Making Things Apart: Gaining Material Understanding

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Abstract
This pictorial explores the material resources that can unfold through taking things apart. We describe a workshop program and according exercises designed around four particular modes of disassembling (interactive) artefacts. These exercises aim to provide low-threshold engagements with artefacts and the materials those artefacts are composed of. Based on a series of workshops we conducted following this program, we depict nine different forms of material resources that are unveiled through taking things apart. With this distinction we aim to contribute to the understanding of how the material histories of components and the rules that were governing their previous relations, are carried over to new compositions during reuse or reinterpretation.

Authors Keywords
Design Exercises; Disassembly; Un-Crafting; Material; Material Understanding; Making;

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Making Things Apart as a Material Practice

While research into making typically emphasizes the synthesizing, the constructing, the putting things together, recent research has foregrounded the relevance of the de-constructive counterpart: For instance, research on practices around repair and obsolescence [6], material literacy [7], playful hacking [5], un-crafting [9], and the collaborative act of taking things apart as means to create shared material knowledge [10] has provided several related approaches.

In the context of interaction design research, those de-constructive encounters with materials – as integral part of many making practices – can be related to experimental engineering, as coined by Vallgårda and colleagues. While their concept of experimental engineering is not "a radically new way of working in design" it is about articulating "the value of open-ended technological experiments as a legitimate design research practice." [13, p. 199] They distinguish three types of experimentation (i.e., recombining, reconfiguring, and recontextualizing technology); all three of which might be well supported or unleashed by deliberately taking existing technology apart.

While studies on taking things apart often depart from existing works in the realm of (mainly engineering or STEM) education, we see *making things apart* as an approach that is not limited to material literacy in education. Rather, we interpret it as a practice of engaging with technology that unfolds particular material resources. In order to unveil the characteristics of those resources, we created a dedicated workshop program around the theme of *making things apart* and conducted a series of according events. In the remainder of this pictorial we will detail the program and procedure, and provide nine categories of material resources and knowledge we saw unfold.

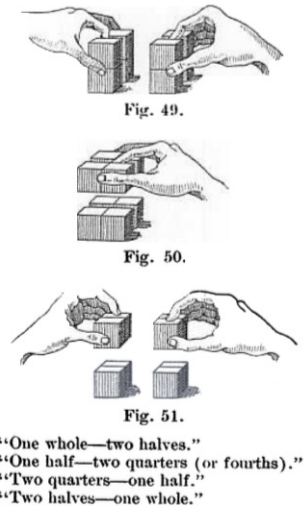


Fig. 49.

Fig. 50.

Fig. 51.

"One whole—two halves."
"One half—two quarters (or fourths)."
"Two quarters—one half."
"Two halves—one whole."

