# 2 Identity: How Loose Elements are Connected

This chapter delineates novelty as the articulation of an object identity. It attempts to delineate how a sense of unity evolves in a state prior to an object's full technical realization, when elements are loose and technically unconnected. In a certain sense, the chapter addresses the ideas of an object. However, it is not about thinking, and my argumentation takes a different perspective than that of regarding novelty as an invention based on ideas. I do not attempt to look inside Deimel's and Baecker's heads and give an account of how they thought of ideas, plans, or genius inspirations for their objects. In this respect, I agree with the natural suspicion of sociologists towards processes that are supposed to happen in minds alone. Nevertheless, it is not only disciplinary provenience that keeps me from thinking of an idea as something cognitive; what I have observed pushes the workings of the mind into a peripheral position. Surely, both creators are clever, creative, and highly technologically knowledgeable, but that was already obvious before I started my investigation and before each of them attempted the project of a new object. Still, referring to an "idea" was so repetitive throughout all the conversations that it seems odd to neglect *what this term articulates*. In this respect, I argue that "ideas" articulate an object identity, as they bring together the histories and potentials of objects.

Referring to ideas is as repetitive throughout conversations as the term's meaning is diverse. For a social scientist, this poses a twofold problem. On the one hand, diverse connotations make it hard to pin down an idea as a particular meaning that is inscribed into an object (i.e. as a script), and, on the other hand, their ubiquitous reference makes it hard to ignore that ideas are somehow related to an object's becoming. Latour and Woolgar similarly described this ambivalence when they stressed how difficult it is to ship around thought processes while investigating "laboratory life" (Latour and Woolgar 1986). Thinking seems to be integral to the peculiar and mythical existence of scientists and their creational work, they write. Thus, sociological accounts can hardly keep ideas out of the analysis of an object's becoming. Instead of taking tales of inspiration and ideas for granted, Latour and Woolgar have taken the notion of someone having an "idea" as a condensed summary of a complex series of processes that have faded from the immediate situation. Aside from reconstructing the biographical path an idea has taken, which makes it unlikely for an idea to still be


J. Stubbe, *Articulating Novelty in Science and Art*,
DOI 10.1007/978-3-658-18979-2_2

regarded as an individual act, Woolgar and Latour also have stressed considering the accounting practices that create and sustain thought processes (Latour and Woolgar 1986, 168).

However, their remarks remain rather short. Moreover, most science and technology studies seem to avoid speaking of ideas. Ideas seem to belong to the perspective of novelty as invention, which considers the creation of technology to be based on plans and intention – a paradigm that is thought of as overcome. Knorr-Cetina has reported that early laboratory studies from the 1970s and 1980s introduced the notion of practice precisely as a contrasting term to highlight that "one investigated scientists at work as opposed to the history of ideas, the structure of scientific theories, or the institutional settings of science" (Knorr-Cetina 2000, 9). The observation of practices and their collective and material ways of doing became a methodological trademark of laboratory studies, which differentiated their ethnomethodological approach from the history and philosophy of science. The notion of practice shifts the focus away from mental objects, such as the interest or intention that inform concepts of action, and toward the contingencies of collective knowledge production among heterogeneous agents. This shift seems to have swept ideas away from the vocabulary of science and technology scholars, too.

In this chapter, I do not attempt to work against the paradigmatic shift from histories of ideas toward practices. I retain a perspective that is concerned with the material contingencies of concepts (Pickering 1993), the "dirty work" of aligning ideas and problems (Fujimura 1987), the striving for the immutability of events (Latour 1987), or the locality of knowledge production (Knorr-Cetina 1988) – aspects stressed through the notion of practice. Thus, I do not open heads, but try to delineate what counts for an idea, how it is enacted, and what it articulates – or, to put it another way: what does an idea *do*? These questions focus on what ideas bring together and how they enact stories, materialities, and bodies. Hence, I go beyond Latour and Woolgar's proposition of stressing the trajectories that lead to an idea and eventually dissolve from the stories of invention, and instead avow ideas as significant for an object's novelty.

My heuristic begins by treating an idea as an actor's category. This addresses the stories told when someone speaks of an idea. Nevertheless, I go beyond semantics and do not reduce my account to verbal or written mention of the term "idea." Rather, I attempt to take an idea seriously as a category that is there for a reason – as an agent that does something. Hence, I follow ideas through diverse realms and situations in order to inquire about how diverse elements become coherent and distinguishable without an object's full technical realization. This account begins with the stories that have led to advancing the RBO Hand and *Mirage*, including the traces that inquiries leave behind in the laboratory and studio. Whereas the first section deals primarily with the selection and reenactment of past events, the second part of this chapter deals with how ideas enact the potentials that are to become effective in the future. Here, ideas become tropic narratives and prototypical embodiments, as well as bodily performances. Closing this chapter, I conceptualize how ideas articulate an object identity. To do so, I step into dialogue with the theory of the self by George H. Mead, who regarded individuation as an interactional process based on responding to the attitudes of others.

## 2.1 Enacting the Past through Stories and Their Tangible Traces

This section is concerned with ideas as a matter of enacting the past. It begins with stories of deviation. Deviation occurred through experimental practice and stories retrospectively account for them as relevant for the new project. From these stories, the section moves on and sketches that deviation within material tinkering leaves traces in the laboratory and studio – but only those traces that matter.

### 2.1.1 Stories of Deviation

The RBO Hand and *Mirage* are not historical monoliths. They have a history – a story that is narrated as their origin. Unlike what Latour and Woolgar reported, that referring to an idea erases the path that had led to a thought regarded as original, the RBO Hand and *Mirage* have been accompanied by histories that enacted their trajectories. Such narrative enactments started with referring to an idea.

> "Such ideas develop over a longer period of time." (Brock, RBO Hand)

Although I had met Deimel several times, and he told me about the idea behind the hand, it became clear that the trajectory that eventually led him to build the Hand began earlier. Hence, I approached the director of the institute, Oliver Brock, and asked for an interview to get an impression of the Hand's origins. The director begins his story by stressing that such "ideas develop over a longer period of time." It all started in a previous position of his, when he worked with a colleague who was engaged in computer vision. Together, they thought about what kind of perception a robot would need for grasping an item. He referred to how the problem was usually understood in robotics – namely, as a matter of understanding the geometry of the item. In contrast, they came up with the "idea" that geometry might not be very relevant to actual grasping, but that an item's surface already indicates how it is supposed to be grasped. That means, Brock told me, that the interaction between object and hand leads to successful grasping. When a human hand grasps an item, its specific geometry is not crucial; human hands automatically adapt to an item's shape when they are closed. However, he said, these ideas are mainly about perception.[12] Therefore, he and his colleague moved on and developed basic perception primitives[13], which exploited the ability of robotic hands to adapt to items' shapes. Based on that experience, they agreed that it would make sense to let robotic hands do more work in order to improve a robot's grasping abilities. Such a reallocation of capacities could make the perception and planning of grasping tasks easier. The hand would gain "responsibility" in such an approach, as it would become more "competent." Brock continued and stressed that, in fact, every artificial hand has somewhat of a kind of compliance. Hence, they started to experiment by using standard robotic hands. Eventually, he saw a video of a research group that was building inflatable and flexible things from silicone. In that video, the research group showed how one of those things was able to pick up an egg. Brock recounted that this was the moment he thought, "That is the answer." Brock's and his colleague's following plan was to build a hand as competent as possible, which meant as compliant as possible. Silicone seemed to demonstrate a way that could be achieved: by giving the hand plenty of degrees of freedom and enabling the hand to control them – that is, the ability to comply with an item's shape by equalizing air pressure. Brock continued with his story, saying that, by accident, there was a colleague in the faculty who had actually worked for Disney Research, where researchers had already worked on molding and inflating silicone. Following that encounter, Brock went to Zurich and had a look at how the fellow researcher's group worked and how they fabricated different objects; he had a look at how the whole process worked. When he finally received his current position at the RBO Lab in Berlin, Brock advertised a position for somebody to conduct the project. He assembled all the materials and tools needed to mold silicone, including the first mold, which had a starfish shape. When Deimel arrived, he was immediately able to start working on a robot hand made of silicone.

The story of the RBO Hand, as told by Brock, began with the intersection of his experience from experiments in robot perception and his awareness of research activities that explore the capacities of soft materials like silicone. Connecting both elements, his experience from experiments and the potentials of silicone was necessary in order to come up with the "idea" of a soft hand for robotic grasping.

12 Perception is a research domain in robotics, comparable to grasping.

13 Primitives are developed in robotics as sub-routines or basic functionalities that can be combined with different applications.

Although the RBO Hand has been developed in a setting very different from *Mirage*, and its scientific provenience is clearly indicated in Brock's story, the stories of ideas still share similarities, as the following narrative shows.

