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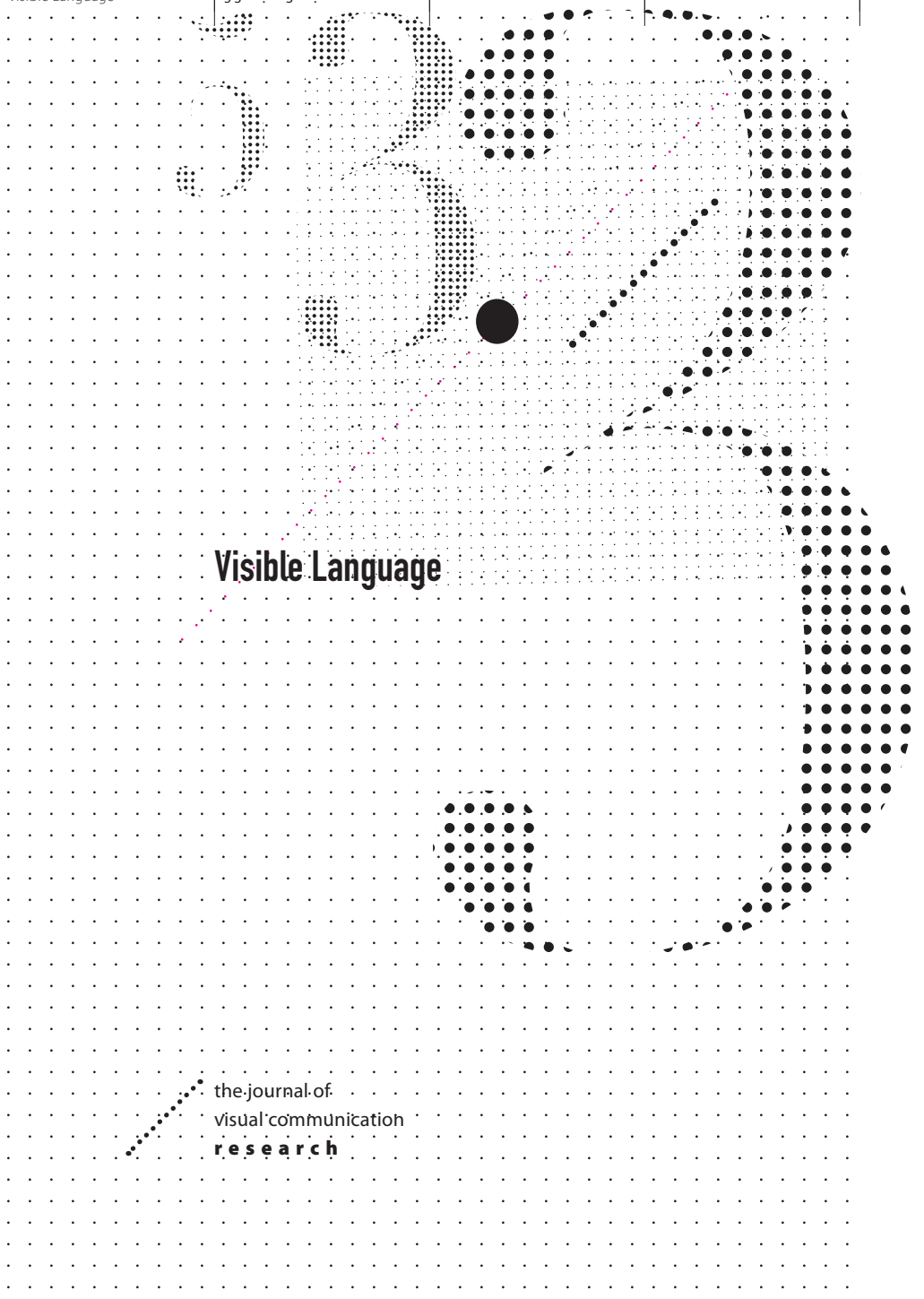

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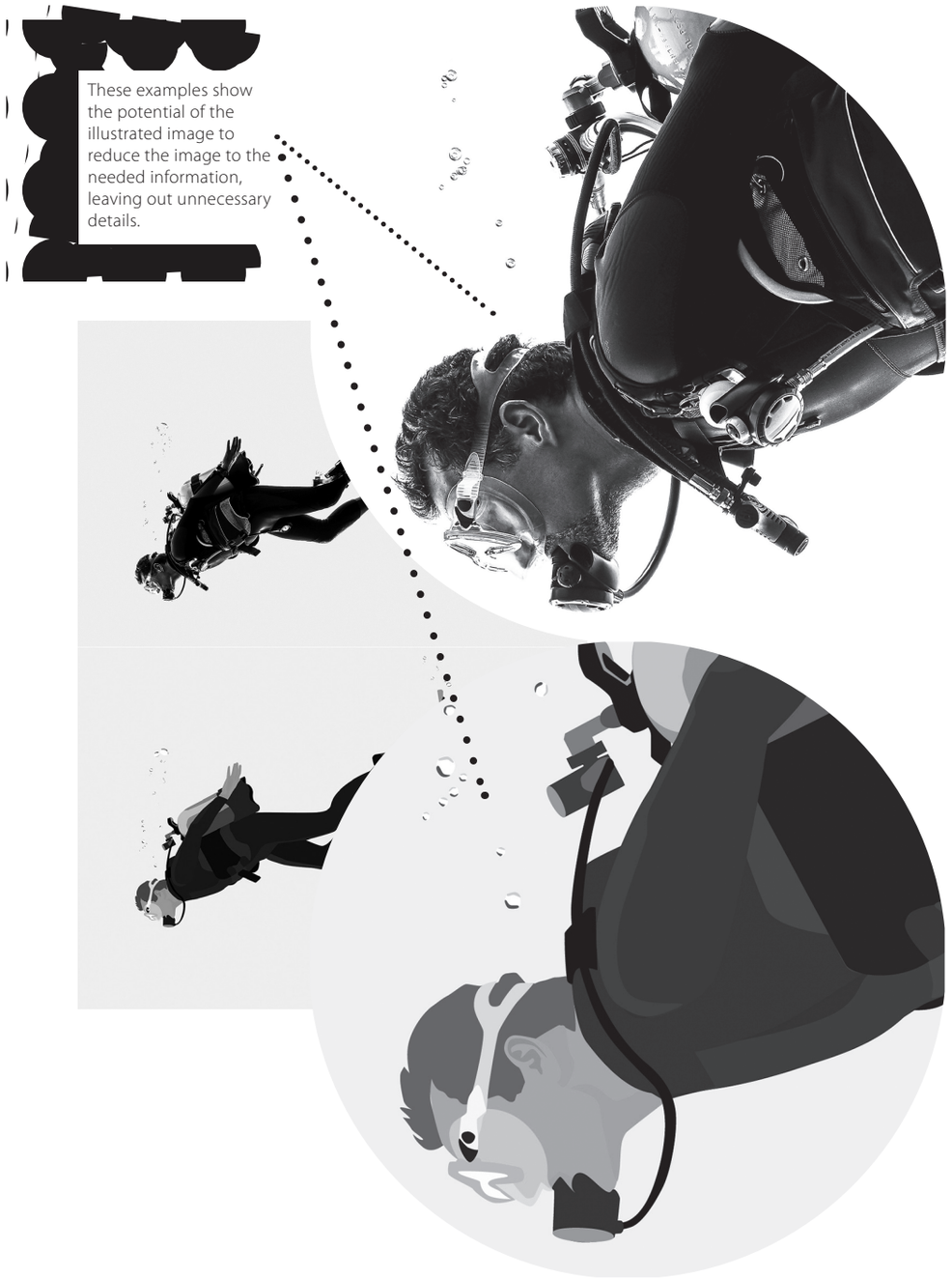