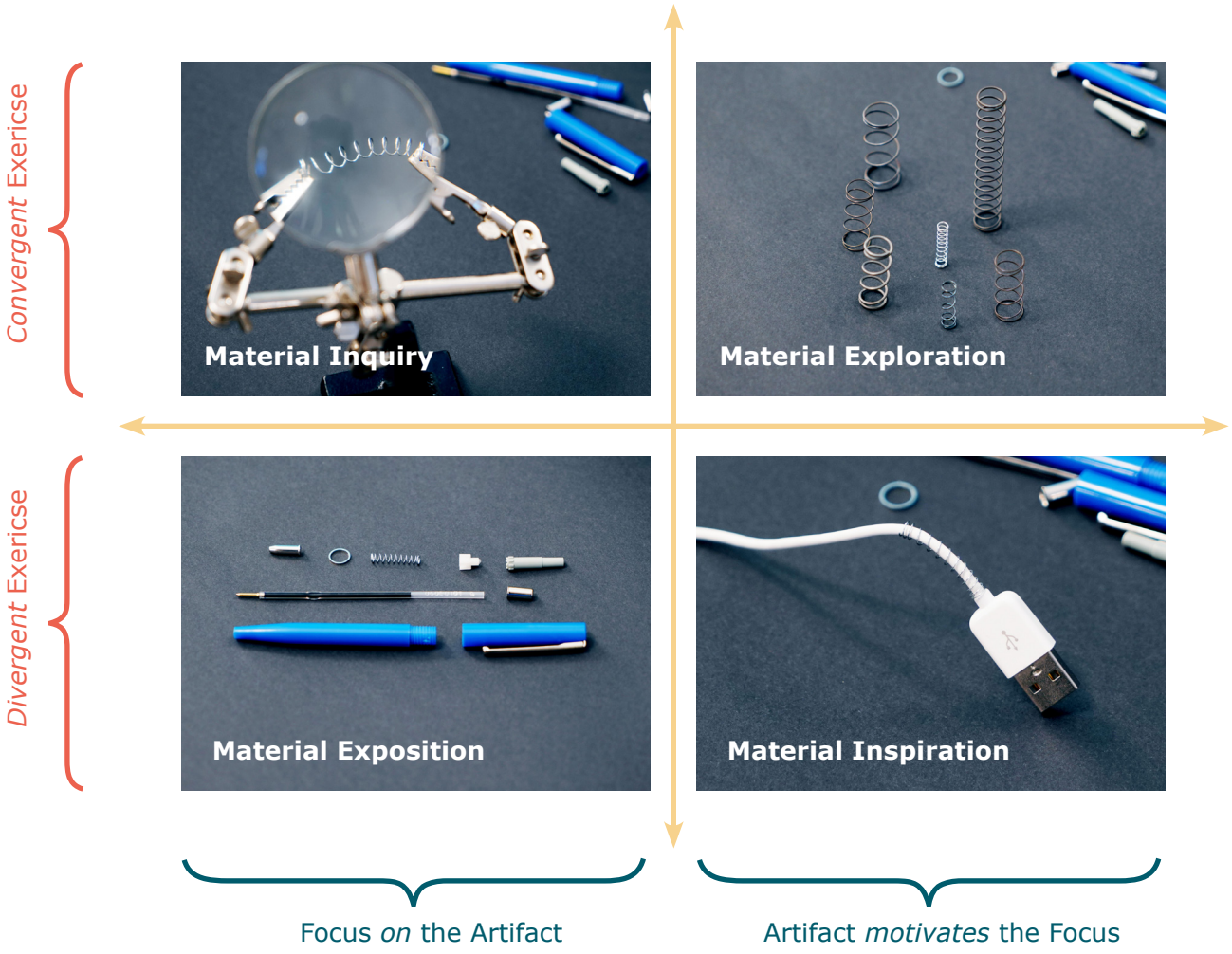
Taking things apart has a long history in education, *starting with Fröbel's Third Gift. As part of a series of educational toys created in the early 19th century, the third gift is composed of eight cubes, accompanied by instructions for the educator to facilitate the development of early number concepts through taking apart and putting back together. While a plethora of related building block kits has found its way into education, and eventually into making and design, tools that specifically facilitate learning through deconstruction are less visible than their constructive counterparts. Image taken from [14, p. 100].*

Un-Crafting as Guiding Framework

The workshops discussed in this pictorial are conceptually based on an organizational framework for un-crafting [9], i.e., taking (interactive) things apart as part of a design, research or making activity. This framework differentiates four modes of un-crafting that are distinct in their focus and orientation.

The un-crafting framework targets two applications: *analytical,* in order to render visible and describe how un-crafting is inherent to manifold making and design processes, and *constructive*, as a means to create material knowledge by engaging with interactive artefacts through disassembling them.

For the workshop program described in this pictorial we instantiated the four modes provided by the un-crafting framework in concrete exercises.



The organizational framework for Un-Crafting [9]. De-constructive activities (or exercises) are distinguished by their focus and orientation. Divergent Exercises are open-ended and characterized by questions about the "What?" (e.g., what is it made of), while convergent exercises are about (design) rationales and attributes ("Why?"). The second dimension of the framework allows to differentiate whether the artifact is in focus or motivates the focus of the exercise.

Making Things Apart – A Workshop Program

In order to explore what material resources unfold through taking things apart we created a workshop program that consists of four stages, organized by the un-crafting framework described above. While not mutually exclusive, the four stages allow to focus on specific aspects of taking things apart. As disassembling and reverse engineering are used in various – mainly educational – settings, the individual exercises were not developed from scratch but are based on or inspired by existing approaches (e.g., [2,3,11]).