> "The finished object is always different from your initial idea. And you simply have to do something new to investigate it further." (Baecker, *Mirage*)

Baecker's history of *Mirage* has no clear beginning. Although there are continuous references that he mentions as ideas, it is hard for Baecker to account for them as starting points or beginnings for that specific installation. Rather, ideas follow him for a certain time, maybe even throughout several works. He might discard them once, but then picks them up again later. He told me that there is always a difference between an initial idea and the finished object. That difference causes him to build something new to investigate it further, as he said. Thus, an idea is not a strict plan, but has materialized several times as prototypes, test structures, simulations, etc. before it is referred to as the idea behind a piece. A common procedure for Baecker is rebuilding ancient technologies that he has read about and that are no longer easily available. There are several material traces of such attempts in his studio. He uses these leftovers to quickly build something new and see what a mechanical movement might look like so as to get a picture of its specific aesthetic.

In this regard, his story about the idea behind *Mirage* also starts with a technical episode. When he and I were sitting in front of his laptop in his studio during one of our first encounters, he showed me a simulation that he found online. The simulation was about sensors that monitor movements in order to predict subsequent steps. These basic algorithms are used, for instance, by short-term weather forecasters. Baecker comments on the patterns on the screen:

> "But when I feedback, these peculiar patterns evolve. And the idea, the analogy is this dream story, that you build a machine that hallucinates. A machine that hallucinates, or learns, or perceives an image and suddenly starts to process and to hallucinate and then re-joins images."

I asked him whether he actively searched for these things. "Yes," he answered, he had looked at different things for a long time. In particular, he looked at artificial neural networks whose development applied dream analogies, too. He referred to Helmholtz machines, which are algorithms used to identify hidden structures in complex data sets. These machines are based on a "sleep-wake rhythm." After researching this idea for a while, he began to program something similar in order to see how it worked and what kind of patterns could be generated from it. For Baecker, approaching the idea of a "dream story" is to render visible the hidden processes of algorithms. He pointed to the screen of his laptop that was still showing the simulation displayed as a moving grid, and he said:

> "It is interesting how these movements evolve and in what direction each point moves next. I use such vectors to predict and generate subsequent images."

The story of the idea behind *Mirage* is that of an inquiry. The story enacts the idea as something abstract (a "dream story") that he had learned about through investigating technological concepts, and that he approached to make it comprehendible. This leads to a series of attempts in which idea and materialization commonly deviate. Baecker does not use the term "idea" to relate his inquiries to a specific installation, but states that ideas follow him. They might be discarded once, but can be picked up again and re-worked.

In this sense, both the stories of the RBO Hand and *Mirage* relate ideas to deviations. They are both stories of exploring technological capacities and accommodating resistance. In the two stories, the term "idea" connects past events, such as when something did not work as planned and deviated from expectations, and attempts to build something new or to explore something in more detail. The storytelling of both actors does not refer to ideas so as to indicate the ingenuity of a single person and, furthermore, does not erase the history of events that led to a new object, like Latour and Woolgar have stressed. On the contrary, these two stories use ideas to select specific past events as relevant for building a new future object.

### 2.1.2 Material Traces

Both Brock and Baecker indicate that deviation was mainly a result of material practice and observing the difference between expectations and results. In both cases, such differences triggered explorations to find solutions or new approaches to their specific problems. However, the histories of such explorations are not just verbally reproduced stories. There are material traces of such explorations, which do not vanish from the surroundings and places of an object's becoming, but remain as materializations of past events.

> "Surely, there is an idea in the background that drives you to move on in specific directions." (Deimel, RBO Hand)

During one of my first visits to the robotics laboratory, I also visited the laboratory's workshop. The workshop is mainly used to maintain the technological infrastructure. Although the institute does not primarily engage in hardware development, and many of their research projects deal with the development of robotic algorithms that run on standard robotics hardware, the institute's workshop is comprehensively equipped. It is located in a large room with several tools, such as drills and electrician equipment. The infrastructure and tools needed to work with silicone and to manufacture the RBO Hand are also located in the workshop. When I was there, most of these tools were placed on one table, which left the impression that it was a designated place within the workshop where the material tinkering practices concerning the RBO Hand took place. The tools on and beside the table included, for instance, apparatuses like a vacuum chamber and a precision gram scale. Furthermore, there were smaller tools for handling silicone, like vinyl gloves (for handling liquid siliconees), polyethylene cups (for mixing siliconees), chopsticks (for mixing small amounts of silicone), and more general tools, like a cutter, scissors, a metal ruler, and a cutting mat. There were consumables like silicone, mold sealant, and sewing thread, too.[14] The tools were not left in a mess, but not in painstaking order either. The whole arrangement seemed to be in constant use.

Close to the tools, at another table, lay a primitive version of the RBO Hand (*Figure 5*). Actually, it was difficult to call that silicone shape a hand, as it was hardly possible to grasp items with it. However, the shape was "hand-like." It consisted of three parallel fingers and a palm. Their size relation was different from a human hand, as the palm was considerably smaller. This proportional difference between fingers and palm hindered the shape from capturing items in order to grasp and hold them. Although this silicone shape did not yet have the crucial capacity of a robotic hand, it was still significant to the RBO Hand's material development. Its significance is the basal functioning of its assembled materials. The shape's main body (fingers and palm) was cast from one piece of silicone, which is approximately 1 cm thick. An inflexible rubber layer was glued on one side of the shape. This layer makes the silicone bend inwards when inflated with air. The whole shape was wound with a thin thread, which prevents the silicone from simply blowing up and directs the air pressure toward a bending movement. Hence, the shape could already perform a capacity, which was of relevance for the forthcoming RBO Hand: it deterministically bends when inflated.

As I picked up the silicone shape to have a closer look, Deimel, who was accompanying me, told me about how they approached the material to use for grasping. He emphasized that silicone is a material that is rather easy to appropriate, since one does not need sophisticated prior knowledge to work or experiment with it. He pressed the surface of the shape softly and said that they, for instance, looked at how various degrees of softness influenced the material's

14 I will go into more detail regarding the manufacturing of the RBO Hand in the following chapter, where I address the Hand's form.

behavior. The possibility of varying softness broadened the scope of possibilities, he explained. The silicone shape, which I held in my hand, was part of such explorations. The sub-optimal size relation of fingers and palm indicated that the shape was produced in order to explore how to direct and control silicone under air pressure and not yet how to accomplish grasping, which would require a different shape or additional material elements. The arrangement of these materials has been significant for the RBO Hand's development, insofar as it is a trace of the exploration of the characteristics of silicone.

*Figure 5:* Hand-like shape in the laboratory's workshop (own picture).

As already indicated, the stories of ideas concerning the RBO Hand and *Mirage* share a similarity regarding their emphasis of deviation occurring in material practices. I outlined that there were material traces of such explorations in the laboratory workshop, where most of the manufacturing and tinkering takes place. In Baecker's studio, traces of past material explorations were ubiquitous.

> "I might have a mechanical idea and then everything coalesces." (Baecker, *Mirage*)


*Figure 6:* Structure for testing the translation of the electric signal into a mechanical pull (own picture).

Similarly to the laboratory workshop, there were several general tools, such as a drill, screwdrivers, and different nippers. More specific to Baecker's practices were tools for working with electricity. These included, for instance, apparatuses like an oscilloscope and a sophisticated soldering station, as well as smaller tools like special nippers for stripping cables. Furthermore, there were several electronic parts stocked in the studio. These included small parts, such as cables and plugs, in addition to more complex ones, such as transformers and electric motor units. Alongside such analogue equipment, many parts were more specific to digital technologies, like a whole box of processors and Arduino boards.[15] In one corner of the studio, there were several wooden boards and metal plates, used shelves and iron bars. The stock of small bits like screws and hooks were too many to list. Most of that kind of equipment was sorted in labeled boxes or designated shelves.

There are no finished or already exhibited artworks stocked in Baecker's studio. He has a designated separate storage place for those. However, there are traces of his work in the studio that are more specific than the tools he uses. Prior to my first visit to the studio, I already knew some of Baecker's exhibited works. Hence, I recognized a pile of plates of acrylic glass, which were used for a previous installation. Baecker told me that they were cut for him and he uses the left-

15 Arduino boards have a large impact on Baecker's work. I elaborate on these in the upcoming chapter concerning *Mirage's* form.

overs as the basis for small prototypes and models. One of such models was arranged on his workbench (*Figure 6*). It was a plate of acrylic glass in which a hole approximately the size of a saucer was cut. There was a mesh of strings, comparable to a spider net, covering the hole. At the center of the mesh was a wire approximately one meter long and connected to a circuit board.[16] The circuit board produced a signal that made the wire contract and deform the mesh of strings accordingly. Baecker told me that he was using these leftovers to test how mechanical pulls translate between materials, such as between the wire and the mesh of strings. Without getting too precise, he went on and said that mechanical delays interest him, in the sense of signals propagating through different materials. This somewhat resembles his idea of giving image to the moving patterns of algorithmic learning. However, when I asked whether it was also a model for his new installation (which eventually became *Mirage*), he denied that it was a model or prototype; it was rather a test for a mechanical idea. He did not yet know if the idea would be sufficiently realized through the test setup.

