DESIGN FOR ORAL FINANCIAL INCLUSION
Briefing Note

If you're illiterate it can be tough to make address book entries on your feature phone - unless you own a Nokia 105. In a study with My Oral Village in Tanzania in 2015, we interviewed several illiterate adults who were making their own entries, using a library of some 25 iconic images that could be linked to phone numbers. This simple feature freed them to store the phone numbers of loved ones, friends and neighbours for easy, touch-of-a-button access.

Good design thinking – like that in the Nokia 105 - can provide illiterate users with more than just easier access to address books. Better interface design could greatly enhance the usability of mobile money interfaces, and support user learning of basic financial numeracy.

An earlier paper offered five principles I believe are distinctive to designing for oral financial inclusion.[1] This note explores practices that support these principles, and offers practice recommendations.

Effective design starts by knowing the user. What makes oral users (those living where text is rarely used, and who are mostly illiterate or semi-literate) different? When performing financial transactions, they experience low context and high stress, compared to their literate peers.

BACKGROUND

Low Context

Literate people absorb much information from contexts that illiterate people can't access. This information comes in many formats: from text and arithmetic notation to literate hierarchies, abstractions and mappings.

Before a literate person must input data into a mobile money app, she may have seen signs, received as demonstration from a friend or funds from a relative, or heard explanations from an agent. At each step, literacy supports learning. An agent's explanations are oral, but they do not stand alone, and she can quickly link them to other information to assemble a fuller picture. While using the app for the first time, she probably knows quite a bit about what to expect already, and is watching for the text-prompts that flag when she must make decisions, and the types of inputs she must make.

By contrast an illiterate individual cannot recognize the text prompts, no matter how well primed in advance. Signs, text messages and brochures are much less accessible, and much verbal information may be ambiguous or even misleading. Each screen involves a decision-point that is important and supported by few clues about what is at stake, or what to do next.

High Stress

Formal financial transactions are conducted quickly, often under time pressure. The trace of numbers carried in working memory decays within seconds,[2] causing those who can't read to

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[1] Matthews, Brett Hudson. *Oral information management tools: lighting the path to financial inclusion.* My Oral Village, Inc. 2014; pp 33-35.
[2] Baddeley, Alan. *Working memory.* Science, Vol 255 (Jan 1992), pp. 556-59.

forget critical information. (Time pressure is now known to be an important cause of math anxiety among school children.[3]) By contrast, many skills are learned in school that economize on working memory. These include fluency with Indo-Arabic numerals and place value, along with working familiarity with written calculations, calculators, calendars and percentages.
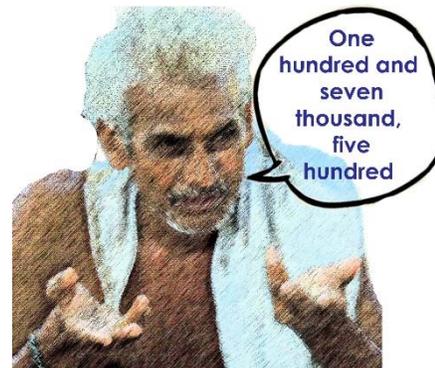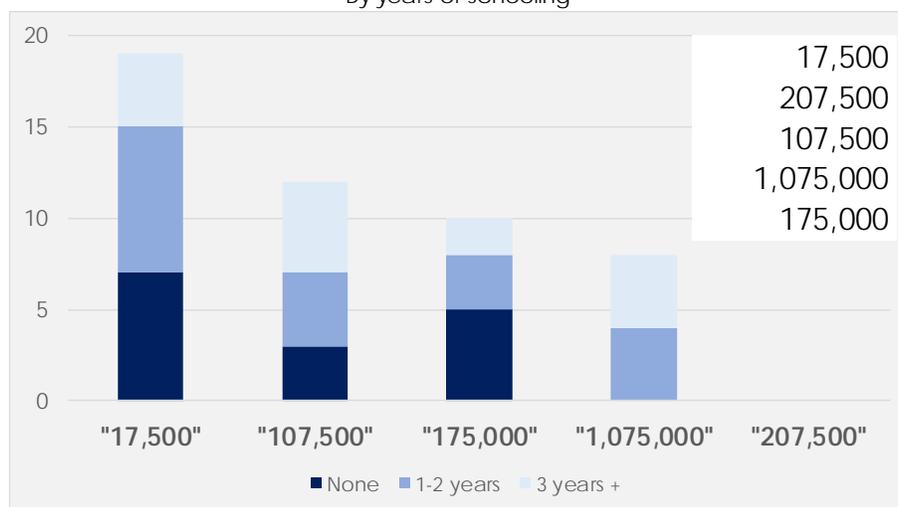
To understand a personal financial record, a user must mentally re-code arithmetic notation into verbal number. To send money on a mobile app she must re-code verbal number into arithmetic notation. Schooling equips people cognitively for these tasks. But numeric cognition experts find that recoding easily triggers errors. For example, the German oral '27' is spoken 'seven and twenty', causing literate adults to often write "72".[4]