Stage 1 – Material Exposition

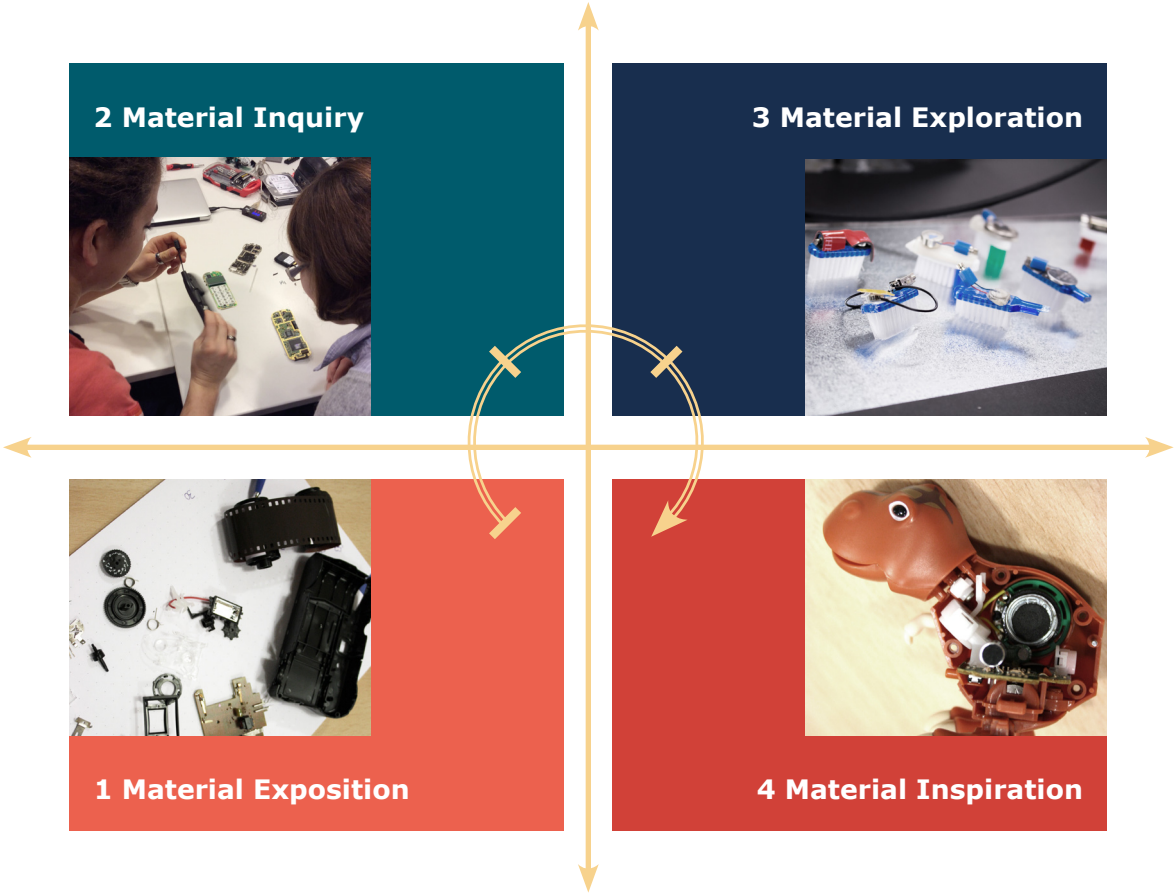
The first phase of the workshop focuses on basic principles of taking something apart. To kickstart the workshop, push-button, screw-apart ballpoint pens, are the disassembled and analyzed. (See [3] for a thorough guideline on applying this particular process in engineering education.) As a second exercise, participants take apart an object of their choice from a pile of prepared artifacts, aiming to disassemble as much as possible without breaking individual components.

Stage 2 – Material Inquiry

The second stage draws attention to the specifics of a material. For this exercise, the participants are asked to find the component that makes a mobile phone vibrate (i.e., its vibration motor) by taking the phone apart.

Stage 3 – Material Exploration

For the third stage the participants are introduced to bristlebots, a design that utilizes vibration to provide propulsion to tiny bots made from toothbrushes. While there is some controversy [11] about their original invention, bristlebots gained a lot of attention both as DIY and commercial educational materials. Taking apart further mobile phones allows to compare and contrast vibrating motors with different characteristics.