At both sites, the laboratory and the studio, one can find material traces of inquiries that either relate to an idea for an object or that are significantly related to materializing ideas. However, only selected traces remain. Although it was probably only by accident that I ran into the hand-like silicone shape and the test setup in the studio, they shared a similarity that I consider significant to their remaining. That is, both were unfinished, but already embodied a technical character. They were assembled from different materials and arranged deterministically working technical relations. The hand-like shape deterministically bent, and the test set-up translated an electronic signal through different materials and actuated a mechanical pull. In this sense, both remained as technical units that indicated the material feasibility of an idea.

However, both units were not objects that spoke for themselves. They did not themselves produce a relation to past events, but required enactment to become relevant. Apparently, the spatial proximity of both units within working environments structured part of their enactment and made them easily identifiable as traces of events that took place there. Furthermore, it was Deimel's and Baecker's stories that made me realize the units' significance for inquiring material feasibilities. In that sense, both stories and materialities articulated what mattered and what did not. The stories enacted the basal technical configurations as matters of exploring ideas, not in the sense of finished technical artifacts that embody a concept, but as material traces of an idea's exploration. In this sense, stories of ideas and their material traces select differential patterns that unfold into past inquiries and articulate them as relevant to an object's becoming.

---

16 The wire is hard to identify in *Figure 6*. At the right bottom of the picture, one can see a small post. The wire is attached at its top and from there runs into the middle of the mesh.

## 2.2 Enacting Potentials through Figures, Prototypes, and Bodies

In the following section, I first leave the empirical sites of the laboratory and studio and turn toward published narratives, before I return to the locations to discuss the situated bodily enactment of ideas. The following sections share that ideas are enacted with an orientation toward the future, instead of an orientation toward the past as in the preceding section. Firstly, potentials are enacted through imaginaries and figures, then through a prototype, and finally through the bodily rendering of future objects.

### 2.2.1 Ideas and Their Figures

The narratives that I analyze in the following are texts taken from the project website related to the RBO Hand as well as a text written by Baecker for the exhibition flyer that accompanied *Mirage*'s first public appearance. Both texts were written prior to each object's technical realization. The website text concerning the RBO Hand was published on the institute's website right after work began on the project, whereas the text for the exhibition flyer was written a few months prior to the finalization of *Mirage*'s. What matters is not so much the date of publication, but that both texts enact the significance of both objects apart from their technical realization based on shared imaginaries and figures.

#### The Drowsy Human as an Ideal for Robotic Grasping

The institute's website[17] presents several research projects categorized by seven research domains. Among these, one is labeled "Compliant Manipulators," under which falls the RBO Hand. Besides pictures and web videos, the website also displays a short text that introduces the overall research objectives within the domain. The text starts with an episode that is not necessarily scientific, but is an imagined everyday scenario that is comprehendible to public audiences:[18]

---

17 This passage refers the structure of the RBO Laboratory's website: http://www.robotics.tu-berlin.de/menue/research/ (last accessed September 11, 2015).

18 The passage cited was copied from the website http://www.robotics.tu-berlin.de/menue/research/compliant_manipulators/ in December 2014. By September 11, 2015, the wording of the last sentence had changed slightly, and the website showed a picture of an advanced version of the RBO Hand, the RBO Hand 2 (cf. Deimel and Brock 2014).

> "It is early morning and you just woke up. Sleepily you head over to your coffee machine, grab a mug and hit the switch. You don't waste a thought on what you just accomplished, while slurping down some black hot goodness.
>
> Why is this seemingly easy process such an accomplishment? First, your delicate machinery of nerves, muscles and tendons changes its properties all the time, depending on whether you were just asleep, being alert, frightened, or just tired. At the same time, your senses might not give you reliable information about your environment, especially when being drowsy after just having woken up. Despite these complications, you grab your favorite coffee with ease!
>
> We want to achieve the same grasping reliability, by using Compliant Manipulators."

The episode starts with a scenario that is probably comprehensible to all visitors to the website: making coffee while still half asleep. The protagonist of this imagined episode does not execute every single step of making the coffee consciously, but fulfills the task without thinking about it too much. The story interprets this mundane activity as an accomplishment. The text sees the accomplishment in the fact that we do not need to be aware of the complex workings of the human hand in order to fulfill easy tasks like making coffee. In such situations, the complex mechanics of the human hand work independently of our consciousness. Interestingly, this aspect of the story entails a paradoxical situation for the problem of grasping: on the one hand, grasping is a complex relation between hand, environment, and senses, and, on the other hand, human hands work somewhat autonomously in mundane situations. The ability of the human hand to cope with this problem with ease makes it a tool whose "reliability" is what the research institute wants to achieve "by using Compliant Manipulators."

I would like to point out two aspects of the story that relate the text to the larger context of robotic grasping: Firstly, the story has a protagonist whose senses are dizzy. This "drowsiness" is crucial to the analogy of the human protagonist to robotics research. In robotics, realizing specific dexterous grasping is less problematic than fulfilling easy tasks in undefined environments. This is reflected in robotics literature, which considers grasping in unstructured environments as a pivotal research issue of the field (cf. Balasubramanian and Santos 2014; Ben Amor et al. 2014; Dollar et al. 2014). In this regard, unstructured environments are comparable to the "drowsiness" described in the story, as it refers to malfunctioning sensors that cannot gather or proceed with sufficient information about the environment to fulfill a presumably easy task. In the text, this state does not seem to be problematic for humans, since mundane tasks do not require totally consciousness of every step taken. Secondly, the language used in the story is not arbitrary, but typical for robotics research. The anatomy of the body is described as "delicate machinery" that continuously changes its configuration in seamless and undetected interrelation with the environment and differing states of the body. The term “machinery” entails the complex workings of intricate mechanical elements. The precision and accuracy of the human hand makes it a unique tool that is admirable in terms of its delicate engineering. Describing the human body, and the human hand in particular, as an ideal “machine” is typical for literature on robotic grasping. In his book *Robot Evolution* Mark E. Rosheim has reported that the human hand’s complexity has fascinated scientists and artists for centuries. He described the human hand in technological jargon as consisting of “a total of twenty degrees of freedom” and “driven” by approximately forty muscles (Rosheim 1994, 190). In that sense, the story figures the human body/hand as unique in terms of its complexity and autonomous functioning. The story uses language that addresses the reader directly and stresses that we tend to forget the admirable workings of our bodies, which enable us to fulfill complex tasks easily.

Both aspects, the problem of grasping in unstructured environments and the complexity of the human hand, are current research issues in robotics (cf. Bicchi 2000; Dollar et al. 2014; Ben Amor et al. 2014; Balasubramanian and Santos 2014). The story of the website provides a pictorial illustration of these problems. However, I think the story goes beyond illustrating problems in the following regards:

Firstly, the story positions the research idea in a larger robotics imaginary. The scenario reiterates the analogy of human and machine, which is a constitutive signifier of humanoid robotics and well described in science and technology studies (cf. Riskin 2003; Hayles 2005; Suchman 2007; Castañeda and Suchman 2014). The constitutive relevance of the figure “human” also holds true for the specific domain of robotic grasping, which is structured through continuous reiteration of what the crucial aspects of human grasping are in order to implement these in the design of robotic hands (cf. i.e. Balasubramanian and Santos 2014). Within the story of the website, the human-machine analogy converges in the term “compliance.” It becomes a buzzword that signifies the approach of the RBO Laboratory in that domain. Surely, compliance belongs to the common terminology of robotic grasping (cf. Controzzi, Cipriani, and Carrozza 2014), but, in the case of the story analyzed here, compliance is signified by referring to an imagined human scenario, which is tropic, as it articulates associative meaning from diverse realms and categories of existence, namely between human everyday life and robotic grasping.

