The bodily basis of product experience

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Abstract

Based on the work of Lakoff and Johnson, this paper argues that part of our product experience is rooted in bodily interactions between people and their environments. Lakoff and Johnson convincingly demonstrated that repeated bodily interactions of a similar kind lead to the formation of image schemas guiding our understanding of verbal expressions. Here, it is proposed that the same underlying principles also govern our understanding of the expression of products. If correct, product expressions theoretically structured by the same underlying schema must be highly related. An experimental study involving chairs partly confirmed this prediction. The paper closes with a tentative discussion on how a chair's perceived expression could be related to the embodiment of schemas in its spatial and material features.

Products of industrial design, like those of architecture, are not only supposed to function in a strict utilitarian sense. Among industrial designers and architects it is well acknowledged that products also influence the way we experience our material environment. Although these experiences change constantly under the influence of context factors, such as trends, technological developments, etc., a designer is able to influence these experiences in a desired direction by manipulating a product's expression. Despite the extensive knowledge available for establishing the behavior of materials, technology, etc., determining the way a product's expression will be understood is less straightforward. In establishing a product's expression, designers often have to rely on subjective knowledge, personal views, and (cultural) values.

Classic theories on perception and cognition offer knowledge of a kind too general to be applied in unique design situations. However, in recent studies in cognitive semantics an experientialist theory on perception and understanding is put forward that provides clues to how we understand human expressions (Lakoff and Johnson, 1980 and Lakoff and Johnson, 1999). According to this theory, experiences, arising in bodily interactions with the world, motivate our understanding of expressions of all kinds. The experientialist theory may be of interest for designers who intend to create a particular product expression. Before looking into this theory more closely, a brief historical overlook will be presented first, indicating that the role of the body in experiencing our world has been acknowledged ever since the end of the 19th century.

1. Empathy and anisotropy

At the end of the 19th century, the German psychologist Theodor Lipps (1897) published a book entitled ‘Raumästhetik’, in which he unfolds a theory on the aesthetic perception of space and spatial features of both natural and artificial things. With regard to this theory, the author is particularly known for the concept of ‘einfühlung’ or empathy, which he describes as the act of projecting oneself into the object of perception. According to Lipps, we are

capable of this projection because we, just like physical objects, are subject to the laws of nature. For instance, when carrying loads we have to exert muscular pressure in order to counterbalance gravitational forces threatening to bring us down. We may therefore understand the columns of an ancient temple as struggling to give enough back-force to the loads acting upon them. In other words, the way we understand objects around us is related to our bodily experiences arising in interacting with the spatial world. Although Lipps' theory is mainly centered on the relation between mechanical aspects of our bodily experiences and the attribution of meaning to objects, and Lipps in that respect represents the thinking of his time, his concept of empathy may be of interest for designers creating meaning through spatial features of their designs.

The role of bodily experiences is also fundamental in the work of Arnheim (1977). In a similar sense, but some 60 years later, he introduces the concept of anisotropy to explain that different directions in space are perceived unequally because of the difference in experiencing our bodily movements in space. Going up takes more effort than going down since we have to overcome the forces of gravity. Having a face defining a bodily front, that governs man's mainly forward directedness when moving in a horizontal plane, makes going forward to be experienced differently than backwards. As a result, different directions in works of art are understood differently, thereby influencing the experience of the work as a whole. Clearly, Arnheim's contribution to a psychology of perception is of importance to the design domain. His plea for visual thinking, his illustration of how artists and designers think with their senses, his contribution to the understanding of dynamic principles in architecture and design, and his discussions on composition in works of art all underline the importance of our bodily functioning to the experience of art and designed objects.

2. Embodied understanding

In line with the notions put forward by Lipps and Arnheim is the work of Lakoff and Johnson, 1980 and Lakoff and Johnson, 1999. These authors consider understanding of our world as the result of experiences arising in repeated bodily interactions between people and their environments. It is in this sense that our understanding is embodied. This experientialist theory rejects the Cartesian separation of body and mind and thus the idea that the body does not take part in our thinking and reasoning, or that knowledge, as they formulate it, is disembodied. In a similar sense, Varela et al. (1991) describe cognition as depending on the kinds of experiences that come from having a body with various sensorimotor capacities.