These examples show the potential of the illustrated image to reduce the image to the needed information, leaving out unnecessary details.

E-Inclusion: Defining Basic Image Properties for Illustrated Stimuli in Aphasia Treatment

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Christine Müller
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Word production is stimulated by images in treatment processes for people with aphasia (Heuer & Hallowell, 2007). Although stimulation through pictorial stimuli has a long tradition in aphasia therapy, there is a lack in research on which image stimuli are the most suitable for this purpose (Brown & Thiessen, 2018). Current research assumes that stimulation via photographic images evokes better and more direct retrieve of searched words, than stimulation by illustrations (Heuer, 2016). However, the illustrations investigated so far mostly comprise black and white line drawings and there are hardly any studies investigating possible effects of different image parameters as style, image cropping or perspective in relation to clear naming.

We developed a visual concept of illustrated images enabling clear determinability of activities and objects. The 128 designed stimuli that meet linguistic research criteria were named by 62 students regarding "name agreement" and evaluated on a 5-point scale with respect to "visual complexity" and "image agreement". The illustrated images will be examined in a following study regarding the correctness of the naming by persons with aphasia and be compared with corresponding photographic stimuli. The analysis presented here is part of the study E-Inclusion, an interdisciplinary project that includes researchers in life science technology, linguistics and speech therapy as well as image research from the University of Applied Sciences and Art Northwestern Switzerland (FHNW).

Keywords

Image stimuli
aphasia
neurolinguistic testing
practice-led iconic research
empirical testing

Introduction

The use of images for diagnosis and therapy in aphasia treatment offers far-reaching possibilities, as aphasia patients have relatively well-preserved cognitive abilities that can be used to train and regain linguistic abilities (Brown & Thiessen, 2018). Image naming tests are considered a valid method for testing word retrieval in patients with aphasia (Herbert, Hickin, Howard, Osborne, & Best, 2008) but in order to name an object, the image must first be correctly recognized (Brown & Thiessen, 2018). The respective quality of the image can promote or restrict the ability of adult aphasia patients to recognize depicted terms and concepts. Brown and Thiessen (2018) state the following factors as influential: Picture modality, richness of detail of the picture content, richness of detail of the image context, addressing of the viewer, composition and layout of the pictures. Image properties such as shape, texture and color influence visual processing and decoding and thus image recognition and naming (Heuer, 2016). Demands for "transparent" and "meaningful" pictures (Brown & Thiessen, 2018, p. 505), however, do not sufficiently clarify what pictures for aphasia patients must actually look like.

The study presented here is a pre-study and part of the study E-Inclusion. The interdisciplinary research project E-Inclusion develops an app for people with aphasia. The aim of the project is to make the benefits of digital technologies accessible to people with a speech impairment through the research-based development of technical, linguistic and visual properties of the app. Researchers from the fields of life science technology, linguistics and speech therapy as well as image research at the University of Applied Sciences and Art Northwestern Switzerland (FHNW) are contributing to the integration of the latest findings within their disciplines into the development of the app.

Our aim within the image research team is to create illustrated stimuli and to compare them to photographs in the main study E-Inclusion regarding the easiness and correctness for aphasic people to name the depicted concept. Photographic images are most frequently used as therapeutic material in aphasia therapy and preferred over illustrations. We argue that drawn images have qualities, that have not yet been taken into account and that the argument for choosing photographs in a therapeutic setting has to be reconsidered. To test this, we decided to produce a set of illustrations suitable for people with aphasia. But what kind of image language should be chosen? The process of defining the illustration style that will be compared to the photographic images defines a study of its own and is the content of this article.

State of the Art

In the past, black line drawings on a white background were mainly used as stimuli for naming tests with both non-aphasia and aphasia patients (Brodeur, Dionne-Dostie, Montreuil, & Lepage, 2010 provide a historical overview of the development of normative image data sets for use in naming tests). Snodgrass and Vanderwart (1980) developed a standardized image corpus comprising 260 line-drawings of objects. Within a short period of time it developed into one of the most widely used image datasets for cognitive science research (Brodeur et al., 2010, p.1) and was extended in the following years by drawings in the same style (e.g. by Cycowicz, Friedman, Rothstein, & Snodgrass, 1997; Bonin, Peereman, Malardier, Méot, & Chalard, 2003; Nishimoto, Miyawaki, Ueda, Une, & Takahashi, 2005; Khwaileh, Mustafawi, Herbert, & Howard, 2018). Although recourse to pure edge-based account theories is still widespread compared to theories that also take surface details into account (Mohr, 2010, p. 35), it is becoming increasingly clear that the visual processing of forms is positively influenced by the use of color (Mohr, 2010; Adlington, 2009). In 2001, Rossion and Pourtois showed that color supports object recognition in an image naming study in which they compared original line drawings of the 1980 Snodgrass and Vanderwart corpus with colored and grayscale variants of the same images. Adlington, Laws and Gale (2009) developed the Hatfield Image Test (HIT, 2009), a body of 105 color photographs showing exposed objects against a white background. Their study revealed that color has a positive impact on object recognition across categories when the process of color decoding is intact. Brodeur, Guérard, and Bouras (2014; Brodeur et al., 2010) created a standardized corpus of 1,410 color photographs of objects (The Bank of Standardized Stimuli (BOSS), 2010).