Secondly, the story unfolds the idea of solving the problem of robotic grasping from the same humanoid imaginary. It does not claim to copy human hands in general, which would also be a sensible thing to do in robotics, but proposes a focus on the relation of environment and the hand under conditions of insufficient sensory information. This focus stresses interactions between environment, hand, and sensors, and is made comprehendible through the drowsy protagonist, who wants to make coffee. In that sense, the story figures human grasping as an ideal, but equally does not propose mimicry of the mechanics of the human hand; it rather proposes a shift of the research focus, away from sensory information toward partial autonomy of the hand. In order to do so, the story does not draw upon the human hand as a category, but instead renders a human capacity. The story enacts the reliability of human grasping under the specific conditions of unreliable sensor information as an accomplishment that is admirable for robotics grasping. In that sense, the story is not only an illustration of research problems, but uses the imaginary human realm to signify the shift from grasping as a planning problem toward an interactional approach that builds upon a more competent hand. Hence, the story accompanying the RBO Hand is similar to the figure "human," as, for instance, described by Suchman. She has addressed how humanness is selectively enacted in robotics and AI research as categories of existence that signify the presumable essence of being human and, in this regard, the humanoid's boundary position between human and machine (Suchman 2007, 226ff.). Similarly, the story of the RBO Hand figures a specific human capacity as the relevant criteria for robotic grasping – human grasping becomes an ideal, in this sense. The story is tropic because it connects an imagined human scenario with the technical realm of robotics.

### Signifying the Dream Story

When asked about the idea for *Mirage*, Baecker answered with the "dream story" I have already mentioned above. In that story, he indicated that the figures of his artwork are drawn from his inquiries into mechanical apparatuses and their combination with contemporary digital technologies. In contrast to the origin story of the RBO Hand, which Brock mainly characterized as a technological endeavor, Baecker did not separate his material inquiries from the figures he had in mind. For instance, he spoke of his intention to "build a machine that hallucinates." In his story, technologies and myth entail each other, which is indicated by the figural language he used to explain what he did at a practical level.

After the interview with Baecker, which was our first meeting, in May 2013, I wrote field notes about the story and was curious about how the figure of a hallucinating machine would change over the course of building the installation. Hence, I was surprised that the terms "dream" and "hallucinate" actually remained within the story that accompanied the finished installation. That story is a text authored by Baecker prior to *Mirage*'s first exhibition and was later published in a refined version on his website[19] and in the exhibition catalogue of *Mirage*'s first public showcase in April 2014:

19 Baecker's website: http://www.rlfbckr.org/work/mirage (last accessed September 11, 2015).

> "*Mirage* generates a synthesized landscape based on its perception through a fluxgate magnetometer (Förster Sonde). A fluxgate magnetometer registers the magnetic field of the Earth, which is dependent on the suns activity and feeds it into an unsupervised learning algorithm for analyzation. At the same time the algorithm that is based on the principle of a Helmholtz Machine 'hallucinates' variations of the previously analyzed signal. […]
>
> I am speculating that the computers in the enormous Google data-centers cut off their perception (search queries, user behavior, speech recognition, image data) once a day and start to 'sleep.' What do their 'dreams' look like?"

In that story, the reference to the Helmholtz Machine, which Baecker had already mentioned in the interview in May 2013, remains. The reference is crucial because Geoffrey E. Hinton, creator of the Helmholtz Machine, made use of the wake-sleep metaphor (Hinton et al. 1995). Hinton applied the term to describe a class of artificial neural networks, which is a scientific domain that attempts to use biological neural networks as concepts for building algorithms. The discourse of artificial neural networks is prominently structured through anthropomorphic figures, similar to artificial intelligence as such (cf. Hayles 2005). Thus, the term "sleep," which Baecker used in the story that accompanied *Mirage*, is part of the same narrative realm applied in Hinton's texts concerning the Helmholtz Machine and AI in general. In this respect, one cannot state that the idea of building a "hallucinating machine" is something that has grown in Baecker's head alone, and he does not claim that this is the case. On the contrary, he even reiterates where he took that particular figure from and informs the reader about existing concepts that combine algorithms and the figures he uses to signify his artwork.

Still, the idea of *Mirage* seems original and individual in the text. I see the reason for this in the use of figurative language. Whereas the aforementioned story of the RBO Hand used an imagined scenario firstly to render a human capacity as an ideal for robotic grasping and secondly to embed this idea in a larger robotics narrative, the story that accompanies *Mirage* extends an existing narrative. The story picks up the wake-sleep metaphor of the Helmholtz Machine and goes beyond it by playfully leaving the reader with the question, "What do their 'dreams' look like?" In that way, the story embeds *Mirage* in the existing narrative realm of wake-sleep algorithms, but extends it by taking the figure more seriously than expected, as it moves from "sleep" toward "dream."

The choice to extend the narrative toward a machine that dreams or hallucinates is sensible for signifying an aesthetic installation. Unlike sleeping, both terms are related to pictures and images created through or within activity. Dreaming and hallucinating are both activities through which images evolve that are not controllable for the mind that produces and perceives them. Both terms implicate generating images without controlling them. This indicates an interesting tension for an image-generating installation. It indicates that the image, which is produced through the laser projection, is not a controlled artistic act, but a visual technical process that happens beyond human control and is caused by complex interactions among heterogonous agencies, such as the Earth's magnetism and digital algorithms. The text describes the visual image produced through such contingent technological processes as a "synthesized landscape." This trope is distinguishable and significant in its reference to a peculiar origin within the hidden life of the machine. In that sense, the trope "dream" connects *Mirage*'s visual aesthetics with a figurative account of a machine's hidden agencies.

The figural narratives of the RBO Hand and *Mirage* continue the object stories described in the previous section as well as embed these within larger technoscientific imaginaries. Through the figurative language, both ideas receive an orientation toward the future, which is concerned with potentials and not with origins. Furthermore, both stories individuate the objects. They reiterate culturally shared analogies between human and machine and use established narrative strategies. Nevertheless, both stories also break with the figures to which they refer. They select very specific aspects of shared imaginaries and alternate them. Through such narrative diffraction, both stories articulate shared technoscientific figures, past inquiries, and imagined potentials.

### 2.2.2 Embodying Material Potentials

> "There are many ideas and perspectives, but no dominant form." (Deimel, RBO Hand)

The robotics institute's website not only displays the text that I have interpreted above, but also displays web videos and pictures. Surprisingly, the website does not present a sophisticated version of the RBO Hand – not in the beginning of my ethnography in 2012 and not when I accessed the website in December 2014, at a time when the RBO Hand was already technically advanced. Rather, the website shows pictures and a web video of early attempts at using silicone as a material for grasping. One of these attempts was the starfish mold that Brock also mentioned as being one of the first shapes they produced after he bought the infrastructure to work with silicone. The web video is located shortly below the text and headlined with "Starfish Grabber."

The Starfish Grabber is made from a single piece of silicone consisting of six "fingers" (*Figure 7*). It is clearly far from being a sophisticated robotic hand – the Grabber is not part of a larger robotic structure, nor does it give the impression of being technically mature. Rather, it is left in provisional appearance – it is attached to a crude wooden stick, and its texture is left uncovered. Apart from its different shape, it is manufactured similarly to the hand-like silicone shape discussed above. It has an inflexible inner layer that makes the silicone bend inwards, and its fingers are wound with a thin thread to prevent them from blowing up. The web video shows the Starfish Grabber attached to the wooden stick and held by a human hand. The video starts by showing how the Grabber bends with air inflation. After fading in the headline "Starfish Grabber in Action," the human hand positions the Grabber close to an apple, which the Grabber easily captures with its silicone fingers. Then, another headline that reads "Grabbing from Suboptimal Positions" fades in. Now, the hand does not position the Grabber above but beside the apple. The Grabber captures the apple from this suboptimal position, too.

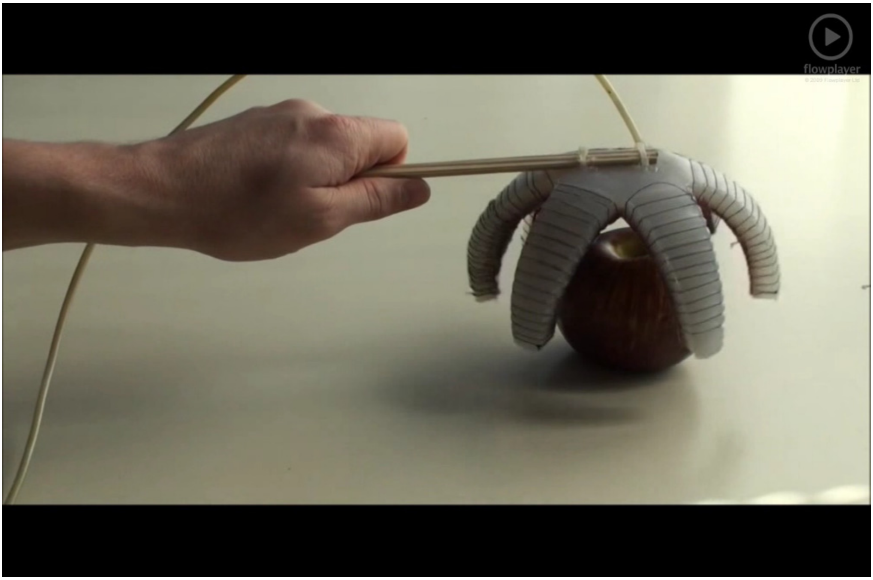



*Figure 7:* Starfish Grabber (source, Robotics and Biology Laboratory).