2.1. Image schemas

According to Lakoff and Johnson, repeated bodily interactions lead to the formation of image schemas determining the way we understand our world. These image schemas make up the basis for our categorizing capabilities and order our perceptual and sensorimotor experiences. They are of a non-linguistic nature and in comparison with mental pictures they are more abstract. Image schemas are so pervasive and constitutive of our ordinary experience that they are taken for granted and easily overlooked. By stressing their importance for human understanding, Lakoff and Johnson put the body, as it were, back into the mind. Johnson (1987) defines a schema as follows:

An image schema is a recurring dynamic pattern of our perceptual interactions and motor programs that give coherence and structure to our experience. The verticality schema, for instance, emerges from our tendency to employ an up–down orientation in picking out

meaningful structures of our experience. We grasp this structure of verticality repeatedly in thousands of perceptions and activities every day, such as perceiving a tree, our felt sense of standing upright, the activity of climbing stairs, forming a mental image of a flag-pole, measuring our children's heights and experiencing the level of water rising in the bathtub. The verticality schema is the abstract structure of these verticality experiences, images and perceptions. Experientially based, imaginative structures of this image-schematic sort are integral to meaning and rationality (Johnson, 1987).

(p. XIV)

Next to the verticality schema explained above, Johnson presents numerous other schemas of spatial orientation also originating from our repeated bodily interactions. Some of them will be discussed in the next section.

The works of Lakoff and Johnson, 1980 and Lakoff and Johnson, 1999 and Johnson (1987) do not deal explicitly with designed objects and their spatiality. They predominantly – and convincingly – demonstrate how these schemas structure our understanding of linguistic expressions. For example, in ‘I was down, but now I'm back on top!’ the bodily condition of being low to the ground or high above the ground is ‘used’ in order to communicate a sense of sadness, being down, or happiness, being up. It is in this sense that the linguistic expression is metaphorical: something (non-physical, abstract) is understood in terms of something else (physical, concrete). The metaphorical expression refers to bodily interactions, in this case moving from a position down under to a position up high, underlying the verticality schema.

Lakoff and Johnson argue that image schemas structure our understanding of expressions of all kind, whether linguistic or non-linguistic. We could thus predict that these schemas also structure our understanding of a product's expression. Depending on the nature of its spatial and material manifestation, specific schemas supposedly play a role in the way a product's expression is understood by its users. Before looking more closely into the different ways schemas could be embodied in a design, the relations between schemas and specific product expressions need first be addressed. In order to test these relations, we will tentatively propose expressions presumably related to the same schema. If certain expressions are indeed based on the same schema, ratings of these expressions must be highly related. This prediction was tested in an experimental study in which chairs were taken as the kind of product to be judged. In case our prediction is corroborated by the results, this should not be taken as lending proof to Lakoff and Johnson's claim that image schemas indeed structure all kinds of expressions, including product expressions. However, finding such relations is a precondition for further systematic studies into the relations between schemas and product features.

3. Study

Before being able to put our prediction to test, we have to reason which expressions may have been structured by the same underlying image schemas. To that end, four schemas will be discussed in detail. Although the number of schemas is certainly not limited to these four, they are regarded as ‘basic’ and discussed most extensively by Johnson (1987) and Lakoff and Johnson, 1980 and Lakoff and Johnson, 1999. Furthermore, these schemas are presumed to be highly relevant in the realm of product experience.

3.1. The container schema

The ‘container’ schema arises from bodily interactions with insides and outsides. Lakoff and Johnson (1999) present a large range of day-to-day activities dealing with moving in and out of spaces. For instance, every morning we wake up, get out of bed, hop into our clothes, leave our bedroom, enter the living room, get into the bus, and enter the office. What all these activities have in common is that they involve an actual movement into or out of a bounded space. These repeated, largely similar interactions involving insides and outsides give rise to the container schema. This schema has three components: an inside, an outside and an opening, defining a path leading from one condition to another.

In interacting with insides and outsides, one may have, depending on the container's degree of enclosure, particular experiences. The main reason for building houses and shelters is to be secure and safe from forces acting on the outside like cold and rainy weather and aggressive behavior from others. Also, being enclosed allows one to engage in activities for which protection is required, like acting out one's emotions, dressing informally or enjoying a night of passion with one's loved one. As argued, Lakoff and Johnson show how we ‘use’ the container schema in order to make sense of metaphorical expressions that refer to a movement in and out of spaces. For example, in linguistic expressions like ‘please, don't keep pushing me out!’ and ‘finally, he let me in on his problems’, the expressions are conceptualized in terms of spaces in which one can move in or out. These examples deal with distance and involvement between people. One is involved when one is inside another person's ‘container’ of thoughts and feelings, while one is distant when on the outside.