The latest findings on the influence of different image modalities and properties diverge. Brodeur et al. (2010) conclude that line drawings, as schematic and simplified representations of concepts, have the advantage of being able to reproduce only the most important properties of an object and are therefore more suitable than photographic image stimuli for certain experiments in which conceptual processing dominates visual processing. In contrast, Brown and Thiessen (2018) argue that black-and-white drawings are not conducive to good cognitive processing, especially for aphasia patients, which can be responsible for misinterpretations and incorrect data in tests. Brown and Thiessen (2018), however, agree with Brodeur et al. (2010) that line drawings and exempted images against a neutral background are particularly suitable for the representation of individual words or concepts. Complex images such as photographs, on the other hand, which show objects and activities in context, can convey more content and more complex language because they require no or at least less

linguistic processing than symbolic and abstract images. For this reason, Brown and Thiessen (2018) see complex images as conducive to use with aphasia patients. Adlington (2009) states that color is contributive to image recognition when visual color processing is intact, regardless of the image modality.

Derivation of the research question for the pre-study

Two observations result from the study of relevant literature. While abstract images are mostly conceived and realized as drawings, complex images are associated with (color) photographs. In addition, the term drawing is understood mostly as black-and-white line drawing. Thus, binarity between the concepts of drawing and photography is created, without taking into account any gradation between the two pictorial modalities. While photographs are commonly assumed to be colored and depict real objects, the term drawing is understood almost exclusively as black outlines on white background, as flat image without color and/or representation of texture, without dimensional depth through shading or perspective means. A further observation concerns the fact that the majority of image data sets developed for naming tests are limited to representation of concrete concepts, i.e. to representation of objects. The depiction of activities is considered in Szekely et al. (2005), who use an image corpus of 795 black-and-white line drawings, of which 520 images represent objects and 275 images activities. Fiez and Tranel (1997) developed a set of 280 photographic single images and image pairs for the evaluation of lexical and conceptual knowledge of activities. According to Brown and Thiessen (2018), the predominant representation of concrete concepts is due to the fact that nouns are generally easier to represent than verbs and adjectives, which is related to their inherent degree of abstraction.

Illustrated pictures are not very common in aphasia therapy except for relatively old material. The possibility to create detailed drawings containing the characteristics texture, color and spatial depth does not seem to have been considered in research on image naming so far. Possible explanations are economic reasons and a lack of skills in handling and producing pictures. In numerous studies (e.g. Brodeur et al., 2014, 2010; Adlington, 2009; Viggiano, Vannucci, & Righi, 2004) the images are created by the scientists. It can be assumed that only a few research teams have designers with professional skills in creating complex, detailed drawings — an honorable example, therefore, is the work of Moys et al. (2018), where the visual stimuli were created by graphic design students during a summer course under the direction of a lecturer. For this reason, the recourse to photography is comprehensible since the creation of images by photographic means is more accessible, faster and cheaper than the involvement of qualified staff in drawing.

Nevertheless, numerous studies (Mohr, 2010; Brodeur et al., 2010) report obstacles when creating photographic image databases, for example, in the depiction of large or living objects such as vehicles, buildings or animals. The use of images available through the Internet is not to be rejected in general since these images can help in overcoming the above-named obstacles. However, it is important to highlight that the selected images from online services should meet certain quality standards. Looking at corpora available, their inadequacy in terms of self-defined criteria, such as the choice of the best viewing angle or the choice of a prototypical example, shows.

If designers are engaged to create specific image material — or even better, if they are involved in the conception of the study — they can create images meeting the criteria for depicting objects as defined in literature comparatively easy, because their professional skills allow them to adapt, add, omit, or emphasize details and specific characteristics. A professional designer can represent objects in their prototypical form and at any viewing angle, as well as insert the object into any desired environment. This flexibility and adaptability of high-quality drawn images is not only advantageous in the representation of objects but could also be particularly beneficial in the representation of activities.

Therefore, it seems a legitimate question whether photographic images actually promote image recognition and naming more than drawn images, especially with regard to the application in the diagnosis and therapy of aphasic patients. We assume that detailed drawn images are just as well or even better recognized than comparable photographic images as they are commonly used in image naming research.

The main study of our research project E-Inclusion intends to compare photography and illustration in terms of fast and correct word reproduction in patients with aphasia. In order to be able to tackle this, the essential question was what kind of illustrations we should contrast with the photographic images. The presented pre-study was conducted to address the following question:

— Focusing on illustrations to support language acquisition in aphasia therapy, which image characteristics need to be defined in order to produce image stimuli that have a positive effect on correct recognition?

Image development and definition of basic image criteria

The development of an illustrated visual language suitable for people with aphasia within our pre-study began with initial research into existing visual material in this field.

Based on the results of existing empirical investigations, we extracted image parameters such as the use of color, texture, and proportions that have been defined as relevant image properties in empirical visual research on healthy and aphasic people (Adlington, 2009; Snodgrass & Vanderwart, 1980; Brown & Thiessen, 2018; Heuer, 2016). However, it quickly became clear that these image criteria were not sufficient and were too superficial to produce convincing image material. In the process of image production, we searched for more specific image parameters than those we found based on empirical research and extended the definition of image properties favorable to stimulate correct word retrieval using the method of "practice-led iconic research" (Renner, Reymond, & Schubbach, 2017).

