

The impact of different formats on learning

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This research is part of the Marie Skłodowska-Curie Actions Innovative Training Network Early Language Development in the Digital Age ([e-LADDA](#)).

Project at DZC & LU: Usage Analysis of Digital and Analogue Learning Materials for Children
Supervisor: Prof. Jurgis Škilters, Prof. Mila Vulchanova (NTNU)



Furhat Robotics



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 857897.

- Identify benefits and drawbacks of digital technologies for (language) learning
- Pursue a highly interdisciplinary and cross-sectorial perspective
- Transform and develop new digital solutions that benefit learners
- Collaborate with industry and the non-academic public sector
- Provide guidance to policy makers, educators, practitioners and families in handling emerging digital environments

e-LADDA project @ DZC & UL

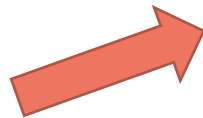
Analogue tools



Content types

- Maths, Sciences, Language
- Reading, writing/composition
- Visuo-spatial tasks
- Problem solving

Digital tools



Content presentation

- static vs. dynamic
- explanations spoken vs. written
- personalised vs. non-personalised
- interactive vs. non-interactive



Outcome measures

- Comprehension, recall
- Performance on visuo-spatial test
- Transfer, synthesis
- Acceptance
- Etc.

Rationale

According to the EU Kids Online report (2020), **around 60%** of children aged 9-16 use online **digital media daily** and spend on average 167 minutes per day online.

There is a need for clear and balanced information regarding appropriate digital technology practices in order for young learners gain benefits while minimising the potential harm.

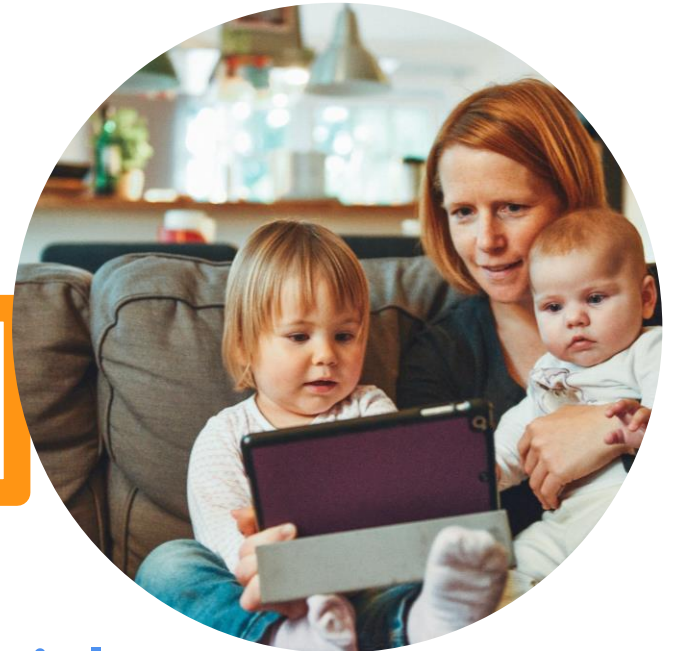
The importance of researching and contrasting the analogue and the digital format hereby potentially informing learning material and learning tool design practises in the future becomes evident.

Children and digital technologies

Young children (0-8) use digital technologies for the following purposes:

- (1) **Leisure & entertainment** – videos and games
- (2) **Information and learning** – frequently encouraged by parents
- (3) **Creation** – creative expression
- (4) **Communication** – a minority - from around age 6

cf. Chaudron, Di Gioia, & Gemo (2018)



Children perceive digital technologies as positive, fun & social

Photo by Alexander
Dummer on unsplash.com



Impact of format on Learning outcome

Some evidence from language learning

Word learning digitally vs. real world

Information when learning with digital media



Pictures by Ryan Fields & Jelleke Vanooteghem

Information such as texture, weight, and smell of an object are absent and material, size and 3D shape information are restricted → have to be extracted from 2D perceptual cues

Access to these properties is important for interpreting the content as using multiple sensory inputs to explore results in richer semantic networks leads to more learning (Smith & Gasser, 2005)

Learning words with digital media can then lead to the **transfer deficit** (Barr, 2013 & 2019)

Recent meta-analysis by Strouse & Samson (2021)

But what about a storybook?