Based on these considerations, one may propose that expressions related to safety, like *safe* and *secure*, and expressions related to informal and emotional behavior, like *involved*, *informal*, *emotional* and *agreeable*, are structured by the same underlying schema, and should therefore be strongly related.

3.2. The balance schema

Balance is crucial for our bodily functioning. Without balance, we would not be able to stand, move, or to function at all. From babyhood on, it takes a lot of effort and ‘falling downs’ to attain our erect position in space since we have to overcome the forces of gravity. In these cases of spatial, bodily balance, the vertical is the reference. The balance schema is not only related to our sense of external balance, but also to our sense of internal balance. For instance, one may experience an imbalance within the body as a result of excessive amounts of blood sugars.

Although a balanced position suggests an absence of movement, balance and motion are closely related. For example, falling out of balance will cause a motion in the direction where forces are no longer counterbalanced. After all, a balanced whole of any kind implies that the different elements are motionless or that the elements' motions counterbalance each other and, by doing so, create stability. Arnheim (1954) convincingly showed how experiencing a visual pattern is related to the placement of its constitutive elements within a frame, and dependent on the structures (center, diagonals and outer frame limits) exerting influence in that frame. In this context, he discusses ‘motion without movement’, the perception of tension in a balanced situation. The bodily origin can be understood easily, realizing that we experience tension in a lot of balanced bodily attitudes in humans preparing to act, for instance an athlete waiting for the starting signal on the 100 m.

Similarly to the container schema, the balance schema makes us understand some commonly used metaphors. For example, when referring to a person as an unbalanced personality, we claim that the person in question may act in unpredictable ways and is therefore not to be trusted. In contrast, a balanced personality is trustworthy and will probably not change his or her opinion every second of the day. In other words, presumably structured by the balance schema are expressions related to positioning in space, like *stable*, *still*, and *balanced*, and expressions metaphorically reflecting a sense of (in)stability or (a lack of) movement, such as *trustworthy* and *lifeless*. Following our prediction, these concepts should be highly related.

3.3. The size schema

Our bodily measurements are also the reference for making judgments of size. As all humans experience their growing up as undergoing an increase in size, we are very perceptive to relative differences in size of all things around us. Having had the experience of being small as a child and treated by our parents of a grown up size with both care and authority, we tend to relate size differences positively as well as negatively. Tall people may be experienced as potentially able to exercise bodily power and control over short people and may therefore be regarded as superior. Both people and objects of great size are perceived more easily because they make a more significant perceptual impression; they catch the eye, attract our attention and may consequently be experienced as impressive. Of course, size differences can be very large relative to the experience of our own bodily measurements. For instance, in a cathedral, one may be overwhelmed by its size and height, making one feel like a very small and modest creature.

Size may also be related to luxury in that an increase in size creates more freedom and opportunities, as living in a big house enables one to move freely around in a large number of spaces. However, in other cases, we may also associate smallness with refinement, as in the experience of relatively small, technologically controlled details in a design. In those cases, disproportional large features may be understood as coarse. Whereas expressions like *impressive*, *luxurious* or *coarse* are most likely not only related to the size of people or things around us, the size schema is, at least to some degree, expected to underlie these expressions.

3.4. The ‘in back of–in front of’ schema

The ‘in back of–in front of’ schema is related to the fact that our bodies have inherent fronts and backs. We see from the front and normally move in the direction the front faces. Places in front of us will be reached in the near future, while places behind us have been crossed in the past. The path we traverse when moving in a forward direction may vary considerably from one situation to another. However, the important point is that all interactions involving movement from some place to another share the same structural features: a path on which the destination is ‘located’ in the future, and the part of the path left behind in the past.

As mentioned before, Lakoff and Johnson use linguistic expressions to support their theory. A linguistic expression like ‘he was far ahead of his times’ reflects this notion of time as a path on which one can be ahead or behind. Expressions reflecting a sense of being behind or ahead, such as *advanced*, *modern*, and *futuristic*, are therefore presumably related to the ‘in back of–in front of’ schema.

The four schemas discussed and their related expressions are presented in Table 1. In concluding the discussion on these relations, we argue that the schematic structuring

discussed may be seen as a basic and relatively stable dimension of understanding expressions. ‘Basic’ because it lies at the basis of our being in the world and ‘relatively stable’ since it is grounded in bodily experience. Our bodies, after all, are and have stayed pretty much the same and so have our bodily experiences. This does, of course, not obscure the fact that understanding all kinds of expressions is also sensitive to historical context, cultural convention, etc., and therefore subject to change.

Table 1.