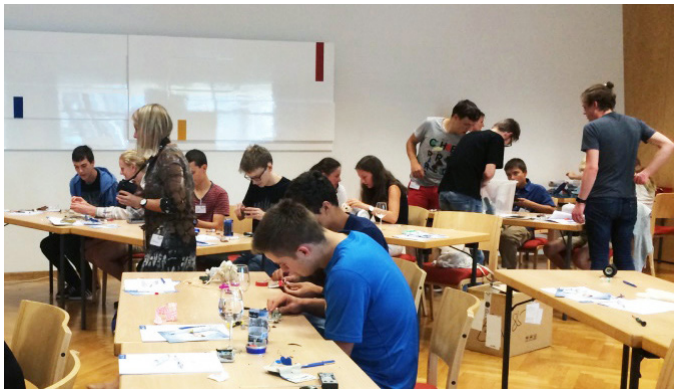
Stage 4 – Material Inspiration

In the final stage of the workshop the participants take apart functioning devices and create new compositions based on the material gathered from all preceding exercises. This exercise is inspired by several existing programs for taking apart toys, such as the one hosted by the Tinkering Studio of San Francisco's Exploratorium [2].

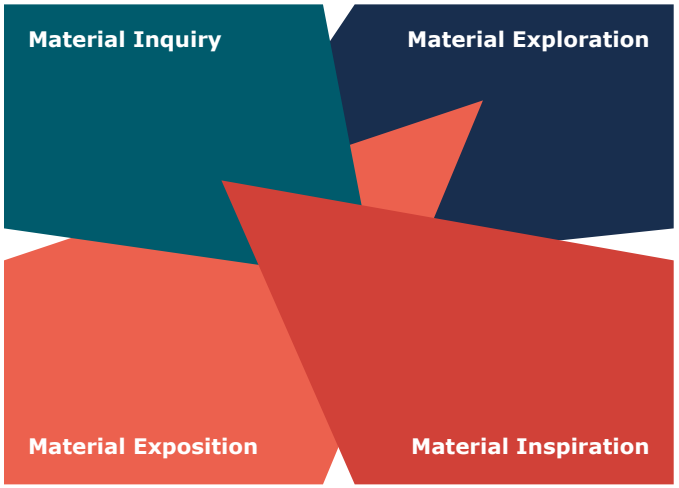
Workshop 1
Setting: International Conference (TEI 2015)
Participants: 8 Design Research Experts
Duration: one-day workshop (8h)
Program: Integration of artifact dissection, open ended experimentation, reflection, and discussion

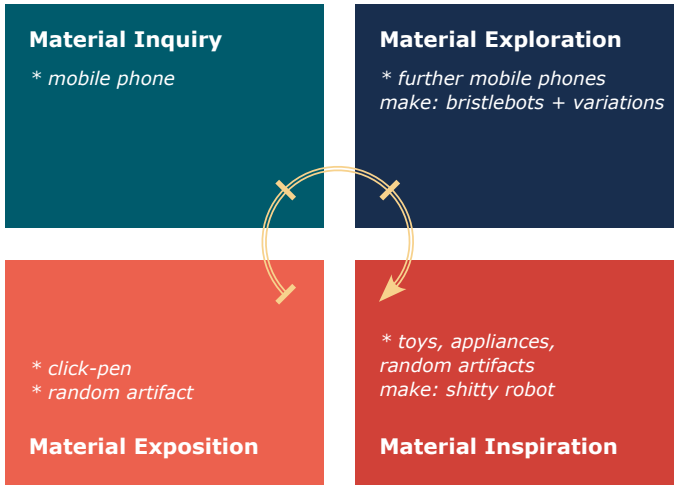
The initial workshop of this series was conducted with experts in Design Research to inform the conceptualization of the making things apart workshop program.

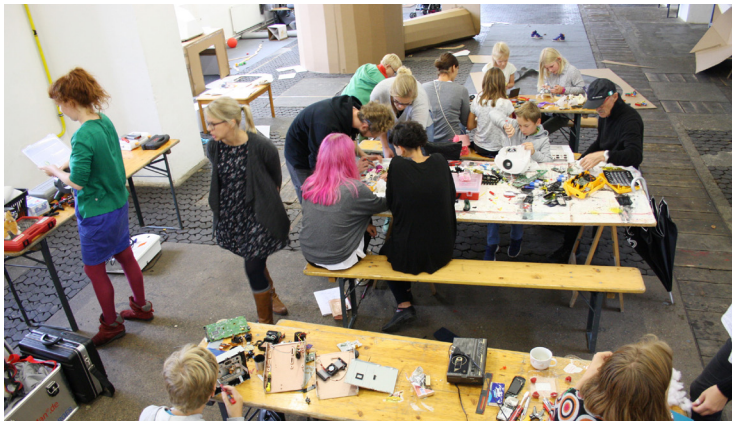
Workshop 2
Setting: STEM event as part of a promotion of excellence program during an international technology forum
Participants: 25, aged 13 - 18
Duration: one-day workshop (8h)

