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Laursen, Linda Nhu; Jensen, Ole B.; Löchtefeld, Markus

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By Linda Nhu Laursen, Ole B. Jensen and Markus Löchtefeld

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Series editors:
Linda Nhu Laursen
Ole B. Jensen
Markus Löchtefeld

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Contents

Design Vocabularies aims to clarify and promote a dialogue about core concepts in design, which are relevant across contexts, disciplines, and scales. The series addresses the understanding and prevalence of the conceptual apparatus in design. Language is a vital part of human connection. Vocabulary lays the foundation for both the construction and communication of knowledge. It allows us to share our ideas, thoughts, and experiences with others.

Design Vocabularies manifest themselves in three ways. First, as words that designers may express themselves with. Second, as 'more-than-words' like for example diagrams, sketches, mock-ups, models, and other ways in which designers articulate their ideas. Thirdly, a design vocabulary is a 'horizon' or a frame within which the designer thinks and works. The book series asks each of its contributors to unearth how their theme connects to these three different forms of vocabulary practice.

The insights communicated in the series are all research-based and linked to 'what we know for now', but in a straightforward, operational hands-on manner. Design knowledge is practical knowledge! The series is aimed at students, practitioners, and others thirsting for more knowledge on the conceptual apparatus of design.

The concept of affordance

Intro

Look around you... Most of the environment, the cities, the buildings and the things that we surround us with every day are human-made. They have been designed by us humans, to make life easier, more convenient, and more enjoyable, or at least to fit a purpose. We have designed them to suit us, to make many potential actions possible for ourselves - to provide certain affordances.

You might have heard the word affordance. When encountering it the first time, it for many brings associations to the verb 'afford'. Can you afford it? You might remember it as a kid, getting a certain amount of money, and figuring out which candy you could afford in the store. Afford entails the question of whether something is made possible by the resources you possess. The concept of affordance is its cous-

in, it is the noun that makes it possible for us to describe, study and understand the encounter. What actualizations are made possible in the meeting of a human and a thing or a space? Children often explore the affordances certain things or objects provide, what can this be used for? What actions are made possible? Children experiment with affordances to understand the properties of the environment in relation to their abilities.

As such affordance describes an object or space in terms of the actions made possible for the human in the meeting of a design (or non-design) of anything. Affordance is a key concept across all scales of design, as it allows us to not only understand a site, structure, or object in terms of its physical, aesthetical, and material, properties but how these relate to the abilities of humans or animals and their opportunities for actions. For an object "to be graspable, an object must have opposite surfaces separated by a distance less than the span of the hand." (Gibson, 1979, p 133). In that way, affordances seek to capture the possible relation, the complementarity of the objects or environments properties and the human's abilities and intent.

Relational

Affordance connects the physical properties of a thing, surface, structure, or sign with the reasoning and abilities of a human, to then describe the opportunities for actualizations. Take as an example, this book. You can read it if you want to, that is if you are intending to. In fact, a book affords reading but only if you can read, are able. As such affordance refers to the inter-

action, the relationship between a thing and a human (or animal). For a toddler, the book does not afford a reading, at least not on its own. For a baby or a dog, the book may even not afford to pick up, as they may not be able to grab it. As such affordance is defined as the relation between the abilities and intent of the user and the properties of a designed object. It is related to behaviour made possible, depending on the recipient.

"An affordance cuts across the dichotomy of subjective objective and helps us to understand its inadequacy. It is equally a fact of the environment and a fact of behaviour."

Gibson, 2014

As such the concept is a key term to explain the interaction that arises between a recipient and a thing, or a site, and how a design may move us. Affordance describes how the properties of a thing, or an environment make a potential action for humans possible. It refers to what Gibson described as "-able", e.g an apple is eatable, a chair is sit-able and a ball is throw-able. Affordances relate the 'objective' properties of a thing, with the 'subjective' experience and abilities of a recipient, thus describing opportunities for actions. It grasps how a thing, or a site and its properties relate to humans and their experiences. In other words, affordances are not features of a given artefact or space. Rather, they are relational qualities that we find when assembling bodies (humans or non-humans), spaces, artefacts, and technologies. So, asphalt affords a smooth ride given your body is in a vehicle with rubber tires compared to if you are driving across gravel or cobblestones.

Agency

Next to being a relational phenomenon, affordance is about agency (or distributed agency). This is one of the very important features of affordance, because not only does that explain why things and spaces are important to us. It also means that we (rarely) 'act alone'! Humans almost always rely on things and spaces that have been designed and made in order to act in the world. We may 'act with' the shovel and remove snow from the pavement in a very different manner than if we had to shovel snow with our bare hands. So, my agency for shoveling snow lies beyond my bodily capacities alone and is actualized by the assemblage of my body, my shovel, the snow, and the pavement (plus perhaps the gaze of angry neighbors). This notion of 'actualization' is important. The Canadian sociologist Rob Shields coins it this way:

"Affordances are the kind of interactions you can engage in conjunction with a given site or element. For pavement, you can walk on it; you can sit on it; you can drive on it … you have to actualize it as this or that. What will it be? It is your choice at any given time. So, in the actualization of things, people may play essential roles. But one should not underestimate the materials: their hardness, their softness, their ability to maintain a shape. All this makes the material a player in a way that is significant, causative not causal."