Schemas and related expressions

1. Inside–outside (Container schema)	Secure
	Safe
	Involved
	Agreeable
	Emotional
	Informal
2. Balance	Balanced
	Trustworthy
	Stable
	Still
	Lifeless
3. Size	Luxurious
	Impressive
	Coarse
4. In back of–in front of	Modern
	Futuristic
	Advanced

4. Method

4.1. Participants

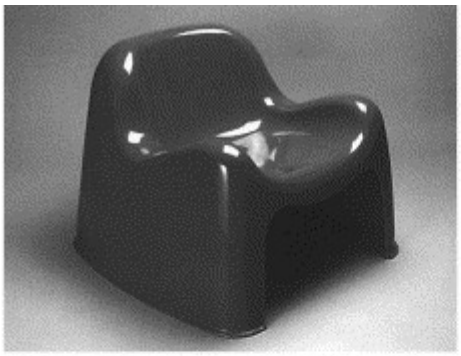
Participants were 107 students (age range 20–27) of the Department of Industrial Design from Delft University of Technology. They were present at two fourth year design classes in which

the experiment was executed. In the first class 36 participants were present, in the second class 71 participants. All participants completed the task.

4.2. Stimulus materials

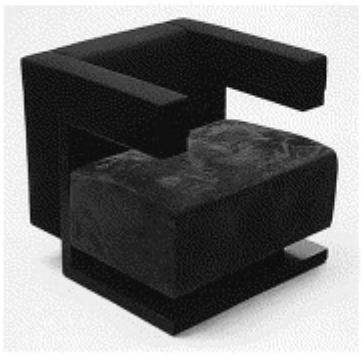
Stimuli were 10 chairs presented on slide (see Figure 1). Since it is assumed that structural properties of repeated bodily interactions with the world, underlying the schemas discussed, are somehow reflected in products' visual/spatial properties, properties accurately revealed by pictures, it was not deemed necessary to use real chairs as stimulus materials.

a



b

c



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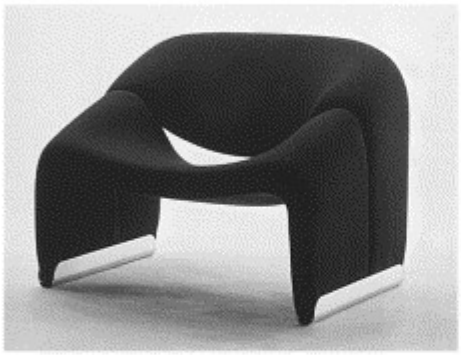

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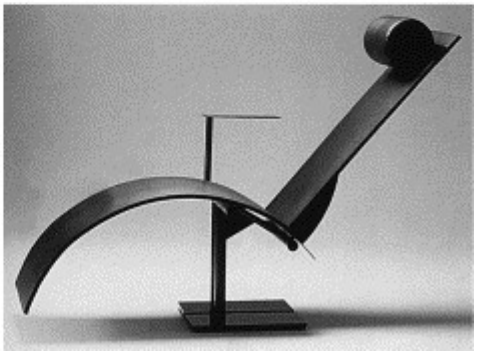

Figure 1. The 10 chairs used in the experiment

To allow proper statistical analyses, the variance in the ratings of the various expressions should be as large as possible. We therefore needed a sample of chairs that would vary substantially on its visual/spatial properties. Instead of drawing a random sample of 10 chairs from a large pool of chairs, we decided to systematically ensure this variability by selecting chairs according to Muller's (1999) typological classification system. This system describes form categories encompassing the whole range of form differentiation. No predictions were made with regard to relations between classifications of chairs according to this system and ratings of these chairs on the different concepts reflecting the expressions. With this systematic selection we only tried to guarantee maximum variation in the expressions judged. All chairs were rated on 7-point bi-polar scales measuring the 17 selected expressions (see left row of Table 2).

Table 2.