Images in storybooks are limited in the same way as those in digital media

but often include a context rich in social cues, variable auditory input, and self-guided exploration

→ Shared, interactive book reading facilitates word learning
(Debaryshe, 1993; Blewitt et al, 2009; amongst others)

Integrating interactive elements into digital media boosts word learning as well as transfer to novel objects (Zack & Barr, 2016)



So, what can we learn from that?

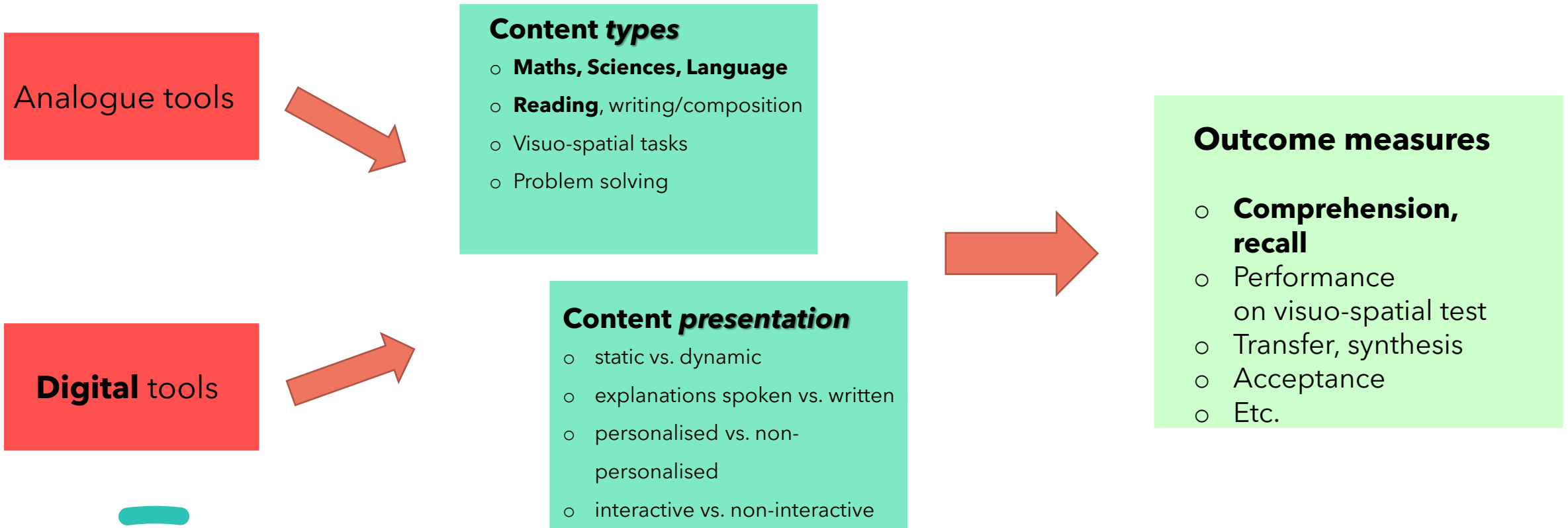
(Language) Learning is multi-modal

Interaction seems to be crucial for (word) learning,
irrespective of the format

Transfer deficit

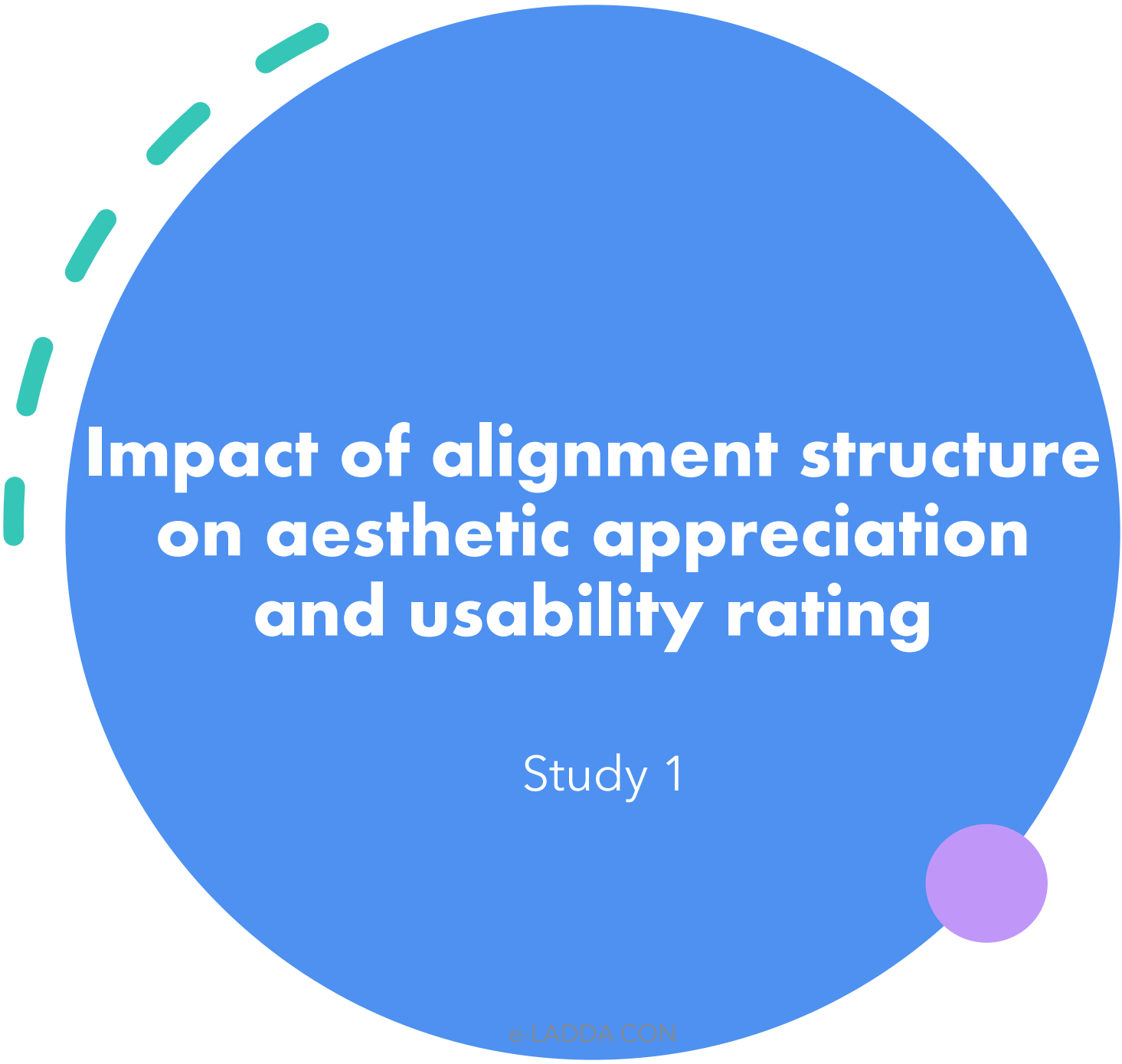
→ declines with age (Ganea, Ma, & DeLoache, 2010)

e-LADDA project @ DZC & UL



The impact of interface alignment structure on aesthetic appreciation, usability rating and content comprehension

Aisha Futura Tüchler^{1,2}, Jurgis Škilters^{1,2}, Līga Zariņa¹, Solvita Umbraško¹
¹University of Latvia ²e-LADDA ITN



Impact of alignment structure on aesthetic appreciation and usability rating

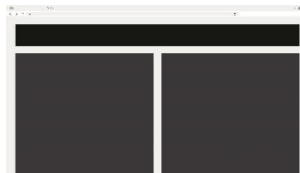
Study 1

Study 1

Exploratory study design – Online survey

Canonical interface layout structures extracted from websites for different purposes, such as education, medicine or leisure etc.

Preference for the obtained layout structures was rated in a quasi-experiment



Stimuli

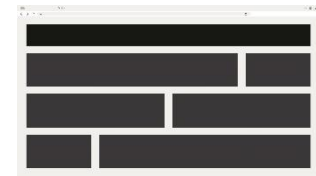
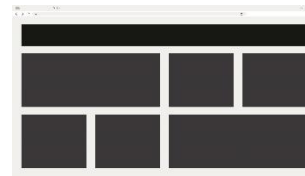
4 layout types were extracted