Many currencies trade at low nominal values. This may require a person to exchange hundreds or even thousands of units of their currency for basic household items. These large numbers may have one or more zeros in them. The zeros are not usually spoken or heard in speech (say any 4-6 digit number and listen for zeros). Instead, zeros appear by implication and in the written notation. Field studies by My Oral Village suggest that this may be causing far larger transcoding errors than any commonly found in studies of numeric cognition among literates.

CHART 1 shows results of our study in Tanzania and Cambodia with 80 illiterate adults, all of whom had to deal with written numbers in savings groups, financial cooperatives or mobile money.

CHART 1
Written numeric processing
80 illiterate adults in Tanzania and Cambodia
By years of schooling

17,500
207,500
107,500
1,075,000
175,000

Legend: ■ None ■ 1-2 years ■ 3 years +

X-axis: "17,500" "107,500" "175,000" "1,075,000" "207,500"

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[3] Jo Boaler introduces her latest book with an extensive discussion of 'math trauma' and anxiety among schoolchildren (Mathematical Mindsets, Jossey-Bass (Wiley), San Francisco, 2016).
[4] Nuerk, Hans-Christoph, Korbinian Moeller, Elise Klein, Klaus Willmes and Martin H. Fischer (2011). *Extending the mental number line: a review of multi-digit number processing*. Journal of Psychology Vol. 219 (1): 3–22; p 9.

After counting 107,500 units of their own currency (usually correctly) we showed them a list of digits (upper right) and asked them to select the correct one? Many would not answer this, waving it away in mock horror, as if it were Fortran or ancient Greek. Those who answered *often made order-of-magnitude errors*: 27 of the 49 who answered selected 5- or 7-digit strings, instead of the correct 6-digit one. Even those who had completed three or more years of school appeared very prone to this type of error.

No one wants to make order-of-magnitude errors in managing their personal finances. A minimum requirement of good oral design should be to relieve users from such a risk.

Oral working memory can be further strained by the need, in many contexts, to conduct cash or financial transactions in a second language.

Formal financial interfaces today are designed in a way that forces oral individuals to contend simultaneously with:
- the many complexities of literate coding,
- the time pressures of routine commercial transacting, and
- personal stakes that rise with transaction sizes.

In the ordinary course of events, these pressures cause substantial stress and eventually overload working memory. They force oral adults into making a Hobson's choice between blind trust and self-exclusion from formal finance.

But there are ways to alleviate these pressures, and they start with better interface designs.

DESIGNING THE USER INTERFACE

Smartphones offer enormous potential to achieve oral financial inclusion. A recent report by CGAP suggested "an initial set of 21 principles" for interface designs for mobile financial services.[5] This blog seeks to extend CGAP's initiative into the oral segment. On this open frontier, there remains enormous scope for further innovation. Many points are still under debate. At this first blush of dawn of an era of nearly universal smartphone access, designs in mobile money remain far too focused on user experience (UX) and voice capabilities, and pay far too little attention to basic *usability* and graphic capabilities.

Key advice for designs of oral user-interfaces for smartphones include the following.
- Learn to recognize literate design elements.
- Voice is useful, but no 'magic bullet'.
- Code for usability first.
- Test numeracy; don't assume it.
- Keep images and icons declarative, uncluttered and to-the-point.
- Avoid interface separation wherever possible.
- Orality affords both abstraction and hierarch – just not in *literate* formats.

1. Learn to recognize literate design elements.
Oral people are not simple, and don't require simplification. (Don Norman, the great design thinker, has emphasized this frequently.)[6] Their constraint is literacy, and products of literate culture.

[5] Chen, Gregory, Alexandra Fiorillo and Michel Hanouch. *Smartphones and mobile money: principles for UI/UX design*. CGAP, Oct 2016.
[6] See for example Don Norman. *Simplicity is not the answer*. ACM Interactions, Vol 15 (5), 2008.

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Unfortunately, this guideline is less straight-forward to apply than it sounds. Consider the Paytm interface at right. What aspects are products of literate culture? Which icons? And how about the screen layout? And what about voice recordings that provide help to a confused user? Or the sequencing of the steps in a transaction?