Rob Shields in Fariás, 2010, p. 297

So, what it's going to be eh? Seen this way, affordance is a concept that allows for choice. You may choose to actualize particular material conditions in the world in specific ways. Such

as walking on the pavement. After all, you could have chosen to jump on one leg or perhaps even lie down and roll over to pass down the street! So even if the notion of affordance seems to be related to things and spaces, it speaks even more to what it means to be human. To have choices and make these out of a range of options is a fundamental feature of the 'human condition'. And this dimension speaks both to how many choices designers are able to offer the acting human, as well as it speaks to the values and ethics behind the choices made. The notion of affordance allows us to understand how we act with designed things and spaces and what that means for us as humans.

So, to round off this first chapter. While this book is about affordance, we also hope the book in itself provides a rich set of affordances. We hope you may start 'reading' it. If you have the physical version you may 'flip-through' it, as the pages afford 'turning'. We made it small, thus easy to 'handle' and 'carry' around with you. It may be 'stowed' in your bag, or your jacket pocket. The affordance of any design, such as this book, suggests what you can do, and cannot do, not what you must do.

Beyond the intended affordances, that is the actions the designers intend people to take with their products, there are also the rich unintended affordances, which the product may be used for. As for this book, we can name several unintended affordances, for example: If you are cold, you may use the book to light a fire. Or you may use this as paper to draw on or rip out pages to make paper planes of. You may also throw it if

you get angry. Or use it to stuff under one of the legs of the table to make a tilting table stable. Affordances present humans (or animals) with more or less meaningful opportunities for action.

Origin and Relevans

"The *affordances* of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment."

Gibson, 1979 p. 128

Gibson

This quote above may be the most cited definition of affordance, which touches upon the complementarity of offering and abilities. It was made by the American environmental psychologist James J. Gibson in 1979 in his book 'The Ecological Approach to Visual Perception'. Gibson originally introduced the term

affordance in 1966 concerning ecological psychology, as he was interested in understanding the relationship between animals (including humans) and the physical world, more specifically what the physical environment offers or what opportunities things provide to humans. As such he introduced it as a relational concept, to be able to explain the complementarity, the relationship between the environment and the human (or the animal as he noted).

In a sense, the concept implies values and meanings of things are external to the recipient and may be directly and naturally perceived. Thus, the composition, structure and layout of surfaces and objects, constitute what they afford. That means, according to Gibson, that affordance is neither subject nor object:

"The affordance of something does not change as the need of the observer changes. Whether or not the affordance is perceived or attended to will change as the need of the observer changes but, being invariant, it is always there to be perceived. An affordance is not bestowed upon an object by the need of an observer and by his act of perceiving it. The object offers what it does because of what it is."

Gibson 1977, p. 78

With the introduction of affordance, Gibson argued that 'organisms' and 'environments' complement each other, thus both should be studied in conjunction, in their natural habitat, rather than separately. Thus, affordance not only concerns one or the other but the complementarity of these elements.

Lewin

However, Gibson was inspired by Lewin (1917) who as a World War 1 soldier had experienced how environments, buildings and things possess certain 'suggestive characters' depending on the present intentions or goals of the human. While Lewin did not discuss affordance explicitly, he gave the example of how a building for a farmer is a shelter and home, but for a soldier depending on their situation and intention may either be a site for hiding or for attacking. Lewin pointed towards embodied experiences in the relation to space and things, depending on our intent in the situation. This note on intention, how we humans experience as immediately given within our intentions, was key to Lewin understanding of things 'Aufforderungscharacter', that is the intentional relations between human and environment.

Norman

Where Gibson introduced the concept as invariant, while relational, but external of the receiver and perceiver, Don Norman, who later picked up the term, emphasized the unique relatedness. He stated how the specific relational measure is what distinguishes affordance as a concept from measurable physical properties.

"An affordance is a relationship between the properties of an object and the capabilities of the agent that determine just how the object could possibly be used... Whether an affordance exists depends upon the properties of both the object and agent."

Norman, 2013, p. 11

As such the affordance of things is external to the human, while also being uniquely relative to each individual. Thus, affordances are external and describe how a thing can possibly be used by a person. The relationship between a thing's properties and a person's perceptive capabilities determines the affordances. As such affordance according to Norman centers around perception, a person's past knowledge and experience. So, what makes an affordance is both something very physical (*can I open that bottle with this knife?*) and something cultural and experiential (*how do I pay on the bus with a rectangular piece of plastic?*).

Where many of Gibson's examples include 'animals' and the 'environment'. Norman specifically works with 'an agent' and 'an object'. Thus, for him, the affordance of an object is how it appears to be useful to a person. He makes the distinction between 'real' affordance and 'perceived' affordance. It is the perceivable, actionable properties or features of a thing. Therefore, his focus of study went from Gibson's study of surfaces, layout, and structures, towards the question of perceived affordance, how to identify the visual clues that make the affordances of the tools apparent.

Gaver

Later, Gaver (1991) contributed to this discussion with a framework to precisely distinguish what kind of affordances can be inferred from perceptual information available to the user. He aimed to be able to differentiate between the potential of perceived- and potentially misinterpreted affordances. The framework is visualized in Figure 1.