This last scene indicates that the Grabber's soft material is potentially beneficial for grasping under imperfect conditions, as the material easily complies with the new surface. In this sense, the Starfish Grabber somewhat materializes the human capacities figured in the story above. The Starfish Grabber's ability to grasp the apple from a suboptimal angle refers to the human capacity to grasp with insufficient sensory information. Clearly, the Starfish Grabber does not perform grasping comparable to that of a human hand, but the video presents what the text describes as an "accomplishment" that can – in principle – be realized for robotic grasping as well. Whereas the material trace of a hand-like silicone shape was enacted as a trace of exploring silicone, the Starfish Grabber is enacted through the video as an embodiment of the silicone's potential to perform reliable grasping based on interaction instead of sensory planning.

### 2.2.3 The Bodily Rendering of Future Objects

In the following, I show that the embodiment of ideas is not merely a storytelling practice nor exhausted by materializing a specific capacity. Rather, the enactment of ideas is a situated bodily practice. For this analysis, I draw on two video sequences recorded in the laboratory's workshop and studio (cf. Stubbe 2015). I first describe both situations before I interpret them together.[20]

> "The idea behind it is actually that interaction is of primary importance for grasping." (Deimel, RBO Hand)

The first sequence is an excerpt from an interview that I conducted with Deimel (*Figure 8*). The interview was part of the same visit to the laboratory that I have already reported above. The sequence continued after Deimel had shown me the hand-like shape. By now, we were sitting down at a table.

Besides its hand-like shape, there is another preliminary version of the RBO Hand lying on a metal box. This particular version is more advanced. It shares the basic design of the hand-like shape, but has an additional silicone element that is stronger than the fingers and molded like the ball of a thumb. With the addition of this element, the palm has a larger surface and better supports grasping, due to the element's rounded shape. Furthermore, the hand is connected to an air compressor and a computer so that its basic grasping function can be demonstrated.

20 The analysis of the video recordings has been methodologically informed, in particular, by Charles Goodwin's sequential interpretations (Goodwin 2000), Hubert Knoblauch's focused ethnography (Knoblauch 2001), and Lorenza Mondada's focus on multiple temporalities that conflate in material practice (Mondada 2012). Charles Goodwin's studies also point out ways to compare small-scale interactions. For instance, he compares interactional patterns in sequences of young girls playing hopscotch with archaeologists classifying colour.

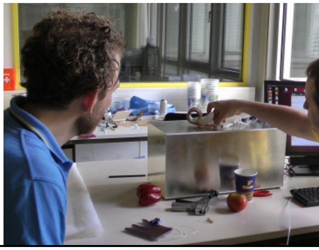
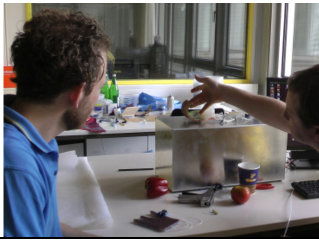
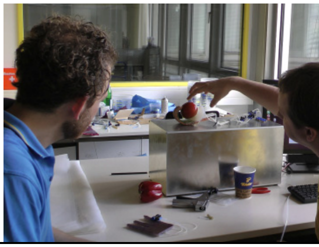
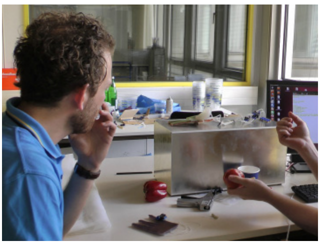
| | Time | Still of the Video | Transcript |
|---|---|---|---|
| I. | 00:55 |  | Deimel: "*You only need one signal: inflating, releasing. But you can make very complex deformations from that. This is usually not done in robotics. Typically, electric motors have very good, linear characteristics. With these rubbers, many interactive things happen with the environment.* [presses some keys; the silicone hand coils up] |
| II. | 01:45 |  | [positions his spread fingers between the finger tips and palm of the silicone hand] *It is soft.* [puts an artificial apple into the silicone hand] *When something gets into the hand, its form adapts to it.* |
| III. | 01:56 |  | [mimics a round form with his hand; the apple rolls out of the silicone hand] *This is exactly what we want to make use of here. That the hand is not steered; where the fingers have to be or how much pressure or power has to be applied. We create another kind of communication of the hand.* |
| IV. | 02:24 |  | [takes the apple in his hand, waves it, and puts it back onto the box] *And we just try to establish as much surface for contact as possible. The more contact surface you have, the better it grasps. Surely, it does not always work, but this is generally the basic principle."* |

*Figure 8:* Enacting the silicone's softness and potential for grasping (own video).

Deimel opens the conversation by explaining the basic advantage of a robotic hand made out of silicone, which he sees in the low signal processing needed to enable complex grasping. He points out that this is not a typical approach for robotics, which is still dominated by hands operated with electric motors. A crucial difference between his Hand and others is the "many interactive things" that happen in relation to the environment. He enacts this in Frame II, in which he demonstrates the Hand's softness by easily spreading its fingers with his fingertips and placing an artificial apple into it in order to show its ability to adapt to its environment. After this practical task, he continues in Frame III by explaining the more abstract principle behind it. His and his colleagues' idea is to "create another kind of communication" for a robotic hand, as opposed to steering it. In the last frame, the pragmatics of this "communication" are again emphasized by referring to the importance of the contact surface for good grasping. The fact that this "does not always work" highlights the exploratory character of their novel approach to grasping. The sequence is a bodily enactment of the silicone's softness and a demonstration of the material's potentials for robotic grasping. Deimel's body is an interactional resource that connects the material artifacts at hand, the conceptual ideas behind the hand, and what he regards as my expectations regarding robotic hands in general.

> "The idea now is that you place an elastic element somewhere here." (Baecker, *Mirage*)

The second sequence shows Baecker and me in his studio (*Figure 9*). We are not doing an interview as I did with Deimel, but casually chat while I observe him during his mundane creative practice. Baecker is working on a new test structure. This new test structure consists of different materials than that which I have addressed as a material trace. It is made from two wooden plates, hooks, threaded bars, strings, nuts, and bolts, as well as customized pulleys and an elastic element. The two plates are attached through the threaded bars; the space between them is approximately 40 cm wide. On each plate is a grid of hooks onto which the customized pulleys are attached. One string is run through several pulleys from one plate to the other. At one end, the string is not directly tied to a pulley but to the elastic element, which is connected to a hook.

The sequence begins with Baecker explaining how the new test structure works. First, he points to the elements that are already in place. He signifies these by referring to "a kind of delay" that is supposed to evolve through a specific ordering of strings, pulleys, and the elastic element. In the second frame, he starts to refer to the anticipated aesthetics, which are supposed to evolve through a kind of movement that appears to propagate through the structure. By moving his arm like a snake, he mimics what kind of behavior he would like to achieve. He emphasizes that this is a challenge. In the following frame, he relies on my ability to imagine what he has in mind. He expects me to imagine how he will continue to build the test structure in order to figure out if he will be able to

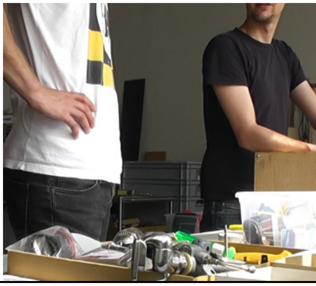
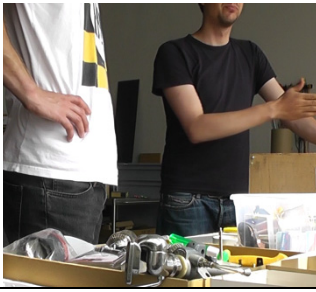
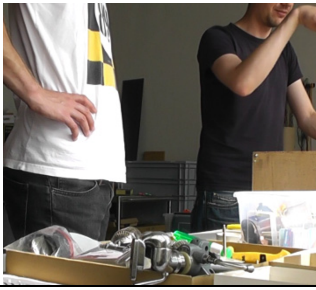
| | **Time** | **Still of the video** | **Transcript** |
|---|---|---|---|
| I. | 02:35 |  | Baecker: *"When you attach this one, then it moves…*<br>[points to the pulley]<br>*The idea is now, if you build in an elastic element; so when I make the movement here, it arrives over there three seconds later, as a kind of delay. Then a string is tightened between the parts.* |
| II. | 03:06 |  | *Then you have a kind of line, which propagates through it.*<br>[makes a snake movement with his hand]<br>*And to have that in several dimensions, so you have a row. I would additionally hang that separate.*<br>[orientates his gaze and hands towards the wooden panels]<br>*… so this is hard.* |
| III. | 03:35 |  | *Imagine this was there in every row, like four, five times, then I would replace this hanger with that.*<br>[makes a bow movement with his hand]<br>*So the whole system is hung in two dimensions, totally detached, totally sprung. Only at every entrance does a signal enter.*<br>[points to the end of the wooden structure]<br>*So there is a motor or a cord entered here and here.* |
| IV. | 04:10 |  | *And you actually have a wafting area. You have a wafting area through which this is wandering through slowly. The best is a closed circuit that is only triggered once. I always had something like a landscape situation in mind."*<br>[continues to pull the string through the eyelets] |