It is possible to imagine a purist approach to design for oral users that removes all literate design elements – from text and arithmetic notation to every form of literate abstraction -- from the interface. This is not the right path.

Quality oral designs will *challenge the oral user to learn while lowering her transaction costs*, such as risk of error or misunderstanding.

2. Voice is useful, but no 'magic bullet'.

Digital voice is (by definition) 'oral', so it is not surprising that it has been hailed as the future of digital financial inclusion.

Voice is both inevitable and integral to a full solution. But it faces obstacles to effective deployment in the near-term. More importantly, voice cannot overcome visual and spatial gaps in oral numeric cognition. Without crossing this cognitive bridge, most oral adults won't embrace cash as a store of value. Instead, they continue to confine their use of cash to medium-of-exchange roles. Not only will this limit their ability to adapt to the modern economy and accumulate household assets, it will also slow the development of a digital payments and financial ecosystem, and the entry of oral adults into the digital world.

In practice, mixed solutions (various design elements including voice) will always be superior to voice alone. They offer oral users reliable, real-time cross-checks during stressful transactions. This increases the sense of personal security, and reduces the risk of error. They also build skills that are essential to adaptation to the formal economy.

3. Code for usability first.

When an oral person sends 1,000 units of her local currency to another person, s/he is likely to be visualizing one or more physical cash notes (such as those s/he is about to hand to an agent). This note or notes has a colour, shape and distinguishing images. It looks physically different from another amount such as 100 units of the same currency. For greater clarity, she is NOT sending a number – i.e., the notation "1,000" – which is inherently more abstract and inaccessible: code (Indo-Arabic), layered on code (cash), layered on code (verbal number). Schooling prepares us to make this translation rapidly and accurately; without schooling it is far less obvious.

In a 2014 conference paper, Woldmariam and colleagues proposed a cash-based interface, with audio support, for illiterate users of mobile money in Ethiopia.[7] Beyond their core focus on usable design, they added that national governments may also prefer to see their national
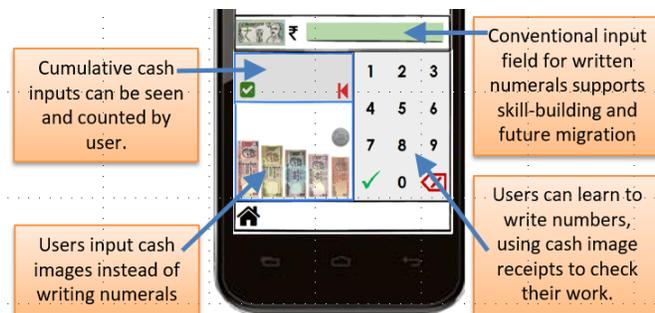
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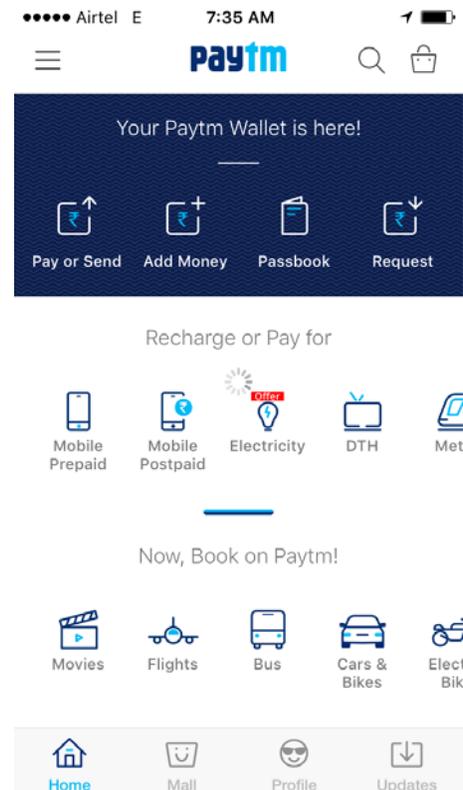
[7] Woldmariam, Mesfin F., Gheorgita Ghinea, Solomon Atnafu and Tor Morten Grønli. *Mobile money system design for illiterate users in rural Ethiopia*. In Design, User Experience, and Usability. User Experience Design for Everyday Life Applications and Services, Third International Conference, DUXU 2014, Heraklion, Crete, Greece, June 22-27, 2014, Proceedings, Part III, pp. 482-491

identities represented through cash images in digital money. In 2016 Aqeel Hayat designed working prototypes for cash-based withdrawals, transfers and top-ups for Pakistan.[8] Hayat envisions these designs to be applicable not just to mobile wallets but to POS machines and ATMs.

