A banknote is a means of payment and this is a general user function of a banknote. To serve this overarching user function, a banknote has 10 user functions. For example, when people look into their wallet for a banknote to pay with, two User Interface functions (UI-functions) are active, recognising value (UIF 1) and handling (UIF 2). The accompanying article entitled “The Coaster-model for Banknote Designers” you may find in this edition of IBDA Insight. This article addresses the subject of human perception of banknotes and introduces 4 modes in which people may pay attention to a banknote. With 10 user functions this leads to a combination of at least 40 different perceptive situations in which people may give attention to banknotes. For banknote designers it is relevant to know which perceptive situations have priority. Banknote designers tend to focus on user functions which are not relevant for everyday use, like the User Experience functions (UX-functions). People will be interested in these UX-functions when the banknote is just issued and when it is new but their interest will decrease once they have seen it and become familiar with it. During a cash transaction, banknotes are perceived in motion, something which is not enough taken into account during the design process. Designers and decision-makers view new banknote designs in a static position. When receiving a banknote, people see part of a rather blurred image and the first information sent by the banknote is its colour.

USER MODE TRIGGERS ATTENTION
To perceive a banknote consciously, people have to pay attention to that banknote. Elmo Lewis (1903) recognised this principle when he introduced the AIDA-model for advertisements, an abbreviation for Attention of the customer (A), Interest (I), Desire (D) and Action (A). Attention is also key in another well-known model from a later date, the Multi-store model of human memory as shown in figure 1 (Atkinson and Shiffrin, 1968). This model divides the human memory into three different memory functions: the sensory memory, the working memory and the long-term memory. Banknotes are typically products to be grasped, stimulating the human senses of vision and touch. When two or more senses are stimulated it is a case of multi-sensory input, the first step in the model of Atkinson and Shiffrin. The stimuli received may be stored for one to three seconds in the sensory memory. Stimuli from the eyes and fingers have to be transferred from the sensory memory into the working memory and from there into the long term memory. Therefore the banknote’s information first has to pass through an attentional filter. To pass this filter, people have to be in an attentive mode, otherwise banknote information will not reach the working memory. Since a working memory freezes the information for a short time span, in the order of 15 to 30 seconds, it is also known as short-term memory (other terms used are primacy or active memory). This memory function supports on-going cognitive processes; the operative term is work and not memory. In fact several working memories are supporting cognition. Specifically, in the case of banknotes, the visual working memory and tactile working memory are involved.

Each working memory has a limited capacity for processing the information coming from one of the human senses. Working memories may be erased and new items may be stored, while others may be kept. With each fixation of the eyes, three objects are stored at the visual working memory for a short moment of time. In the case of simple graphic patterns, the capacity of the visual working memory may increase from three to five objects. Tactile perception follows a similar process, although in comparison to visual perception, touching banknotes while the fingers are in movement, known as haptics, is less often studied.

Once the multi-sensory input is processed, an encoded banknote will be compared with an inner image stored in the long-term memory. Inner images are not static, they change over time and should therefore not be compared with fixed repositories like a photo or a CD ROM. The division of the long-term memory into an implicit and explicit long-term memory is one more distinction relevant to banknote designers. The overall banknote is stored in the implicit long-term memory, while features are stored in the explicit long-term memory. An overview of the terminology used is provided in figure 2.

INNER AND OUTER IMAGES OF BANKNOTES
Inner images are introduced and outer images are actually the images of the banknotes as seen in daily life, the banknotes people use for their daily payments. There are two ways to recall an inner image:
1) By looking at a banknote (external stimulation)
2) By memory only (internal stimulation).

Figure 3 provides two examples of outer images, the original euro 10 (figure 3a) and the upgraded model of this denomination issued in 2014 (figure 3b). This figure also shows two inner images of these two models, respectively, in figure 3c and 3d. These fabricated examples follow the example of the inner images of a dog (Ware, 2008). The old euro 10 is the believed original or the category prototype. The figure illustrates the assumption that the two inner images of the euro 10 show less differences than the two outer images. This may explain people's reaction - we already have this note - when they see an upgraded banknote for the first time. As a result, people may not show much interest in an upgraded banknote. Furthermore, they probably tend to keep the inner image of the original banknote. Therefore, a completely new banknote design will
have a better chance to find a permanent place in the long-term memory than an upgraded design, as a new design creates a new additional category prototype.

**GIVING ATTENTION TO A BANKNOTE**

The scheme of figure 4 has been compiled by bringing the banknote and the human brain together. The sensory information on a banknote will enter the brain in *banknote mode*, a novel term. Following the work of Asch (1946), the sensory information of a banknote is either processed in *configural mode* or in *feature mode*. When the sensory information includes the complete banknote, the banknote is perceived in configural mode. When the sensory information is focussed on a specific feature, on a part of a banknote, the banknote is perceived in feature mode. So the banknote mode is either in configural or in feature mode.

Following the work of Kahneman (2011) the human brain may process the sensory information of a banknote - complete or a part of it - in two *brain modes*, either fast or slow. When the information on a banknote is processed fast, people are in *automatic pilot mode*. This is like driving a car or walking a stair. When people are looking more carefully at a banknote, the brain operates in *controlled mode*.

By bringing these four variables together, a recognisable model is created for banknote designers. Recognisable because it produces four typical usage situations scenarios that all banknote designers are aware off.