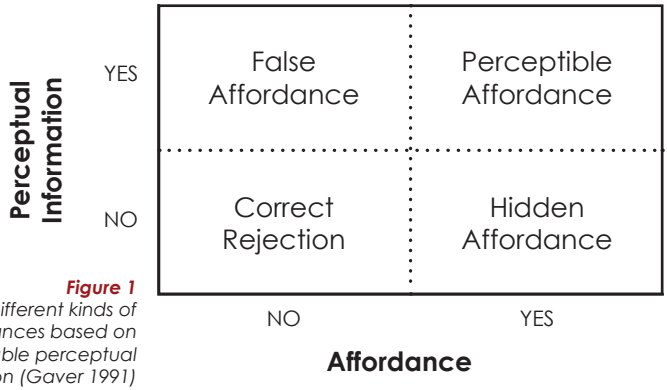


Figure 1
Different kinds of affordances based on available perceptual information (Gaver 1991)

It illustrates the different kinds of affordances based on the available perceptual information. A 'false affordance' occurs when there is no action possibility despite the presence of misleading information. An example of this is a door handle that cannot be turned and only has decorative functionality. In contrast, a 'correct rejection' occurs when no affordance is available and no perceptual information indicates it. A 'hidden affordance' describes a case when in reality an affordance is present, but there is no perceptual information available to the user. An example would be that you can use the back of a kitchen knife to crush garlic or ginger. Most of the time "hidden affordances" are alternative use cases, however, they can also be on purpose and meaning. For example in dementia care facilities, doors (e.g., to staff areas or exits) are often hidden by stickers or wallpaper e.g. appearing to be a bookshelf to divert people with dementia to use the door. Comparing this classification to Norman's interpretation of affordances, both 'false affordance' and 'perceptible affordance' correspond to Norman's 'perceived affordance'

(the top row in Figure 1). Norman's original definition simply considers perceptual information as the critical factor, so when it exists, whether or not the actual affordance does, it is still considered a perceived affordance in Norman's sense.

Heft

The psychologist Harry Heft criticized Gibson for focusing on functionality and not meanings and the subjective 'readings' of the environment (Heft 2010). And further, Heft was attentive to what he termed the 'attraction' by which he alluded to affective and emotional relations that would also influence how we make sense of the environment. This we may for example find in children's playful attitude to a bench. An 'adult way of seeing' the bench would perhaps restrict our understandig of the bench. (i.e. offering opportunity for rest). Heft wanted to expand the notion of affordances understood by the human in the situation to also include the ludic, affective, and ambient. Needless to say, these dimensions are important additions to Gibson's notion of affordance that allow our analysis to include even more subjective dimensions of human's understanding of their environments. In this context, the main takeaway point is that understanding the affordance of an artefact, or a space moves beyond simply its material functionality to also include how it is understood contributing to the atmosphere and the subjective understanding by the person(s) present.

Ingold

Anthropologist Tim Ingold also contributed with a critique that proposed revisions of the notion (2011). He argues that Gibson seems to

have a fundamental assumption that the world consists of discrete 'objects' and that these are there before we enter the situation where we assess their relevance to our actions. Ingold prefers to blur the distinction between humans and the environment but finds that Gibson is putting too much emphasis on the objects and environment, and too little on the living being making sense of it (p. 79). Ingold's critique suggests that Gibson separates the 'animal and environment' in a way that is not right for understanding the relation. His critique has to do with the reduction of the objects to what they are on their own.

Ingold would (inspired by philosophers such as Heidegger and Merlau-Ponty) rather insist on including the animal in understanding the affordances of the objects. Ingold is trying to capture the 'full situation' and how the animal's relation to the environment and objects are key to understanding the affordances. Trying to grasp how we as actors are part of the affordances and not just coming into an environment full of them in advance is a powerful and sensible correction of the term. Elsewhere (2022), Ingold is describing the affordance thinking within environmental psychology as falling into two camps: a realist and a relational. The former (where he thinks Gibson belongs) is seeing affordances as related to the object's properties in themselves, whereas the latter (that he sees himself closer to) sees affordance as something that comes into being with the co-presence of animals, objects, and environment. He puts it squarely as: 'No creature, no affordance' (p. 53), which is similar to the relationship that Norman describes as affordances.

Davis

Moving even closer to the contemporary we find the sociologist Jenny L. Davis' application of affordance to understanding the 'power and politics of everyday things' as the subtitle is called for her book 'How Artifacts Affords' (2020). The key thing to her is that the notion of affordance allows us to understand how we act in the world with things, but without falling into the so-called trap of 'determinism' (p. 7). In other words the lure of thinking that technologies or things 'make us do things'. In her understanding, an analysis using the notion of affordance needs to allow for free will and choice on behalf of the animal/human in question. Being strongly informed by a pragmatic interest in people's actual actions, Davis also argues that the important question is not 'what' technologies (or artefacts, or spaces) afford but rather 'how' they afford. Substituting the 'what' question with the 'how' question leads to a better understanding of social action as related to processes, dynamics, and variation. The stuff that our messy social life is full of rather than rational, linear, plans of progression.

Davis is interested in coining an operational understanding of affordance that lets us understand 'how objects enable and constrain' our acts in the world (p. 11). Davis makes an operational and very accessible framework that stresses the notion of 'dexterity' which refers to the capacity of someone to enact the functions of an object (or a space) (p. 94). Here she shows an important bridge to critical disability studies and research on how we need to consider both physical and cognitive capacities when design-

ing. Furthermore, much design leaves out people with different bodily and cognitive capacities be that either lack of skills to navigate for example complex urban environments or the lack of ability to walk stairs if one is a wheelchair user. So, for Davis, the notion of affordance is also a theory and concept that allows for a critical and ethical assessment of the design of everyday living spaces and artefacts.