Degree of agreement between participants (intraclass correlations) based on complete cases (*N*)

Scale	**Interrater Agreement (Ri)**	***N***
Insecure–secure	0.70	10
Dangerous–safe	0.54	10
Distant–involved	0.38	10
Disagreeable–agreeable	0.27	10
Rational–emotional	0.41	9
Formal–informal	0.30	9
Balanced–unbalanced	0.42	10
Trustworthy–untrustworthy	0.51	10
Stable–unstable	0.58	10
Still–moving	0.47	10
Lifeless–animated	0.17	10
Poor–luxurious	0.36	6
Modest–impressive	0.33	9
Refined–coarse	0.35	10
Old fashioned–modern	0.16	10
Passé–futuristic	0.14	10
Dated–advanced	0.18	10

4.3. Procedure

Participants were seated in a lecture room in front of a white screen on which the slides were projected. At the beginning of a session, participants were informed that the experimenter aimed at researching product expressions and they were told to base their ratings on their first impression. Next, the evaluation forms were distributed on which the participants first had to fill out their name and age. On top of each form, a text was presented saying 'This chair is…' followed by the 17 rating scales. Following these instructions, each slide was presented for 2 min in which the scales had to be rated individually. The order in which the scales were presented was systematically assessed to exclude sequential effects resulting from expressions presumably related to the same schema positioned next to each other. This order remained fixed during the experiment.

During the presentation of the slides, the experimenter informed the participants twice, after 60 and 90 s, respectively, of the remaining time of exposure of the particular slide. Pilot studies indicated that 120 s was ample time to give the 17 ratings. All participants completed the task within the given time period.

5. Results

5.1. Reliability

In order to assess the degree of agreement between participants on any given scale, intraclass correlation coefficients (Ri) were calculated. Thus, if a participant rates a chair high on *secure*, to what extent do the other participants agree? These intraclass correlations, calculated over the 10 chairs (in some cases $N < 10$ as the result of missing values), are presented in Table 2. It should be noted that the values of Ri are generally lower than those of the mean interobserver reliability based on Pearson product moment correlations. The intraclass correlations reveal that the interrater reliability varies considerably over the scales. For most expressions, agreement scores are relatively satisfactory ($Ri \geq 0.30$), on some even excellent (*stable* = 0.58, *secure* = 0.70). Relatively low agreement scores ($Ri < 0.30$) indicate that participants' ratings vary considerably and thus warn against conclusions based on mean scores over the participants on the scales involved. In addition to the scales for *lifeless* and *agreeable*, all three scales presumably related to the 'in back of–in front of' schema show low agreement scores (see Table 2).

5.2. Inter-scale correlations

As discussed, we predict ratings of expressions based on the same schema to be highly correlated. To test this prediction, mean scale scores were calculated for each chair by averaging participants' ratings (Table 3). Next, correlation coefficients between each pair of scales were computed over the 10 chairs (see Table 4).

Table 3.

Mean scores for chairs on the 17 expressions

Chair	Secure	Safe	Involved	Agreeable	Emotional	Informal	Balanced	Trustworthy	Stable	Still	Lifeless	Luxurious	Impressive	Coarse	Modern	Futuristic	Advanced
A	4.43	5.27	4.29	3.93	5.39	6.00	4.79	4.56	5.92	4.19	3.21	4.04	4.82	4.64	4.98	3.92	3.53
B	2.21	2.89	2.71	3.19	3.37	4.19	2.94	2.61	2.15	2.88	2.97	3.98	4.01	3.07	5.47	4.87	4.64
C	5.37	5.67	3.86	4.52	3.18	3.16	5.92	5.63	6.44	5.62	4.23	5.31	5.12	5.21	4.92	4.44	4.27
D	2.50	4.21	3.18	3.93	3.53	3.48	5.08	3.81	3.85	5.51	4.20	3.91	2.73	2.23	5.06	4.55	4.15
E	6.22	5.74	5.55	5.67	5.85	5.36	4.64	5.73	4.94	4.73	2.69	5.99	5.87	4.17	4.64	4.53	4.14
F	2.20	3.42	2.76	3.08	3.68	4.14	3.10	3.47	3.45	2.71	3.41	3.65	4.10	2.84	5.04	4.48	4.15
G	5.64	5.78	5.03	5.52	4.82	4.41	5.78	5.83	6.02	5.77	3.43	5.71	4.83	4.07	5.20	4.48	4.56
H	2.31	2.36	3.72	4.32	5.79	5.84	2.89	2.42	2.61	2.17	1.99	3.90	5.50	2.34	5.74	5.94	5.70
I	6.49	5.80	5.30	5.30	5.55	5.64	5.26	5.71	5.28	5.36	3.44	5.44	5.65	4.79	3.50	3.93	3.24
J	2.18	2.93	2.48	3.12	2.68	3.21	3.57	3.09	2.88	3.61	3.76	5.16	5.17	2.82	5.54	5.21	4.74

Table 4.