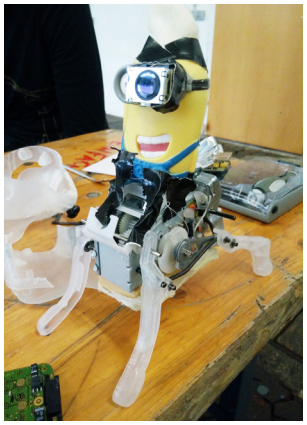


The second event followed exactly the workshop program outlined above. As accompanying inspiration, photos and videos from related work in the arts was used (e.g., Todd McLellans fabulous photographic work on disassembled technology [8], or videos form Simone Giertz, the self-entitled "Queen of Shitty Robots" [4]).



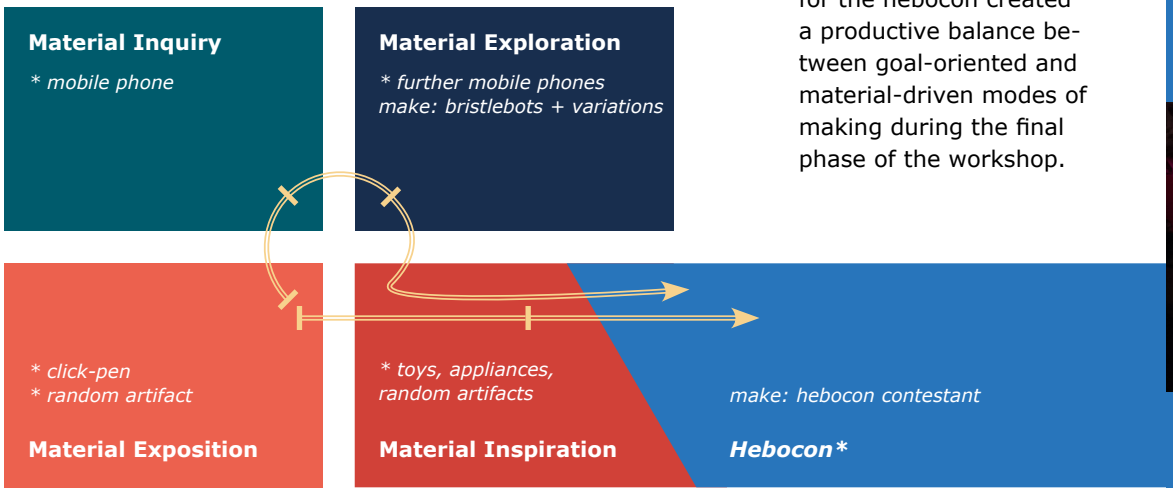






Workshop 3

Setting: public workshop as part of *Schmiede 2016,* an annual media art festival in Hallein, Austria
Participants: 28, aged 4 - 59, children, their parents, artists, makers, designers
Duration: one-day workshop (8h)



This workshop was organized in coordination with a hebocon taking place the following day at the same festival. Working towards a *crappy robot* for the hebocon created a productive balance between goal-oriented and material-driven modes of making during the final phase of the workshop.

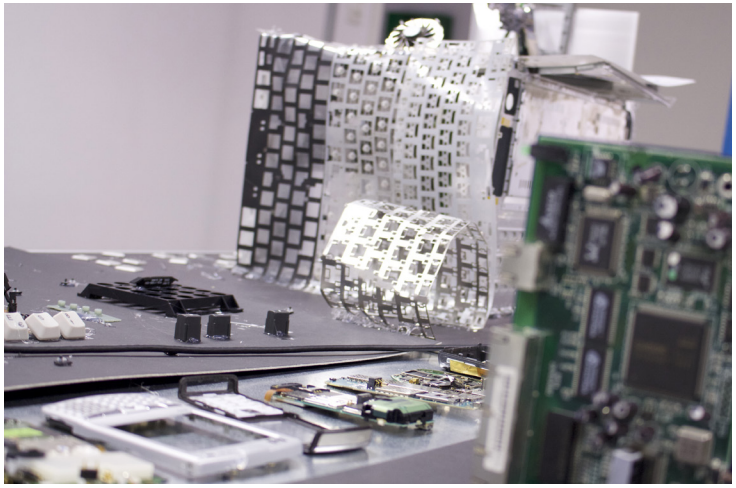
*Hebocon - A robot contest for the ungifted