At a glance

The view into the evolution of the concept and how authors have treated it differently also highlights the complexity, nuance and depth of the concept. While revising the texts, we might still not have that 'perfect grasp' or understanding of the concept. All authors, however, agree that it is a concept that in its essence describes complementarity between humans and the environment or artefact, it is a relational concept that is key to understanding not only the environment or the human but what bridges them.

In the text, we also highlighted several important critiques of the concept. It is important to understand that diverse perspectives and criticism are what move our understanding and increase our reflexivity. So rather than being defensive or dismissive we should think of the criticism as constructive ways of improving the value of the notion of affordance. Of course, you could find a critique that on its own completely dismisses a term or a theory. But that is not the case here. The critique we present here is rather helpful amendments and revisions that make us wiser. Also, we see that thinkers within fields as diverse as psychology, anthropology, and soci-

ology have found it worth criticizing and revising Gibson's notion of affordance. This is in our understanding a very good sign. When more disciplines 'claims' an author, a theory, or a concept, it is a sign of impact and relevance.

The discussion above gives a glance into the rich discussion around the affordance concept. It is important to note this is a 'frozen' picture at a certain point in time in each of the author's life. Our purpose has not been to identify one definition of 'affordance', but rather to deepen and nuance the discussion of how a concept evolves over time, also as exemplified in the case of Norman how his understanding matures and changes over time. The chapter in its essence shows how a concept is interpreted differently by different authors in different domains and disciplines. It also highlights the academic tradition and discipline in which a community together, discusses, critiques, builds and works with a concept. In the following chapters, we will unfold how affordance is situated and applied across different domains of design.

Affordance across design disciplines

Affordance in architecture and urban design

When thinking through how the notion of affordance makes sense in the context of the architecture and urban design the potential array of examples is huge. All the spaces, buildings, and sites we move into and through during our mundane everyday life are designed and assembled in ways that support and prevent different activities and practices. Hence, one might say that understanding architecture and urban design is very much about knowing how to orchestrate affordances for human actions. A parking lot in front of a shopping mall affords the customers to buy many goods whereas having only a bus stop will afford less volume in shopping (which is why IKEA would not be happy only having bus stops and no car parking!). A theatre with adequate spaced seating and a good positioning thereof relative to one another will afford that the audiences can see and hear the actors.

When thinking of mobility within urban spaces or buildings, stairs afford muscular-powered mobility whereas lifts afford mobility where you do not need to exercise any bodily effort.

Urban design

We could go on with many examples. However, let us dive a bit deeper into one particular case. Elsewhere, Lanng and Jensen (2022) describe the park behind the old castle in Aalborg. This is an old space with links to when the castle was built in the period of 1539-1555. There are reminiscences of what might seem like a fortification with the sloped ramparts that define the park as a green space (fig 2).

However, the truth is that the castle was not worth much for keeping enemies out and at the gates. What it did do, however, was to work as space for the king's tax collector. Today, the park is a public space and the topography of its slopes may indeed be interpreted through the concept of affordances. So the question to ask is: *what are the affordances of these sloped ramparts?* And of course, the answer is that there are many more affordances here than we can possibly mention. This has to do with the park being what Mike Waltzer (1986) terms an 'open-minded space'. That is to say, the programming and 'scripting' of what the architect or urban designer imagines people could do here is very open and loose. Riots, parties, concerts, picnics, ball games, kite flying, poetry readings, sleeping … The list is endless! But let us zoom in on the topography and the sloped ramparts. These are the defining physical features that give the space its identity. But they are also important clues to what

Figure 2
Urban slope, Aalborghus Slotspark, Aalborg, 08/07/2019, 6:58 PM (photo: Ditte Bendix Lanng, in Lanng and Jensen 2022, p. 44).

affordances we may find here. In their analysis of the park, Lanng and Jensen list a few of these (p.46) :

- *The slope affords a rest at the foot of it;*
- *it affords a playful, unrestrained run downwards;*
- *it affords cloud watching on the soft grass;*
- *it affords a struggling bodily effort to get to the top – perhaps pulling the sledge up on slippery snow;*
- *it affords a privileged position from which to see and be seen.*

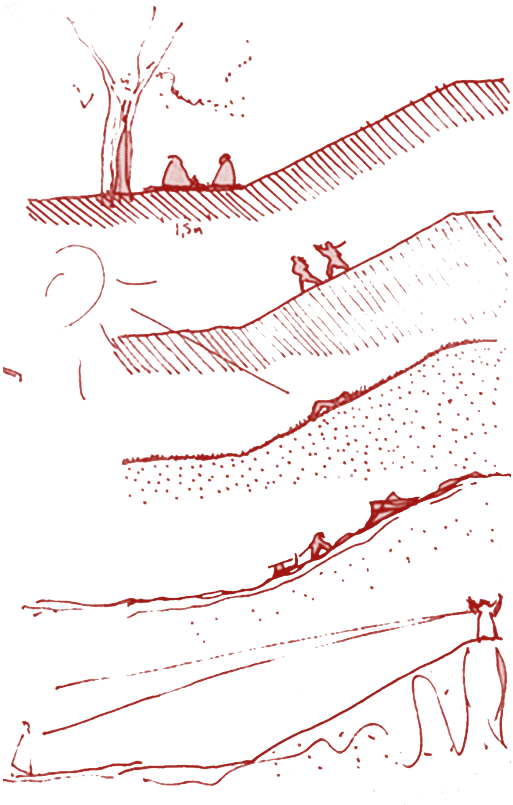


Figure 3
Five diagrammatic sections, Slope of Aalborghus Slotspark. (Ditte Bendix Lanng in Lanng & Jensen 2022, p. 45). The rendering is based on the analysis, conceptualization, and visualization by Ditte Bendix Lanng.