*Figure 9:* Enacting the "landscape situation." (own video)

establish the propagating movement within a closed circuit (Frame III). Furthermore, I should also grasp the image that he has in mind. The first image is a "wafting area" – an image close to the movement of strings, which lie partly assembled in front of us. The second image is "a landscape situation" that he had in mind as an initial idea for the installation. In the sequence, Baecker's body connects the rudimentary test structure at hand with the figures of his artwork. By embodying and acting out the "landscape situation," the imagined image becomes part of the shared reality between him and me.

Both situations stress consideration of the objects' enactments as framed through interaction. In particular, the stills of the video recordings capture distinct bodily activities in these interactional framings. Firstly, there are pointing gestures. They accompany explanations and indicate what Deimel and Baecker are referring to when they talk (cf. Goodwin 2000). In the second sequence, for instance, these pointing gestures select those parts of the structure that are described as crucial to establishing the anticipated movement. Secondly, there are gestures that mimic and physically enact the future object. This bodily simulation is a distinctive form of enacting epistemic objects that have not yet materialized, but that are referenced in communicative situations. Myers calls such bodywork "embodied imagination" (Myers 2008, 165). In her study on protein modeling, she argues that material and mental models are not to be regarded as dualistic, but rather as deeply entwined. Through embodied imagination, researchers incorporate the inner structures of models and enact them as epistemic objects. They use their bodies to make graphical objects tangible, and they employ gestures and movements in communication with novices in order to flesh out and relay their knowledge about otherwise only virtual objects (Myers 2008, 180). In both sequences, I am such a novice. In the first sequence, Deimel uses his body not precisely to mimic the Hand, but to enact the distinctive difference of his silicone Hand from how he expects me to think robot hands typically work. In order to do this, he demonstrates the softness of the silicone Hand by easily spreading its fingers with his. He does so without force or additional programming, so I can comprehend the Hand's compliance. As already mentioned above, this compliance is a basic principle of the Hand's distinctive kind of grasping. Nevertheless, here it is not referenced through a story like above, but through Deimel's distinctive bodily movements. In a similar but not identical way, Baecker makes use of his body, not to enact the test structure as such, but the idea behind it. The snake movement in the first sequence (Frame II) gives body to the not-yet-realized aesthetics of the future installation. Its realization might still be far away, but the image of "a kind of line that propagates through it" already structures the situation at hand. Both situations are co-produced by my bodily presence, which is reflected in the specific gestures Deimel and Baecker use to enact their objects. I cannot tell whether they would have acted similarly toward somebody else (probably yes), but, crucially, what the sequences indicate is that articulating an idea is a situated practice across material assemblages, bodily movements, and accompanying stories.

## 2.3 Articulating an Object Identity

For the preceding empirical analysis, I regard ideas as articulations. This stresses what ideas connect instead of what they make vanish. This is how ideas connect heterogeneous elements from different temporal, discursive, and material realms to create a temporal sense of unity. That perspective is the opposite of regarding novelty as invention, which would consider ideas as plans or objectives. Furthermore, the perspective pushes ideas back into the scope of science and technology studies, because articulations begin by treating ideas as actors' categories that *do* something. In the following section, I approach the question of *what ideas do* in more abstract terms than before in order to delineate how novelty becomes part of a shared reality. In the following, I sum up four typical articulations of ideas from the preceding section before I turn to the work they do in the remainder of this paper. I regard this work as building an object identity.

### 2.3.1 Four Articulations of Ideas

First, an idea articulates *selected pasts*. The stories in the first section enact past events, inquiries, and explorations as relevant to how the idea for an object emerged. They do not enact any elements, but only those that mattered. What mattered to both actors was the deviation that occurred in material practices. Brock emphasized that ideas developed over a longer period, through different experiments and intersections. Baecker similarly reported that a finished object was always different from an initial idea, and this deviation made him investigate something further. In this sense, an idea is not a narrative element that erases the trajectory of an object, as Latour and Woolgar would stress. Rather, ideas mark selected pasts as relevant and make differential patterns accountable for an object's becoming. This concerns the general production of temporality. The narrated histories of the RBO Hand's and *Mirage*'s origins produce their own temporal order by marking what matters and what does not. This marking refers to an idea and relates its formation to past events. By visiting places of inquiry, one encounters that marking is not only a narrative practice, but also entails material traces that sediment past inquiries.

Secondly, ideas are figurative, *which makes future objects relate to and contest shared imaginaries*. This is shown in both ideas' enactments as part of larger technoscientific imaginaries. In the case of *Mirage*, the imaginary was the story of the idea's initial expression. Baecker mentioned the dream story and a machine that hallucinates as the idea that drove him to build *Mirage*. In the case of the RBO Hand, imaginary and idea seem to have a different temporal relation. Brock regards the idea as a logical consequence of inquiries, and its positioning within a larger imaginary is more a second-order storytelling that signifies the research approach. However, despite these differences, using tropes made both future objects coherent, as they relate their respective ideas to a shared imaginary that signifies the object's potentials. This is not to say that ideas were mimetic or representational. Rather, tropes enact ideas as capacities that signify an object's future existence and, in particular, its difference. Figures not only relate anthropomorphically to technical realms, but also extend, modify, and contest them in order to render specific human capacities significantly different from the common interpretation of that imaginary.

Thirdly, an idea's potential is not only a narrative promise, but is *co-produced through concretization*. This meaning of ideas requires movement beyond an idea as a semantic term and stresses consideration of material processes that open an object to meaning-making. The pragmatic entailment of idea and materialization is shown, for example, in how Baecker reports that he "might have a mechanical idea and then everything coalesces." In this sense, an idea and its materialization have a twofold relation: a) ideas are inscribed in the engineering of an object, and b) technical elements need to be assembled in terms of their internal resonance in order to open up for attribution (Simondon [1958] 2012a). The second relation was the condition for the Starfish Grabber to exist as a meaningful object. Its embodiment does not resemble a robotic or human hand, but, foremost simply works as a functioning unit, since the unit has the capacity to grasp an apple from a suboptimal position. This technical concretization opens the object to articulating the feasibility of compliant manipulators and its potential for advancing robotic grasping. In this sense, concretization co-produces an idea's potential.

Fourthly, ideas are *situated enactments*. The bodily rendering of ideas brings into focus what the previous sections have implicitly carried or marginally noted: ideas are enacted in specific situations in response to expectations and immediate interactional resources. Both sequences capture how expectations co-produce the performance of what is original or different. I, a researcher who is interested in the actors' projects, am inscribed into what is regarded as interesting or worth emphasizing. Both actors address me personally, which entails addressing my expectations. This includes gestures that mimic or perform objects and respond to my bodily presence. Furthermore, in both situations, future objects are enacted through several interactional resources as stories, materialities, and bodies. Such resources give body to an idea and connect what was once separated. Here, ideas articulate immediate situations of materialities, expectations, and bodies with the images and potentials of future objects.

### 2.3.2 Object Identities

Now, I want to turn to the work ideas perform and reflect upon the tension between individuating and relating objects. Whereas the preceding four points make up a summary of the actors' meanings of ideas, now the focus is on what these articulations do to the object in terms of its novelty. In the following, I approach this question through an analogy.[21] This analogy is Mead's theory of the human self (Mead [1934] 1967, 135ff.), which I use to think through the ways in which an object becomes something coherent *and* significant. My claim is that ideas, as I have rendered them in the preceding section, work toward an *object identity*.[22]

#### The Generalized Other: Biographical Trajectories and Kin Objects

Mead's theory is one that is concerned with the genesis of the self as a social process. He began his theory by sketching the initial structure from which this genesis proceeds. In this step, his theory is already marked as one that focuses on

21 Using an analogy is a way to learn something about what is not yet understood through something that is better understood. In this sense, I want to learn something about objects and novelty, and, in order to do so, use Mead's theory of the self to find interesting similarities, connections, or differences in comparison to my analysis. This methodological approach is inspired by Strathern's style of analogical comparison (Strathern 1991; Strathern 1999; Morita 2014). To clarify, I do not transfer Mead's theory onto my object theory, which would entail claiming that all *a priori* assumptions (i.e. that it would be nonsense to assume the relevance of thought processes for objects), as well as entailed processes, match. Instead, I use selected elements of Mead's theory and ask if I can find similar patterns or movements in my material that are significant to an object's novelty in a state of previously disconnected elements.