In both these cases, voice is seen as a useful ancillary design element, but *not as a stand-alone substitute* for inaccessible codes like long numeral strings or text.

Multi-coding is often the best way to unlock information flows that challenge oral users. The 2016 collaboration between MicroSave and My Oral Village created a cash-numeric keyboard with voice support that permits user input in either cash or numeric modes, with a graphic cash-based 'receipt' area that updates and is visible at all times during numeric entry.[9] This prioritizes usability while supporting graduation by the user at a time of her choosing.

Cumulative cash inputs can be seen and counted by user.

Conventional input field for written numerals supports skill-building and future migration

Users input cash images instead of writing numerals

Users can learn to write numbers, using cash image receipts to check their work.

4. Test numeracy; don't assume it.

Most oral individuals can read 1-digit numbers, even if they can't read text. This makes these useful for many purposes, such as '7' rather than the written 'July' on a calendar. However, tolerance for longer Indo-Arabic numeral strings is strictly limited among oral individuals, varies by context, and should be empirically verified. It is rare for unschooled adults without business interests to be able to comfortably process number above 3 digits in length.[10] In many contexts familiarity with 2-digit numbers is limited to practical experience with numbers in the 20s or 30s, with confidence rapidly dropping off at higher counts.

Specific vocational skills (such as weaving or shop-keeping) and specific traditions (such as an active pre-modern currency like cowrie shells or beads) support more advanced skills among some individuals and communities.

5. Keep images declarative, uncluttered and to-the-point.

In an insightful study of 200 illiterate and semi-literate individuals, Indrani Medhi and colleagues compared oral responses to text, hand-drawn images, photos, animation and video.[11] They found that the fastest and most intuitive understanding came from hand-drawn images. They also observed that oral users often find photos distracting because, unlike hand-drawn pictures, they include unrelated objects and interactions.

My Oral Village has used both urban design firms and village artists to develop designs for oral financial services users. Villagers usually prove more adept, because they need not 'unlearn' literate abstractions, iconography and visual protocols that confuse oral

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[8] Hayat, Aqeel. *Achieving ubiquitous mobile banking in developing countries*. Dawsun Technologies Inc. Islamabad, 2017.

[9] Matthews, Brett, Richa Valechha, Vivek Anand, Avantika Kushwaha, Saborni Poddar and Rachit Ohri. *Digital wallet adoption for the oral segment in India*. MicroSave and My Oral Village, Lucknow, 2017.

[10] Matthews, Brett. *A cash keyboard for digital finance*. My Oral Village, Toronto, 2017.

[11] Medhi, Indrani, Aman Sagar and Kentaro Toyama. *Text-free interfaces for illiterate and semi-literate users*. Information Technologies and International Development, Vol. 4, No. 1, MIT Press, Fall 2007.

users. Low context means that oral users depend on cues from uncluttered, declarative pictures that are easily recognizable with a minimum of space.

6. Avoid interface separation wherever possible.

Should separate interfaces be designed for illiterate individuals? Most retail interface solutions, whether digital or not, serve large populations including, but not confined to, illiterate and innumerate individuals. While some concessions to interface separation may be unavoidable, they should be parsimonious, tactical and as rare as possible. And wherever possible they should incorporate graduation into their designs. Sighted people are not bothered by Braille on ATMs or on cash notes, and well designed oral interfaces will not inconvenience adults who are well adapted to the notations of formal financial interfaces.

Separate products may be warranted in some cases. For example, a digital ROSCA or funeral society app may appeal to many oral populations, but not to literate users who use these oral institutions less frequently (though even in this case, many saving groups are used by literate individuals, and a literate industry of interface design is evolving). As smartphones spread through rural areas such opportunities will multiply.
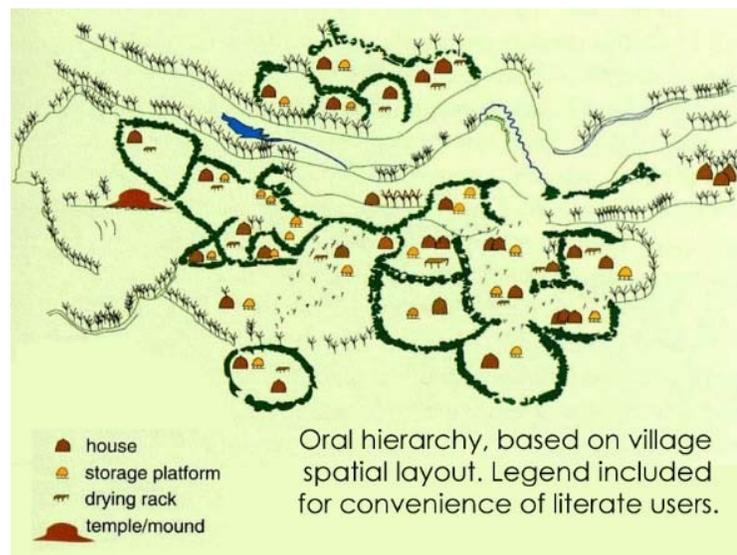
7. Orality affords abstraction and hierarchy – just not *literate* abstraction.