Inter-item correlations

	Secure	**Safe**	**Involved**	**Agreeable**	**Emotional**	**Informal**	**Balanced**	**Trustworthy**	**Stable**	**Still**	**Lifeless**	**Luxurious**	**Impressive**	**Coarse**	**Modern**	**Futuristic**
Safe (1)	**0.93**															
Involved (1)	**0.92**	**0.81**														
Agreeable (1)	**0.88**	**0.77**	**0.95**													
Emotional (1)	**0.53**	**0.36**	**0.80**	**0.69**												
Informal (1)	**0.34**	**0.17**	**0.60**	**0.42**	**0.93**											
Balanced (2)	0.78**	0.90**	0.63*	0.67*	0.13	−0.10										
Trustworthy (2)	0.95**	0.98**	0.83**	0.81**	0.35	0.12	**0.89**									
Stable (2)	0.84**	0.94**	0.70*	0.66*	0.30	0.13	**0.91**	**0.92****								
Still (2)	0.73**	0.86**	0.57*	0.64*	0.04	−0.20	**0.97**	**0.85****	**0.79**							
Lifeless (2)	0.08	0.34	−0.22	−0.16	−0.68*	−0.75**	**0.57***	**0.32**	**0.38**	**0.63***						
Luxurious (3)	0.80**	0.67*	0.68*	0.75**	0.21	−0.02	0.61*	0.77**	0.56*	0.63*	0.14					
Impressive (3)	0.57*	0.29	0.58*	0.53	0.55	0.49	0.08	0.38	0.29	−0.02	−0.46	**0.63***				
Coarse (3)	0.87**	0.85**	0.67*	0.56*	0.28	0.22	0.70*	0.83**	0.86**	0.59*	0.22	**0.61***	**0.52**			
Modern (4)	−0.73**	−0.70*	−0.64*	0.54	−0.37	−0.31	−0.53	−0.69*	−0.53	−0.56*	−0.23	−0.44	−0.28	−0.62*		

	Secure	**Safe**	**Involved**	**Agreeable**	**Emotional**	**Informal**	**Balanced**	**Trustworthy**	**Stable**	**Still**	**Lifeless**	**Luxurious**	**Impressive**	**Coarse**	**Modern**	**Futuristic**
Futuristic (4)	−0.61*	−0.79**	−0.45	0.28	−0.11	−0.11	−0.65*	−0.70*	−0.71*	−0.63*	−0.49	−0.25	0.09	−0.69*	**0.74****	
Advanced (4)	−0.55	−0.69*	−0.40	0.22	−0.13	−0.16	−0.54	−0.61*	−0.58*	−0.55	−0.46	−0.21	0.03	−0.62*	**0.83****	**0.96****

Expressions are grouped according to their presumed schema origin as indicated by numbers (see Table 1).

* = $p < 0.05$, ** = $p < 0.01$.

Note: correlations in bold refer to correlations between characteristics derived from the same schema.

With regard to expressions presumably related to the container schema (1), the results are only partly as predicted. Whereas *secure*, *safe*, *involved* and *agreeable* are highly intercorrelated (all $p < 0.01$), and the two other scales, *emotional* and *informal*, are also highly related ($r = 0.93$; $p < 0.01$), the latter two scales do not always correlate significantly with the former four. Expressions related to the balance schema (2) show high intercorrelations (all $p < 0.01$), except for *lifeless*. The intercorrelations of expressions presumably related to the schema for size (3) are only moderately correlated. Finally, as predicted, expressions presumably related to the 'in back of–in front of' schema (4) correlate highly (all $p < 0.01$). Although the intercorrelations are generally in line with the predictions, a factor analysis was conducted to gain more insight into the relations between the scales.

5.3. Factor analysis

To further examine the relationships between the 17 scales, a factor analysis, using varimax rotation, was performed on the mean scale scores. This analysis reveals the extent to which the different scales (the 17 expressions) reflect one or more underlying constructs or factors. Although finding factors matching the expected clusters of expressions is no evidence for the existence of underlying schemas, factors resembling proposed clusters of expressions would confirm our predictions on the relations between the expressions. This analysis revealed three factors with eigen values >1 and a fourth factor with an eigen value >0.8. The following description of the factors will indicate why this fourth factor was taken into account. Factor loadings of the scales are presented in Table 5.

Table 5.

Results of the factor analysis

	1	**2**	**3**	**4**
Secure	0.74			

	1	2	3	4
Safe	0.80			
Involved	0.70			
Agreeable	0.82			
Emotional			0.95	
Informal			0.96	
Balanced	0.90			
Trustworthy	0.82			
Stable	0.77			
Still	0.89			
Lifeless			−0.83	
Luxurious	0.68			0.67
Impressive				0.88
Coarse		0.60		0.51
Modern		−0.77		
Futuristic		−0.91		
Advanced		−0.96		

Note: only loadings >0.5 are presented.