Columns

Blocks

Advanced grid

Broken grid

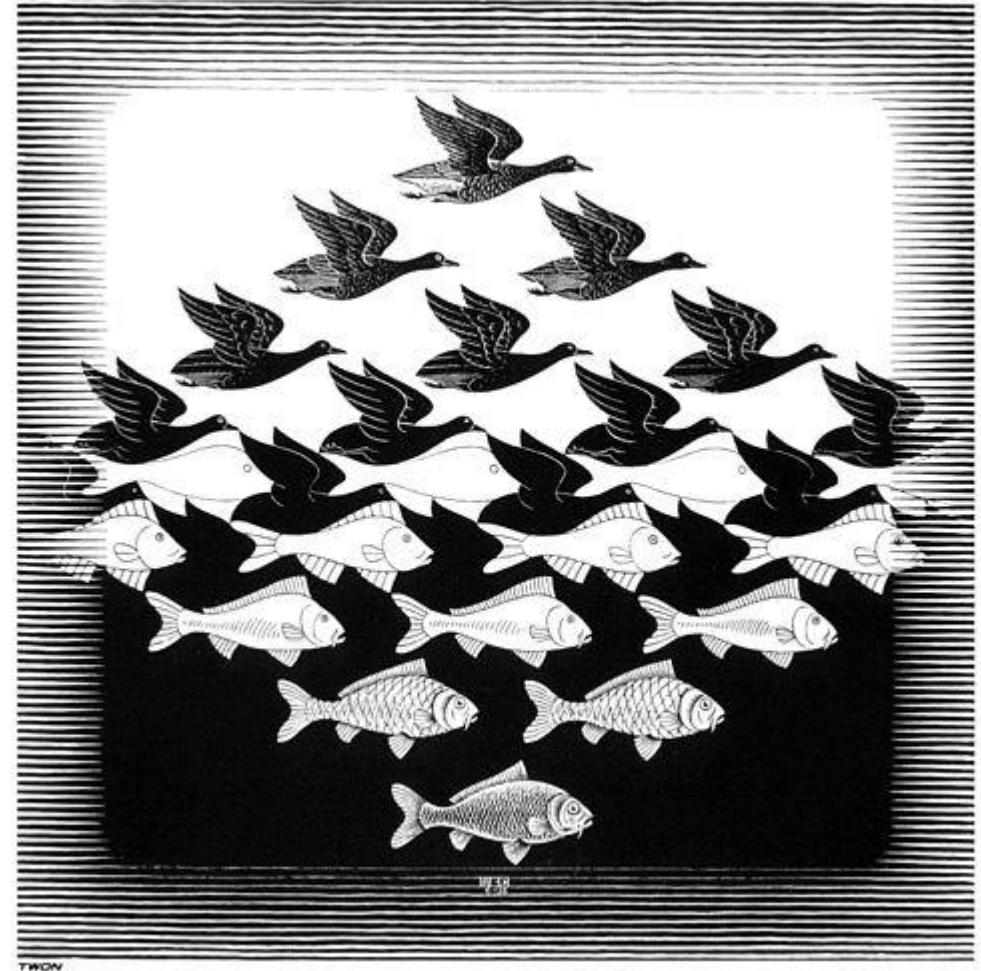


For each layout type, 8 stimuli were created

based on symmetry properties (reflection, rotation, translation, glide reflection) and axial direction (vertical, horizontal)