22 Ideas are part of Mead's theory, too. Mead's understanding of ideas as responses to social demand (Mead [1934] 1967: 180/1) is not contradictory to my analysis. Nevertheless, I see no epistemic potential in transferring his understanding of ideas into my analysis, as this would entail giving up the inductively articulated four meanings of ideas. Mead's understanding of ideas is too abstract and restricted to his theory of human conduct; the primer offers no epistemic resistance for my analysis, and the other would transfer my focus onto conduct and away from articulations. Hence, when I speak of ideas in the remainder of this study, I mean my account and not Mead's.

the social as explicans. He stressed that what people consider a self is constituted by the collective's and individual's relation to it. Crucial to relating to the collective is language and the use of symbols that stimulate response. Through reflective observation of such responses, and the ability to take on another's role, one can find or build his/her relation to the collective. A children's play already entails this process and Mead considers play an initial phase in the genesis of the self. Whereas play already entails self-awareness, it is the game that requires handling of the attitudes of the some toward another. In a game, one needs to organize the multiple attitudes of different players in order to participate and compete. In order to cope with this complexity, we act upon the collective in a generalized way – upon the "generalized other," in Mead's words. The structure from which the self is built is the response of the generalized other. From this understanding, being part of a community is the initial condition for the self's becoming, and the self is immanently social (Mead [1934] 1967, 164):

> "No hard-and-fast line can be drawn between our own selves and the selves of others, since our own selves exist and enter as such into our experience only in so far as the selves of others exist and enter as such into our experience also."

What does this mean for the work done by ideas? Mead stressed that language is a means through which one relates to another. In the beginning of this chapter, I stress that an idea is foremost a category in the actors' language. In their first articulation, ideas structure events as they unfold the trajectories of the inquiries and experiments that have proliferated something deviant. By referring to an idea, the not-yet-realized RBO Hand and *Mirage* are placed in relation to selected past events and receive a biographical origin. This is not a causal relationship and does not determine the path a technology takes. On the contrary, telling origin stories is a matter of constructing coherence or a sense of unity in an otherwise messy past – and language is a means to doing so. Furthermore, language not only structures the biographical route an object has taken, but also a future object's position within a generalized collective of pre-existing objects. For instance, the story of the RBO Hand's origin continuously refers to the Hand as resulting from a research process within the field of robotics; it refers to the problem of grasping in unstructured environments, which is a shared problem in the robotics community and to which the Hand is a response. Similarly, the idea of *Mirage* not only signifies the material inquiries that took place in an isolated studio; additionally, inquiries led to attempts at building objects that were similar to scientific apparatuses, and hence referenced technologies that were not akin to *Mirage* by origin, but via the desired behavior. As such, the idea for *Mirage* articulates the Helmholtz Machine into a figurative story. In this sense, the ways ideas work upon objects is analogous to the power of the language and shared symbols that constitute the genesis of a self: they articulate an object's biographical trajectory and the generalized collective of kin objects, both of which are the initial conditions for an object's identity. In this sense, ideas organize the generalized others that exist and signify the game that is played.

### Becoming Distinct through Rituals

The self, or an object identity, is built upon this background. Mead emphasized that the self is built from interaction among individuals, which in return entails that the collective exists before the self. Nevertheless, having said that, the question remains as to how something becomes distinct. Addressing this question, Mead continued his argument by stressing that the self arises when one takes over the responses of the others into one's own conduct. When the attitude of the others affects conduct, in the sense that one takes on attitudes and replies to them with corresponding gestures, then a subjective self comes into being (Mead [1934] 1967, 167). This is a matter of becoming distinct from others and taking on attitudes requires self-consciousness. In that sense, Mead said, being self-conscious and reflectively responding to one's own position in conduct means becoming an object to oneself (Mead [1934] 1967, 172).

However, searching for an analogy between self-consciousness and the genesis of an object identity has little potential for understanding how an object becomes distinct, as Mead's theory draws on a thinking and reflective human being that is very unlike the objects that I investigate here. Despite this undisputable difference, there is a passage in Mead's theory in which he proceeds from the question of how one becomes subjectively distinct toward the special case of how one reacts against the disapproval of the collective. For Mead, there is only one way in which we may change the attitudes of a whole group, which is "setting up a higher sort of community which in a certain sense out-votes the one we find" (Mead [1934] 1967, 167-8). In so doing, one can stand out as oppositional and go against the world with the potential to change it, or at least the other's attitudes. Integral to convincing the other is speaking with a voice of reason, with "voices of the past and of the future" (Mead [1934] 1967, 168). For Mead, this is the only way the self can obtain a voice that is more than the voice of the collective. With a voice of reason, one is not simply bound by the collective, but may reform the order of things. This speaking out is embedded in social rituals. As an example, he drew upon a day in court, which is a critical situation wherein the self is oppositional to the judging other. The defendant may present his/her views in order to change the other's attitude. Speaking out is not only a right one has, but foremost a duty in order to legitimately change the attitudes of a community. The self is mutually oppositional and part of the collective in this situation.

Bringing about changes takes place through the ritual interaction that enacts the distinct positions and roles of participants.

This episode in Mead's theory on how the self becomes subjective has more potential as an analogy for an object identity than the previous remarks on self-consciousness. By comparing Mead's theory with the four articulations of ideas, which I outline above, one can draw connections between how ideas organize the others that exist and how they make an object distinct through basic rituals before it is fully realized. Similarly to Mead, the first and second articulations focus on the use of language. In the first articulation, ideas relate selected past events and future activities. The crucial situation of their enactment is the basic methodological procedures that have brought such stories about: the interview. The interview requires the ordering of past events and signifying the object that is about to become. In light of Mead's remarks, such situations are rituals in which selected past events are presented as stories of reason that legitimate the position of the self. In rituals such as an interview, one has to mark what is distinct about a new object and how its characteristics are a matter of directed explorations. The object becomes part of a biographical trajectory and distinctly different from what came before. In their second articulation, ideas are stories that build upon figurative accounts of shared imaginaries. Mead regarded such stories as "setting up a higher sort of community." These stories embed a future object in shared imaginaries, but also go beyond them, as they emphasize disregarded elements or extend a narrative. Both strategies entail abstraction in order to set up a higher form of narrative that mutually allows embedding an object in a shared imaginary and alternating the imaginary. This strategy is similar to the defendant in court, who gives an account of law through abstracting and relating elements of his own crime. In this sense, the figures of the RBO Hand and *Mirage*'s accompanying stories are legitimately oppositional, as their deviance builds upon the beliefs of shared imaginaries. Surely, the analogy is limited so far as ideas do not make an object fit the common standard like the defendant would try to in court. What the analogy allows is the connection of ideas and the ways an object is justified as meaningfully different. In this sense, ideas articulate an object identity, as they embed an object in the imaginaries of a collective and mutually give reason to its opposition.

### "I" and "Me" as Meaningful Potentials

Continuing with his theory, Mead elaborated on the mutual character of being part of a collective and becoming distinct. He captures the organization of both with his prominent distinction between the "I" and the "me." Whereas the "I" reacts to the self, the "me" is the organized set of the other's attitudes to which the "I" reacts (Mead [1934] 1967, 174-5). Mead considers the "I" as the part of the self that responds to attitudes it is confronted with – it is impulsive compared to the "me," which mirrors the attitudes of the collective: "the 'I' gives the sense of freedom, of initiative" (Mead [1934] 1967, 177). In that sense, the "I" is the part of the self that causes diffraction as it moves into the future and pushes off expectations. Mead wrote that the steps of the "I" are "in a certain sense novel" (Mead [1934] 1967, 177). Whereas the defendant in the example above mainly attempts to find a language that legitimizes his opposition, the "I" is pre-social and not concerned with fitting into the given order. On the contrary, fitting expectations is how the "me" structures the self.

In the object stories of the first articulation of ideas, I addressed deviation as a central narrative element. Whereas I consider deviation as a narrative construction above, in the sense of giving reason to the biographical trajectory of an object, Mead's theory of the "I" suggests taking the material inquiries of the object stories for granted. If I take the stories of deviation for granted, the inquiries Brock and Baecker have reported on were structured by an idea with a strong "I." Brock reported that the idea of the RBO Hand was a consequence of experiments concerning a different topic. Their experiments enacted resistance that was accommodated by following a new direction (cf. Pickering 1995). Similarly, Baecker's inquiries responded to deviation between his idea and the contingencies of material practice. Analogously to Mead's "I," these material inquiries entail resistance that enforces movement and changing of the given order.