The method of "practice-led iconic research" includes different phases of analysis. The formulation of a precise question is followed by the production of different images, addressing the formulated question. One image parameter after the other is extracted to be evaluated regarding its influence on the meaning of the image and the research question. Arranging the produced artifacts in different sequences, ordering, i.e., categorizing the images through differentiating groupings allows distinctive, hidden image properties to become visible. The act of relating the images in the series permits one to detect what effect a defined parameter has on the meaning of the image (Reymond, 2017).

In the following, three examples are shown that analyze the image aspects illustration style, image cropping and image perspective in regard to their usefulness in the context of illustrated images for aphasic people.

Illustration style

It seems necessary to define the use of the term "illustration" for this article since it is used differently in literature and in practice. In our work, we understand an illustration as a graphic implementation of a concept. The decorative connotation of the expression takes a secondary position in favor of comprehensibility and a high informative content of the pictorial representation. An illustration is on a par with the written denomination of the concept.

The search for the best image modality to depict an activity or an object in an unmistakable way led us to compare different illustration techniques on the basis of the same motive. Starting with the activity of drinking water, we tried to put different aspects of this action in the foreground. One approach was developed to illustrate a clean and unambiguous visual language. In these attempts, the intention was to bring the action and the performer onto different levels and thus create a focus on the object included in the action (Figure 1, on the top left). These illustrations show the technical facets of the action and have a purely informational appearance. Using the technique of watercolor painting, we focused on the depiction of the skin of the drinking person with the simultaneous intention to dismiss details and personal information about the individual. The result was pictures with a gentle impression that leave —contrary to the cleanness of the line-illustrations — an openness for further interpretations and show a more narrative aspect of the action (Figure 1, on the top right). The color pencil drawing allows a fine differentiation of details with a simultaneous softness of the expression (Figure 1, bottom left). The clear expression of the outline permits a distinct formulation of the shape, but at the same time, gives the drawing a somewhat hard and unnatural expression (Figure 1, bottom right). The examples show how different drawing styles allow to emphasize on diverse aspects of the action: on the image on the top left, the glass of water is highlighted, showing the object involved in the action,

FIGURE 1:

Examples of different illustration styles depicting the verb "drinking." *Please refer to the online version of this article to view the images in color.*

on the other images, the focus lays on certain details like the eyelashes or the hair or there seems to be no clear focus on a specific aspect at all.

While some of these examples are hand-drawn, the experimentation went on towards digital illustration. Digital illustration allows fast testing between various representation details. The clean style of digital illustrations was also in line with the request from literature to produce illustrations as clear and unambiguous as possible (Snodgrass & Vanderwart, 1980).

Image Cropping

The question of how to crop the image seems to us to be of great importance. A question that — to our knowledge — has not been asked in this context yet. Figure 2 illustrates an analysis of how the depiction of an action can be changed by the cropping of the image. The picture above left allows a general view of the activity without focusing on a specific aspect. The interpretation of the illustrated activity remains open. Is this image meant to show a specific person drinking? Or is the hairstyle or the clothes of the person of any importance? The images above right and below left clearly place the glass in the center of the picture, indicating that the focus is less on the individual than on the act of drinking. In the lower right picture, the drinking person disappears out of the format, only the mouth and a part of the hand remain visible.

FIGURE 2

Analyzing the cropping of an image and its influence on the understandability of the depicted action

We argue that this series of pictures evidences that the cropping of the image plays an important role when it comes to clarifying the comprehensibility of a depicted activity. If the picture shows too much context information as in the image above left, the action loses its importance. If, however, as in the lower right picture, practically no environment is shown, the picture becomes too specific and the risk of not understanding the message increases. For the unmistakable interpretation of an activity, it seems important that the body parts involved in the execution remain recognizable, even if they are cut by the picture format. In our case here, the visibility of the face, hand, and arm supports the recognition of the action depicted. Placing objects used to carry out the action in the center of the image frame and at the same time providing enough information about the person carrying out the activity seems to be essential to understand the action unmistakably.

Image Perspective

We also examined from which perspective an action can be most clearly recognized and conducted image research to see from which point of view an action can be easily identified. Can an action be best recognized when it shows the perspective we see when we perform the action ourselves (Figure 3, on the left)? Or is it more common to see an action performed by another person (Figure 3, on the right)? Is it easier to see the hand from a remote perspective or from one's own perspective (Figure 3 bottom right)?

Our image study has shown that there is no single answer to this question. Rather, it is a question of what activity is depicted. If it is an activity that requires the use of the whole body, such as "swimming" and "diving", or if several people are involved like in "dancing", the action is more recognizable when the viewing perspective is presented. Also, if the activity is very specific or requires complex skills such as "soldering", "baptizing" or "to how down a tree", which many people do not know from their own experience, the foreign perspective is better suited. Everyday actions such as "cutting" or "gluing", on the other hand, can easily be recognized from one's own perspective.

Although the ease with which an onlooker can understand an action was placed in the foreground, the practical question of the perspective from which the activity can best be depicted was also taken into account. For example, though washing an object is a very common action, the complexity of an image depicting the flowing water over one's own hands is very high. The action of washing becomes clearer when it can be illustrated from a beholder's perspective.