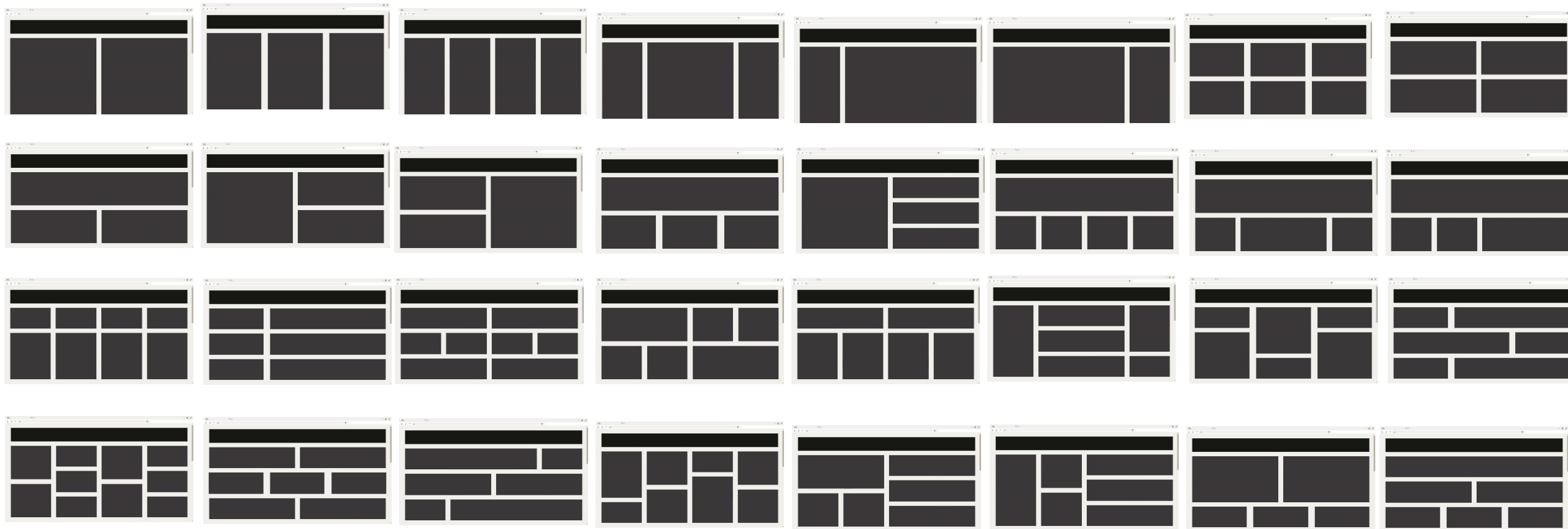
Symmetry types

- Reflection
- Rotation
- Glide reflection
- Translation



M.C. Escher – Sky and Water I – woodcut (1938)

Stimuli



Criteria according to Lavie & Tractinsky (2004)

Criteria developed following a factor-analytic approach

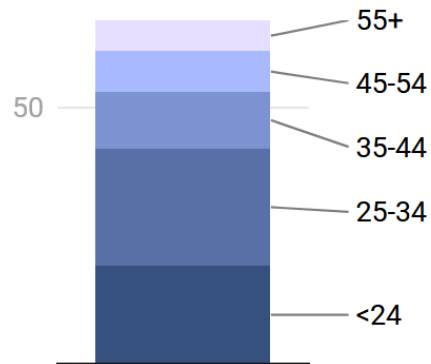
Classic aesthetics	Pleasant, Clear, Clean, Symmetric
Expressive aesthetics	Creative, Fascinating, Use of special effects, Sophisticated
Usability	Convenient, Easy orientation, Easy to use

Preference for the obtained prototypes was rated in a quasi-experiment (online survey)

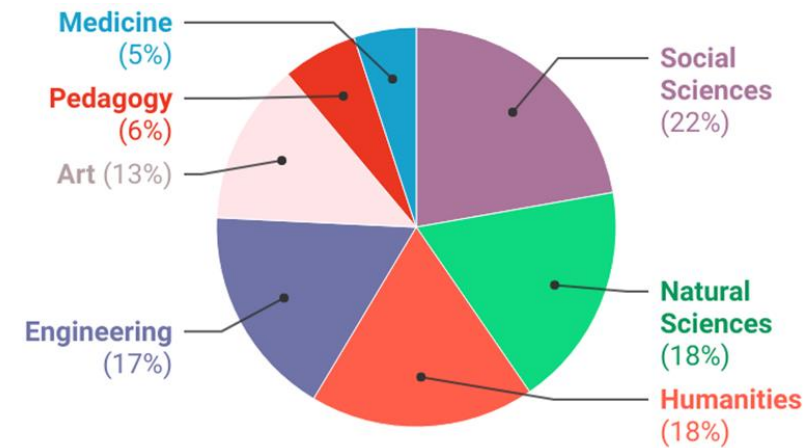
The sample

67 participants, 30 male and 37 female

Age in years



Field of study



Results

Alignment properties, such as symmetry and complexity, shape the rating of expressive and creative aesthetics as well as perceived usability

Simple and symmetric alignments are preferred by users

However, the most symmetric are not necessarily the most preferred

→ degree of complexity seems to also play a role

Similar to the findings of Lavie and Tractinsky (2004), our results indicate that perceptions of aesthetics and usability are associated, in particular with the dimension of **Classical aesthetics**



The impact of interface alignment structure on aesthetic appreciation and usability rating

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1. Introduction

Interacting with visual displays of websites is a central part of our everyday online practices, but little is known about the impact of geometric principles on users' perceptions of websites.