However, this is one way to use the analogy of the "I" and "me" for an object identity. However, I do not want to go deeper in that direction, as it entails giving up a critical stance. Still, there is another aspect in Mead's theory of the "I" and "me" that is significant for the work performed by ideas, as I understand them here. This aspect is the relation between impulses through material inquiries and the expectations of fitting a specific object type or label such as "robotic hand" or "media installation." I have already outlined that ideas organize the others that exist and how they embed an object into the imaginaries of a collective. Whereas this aspect focuses on how ideas become part of shared meanings and manipulate them through language, the analogy for the "I" shifts the focus onto micro scales of accommodating ideas. This accommodation is addressed in the third meaning of ideas, which captures the co-production of ideas through material concretization. The example of the Starfish Grabber shows how an idea gains potential through material assemblages with a technical character. The Grabber's functionality indicates that an idea has the potential to solve a collective problem – namely, solving the collective problem of grasping from suboptimal positions by using silicone as a material for robotic grasping. This collective problem is similar to what Mead regards as the "me," because the problem articulates expectations of a new robotic hand. The potential of the silicone responds to these expectations, not in the sense of a defendant as referred to above, but by enforcing a new material form, the Starfish, that is uncommon to robotic grabbers but responds to the collective problem. In this sense, there is a reciprocal relation between material impulses and collective expectations. The work done by ideas is analogous to coping with the struggle between the "I" and "me." Ideas articulate impulses and expectations as they enact material potentials in a form that makes them meaningful to the collective.

## Embodiment and Materiality

These analogies raise questions regarding what role materiality and embodiment play in building an object identity. So far, I have focused on the power of language and only stress in the last paragraph how ideas articulate material potentials and expectations. Left out is the embodiment of ideas, either through material objects like the Starfish Grabber or bodily enactments as captured in the fourth meaning of ideas. Surprisingly, the role of the body is somewhat neglected in Mead's theory of the self. Although Mead indicated that gestures and organisms are implicated in an individual's response to the world, he conceptualizes the genesis of the self as a cognitive process (cf. Gugutzer 2001, 70). This is surprising, so far as Mead was a social theorist who largely attended the physicality and materiality of social processes. If I change my method for now and do not treat Mead's theory as an analogy between self and object identity, but rather take his theory literally as a social theory of conduct, then I can use his remarks on symbolic interaction to better understand how Deimel and Baecker enacted their objects bodily and how this enactment pushed forward an object identity. For this interpretation, I take up how Mead addressed materiality in his philosophy of conduct (Mead 1987).

Mead regarded the physical environment as not exterior to the mind; rather, he regarded our bodily response as always implicated in how we act toward material things (Mead 1987, 88ff.). For Mead, we identify the universal character of things by anticipating how we respond to them. Our response is not naïve, but meaningful through experience and the significant gestures and symbols that we use to communicate a thing's character. In that sense, our bodily response to things is included in how we communicate an object's meaning (Mead 1987, 103). To a certain extent, there is not much new coming to the forefront if I retell my account of the bodily rendering of ideas with Mead's words. I have already addressed how bodily gestures respond to Deimel's, Baecker's, and my bodily presence, and furthermore how they used their bodies to either act out the physical character of an object or to enact an object's material behavior. In both situations, bodies communicate an object's character through meaningful gestures that consider bodily presence, just as Mead said.

However, there is another aspect of Mead's theory that he might not have focused on explicitly, but which I would like to push to the forefront. It is how the object's technical character transduces[23] diverse realms (cf. Simondon 2009, 11). Mead randomly addressed this aspect by mentioning how our anticipated physical response is continued in conduct (Mead 1987, 95). By transducing, I mean how the silicone's behavior and respectively the behavior of *Mirage*'s test structure continued in Deimel and Baecker's bodily movements. Though the bodily rendering of ideas, Deimel and Baecker flesh out the object's physical behavior that is not yet realized, but which becomes part of a shared situation through its bodily enactment. Deimel enacts the silicone's potential for robotic grasping by using his fingers to demonstrate its compliance. Similarly, Baecker continues the movement of his test structure by mimicking a snake movement with his arm. In both situations, gestures act out those parts of an object's technical physicality that are not yet fully realized, but that are meaningful to an object's novelty, as they signify its potential to be different. These unrealized characteristics of an object become part of a shared reality by continuing the partly realized behavior of material elements in another realm, the body. In that sense, Deimel and Baecker respond to an anticipated physicality that implies their experience of physically engaging with the materialities at hand. Their bodily movements push forward an object identity as far as they enact the missing, but meaningful, physicality of an object.

To sum up, analogously to and in dialogue with Mead's theory of the self, I delineate four aspects of an object identity articulated though ideas. Firstly, ideas organize the others that exist, as they signify an object's biographical trajectory and reference its generalized collective of kin objects. Secondly, ideas articulate stories in rituals, which embed an object in the imaginaries of a collective and mutually give reason to their opposition.[24] Thirdly, the work performed by ideas is the articulation of impulses and expectations, as they enact material potentials in a form that makes them meaningful for the collective. Fourthly, ideas respond to situations, as they transduce different material realms. In all four of those aspects, ideas articulate an object identity as they simultaneously individuate and relate an object; they are necessary for articulating coherence in the diversity of materialities, stories, and bodies that make an object.

23 Transduction is an operation that propagates from one element to the next (Simondon 2009: 11).

24 In the third articulation of novelty, I address biographical rituals, too. There, I address them as passage points, like *Mirage's* exhibition. In contrast to the identity building here, later passage points require an object's realized efficacy.

### 2.3.3 Novelty as Object Identity

I open this chapter by stressing that ideas have somehow vanished from the rhetoric of science and technology studies. Either they are neglected as belonging to the perspective of novelty as invention, and hence lie outside the ethnographic interest in differential patterns, or they are shipped around as they evoke associations of paradigms that are not concerned with the "dirty" practices of laboratories. In the preceding section, I show that ideas can be beneficial for investigating the becoming of technological objects; given, one takes them seriously as what they are in the first place: an actor's category – a trope that belongs to the stories of an object's becoming. In that sense, the analysis of ideas is a methodological access point to studying how symbolic, material, and bodily elements articulate a sense of unity in an otherwise messy constellation. Furthermore, using ideas as a starting point creates comparability, as they make up an empirical category that appears in various situations across cases and sites. Such an approach to ideas is not contradictory to the practice orientation found in science and technology studies, nor in the more general perspective of novelty as differential pattern, because it does not take ideas for cognitive plans or intentions. Rather, it builds upon the symmetrical perspective that signifies the methodology of laboratory studies and takes into account the diverse realms via which an object exists.

The genesis of an object identity takes conceptual inspiration from the perspective of novelty as biographical passage. Object identities, as understood here, share with that perspective a concern with novelty as a process of meaning-making and the conceptual analogy for human socialization. In contrast, I focus on activities like selecting and re-arranging diverse elements so as to create meaning that takes the response of generalized collectives into account. This is different from the approaches summarized as biographical passages so far, as it connects accounts of collective meaning with the future orientation of actors and their prototypes. In this regard, object identities can be related to the discussion of scenarios and expectations in technological development (cf. Lente and Rip 1998; Lente 2012; Schulz-Schaeffer 2013). This discussion elaborates on how imaginaries and scenarios coordinate collaborative actions. My analysis of ideas relates to this discussion as far as it shares the interest in stories and how ideas build a reality that becomes the symbolic habitat of new technologies. Whereas the discussion mainly remains on a macro level, I add that such realities not only repeat on a macro scale, but are foremost negotiated with individual objects and experienced in immediate micro-scale interactions. The object identities delineated here do not simply relate to a larger scenario or general expectations, but always contest these. Such contestation is an interactional practice across diverse realms and signifies an object's novelty.

Novelty, in this regard, is the articulation of meaning. It goes beyond language, since an object's individuality and difference is *made* with materialities, which remain as traces of differential patterns or embody and signify potentials. *Novelty as object identity is the* sense of unity *that connects biographical trajectories, shared imaginaries, and generalized collectives, as well as materialities and bodies that come together in interactional situations*. It is a shift from the unconnected toward joined elements with a shared identity.

http://www.springer.com/978-3-658-18978-5

Articulating Novelty in Science and Art
The Comparative Technography of a Robotic Hand and a Media Art Installation
Stubbe, J.
2017, XII, 245 p. 30 illus., Softcover
ISBN: 978-3-658-18978-5