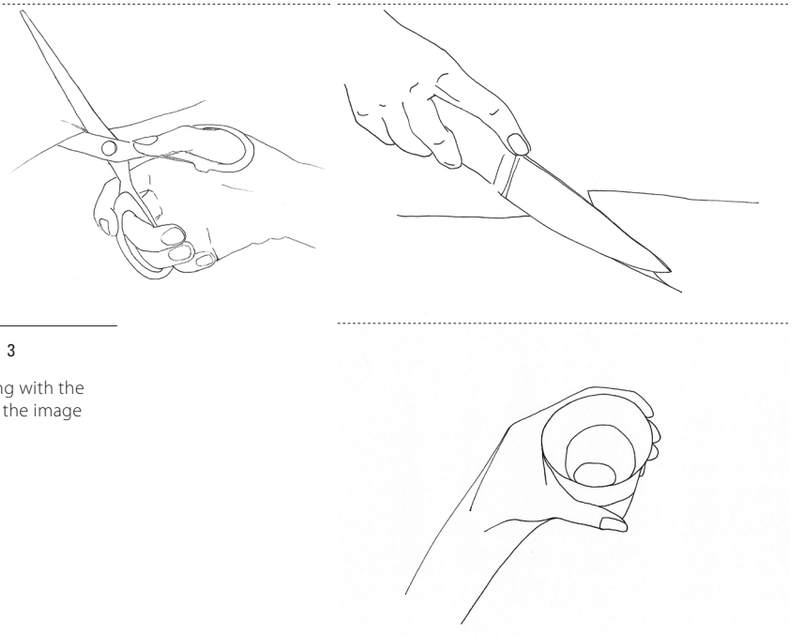


FIGURE 3

Experimenting with the viewpoint of the image

Defined Image Criteria

In analyzing image questions as shown above by producing variations of illustrated images in adding or reducing information, zooming in or out, changing color, adding texture information, an image concept for illustrations was developed and defined which understands and uses the image as a medium that produces meaning. The designed image concept was examined by showing different image examples to three people with aphasia of low to intermediate severity. Their feedback was evaluated in an open discussion within the research team and the concept was adapted where needed.

The result is a visual language that uses the following image characteristics to support accurate recognition.

Criteria defined by scientific literature as elaborated and referred to above.

General Criteria

- Color is used as a distinctive image medium and objects are shown in their most iconic color (Adlington, 2009; Mohr, 2010)
- Textures are implemented in the form of different color shades and shapes (Roisson & Pourtois, 2001)
- Three-dimensionality is simulated by the use of shading and gloss spots (Roisson & Pourtois, 2001)
- 45° angle positions for small narrow objects (Snodgrass & Vanderwart, 1980)

Criteria defined by the practical image research described in this paper:

- No outline is used around the figures, avoiding to give the image a schematic appearance
- The illustration style is recognizably digital and creates an accurate picture language
- Image information that is not required for unambiguous recognition is simplified or omitted
- All images are depicted in similar lighting, specified by neutral light, with as little shadows and reflections as possible

Activities

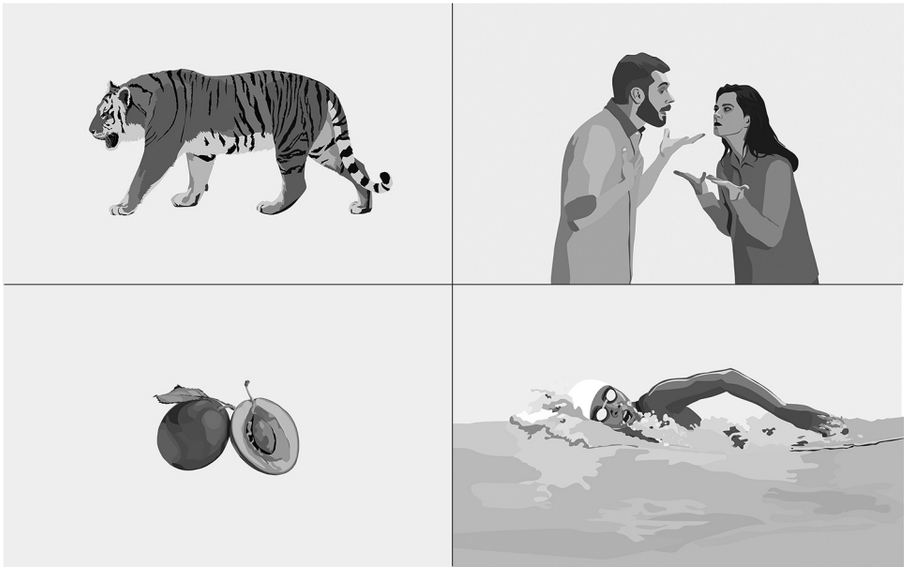
- Activities that include the whole body are shown from a viewing perspective
- Specific actions that require complex skills are shown in the foreign perspective
- Common actions are depicted from one's own perspective
- Body parts used to execute the action are shown sufficiently
- Image section focuses on the activity and places objects required for executing the action in the center
- Actions are shown without contextual information, except if the surrounding is part of the action

Objects

- The objects are depicted from three different points of view based on the most common viewing position: frontal or side eye-level, three-quarters visible from above, rotated visible from above
- Long narrow objects, mostly tools, are shown rotated around 30 degrees visible from above
- Objects are depicted as a whole, with the most common features visible, slices or details may be added
- Clothes are shown from the front. Colors of the clothes are chosen to be neutral or the most common for the represented object
- Animals are shown from the side view with a slight angle for details, such as head being turned a little sideways so that the face is 3/4 (2/3) visible
- Legs are spaced apart to underline three-dimensionality
- Objects are shown in their entirety and scaled proportionally to their size in four groups:
- size 1, the smallest ones, such as "wasp", "spider", "needle" are depicted scaled up (x:1) from their real size
- size 2, mostly handheld objects such as "spoon", "syringe", "plum" are almost 1:1 or a bit smaller than their real size
- size 3 and size 4 are scaled down relative to each other's sizes within the group
- Objects are shown without contextual information and not edge-denominated

FIGURE 4

Examples of the illustration style: objects ("tiger" above, "plum" below) shown on the left, activities ("arguing" above, "swimming" below) on the right.
Please refer to the online version of this article to view the images in color.



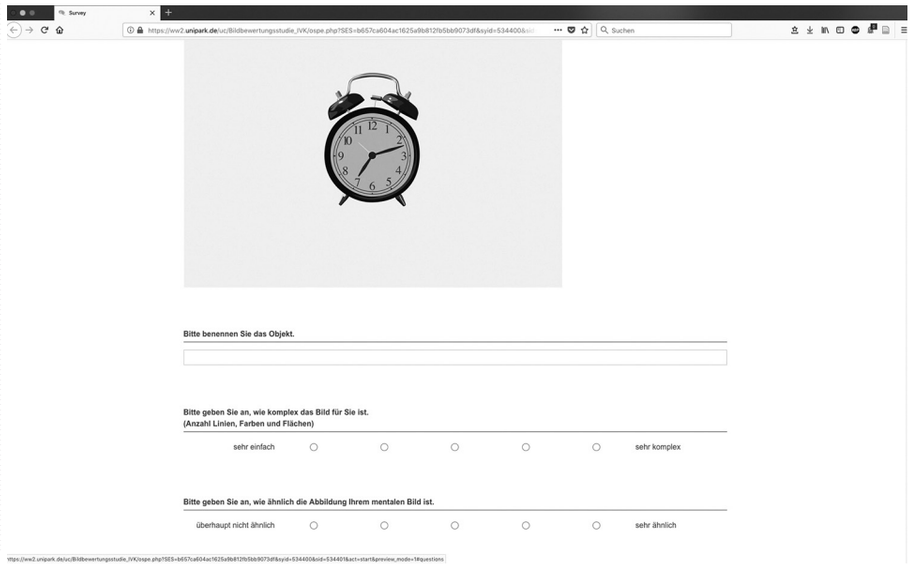
Four examples of the illustration style following those criteria are shown below. The defined image criteria listed above have an intention: the illustrated image should be as close as possible to the mental image that people possess of the activity or object, the picture should be as simple as possible although containing all needed information and the picture should evoke a clear concept.