In his 1930s studies of oral psychology in Central Asia, Alexander Luria asked his subjects to select three similar words from the following list: "hammer, saw, log, hatchet".[12] His respondents rejected the literate solution (removing the log to produce a list of 3 tools) on practical grounds: life does not create situations that require three wood-working tools and no wood.
Luria's influential conclusion was that oral thinking is concrete, not abstract.

A 2013 study of mobile phone use by illiterate individuals built on this view to argue that oral users cannot afford interface hierarchy. Mobile designs should keep "navigation linear to the extent

possible and to minimize hierarchical depth."[13] Unfortunately, the study tested only literate hierarchies. Oral hierarchies can be fueled by oral categories: for example, family lines of descent or spatial mappings like a generic village layout or building interior. The power of this approach to support later recall has been known since the development of the method of loci by the ancients.

Oral individuals increasingly run into literate hierarchies and categorizations in the real world: on store shelves for example. While literate hierarchies may not render an interface unusable, oral hierarchies

Legend:
- house
- storage platform
- drying rack
- temple/mound

Oral hierarchy, based on village spatial layout. Legend included for convenience of literate users.

[12] Luria, Alexander Romanovich. *Cognitive Development: Its Cultural and Social Foundations*. Harvard University Press, 1982.
[13] Indrani Medhi, Kentaro Toyama, Anirudha Joshi, Uday Athavankar, Edward Cutrell. *A comparison of list vs. hierarchical UIs on mobile phones for non-literate users*. In Paula Kotz´e; Gary Marsden; Gitte Lindgaard; Janet Wesson; Marco Winckler. 14th International Conference on Human-Computer Interaction (INTERACT), Sep 2013, Cape Town, South Africa. Springer, Lecture Notes in Computer Science, LNCS-8118 (Part II), pp.497-504, 2013.

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may enhance oral users' experience, and are unlikely to deter literates, who can navigate either world comfortably. There is also scope for designing graduation from oral to literate abstractions and hierarchies into interfaces.

DESIGNING FOR ORAL FINANCIAL INCLUSION

Just as the literate person has strong command of the defining code of oral culture, speech; the literate mind can generally understand and appreciate oral design elements. This can create win/wins that enhance everyone's experience at once. But in design for financial inclusion, the *usability* component of user experience (UX) has been neglected.

Usability is the centre of gravity in designing for illiterate and innumerate adults. But design for orality also tilts strongly towards the field of assistive technology (the domain of Braille on ATMs, and Talkback for Android smartphones, among many others), which lies entirely outside the conventional UX field.

There is a reasonable chance of near-term success with design and deployment of mobile payment systems that oral individuals find usable. Long term planning in cash is however, a larger, more complex cluster of problems that will take longer to solve. An oralized mobile wallet with features like a cash flow planner, calculator and numeracy games could greatly reduce the cognitive burdens faced by innumerate people trying to adapt to the formal cash economy and financial system. Much can be accomplished with voice, but the most effective systems are more likely to be mixed: integrating voice visual and spatial design elements that afford faster learning in areas like financial stores of value, percentage, and modern measures of time.

Several fintech firms, from Xapo and PayTM to Trulioo and bitPesa, are creating infrastructure rails that can in principle build oral identities and reputations, and support frictionless transactions with relatives, business partners and others nationally and across-borders. Smartphone diffusion will increasingly expand this potential in the coming years.

The graphical user interface popularized by Steve Jobs and developed by Alan Kay and Xerox PARC featured much less writing than contemporaneous user interfaces. Far from being an affront to literate people, GUIs reduced the need for constant mental re-coding of text, freeing users' cognitive resources for more useful interactions. Many oral designs may offer similar benefits for literate users. But, can literate designers transcend literate mindsets and realize the latent potential in oral design?

There are still many unanswered questions about the elements of good design for oral financial inclusion. This frontier is an exciting one, with huge potential, especially for digital financial services.