The first factor comprises expressions presumably structured by both the container and the balance schema: *balanced*, *still*, *trustworthy*, *agreeable*, *safe*, *stable*, *secure*, and *involved*. In line with the intercorrelations, container schema expressions *emotional* and *informal*, as well as balance schema expression *lifeless* do not load on this factor. The high loading of *luxurious* on this factor is also unexpected. The second factor comprises, in addition to the size-schema expression *coarse*, all expressions expected to be structured by the 'in back of–in front of' schema: *advanced*, *futuristic* and *modern*. Scales loading high on the third factor are *informal* and *emotional*, expressions presumably structured by the container schema. Another scale loading on this factor is *lifeless* (negative loading), presumably related to the balance schema. The fourth factor comprises the expressions presumably structured by the schema for size: *impressive*, *luxurious*, and *coarse*, although the latter two expressions load on, respectively, the first and second factor as well. The four factors account for 94.7% of the total variance.

6. Discussion

The factors revealed by the factor analysis presented partly confirm the expected clustering of the expressions. Of the four clusters predicted (see Table 1), three are more or less confirmed by this analysis: the one based on the 'in back of–in front of' schema (second factor), the one based on the balance schema (first factor), except for *lifeless*, and the one based on the size schema (fourth factor). Expressions presumably structured by the container schema are split over the first, 'balance' factor and the third factor. In other words, the main deviations concern the blending of the expressions related to the balance and container schemas within the first factor and an unpredicted factor comprising the expressions *emotional*, *informal*, and *lifeless* (negative loading). Despite their loadings on a separate factor, these latter three expressions do however moderately correlate with the expressions from their predicted cluster (see Table 4). With respect to the balance and container schema expressions loading on a single factor, it may be argued that both schemas, and the expressions presumably structured by them, deal in one way or the other with a sense of support and protection. These two experiences seem highly related in that a sense of support and stability may be seen as a precondition for feeling safe and secure.

Another result that deserves further discussion concerns the variability in the interrater agreement scores. Whereas some expressions show very high Ri-values, indicating that people generally agree that a chair expresses them or not, some other expressions were not reliably assessed. Two possible explanations can be raised to explain these differences. First, some expressions may be more subject to interpretation variability than others. Whereas an expression such as *lifeless* (low Ri) may be interpreted as 'not moving', 'predictable', or 'boring', an expression such as *stable* (high Ri) seems less ambiguous with regard to its meaning. Secondly, expressions may differ to the extent that they solely refer to product features. For instance, the expressions presumably related to the 'in back of–in front of' schema, *modern*, *advanced* and *futuristic*, show low agreement scores (see Table 2). It is easy to see that the degree to which they are expressed by a product does not only depend on product features as such, but also on an observer's knowledge of other chairs. Since such knowledge will vary among participants, they will partly disagree as to whether a particular chair can be seen as *modern* or *futuristic*. On the other hand, a rating of a chair as *secure* (high Ri) is probably highly determined by the degree of closure a chair's properties seem to offer to someone sitting in it, i.e. to observable product features. It is precisely this type of relationships between a product's formal characteristics and perceived expressions that are of interest to designers, for these indicate how schemas may be embodied in a design. Although the experimental findings do not allow for a systematic discussion of this issue, in the final section of this paper we will speculate about these relations by looking more closely at features of the chairs in relation to their scores on the schema based clusters of expressions.

7. On the relation between expression and form

An image schema is an abstraction of what similar bodily interactions with the world, giving rise to specific experiences, have in common. Arguably, artifacts can make a reference to structural properties of those image schemas, resulting in a particular experience related expression. In this last section, we want to explore whether we can relate expressions characterizing a particular chair to particular product or form features. To that end, we assessed the rank order of the chairs according to their mean scores on the expressions belonging to a predicted cluster (Table 1). Thus, for each chair a mean score was computed on each cluster (schema) by averaging its score on the scales representing that cluster. These mean cluster scores for each chair are presented in Table 6.

Table 6.