Validation Process of the illustrated Images

After creating the images, we subjected the images to a validation process in order to test the accuracy of the depicted term and the homogeneity of the visual language. A picture set of 130 illustrations of which 65 showed objects and another 65 showed activities was divided into two sets, set A containing 33 images of objects and 32 images of activities, set B containing 32 images of objects and 33 images of activities. The division of images was pseudo-randomized. The sets were assigned randomly to the participants and presented to under-graduate and graduate students of the FHNW Academy of Art and Design. Each image was evaluated on three dimensions "name agreement," "image agreement," and "visual complexity." "Name agreement" indicates the extent to which people agree on the naming of the object or the activity depicted. For its assessment, participants were asked to name the image in writing. "Image agreement" implies the extent to which the image corresponds to one's own mental idea of the concept. It was captured on a five-point rating scale, ranging from "not at all similar" to "very similar." "Visual complexity" indicates how high the complexity of the image is estimated if the number of lines and colored areas are taken into account. The participants rated it on a five-point scale from "very simple" to "very complex." The online study was presented in February 2019 on Unipark (2017) and assessed using descriptive statistics to obtain an objective evaluation of the drawing without relying solely on the subjective estimation of the images by the designers.

FIGURE 5

Example of the online survey analyzing "name agreement", "image agreement" and "visual complexity."



From the total of 73 participants, eleven were excluded due to invalid data or because the participants did not meet the study's requirements. The 62 remaining participants (23 male, 35 female, four without specification; mean age 25.6 years) indicated no color blindness and German as a mother tongue. Of the 62 participants, 34 named and rated image set A and 28 image set B. Completing the survey took the subjects on average 22m 45.5s (Median) and was conducted during school classes. The participants were compensated with a chocolate bar.

The two bar charts in Figure 6 illustrate the descriptive evaluation of the survey. The first line of the charts shows the answers to "name agreement", the second line to "image agreement" and the third line to "visual complexity." On the left side the evaluation of the term "cube" ("Würfel" in German) is shown, indicating that the naming of the concept is unambiguous, that the agreement with one's own mental image is high and that the illustration is rated as rather little complex. The diagram on the right shows the evaluation of the illustration "to scream" ("schreien" in German). For this image, the "name agreement" is high as well, but the data show that the agreement with the mental image is not as coherent as for the image "cube." The "visual complexity" was assigned average for the depiction of screaming. This example illustrates that although "name agreement" may be high, it is not necessarily correlated with "image agreement."

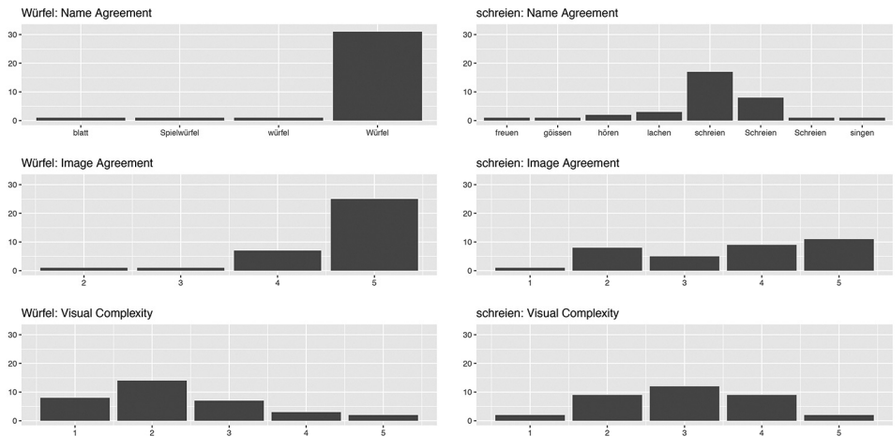


FIGURE 6

Bar charts showing the scores achieved regarding "name agreement," "image agreement," and "visual complexity" (from top to bottom).

The evaluation of the data was carried out in three successive stages. First, those images that did not have a clear "name agreement" were sorted out. Spelling mistakes were not taken into account and formulation in dialect were allowed. The bar charts were evaluated descriptively and images were rated "0" (failed) or "1" (accepted). If the bar chart showed no clear preference for one term, this was interpreted as a sign that the image statement is not clear enough and the image was sorted out. The sorted-out images were not analyzed regarding the other dimensions and had to be reconceptualized from scratch. These images, which had passed in terms of "name agreement" were examined on the following level.

On the second stage, the images that passed the level of "name agreement" successfully were analyzed regarding "image agreement." We analyzed if the majority of respondents' rate "image agreement" as "4" or "5." Scores of "1" or "2" in 10% or more of the cases, and if more than 5% of the evaluations were rated "1" were considered as failed and those images were sorted out.

At the last stage, the remaining images were examined with regard to "visual complexity." The aim was to sort out images which the majority of participants consider too complex (ratings "4" & "5"). Images rated "5" on the rating scale by 10% or more of the subjects and/or rated "2", "3" or "4" by less than 20% of the subjects were judged insufficient and sorted out. Images with low complexity were maintained if they showed good "image agreement." Those images that successfully passed through the three levels of evaluations were judged as good and added to the final set of stimuli.