The way to think about affordance in relation to architecture and urban design is closer to the 'relational' than the 'realist' way that we described above. Riding a sledge down the slope is not possible without the slope of course. But neither is it without a body, a sledge etc. In architecture and urban design, the notion of affordance can be used to remind ourselves about how much more intertwined humans are with their material world and environment. In Modern philosophy and thinking we have been used to understand humans as powerful creatures that not only are separate from 'nature' and 'things' but also in command of them. In light of the debate related to how our acts as a species influence the world (by some termed the 'Anthropocene') the notion of affordance reminds us that we 'act upon' the world but also that we 'act with' the world. The 'full situation' is what we study, and architects' and urban designers' job is to understand this holistic complexity in order to build liveable spaces and high-quality environments.

Architecture

Debora Lombardi, who is a psychologist researching architecture, argues that the notion of affordance is particularly relevant to the design of buildings and spaces because it captures the relation between 'users' and 'spaces' but in a way that is open and not deterministic (i.e. allowing alternatives to the imagined design). She uses affordances to stress that spaces and buildings are full of 'invitations' rather than instructions: 'architectural interventions can only invite or discourage a certain use of space, yet they cannot cause it' (p. 189). And from this openness and lack of strict control, we may think of architectur-

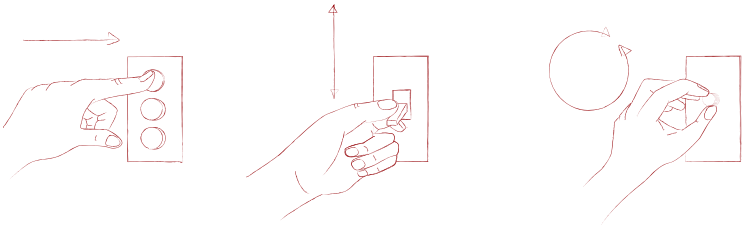
al and urban spaces as being marked by 'polyvalence'. In other words, people may indeed choose to do fundamentally different things in the same space, and they may evaluate the same space in very different ways. Like the slopes in the castle park, these may be looked at with fundamentally different ideas about what they afford depending on who looks at them.

The architect and urban designer's job is then to balance the design brief or the task at hand with the ways in which humans make sense of spaces and see these as integral to their actions and practices. This requires a lot of knowledge about what it means to be human, but also some concepts and frameworks enabling how to understand the human-space relation. Affordance is surely one such quite operational concept.

Affordance in product and industrial design

Actionable

Most issues in product and industrial design concern product questions of how design teaches us without words, what to do. Most issues around affordances in design discuss how products are built to be naturally, almost physically and psychologically intuitive. Therefore 'the designer cares more about what actions the user perceives to be possible than what is true' (Norman, 1999). The illustration below is a classic illustration from product and industrial design around affordance.



botton - push *switch - flip* *knob - rotate*

Figure 4

Rather than building on Gibson's analytical and descriptive understanding, which were more passive in terms of the complementarity of the product and person, the understanding of product design is much closer to Norman, who sought a more active and prescriptive concept. In many ways, the affordance term emphasizes the pushy transformative nature of the process of designing a product:

"...the term affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. [...] Affordances provide strong clues to the operations of things. Plates are for pushing. Knobs are for turning. Slots are for inserting things into. Balls are for throwing or bouncing. When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction needed." *Norman, 1988 (p.9)*

Things "tell us what to do with them" they have a "demand character", the button "wants to be pushed", and the handle "wants to be grasped" (Koffka, 1935; p. 353). In many ways, the concept may be used to shift focus in prod-

uct design from high-level cognitive processing to a focus on perceptual-motor level interaction (Hsiai-cen and Kuohsiang, 2007). Industrial design and engineering design affordance refer not to the properties, not the abilities, but the interaction, the behaviour made possible when these two (or more) meet. It only describes interacting systems. Affordances are what a person can or cannot do with the product, it refers to the possibility of actions.

Intent

Compared to interaction design, the concept of affordance in product design is proportionally less used. However, we argue it is implicitly embedded in the paradigm, which the majority of design processes and methodologies build on. In particular, the perspective from Gestalt psychology inspired by Lewin (1917) has influenced the field of product and industrial design. In Gestalt psychology, the meaning or the value of a thing appears to be immediately perceivable, just as the colour of the thing. The concept of affordance opens the design process to determine what affordances an object should or should not have. The discussion which concerns affordance in the product and industrial design domain encompasses a more explorative process perspective on what wanted and unwanted affordances may be identified.