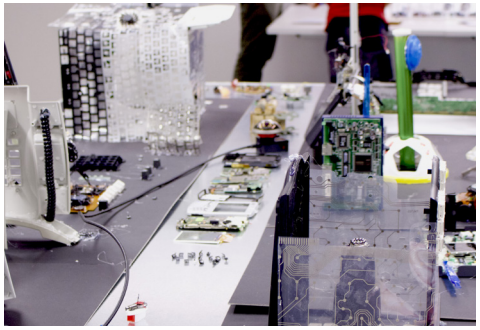
Hebocons are robot sumo-wrestling competitions for crappy robots. The Hebocon format was envisioned by Daiju Ishikawa in 2014 after realizing "... that the way people fail in engineering is very interesting and entertaining." [1| Since then, hebocons got pervasive at, e.g., makerfairs and media art festivals as well as in manifold educational contexts as a low-threshold, engaging and fun way of approaching technology. In the context of creating a hebocon contestant, reusing broken or decommissioned hardware is almost self-evident.

The hebocon battlefield and audience during *Schmiede 2016*. *Schmiede* is an annual media art festival in Hallein, Austria.

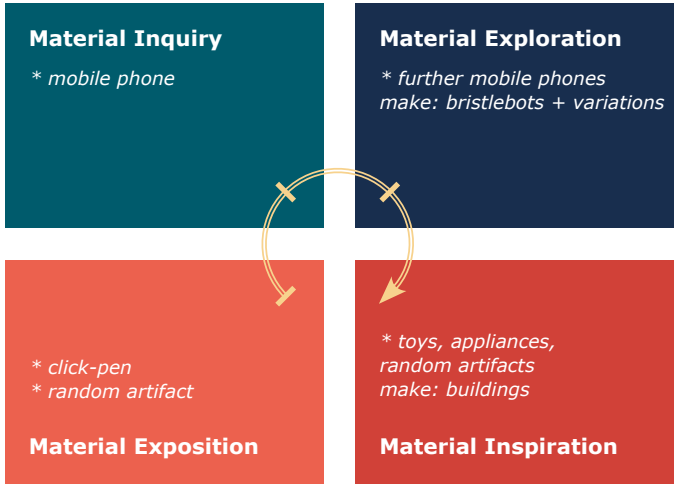
Workshop 4

Setting: STEM event as part of a promotion of science and technology week
Participants: 26, aged 13 - 14
Duration: half-day workshop (4h)



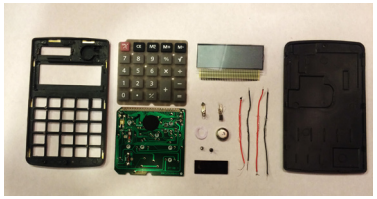


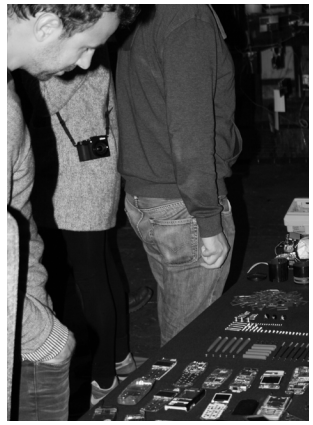
Due to a limited duration of 4 hours, the workshop program was adapted: Instead of creating functioning (crappy) robots in the concluding material inspiration exercise, we asked the students to create scale models of imaginary buildings based on the material gathered.



Material Resources

During all workshops, photos were taken to document the processes and outcomes. Afterwards, photos that expose some sort of material resource were annotated and clustered based on similarities. On the following pages we depict exemplars of the nine categories of material resources we saw unfold through the exercises. The categorization provided here is not to be understood as exhaustive or mutually exclusive, i.e., a single material component might as well fall into several classes of material resources simultaneously.



