, A., Harper, R. and Regan, T. (2013). Designing web-connected physical

artefacts for the ‘aesthetic’ of the home. In *Proceedings of the 2013 SIGCHI conference on Human Factors in computing systems (CHI 2013)* 909-918. New York: ACM Press.