Intentionally (or not), designed products make a statement through their material, shape, form, texture, etc. As such a product design (well-designed or not) communicates something with users. Product designs are never contextually neutral. In industrial design the concept of

affordance has therefore been discussed as a theory, underpinning product semantics, that is the "study of the symbolic qualities of man-made forms in the cognitive and social contexts of their use and application of the knowledge gained to objects of industrial design." (Krippendorff, 1995). Product semantics concerns the relationship between the product and the user. It may be described as a language structure, which implies designers should not only know what messages and responses they expect from the receiver, but also the form, shapes, features, symbols and forming of the language. In fact Norman states:

"The value of a well-designed product is when it has such a rich set of affordances, that people who use it can do things with it the designer never imagined."

Norman (1994, n.p.)

Industrial design and product design do not entail one specific product category or typology. A phone may become a camera, music player, calendar, email etc. Whilst the iPad is neither a phone, computer, nor a tv, but something in between. Instead, the discussion has turned to consider a related, but also differing concept, the semantic functions of products. Product designers work systematically with identifying the semantics, and the following affordances. The product provides the designer with the possibility to define what the product is 1) its purpose and task, 2) expresses its values and qualities, 3) signals how to interact with it and 4) how it identifies itself within a product category (Demirbelek and Sener, 2003).

Thus on the direct level product design concerns the affordances in the relation between the product and the user, i.e. what is this product and how may it be actualised. The user's ability to identify and act on the properties of a product. On a meta-level much of the expertise taught in product design and industrial design schools, concerns the core experimental task of exploring the rich set of intended as well as unintended affordances.

Experimenting

A product designer may do early mock-ups, prototypes and objects, to understand what the product affords. Hence the discussion which concerns affordance in the product and industrial design domain encompasses a process perspective, which is more explorative on what affordances to design. Affordances may be studied as embodied experiences, during an experimental process of intended and unintended affordances. This means the designer has to understand what should and what should not be communicated and enabled through the product, as well as what affordances are in fact understood and enabled through the product.

Much of product design takes an off-set in fieldwork, user studies, participatory design, mock-up tests etc. with the aim to understand patterns of affordance, intended and unintended affordances a product creates for a user group. For example, the idea of bringing 5 very different mock-ups for user tests is to explore affordances, what actions the properties of the things and the perception and abilities of the

person lead to. See for example the user tests below, for damping the vibration for road workers. Here the designers examined the shape and position of handles for reducing vibration damage for workers. These tests simultaneously examine the properties of the handles, the abilities of the person, and the required actions in certain situations.

Pressing down on the handle only creates rotation around the mounting axis and handle axis. Making it impossible to press forward.

The arm position is great. Pressing down creates an undesired rotation at the handle in the vertical plane. Turning sideways creates an undesired rotation at the handle in the horizontal plane.

The arm position is too wide making maneuverability more difficult. Pressing down still provides the expected outcome. Turning the machine is awkward as the input direction is angled from the desired outcome.

Figure 5
What affordance is intended vs. what affordance do the concepts provide? (illustrations, photos and texts from design students process worksheets)

For example, when designing the first version of the MacBook, an unintended affordance of laptop computers was identified. Humans tend to trip over the power cord, ripping it over damaging the connector or the computer power socket or pulling the computer off the table surface. For this purpose, Apple introduced the 'MagSafe', where the connector is held in place magnetically, which affords tripping over the wire, simply pulling the connector out while leaving the laptop and wire intact. That also means in product design if products are difficult, complicated, and misused, we often describe it as a bad design. The properties of the product, the abilities of the person and the action intended do not work. The product does not afford what it promises or intends to do.

Affordance in interaction design

Affordance is also one of the most used concepts in Interaction Design and Human-Computer Interaction (HCI). After Norman started discussing affordance in combination with product design, the notion of affordances gained swift acceptance in the realm of interaction design, garnering popularity among practitioners, researchers, and educators alike. For designers of interactive technologies, this concept holds great potential in utilizing the potency of perception to enhance the intuitiveness and overall usability of their creations.

Signifiers

There are several reasons why affordance plays such a big role in interaction design. The first point that demands inspection is the material aspect. On the one side, there are the physical input devices such as mouse, key-

board, and touchscreen, which all have some form of affordances (e.g., the shape of a mouse affords to lay a hand on it in such a way that the fingers align with the buttons) that are more closely related to the ideas discussed above in the section on product design. On the other side we have the complexity of the output, the graphical user interface. Pixels by themselves don't afford anything but observing them, the graphical design must do the job. Affordance is not confined to the design of physical objects, as it has found a significant role in the design of graphical user interfaces. In contrast to traditional product designers, user interface designers have much larger freedom and flexibility in developing visual properties for their creations.

Consequently, they are better placed to offer what Norman (1988) refers to as "strong visual clues to the operation of things". Clickable buttons or draggable sliders are just some of the many examples of user interface elements that provide visual clues that can even be extended with animations to give further hints on how they are supposed to be used. Today's computers such as smartphones have several possibilities to give clues using auditory- or haptic perceptual channels, which allow for a multitude of potential affordances. For example, a smart home speaker such as Amazon Alexa or Google Home will use multimodal feedback via sound and light to indicate whether it is ready for the user's command. While these possibilities of course are great for designers, they also can create complexity and break the user's mental model - their internal representation of how the product works and how to use it, based on knowledge, experienc-

es, and expectations - of a product. This myriad of options prompted Norman in 2013, to clarify his definition of affordances more in the second edition of "The design of everyday things" and he added the concept of signifiers. He describes them as cues that designers can use in interfaces to help users easily understand what actions to take. By indicating how and where to act, signifiers enhance the affordances of an object. Designers can use various methods, such as marks and sounds, to provide users with the appropriate signals to perform tasks effectively.