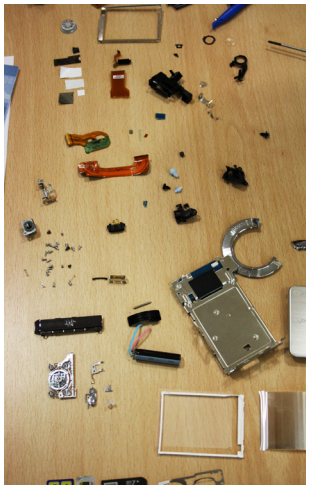


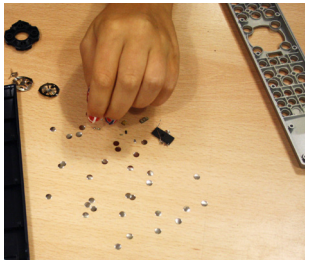
The Totality of Components as Material

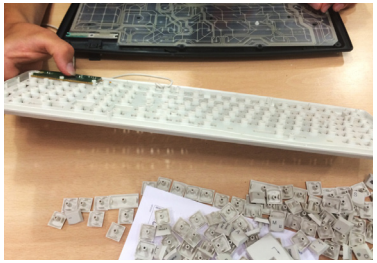
The wholeness of an artefact bears its own distinct quality; even in its disassembled state.

A Treasury of Components as Material

Through dissecting one or multiple artifacts, the maker gains a treasury of components as a source for, e.g., a subsequent bricolage (see e.g., [12]).





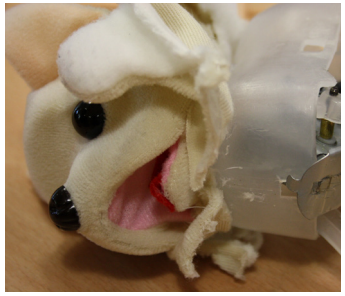
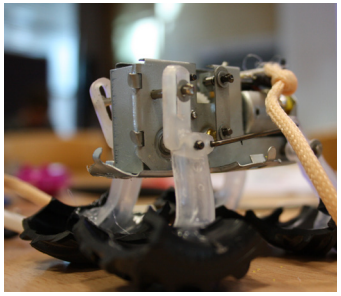


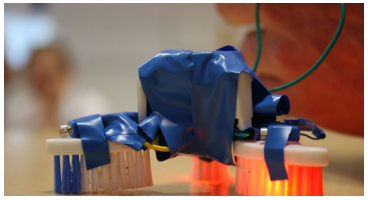
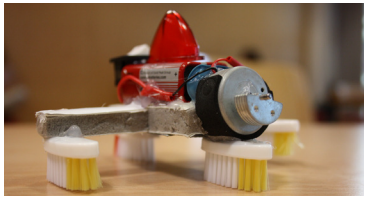
A Quantity of Components as Material

Certain components do occur in groups and thus create a stock of new material to work with.

Movement as Material

Movements of (parts of) artifacts can be conserved, reused or reinterpreted as a material of its own. For instance, here the movement of a remote controlled plush dog got reinterpreted as a "mars rover". Subsequently, the preceding "mars rover movement" was reinterpreted as a "horse", carrying a minion knight.

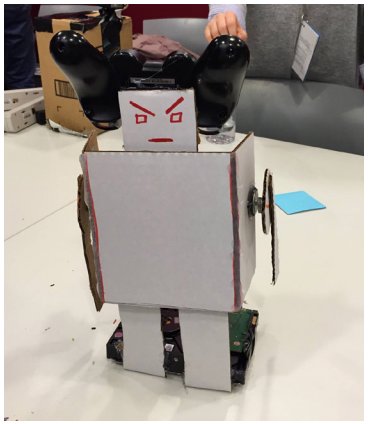




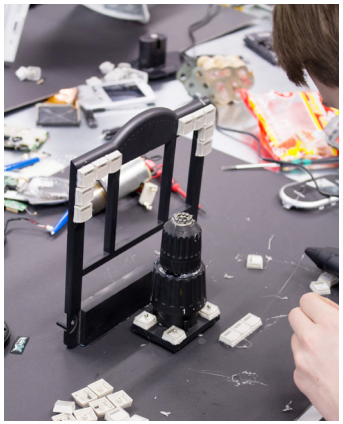

Function as material

The function of individual components provides a material resource to be reinterpreted by creating new expressions. For instance, the rotation of a small handheld power drill, refactored into a pen drawing dashed lines.

The Unfamiliar as Material

Being unfamiliar with the qualities of material components can create suspenseful mysteries and new connections.