Evidence suggests that symmetry impacts our perception of different displays (Wagemans, 1997), and that aesthetic appraisal is a crucial component of users' satisfaction and appreciation of websites (Lavie and Tractinsky, 2004). This contribution aims at exploring geometric constraints in UX analysis and giving an outlook on potential impacts of preference on content comprehension in an ecological setting.

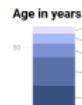
2. Methods

In an exploratory study, canonical interface layout structures were extracted from websites for different purposes, such as education, medicine or finance, amongst others.

For each of the layout types, we created 8 stimuli (see section 2.2), applying all standard symmetry types, such as reflection, rotation, translation and glide reflection. Preference for the obtained prototypes was rated in a quasi-experiment following aesthetic and usability criteria (Lavie and Tractinsky, 2004).

2.1 Sample composition

67 participants, 30 male and 37 female



Created with Datawrapper



2.2 Stimuli



Alignment Type 1 - Columns



Alignment Type 2 - Blocks



Alignment Type 3 - Advanced Grid



Alignment Type 4 - Broken Grid

3. Results

Vertical and horizontal alignment properties, such as different degrees of symmetry and complexity, shape the rating of expressive and creative aesthetics, as well as perceived usability.

Main findings

Our findings hint towards symmetrical and simple alignments to be preferred by users. However, alignments with a higher degree of symmetry did not obtain a high preference rating, and, conversely, alignments with lower degrees of symmetry did not necessarily obtain low preference ratings. Further research is indicated.

Similar to the findings of Lavie and Tractinsky (2004), our results indicate that perceptions of usability and aesthetics are associated, in particular the with the dimension of classic aesthetics.

Link to detailed overview of results and/or pilot results: <https://sites.google.com/view/detailedoverviewpilot/startseite> or via QR Code:



Acknowledgements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 857897 and the European Regional Development Fund (ERDF) for Post-doc projects grant agreement No 1.1.1.2/VIAA/3/19/506.

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Impact of alignment structure on comprehension

Experiment design – status quo

Research questions

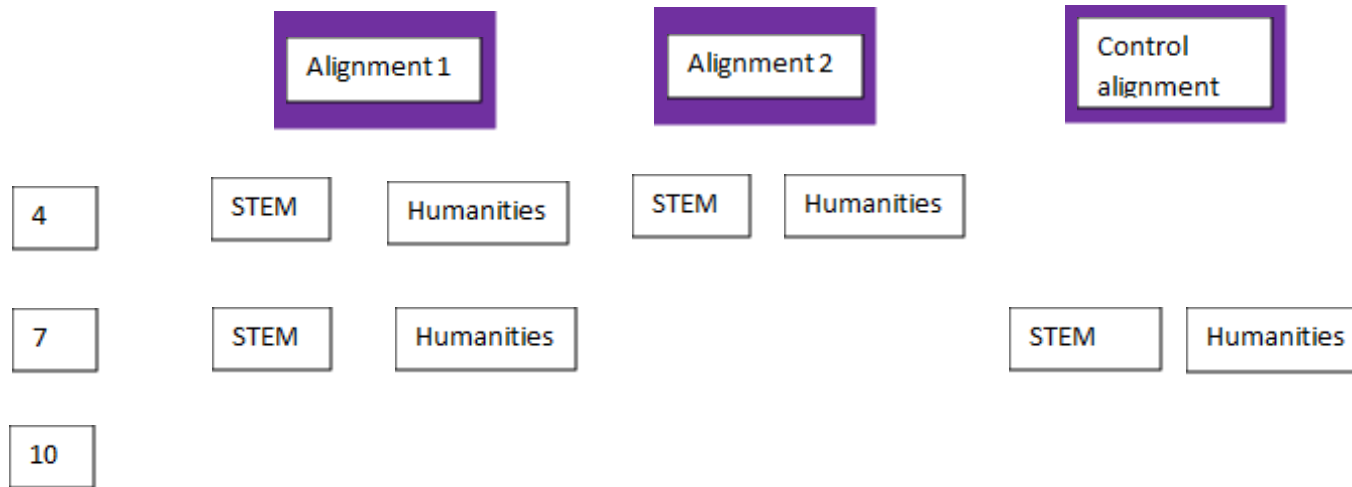
Is text presentation in alignment structures associated with text comprehension?

Does this presumed impact of alignment type differ for different fields of knowledge (here Humanities vs. STEM)?