"Affordances determine what actions are possible. Signifiers communicate where the action should take place. We need both. [...] Good design requires, among other things, good communication of the purpose, structure, and operation of the device to the people who use it. That is the role of the signifier."

Don Norman (2013, p. 14)

Signifiers are not necessarily a new idea. For example, in semiotics – the study of symbols and signs –, in film studies, or literature, it is a very common concept. Broadly speaking, a signifier is an object or symbol that points to or foreshadows something else. Don Norman took this idea and introduced it as a concept to interaction design, to assist affordances and help overcome issues that arise from false affordances or hidden affordances.

Feedforward

However digital user interfaces can do even more! Vermeulen et al (2013) elaborated on the concept of feedforward in interaction design. Feedforward, compared to feedback,

refers to providing information or signals in advance of a particular event or action instead of after it.

It is meant to allow users to anticipate the response that the system will have to their interaction through sensory information, thereby guiding the user. An example, from the physical world, would be when a person reaches for a cup, the visual and spatial information provided by the environment allows them to adjust their arm and hand movements in advance, leading to more accurate and efficient actions. A well-designed user interface may provide clear and concise instructions on how to complete a task before the user starts the process. This approach can help users understand what is expected of them, reduce confusion, and increase their confidence in completing the task.

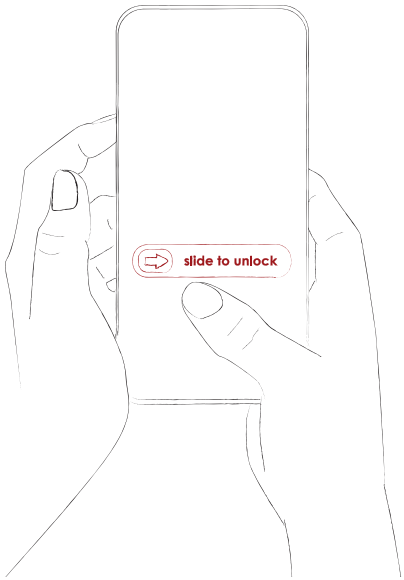


Figure 6

A good UI (user interface) design that highlights many of these elements is the "slide to unlock"-bar that was introduced with the first-generation Apple iPhone (see fig. 6). The UI has a clear signifier, both with the arrow in the slidable button, indicating the direction as well as through the text. Furthermore, it used an animation indicating the direction, with a white highlight running over the text from left to right. Lastly, it also includes feedforward in the text, as it is clear what will be the result of this interaction – the phone will be unlocked. While this interaction form was completely novel at the time, it was quickly understood and picked up. It has the advantage that it can not easily be done by accident and has therefore been reused in many other application scenarios, for example as confirmatory action for bank transfers.

Skeuomorphism

As mentioned already, the digital world has limited inherent affordances, so interaction designers have traditionally resorted to something called skeuomorphism. Skeuomorphism involves replicating or rather imitating the affordances and metaphors from the physical world. This entails integrating ornamental elements, features, and affordances from physical objects or materials into digital objects that would not necessarily require these elements for their functionality. In other words, skeuomorphism involves using design elements that are no longer necessary but were once part of a functional or necessary aspect of the original object. The first computer with a graphical user interface, the Xerox Star, introduced this, by heavily relying on desktop and office metaphors. And a lot of these metaphors

on how we structure the digital world have survived until today. We still use the idea of files and folders and the garbage bin as a representation to interact with our digital information, and we understand that a file affords to be thrown into the garbage bin.

When the first iPhone was released in 2007, it revolutionized the smartphone industry with its sleek design and intuitive interface. However, what many people may not realize is that the first version of the iPhone heavily relied also heavily on skeuomorphic design elements to create a familiar and user-friendly experience. One of the most prominent examples is the Notes app featuring a yellow legal pad with blue lines, designed to resemble a real-world notepad common in the US. This design choice was likely made to create a sense of familiarity and comfort for users who were accustomed to writing notes on physical notepads. Similarly, the calculator app featured large, colourful buttons that resembled the design of traditional Braun calculators. The app also made use of sound effects, such as a satisfying "click" sound when a button was pressed, to create a sense of tactility and interactivity. Furthermore, all app icons were designed to look like physical objects, such as a clock, camera, calculator, and notepad, with realistic textures and shadows.

While skeuomorphism was a dominant design trend, it has since fallen out of favour with many designers and is often replaced with simpler, flatter designs. Skeuomorphism can be used to create a sense of familiarity or comfort for users who are accustomed to traditional or

familiar objects, but it can also be criticized for being unnecessarily confusing in some cases. Besides this, the growing familiarity with digital technology and the increasing number of so-called digital natives that don't require such metaphors anymore are also potential reasons why skeuomorphism has fallen out of fashion. So, it will be interesting to see how long the floppy disk will be the save icon.