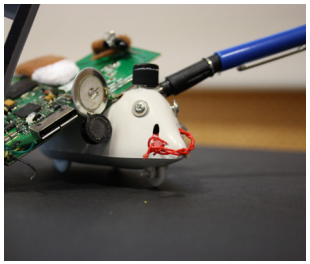


Shape as Material

The shape of components can be reinterpreted in a new composition. For instance, here what used to be an industrial keyboard's casing and keys are refactored into a facade.

Retained Expressiveness as Material

Material gathered from decomposition can carry on some of the expressiveness of its donor, even when the physical configuration and composition is altered.

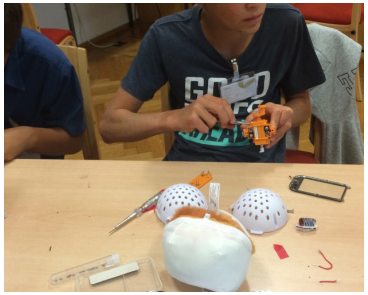


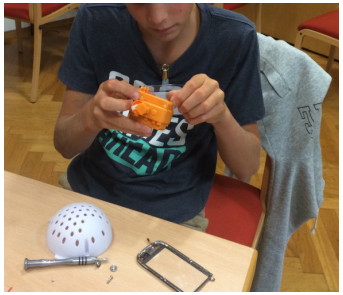
Bim Bim the Nutty Squirrel™, a plush toy. Squeeze it, and it starts shaking and bouncing while emitting a nerve-racking, boisterous laughter.

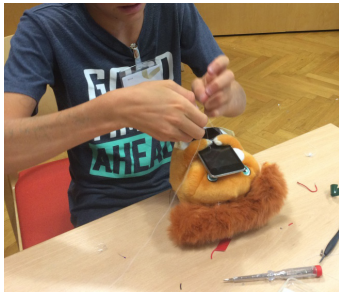
Performance as Material

Entire artifacts can become materials by taking apart and remixing its performative structure.

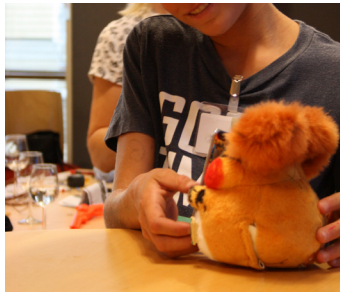
The final design, entitled "trumpster", is still nervously jumping up and down and emitting its annoying laughter, while the iPod touch, reinterpreted as a banner, displays a video loop of the then presidential candidate Donald Trump. Trumpster was a result of remixing not only the original toy's physical parts but its whole performance into a new composition, based on the toy's physical appearance, its movement, and its sound.







After full disassembly and reassembly of the toy, the squirrel's tail got chopped off and reattached horizontally on the head, mocking a contemporary prominent hair flip.



The redesign got further extended by the addition of an iPod Touch and some makeup.

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Conclusions

In this pictorial we presented a workshop program for *making things apart* that aims to harvest the potential of an un-crafting practice for experiential engagement with the materials (technological) artifacts are composed of. The material resources gained are essentially based on, constrained and shaped by the particular artifacts taken apart. Thus, making things apart is not to be understood as method to be applied in conceptual design, but rather as a tool that provides points of departure for engaging with materials in making and design (education).

Those in-situ constraints imposed by the specific nature of a given artifact might moreover be used in a productive way by deliberately selecting objects and technologies to start from, and, thus, providing a targeted material grounding to an open ended, exploratory journey.

While we were not specifically targeting collaborative practices, the greater part of the exercises conducted almost naturally grew into collaborative endeavors. Making things apart as a team effort not only benefits from an extended set of preconceptions and skills, it also has the potential to create shared conceptualizations about the material gathered to be subsequently used in a collaborative construction activity.

The set of nine material resources we derived from a series of workshops provide a glimpse into how the material resources gained are accompanied by material knowledge that is constructed through the act of disassembling. This material can be seen as inherently distinct from material gathered from other sources as each harvested component stays tightly connected to its material history: It carries on the rules that were governing its previous relations to other components. It is this material history that provides starting points for reconfiguration and reinterpretation when disassembling is incorporated in design, making or experimental engineering practices. We hope the nine categories of material resources presented in this picturial can help to better articulate the relations between material and material knowledge we gain by taking things apart.

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