The evaluation of the data allows a differentiated view of the produced image stimuli. As the examples above show, images can be assessed very differently. "Name agreement" is regarded as a relatively easy to interpret variable: if an image is named with many different terms, it is a sign that the image statement is not clear enough. When evaluating "visual complexity," on the other hand, it is not only the presentation properties that play a role but, above all, the construct to be represented that is relevant.

Naturally, a needle and a cake cannot be compared to each other in terms of complexity. Nevertheless, this evaluation is necessary to examine the uniformity of the visual language of an image set. With regard to the main study, where the images will be measured in terms of the correctness and speed with which they can be named, the specification of "visual complexity" is relevant to investigate a possible effect between complexity and naming latency. "Image agreement" is the hardest dimension to achieve in an image as this dimension is significantly influenced by personal factors such as experience, education or preferences and was thus placed as to be the last level of evaluation of the images.

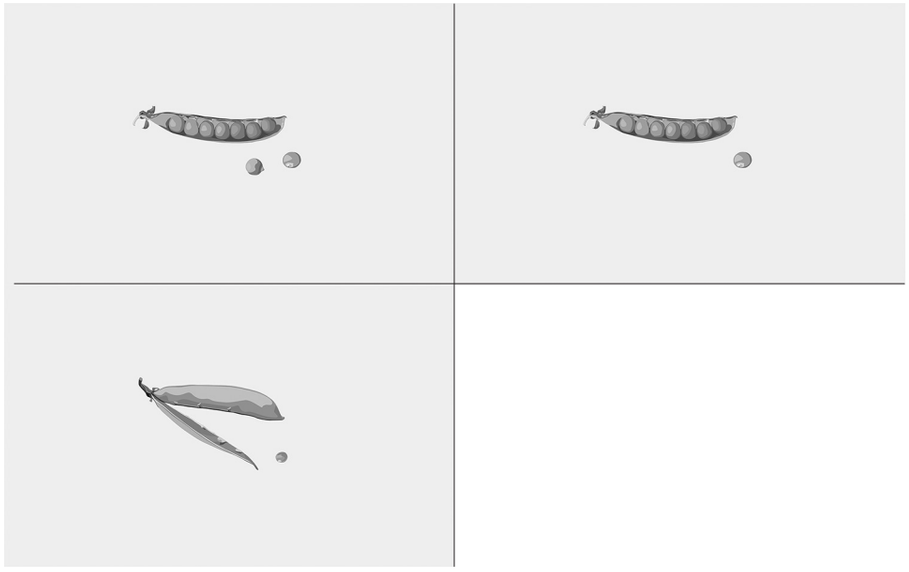
Process of improving the images based on the validation

On the basis of these results, images whose values were insufficient were revised or even exchanged. 29 out of 130 images were sorted out in order to be corrected or designed again. In order to describe how the results of the pre-test were incorporated into the correction of the images, two examples are illustrated below.

The term "pea" needed a small correction only, as the analysis of the responses showed that the majority of people agreed on the concept of the image, but mainly indicated the plural form "peas," whereas the image should evoke a single pea. In a first step, the second, single bean was removed (Figure 7, on the upper right). In order to make the singularity of the searched object even clearer, a new image was finally produced that represents only one single bean and the empty bean pod is presented as a reference (Figure 7, below left).

FIGURE 7

Correction of the image "pea." The image above on the left was tested and corrected in a first step as shown above on the right. The final version is shown below.



More fundamental interventions in the existing picture were necessary, for example, to map "digging." Since the majority of people described the first version of the picture as "gardening," "planting," or "shovel," showing that the concept of the image was unclear, the picture was rethought from the beginning. The difficulty in identifying a specific action in the first version of the image (Figure 8, on the left) seems to be due to different factors. The red color of the boots (please refer to the online version of this article to see the colored stimuli) puts them in the center of attention. Also, the spade gets a lot of attention because of the shine and the strong contrast. The result of the action, however, the dug hole, is not depicted. It is possible that the ambiguity of the concept is due to the fact that the original image does not contain an actual focus. Boots and spades are equally important and do not allow a clear assignment of the image to an activity. The new version of the image clearly focuses on the hole being dug, showing the outcome of the activity and places the other components such as the boots and tool in the background (Figure 8, on the right).

FIGURE 8

Correction process of the image "digging." On the left the initial version, on the right the revised version.

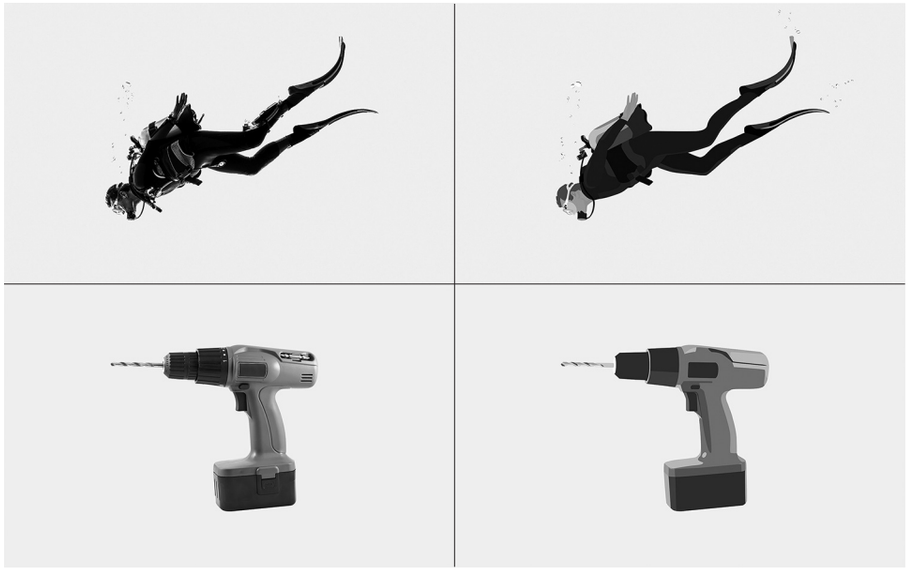
The corrected images were not retested on study participants before using in the main study. The final versions of the images were produced on the basis of the study results and represent an improvement on the previously criticized aspects as well as on the decisions of the designers. One hundred thirty illustrations were tested in the pre-study reported here. In the main study, however, 128 images will be tested on persons with aphasia while 2 illustrations are used as example material preceding the test.