Affordance ++

The above discussion highlights some of the problems with affordances in digital user interfaces, however, it should at this point also be clear that there is a much larger pool of possibilities to create affordances for digital products. Lopes et al. (2015), drastically extended the notion of what an affordance of an object is. They call this concept affordance++ and they allow an object to communicate how it wants to be used employing electrical muscle stimulation (EMS) on the hands and arms of a user. They gave the objects the ability to directly instruct the user in dynamic cases, such as distinctive motion patterns, the correct application of multi-step processes and even behaviours that should change over time use. One example of their system is the correct use of a paint can. The moment the user touches the can, the system activates the user's muscles via EMS to make a shaking motion indicating that it needs to be shaken. The system can also instruct the user that it can only spray after it is shaken, it needs to be shaken again or it is empty, and the user should stop using it. Instead of enhancing the object, their system stimulates the user's arms to allow objects to make the user interact with them in the appropriate manner.

Perspectives of affordance

Discussion

So we started by stating that affordance is a useful term. Come this far we hope that the reader would agree. We have tried to use many examples across the disciplines we are engaged with ourselves (industrial design, human-computer interaction, and urban design). However, many more areas and disciplines would find the notion of affordance relevant. This has of course much to do with the very fundamental claim made by the notion: that humans 'act with and upon' spaces, artefacts, things, and technologies. So at the level of most ordinary and practical, namely 'what we do when we act', the notion of affordance allows us to get a grip and understand what goes on in the world. Needless to say, there are differences between the ways in which discipline utilizes the term. But the power of the notion of affordance is its applicability across any kind of discipline. This is a direct effect of its

focus on the very simple (and yet complex) level of human action in the world.

Tool for thinking

Along the road, we have tried to illustrate the usefulness of affordance as a 'tool for thinking'. So many would consider it a 'theory'. However, we think there is more at stake here. We may of course think of theories as abstract and detached statements about the world. But with the notion of affordance, we face an example of theory as something practical. We would argue that the concept of affordance is highly relevant to designers (of any kind) exactly because it not only allows us to (theoretically) analyze what is happening in the world. We have shown throughout this book that the notion of affordance gives us a very hands-on and operational tool for seeing how we act with and upon things, spaces, and technologies. This, in turn, becomes a potential design tool. If we understand how humans act upon and with things, we may also start exploring the design dimension. This can be done very simply by asking if what we see happening in the world is also what we want. If for example, we see that people use the wide streets paved with asphalt to drive dangerously fast, we can use our knowledge of affordance to re-design that situation by adding speed bumps or chicanes to the environment. That is in a sense to 'remove affordances'. But of course, we could also 'add affordances' as when we see older people struggling with crooked streets and we thus add a cable cart to the environment. The key point is, that a concept like an affordance lends itself to (theoretical) analysis as well as to (design) intervention.

Presence

Looking across the design landscape we find affordance is implicitly embedded in some fields, such as product design, architecture, and urban design while being explicitly present in interaction design. This raises the question of why affordance is not so present in design fields, that indeed all are real, physical, measurable and embodied, compared to the interaction design domain, which is more intangible. We question whether it in fact may be because of the lack of physicality, interaction design researchers and practitioners had a need to refine the concept. What properties do pixels on a screen have in themselves? What do they afford?

The physical design and the elements we create are extremely important in the way they shape our assumptions. Kankaanp and Hirskyj-Douglas (2023) employed rapid prototyping methods from HCI to design tangible buttons for monkeys (white-faced sakis) with the goal to allow them to interact with a computer. Their findings also showed that more colourful prototypes with ergonomic size (fitting the monkeys' grip or mouth) had stronger effects on eliciting the monkeys' curiosity. This highlights again the importance of the relationship between the abilities of the user and the visual perception of the user. Affordances in interaction design often arise from prior knowledge. Interactions that we have seen before can be easily replicated, which means that interfaces that are designed consistently to prior interfaces could rely on prior knowledge.

So, in a way, we argue affordance has been unavoidable in the discussion of interac-

tion design, while the more physical design fields have not been forced to make it as explicit. Thus, for many it exists as tacit knowledge, which we argue would benefit from being grasped, understood and worked through more explicitly.

Intentionality

Through this book we showed and discussed, how there has been a development, and evolution of the concept. Scholars have had different definitions of affordance.

We however argue, the history of the affordance concept alone, indicates the concept seeks to explain something worthwhile to understand, however difficult to grasp. Affordance is important as it seeks to describe the essential complementarity between humans and the environment. In this last discussion, we turn to Lewin (1917) who did not discuss affordance, but inspired Gibson in his writing. In particular, we turn to Lewin's idea of intentionality, both the designer's intentionality, and the user's intention and how that relates to the object. Intentionality changes the interaction and complementarity. For example within the area of critical disability studies, this 'activist' potential of the notion of affordance has been shown by anthropologist Arseli Dokumaci (2023). She shows how disabled people critically and creatively re-design and 'hack' the affordances offered by ordinary things, spaces, and technologies. Disabled people living in a world designed around 'ableist' standard bodies have developed creative and artful ways to challenge the exclusionary designs that they experience. Dokumanci dubs this 'activist affordances' to illustrate the practical appli-

cability and usefulness of the concept.

Good and relevant concepts, we would argue, precisely have this capacity to them; to be analytical as well as interventionist. And this is then a nice example of why one has to be very cautious about thinking that theory and practice are two separate and unrelated realms. Rather, we would argue, one should apply the view of pragmatism and see theories and concepts as useful tools. Tools for thinking, as well as tools for designing!

If you want to know more

As you already noticed, the notion of affordance is complex, rich, and cuts across a wide array of different disciplines and domains. So compiling a list that points to all relevant literature is impossible. Instead, we have collected here a handful of the (in our opinion) most useful references to study 'if you want to know more'.

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