Mean cluster score for each chair

Chair	Inside–outside (Container Schema)	Balance	Size	In Back of–in Front of
A	4.89	4.53	4.50	4.14
B	3.09	2.71	3.69	4.99
C	4.29	5.57	5.21	4.54
D	3.47	4.49	2.96	4.59
E	5.73	4.55	5.34	4.44
F	3.21	3.23	3.53	4.56
G	5.20	5.37	4.87	4.75
H	4.06	2.42	3.91	5.79
I	5.68	5.01	5.29	3.56
J	2.77	3.38	4.38	5.16

In studying the container schema, we discussed bodily interactions involving insides and outsides. Numerous artifacts represent inside/outside structures in various ways. Our houses and shelters, our pots, and the housings of many of our appliances all represent a bounded space, more or less enclosing a content, people, things or substances, and enabling movement in or out. Interactions involving these kinds of products, like the storage of a substance inside a container, may share similarities with interactions between people and insides and outsides in their environments, for instance someone seeking refuge inside a shelter in order to feel secure. It is by virtue of these similarities (both interactions involve a container in which people or things are ‘moving in’) that experiences arising in these interactions are projected onto the product, resulting in an experience related expression.

One property of chairs that may refer to the container schema is the degree to which a chair establishes a division between an inside and an outside and, as such, provides an enclosure for someone sitting in it. Inspection of the scores in Table 6 reveals that chair E has the highest score on the container schema cluster, while chair J received the lowest mean score (see Figure 1 for pictures of the chairs). Clearly, chair E, as well as other high scoring chairs, is indeed characterized by a high degree of closure, thereby establishing a division between an inside and an outside, whereas chair J is a clear example of an open, space-structuring chair, not bringing about this division. Therefore, we could tentatively conclude that the degree to which a chair manifests this inside/outside division indeed guides a user in understanding a particular chair as expressing characteristics related to bodily experiences with insides and outsides, and thus as more or less *secure*, *involved*, etc. Likewise, Van Rompay and Hekkert (2001) studied the relation between enclosedness and the perceived security of bus shelters. This study revealed a similar relationship between degree of closure and rated security.

With regard to the balance schema, products, in being materialized objects, do not just fall apart, but show internal stability. Taking into account Arnheim's (1954) notion of 'motion without movement', products by their form and/or position may also give rise to perceived (in)stability. Since we experience a near breakdown when loosing our balanced position, a product perceived as unbalanced may give the impression of being ready to move, fall apart or fall down. Consequently, the product may be understood as *unstable*, *untrustworthy*, etc. In inspecting the ordering of the chairs on the expressions presumably related to the balance schema, chair C turns out to be the highest scoring chair, while chair H turns out to be the lowest scoring chair. In comparing these chairs, the difference between linear and massive features is manifest; high scoring chairs seem to express stability and stillness by their massive features, while low scoring chairs express instability and movement through their linear features.

In discussing the size schema, it was argued that big objects, whether designed objects, buildings, or people, make a more significant perceptual impression, giving rise to qualifications like *impressive*, *luxurious*, and *coarse*. In line with this theorizing, chairs scoring high on the size factor are expected to be in some way 'bigger' than low scoring chairs. Chairs scoring high on the expressions related to this schema, of which chair E is the highest, are indeed literally 'bigger' than low scoring chairs, such as chair D. Besides being bigger, the amount of materials used in the production of high scoring chairs is also larger, an aspect presumably related to the judgment of a chair as *luxurious*.

In discussing the 'in back of–in front of' schema, it was argued that the schema allows for the understanding of past, present and future as located on a path. The ordering of the chairs on the expressions derived from this schema shows a gradual change from low scoring chairs characterized by massive, space filling features, chair I being the lowest scoring chair, to high scoring chairs, chair H being the highest scoring chair, characterized by linear, space-structuring features. In other words, chairs characterized by linear, space-structuring features are understood as *modern*, *advanced*, and *futuristic* whereas massive, space filling chairs are understood as *old fashioned*, *passé*, and *dated*. It seems likely that we have come to associate past, present and future with specific form typologies. In this context, the 'in back of–in front of' schema may be thought of as guiding one in the comparison of products as if they were located on a path signifying past, present and future.

Acknowledging the speculative nature of this discussion, the findings point at a schema based structuring of (product) form expression. Designed objects may indeed embody schemas, and as such manifest similarities with bodily interactions of which the schema is the resultant. By virtue of these similarities, products may be understood as expressing characteristics related to bodily experiences. In order to assess the extent to which these speculations are justified, controlled experimental studies must be conducted to test predictions about form-schema relations and the speculations brought forward in this section. Such studies should not be restricted to products in which one may actually move in and out of, but should also include 'small scale' products. The aspects of form expression presumed to be structured by image schemas are of a basic nature and it should thus, in principle, be possible to trace them in all artifacts.

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