The first quadrant represents people who do not give attention to a banknote, as demonstrated by Brown (2007) in his movie “Paying with paper”, available on the internet. In this movie people accept blank paper as a banknote. The second quadrant represents the usage situation of a quick authenticity self-check on one or two favourite features, like a check for a thread. Quadrant three concerns the situation where a recently received banknote is compared to another, similar banknote, not received at the same time as the first. Finally, the fourth quadrant will be especially recognisable to employees of a central bank’s communication department. This involves a proper authenticity self-check following the instruction of the central bank’s leaflet.

The first usage situation seems to be the most common occurrence. During a cash transaction people handle banknotes in configural and automatic mode. As they are not in authenticity feature mode and not in attentive mode, they are unaware of any mimicked banknotes. Supporting evidence is the low number of counterfeits detected by the public. The experience of the DNB demonstrates that about 90 % of the counterfeits are detected at sorting systems and about 10 % by retailers and the public detects a counterfeit only incidentally. Of course, it is also possible that people who have noticed a counterfeit return these mimicked notes into circulation. Furthermore, the provided model explains why people often tell that they discovered a counterfeit by its feel (De Heij, 2010). As their short term visual memory is occupied with denomination and handling features (usually 3, maximum 5), the tactile working memory has capacity left to discover counterfeits.

**USER FUNCTION MODE ACTIVATES THE BRAIN**

Depending on the usage situation, people operate or control a banknote in a specific *user function mode*. Looking in their wallet for a euro 20 banknote, people will recall that it is blue and start searching for blue, ignoring other colours. As recognising value of a banknote is the most frequently operated user function, the information on a banknote will in general be processed in recognising value mode or denomination mode (UIF 1). When a recently received banknote is dirty, damaged or looks blurred, people may switch from denomination mode to *confidence mode*, corresponding to the UX-function of keeping confidence (UXF 3). *Confidence features* may assist the development of trust in banknotes. Features like a signature and a banknote number fall into this category. Authenticity features will also support trust, although, at this stage, people may not (yet) use them. People will simply make up their mind whether they can trust the deviant, recently received banknote. If they have doubts, they may switch to *authenticity mode*, in accordance with the UI-function of checking authenticity (UIF 3).

**CONCLUSION**

Attention to any feature in a banknote depends on three variables:
1) User mode (6 UXFs and 4 UIFs)
2) Banknote mode (configural or feature)
3) brain mode (automatic or control).

With 10 user modes, corresponding with 10 user functions, and 4 combinations of banknote and brain modes, there are at least 40 different perception situations in which people may give attention to banknotes.

Most often people are in denomination mode, having a quick look (automatic mode) at the complete banknote (configural mode). People will operate UX-functions when a banknote is just rolled out or when it is new. For example, people saying that they find the new banknote beautiful are in *aesthetic mode*. When they like the picture, they are in the *main image mode*.

As attention is key for memorising banknotes, new banknote designs are preferred over an upgrade. The development of tactile public authenticity features are preferred over features stimulating the visual working memory.

**References**


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General scheme of the multi-store model of Atkinson and Shiffrin (1968). This model divides the human memory into three different memory functions: the sensory memory, the working memory and the long-term memory.

Figure 2
Overview of terminology concerning the overall banknote and its features.

Figure 3
Outer and inner images of euro 10 banknotes. Inner images are fabricated examples.
- a) Original euro 10 banknote (2002).
- b) Upgraded euro 10 banknote (2014).
- c) A fabricated inner image of a euro 10 banknote (2002).
- d) A fabricated inner image of a euro 10 banknote (2014).

Figure 4
The 4M-model, a model of the 4 Modes of giving attention to a Banknote. In italics an example is provided for giving attention to a banknote in authenticity mode.

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Figure 4
Relative importance of four user functions of a banknote to the Dutch in 2013. Respondents were asked which of these four functions of euro banknotes are most important to them (4 = high importance, 1 = low importance) and how they would rate these functions on a score from 1 to 10.

<table>
<thead>
<tr>
<th>User Interface Function (UIF)</th>
<th>Importance</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Recognising value</td>
<td>2.6</td>
<td>7.7</td>
</tr>
<tr>
<td>2. Handling</td>
<td>1.6</td>
<td>7.1</td>
</tr>
<tr>
<td>3. Checking authenticity</td>
<td>1.7</td>
<td>5.7</td>
</tr>
<tr>
<td>4. Receiving a communication message</td>
<td>0.2</td>
<td>5.2</td>
</tr>
<tr>
<td>Usability score (average of 1-4)</td>
<td></td>
<td>6.4</td>
</tr>
</tbody>
</table>

Figure 5
Three different banknote designs. Each designer grounded their on a different user functions.

a) Banknote design focussed on experiencing identity (UXF 1).
   Design of the NOK 100, part of a new series of Norwegian banknotes to be issued in 2016.
   Front. According to the Norwegian bank: An open expression, open, light and typically Nordic. (design by The Metric System).
   Reverse. According to the Norwegian bank: Using the pixel motifs from as the reverse will give the notes both a traditional and a modern expression (design by Snøhetta Design).


c) Focus on receiving a communication message (UIF 4). RUB 100, issued in 2014 on the occasion of the Olympic Winter Games in Sochi, Russian Federation.