Set of 128 illustrated images depicting actions and objects

For the main study, an image data set consisting of 128 illustrated images will be compared to a corresponding second set consisting of 128 photographs. To contribute to the ubiquitous question in aphasia therapy research as to whether people with aphasia can produce terms more correctly when the word is evoked with a photographic image compared to the same illustrated motive, the illustrations of objects and activities will be compared to corresponding photographs of identical motifs. As described above the image concept for the illustrations was determined after the definition of a large number of image parameters at the beginning of the image production process. Not only the latest scientific requirements but also aesthetical criteria coming from image practice were considered. The developed image concept was applied not only for the creation of illustrations but also on the selection of stock photographs to be used in the main study. Figure 9 shows the comparison between photographic and illustrated images in the way they will be tested on people with aphasia.

FIGURE 9

Differentiation between photographic image and drawn image. Left side photograph, right side illustration. These examples show the potential of the illustrated image to reduce the image to the needed information, leaving out unnecessary details.



Conclusion

The current state of aphasia research sees photography as the most suitable image medium to evoke a clear recall of words. This statement understands the image category of the drawing as an uniform grouping, without taking into account the diversity of the illustration and the countless possibilities of depiction, other than in image research, which differentiates various illustration styles and understands them as manipulable in their perceptual message. We argue that illustrations contain qualities that have not yet been investigated in the search for the ideal image stimuli for aphasia therapy. The aim of the research project described here was to define image features suitable to develop an illustrative language that allows a clear and unambiguous evocation of a concept.

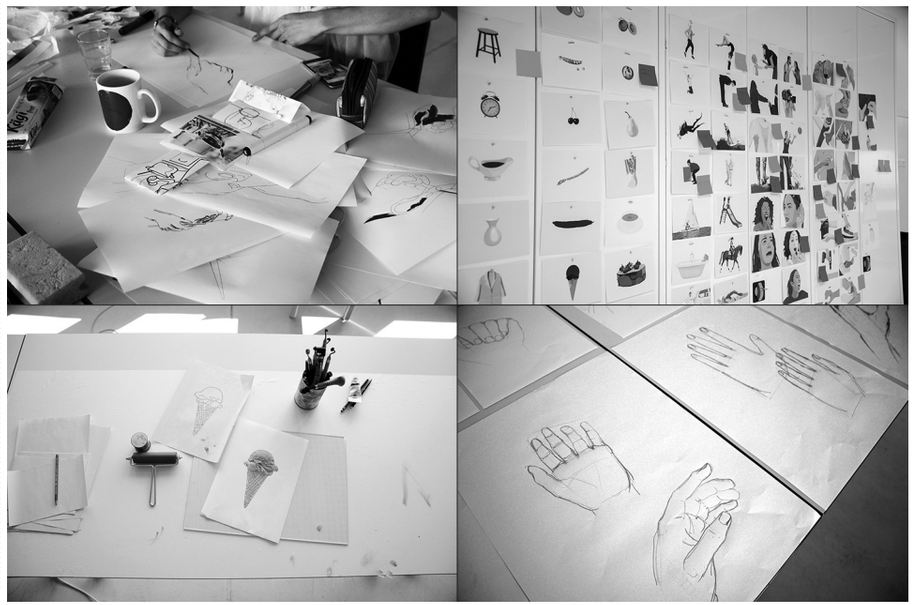
In addition to aphasia research, there is a well-founded body of research into the nature of pictorial stimuli, in which drawing often serves as an object of investigation in order to examine the different aspects of image properties on their perceptibility by healthy persons. Although illustration in this empirical research is regarded in detail, the image criteria

mentioned and examined are not yet sufficient to conclusively answer the question of which image aspects are relevant for the rapid and unambiguous perception of image stimuli. Therefore the aim of our research presented here was to define further image features such as image frame, perspective, or illustration style that play an essential role in image recognition. Of course, a single study cannot conclusively clarify those gaps and more research in this area is needed to further clarify the pending questions. The image aspects we have been investigating have been chosen form a designerly perspective, evolving from the process of image development. In this respect, we make no claim to completeness, but see the image characteristics examined here as the first examples of a hopefully subsequent investigation. Systematical analysis of different image properties, as well as empirical examinations thereof, would be a needed next step. The answer to the question of whether photographic or illustrated images are better suited for the therapy of aphasia plays a subordinate role in the analysis described here.. In our opinion, it is of great relevance to define image properties — as they have already been described here — and to investigate the effect on the perception of the image. These findings, in turn, would have an essential influence on neuropsychological tests that use images as stimulus material and could increase the quality of test results. Tinio and Leder (2009) claim, "[…] the importance of having a controlled set of stimuli, especially for studies fundamentally based on evaluations of visual representations. If image quality is not systematically controlled, it could become an artifact of the experimental context." (p. 55). The state of research clearly shows that further investigation is needed in this area.

Before starting with our study, it was already clear that the term "illustration" comprises understandings of many different styles of drawing. Illustration — even more than photography — offers a wide range of possibilities to depict an object or an activity, from the ambivalence and abstraction of fantastic images showing a fictitious situation, to the exaggerated accuracy of representation which is able to represent details that are hardly recognizable on the real object. An illustration is, therefore, an ideal medium to create an image for a specific purpose such as accentuating specific details. In our study, we looked at the image from an iconic research-perspective, including results from empirical studies but mainly relying on our knowledge in image creation. From a design perspective, it was possible to understand the stimulus as a malleable artifact and to actively question and specifically define the image's own characteristics that are at the forefront of every image design process. Brightness, perspective, contour, view, color, detail, etc., are image characteristics that can be set as primary parameters in the production of images and adapted to the benefit accordingly. By combining the methods of "practice-led iconic research" and empirical analysis, we described image properties that lead to an extension of the knowledge on which image properties should be considered for stimuli in an empirical context. In this combination we see an immense potential to advance research on perception and creation of images where both disciplines — image creation and empirical research — contribute to the same aim.

FIGURE 10

Development of the visual language for stimuli in aphasia therapy.



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