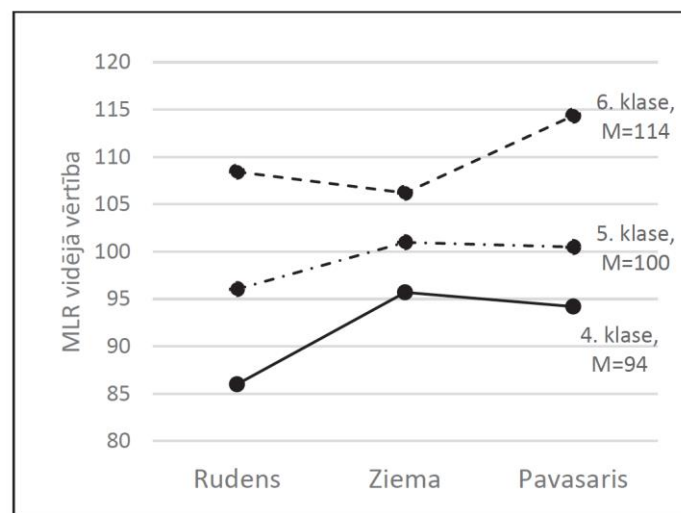
Do these presumed differences in text comprehension differ in the different age groups (unskilled vs. skilled readers)?

Prospective participants

Participants will include pupils of the grades 4, 7 and 10
Texts in the different alignments will be shown on a website
In total, 12 experimental groups
and 2 control groups are planned



Text composition



10.1. attēls. *Acadience™* testa Mutiskā lasīšanas raituma (MLR) vidējie rādītāji 4. – 6. klasei

Figure 10.2. Reading fluency (average number of words per minute) for different texts in different grades (4th-6th) and different measurement periods (autumn, winter, spring)

Taken from Raščevska, M. (Ed.). (2019). Lasītprasmes attīstība 4.–6. klases skolēniem *Acadience™* (DIBELS Next) mērījumos un intervences efektivitāte [Development of reading skills in grade 4th-6th measured with *Acadience™* (Dibels Next) and the efficacy of intervention]. Rīga: LU, VISC.

Alignment 1

1947. gada 28. aprīlī norvēģu rakstnieks un pētnieks Tūrs Heijerdāls un viņa komanda devās ceļojumā pāri okeānam. Tūrs Heijerdāls bija etnogrāfs, kurš bija studējis arī zooloģiju, botāniku un ģeogrāfiju. Pirms sava ceļojumu pētnieks kopā ar savu komandu - citiem zinātniekiem, inženieriem un piedzīvojumu meklētājiem - no balsa koka, priedes un bambusu uzbūvēja plostu. Balsa ir ļoti viegls koks, kura dzimtene ir Ziemeļamerika un Dienvidamerika. Konstrukciju kopā saturēja kaņepju virves, un tajā netika izmantots metāls. Plosts bija burukuģa kopija, kura būvniecībā tika izmantoti tikai tādi materiāli un tehnoloģijas, ko inki lietoja pirms vairāk nekā 500 gadiem. Inki bija nozīmīga civilizācija, kas apdzīvoja Dienvidamerikas daļas laikā no 1438. līdz 1533. gadam. Šis laiks vēsturē tiek dēvēts par pirmskolumbiešu laikmetu. Tas ir laiks, pirms Kristofors Kolumbs ieradās Amerikā, līdz nesot Eiropas ietekmi un izmaiņas Dienvidamerikas kultūrā. Par godu pirmskolumbiešu inku kultūrai un nozīmīgai dievībai inku mitoloģijā - saules dievam - Heijerdāls un viņa komanda plostu nosauca par "Kon-Tiki. Plosts "Kon-Tiki" devās ceļā ar mērķi sasniegt Polinēzijas salas. Tūrs Heijerdāls un viņa komanda uz Polinēziju devās tieši no Peru, jo vēlējās pierādīt transatlantisko ceļojumu iespējamību, ko varētu būt veikuši inki laikā no 15. līdz 16. gadsimtam.

Heijerdāls bija pārliecināts, ka Polinēzijas salu iedzīvotāji ieradusies tieši no rietumiem, no Dienvidamerikas, un tie varētu būt inki. Par to liecināja atrodami artefakti, piemēram, statujas, kas līdzinās pirmskolumbijas Peru sastopamām skulptūrām. Pēc vairāk nekā 100 dienu ilgas burāšanas ekspedīcija ietriecās rifos apmēram 7000 kilometrus no viņu izbraukšanas vietas - Peru ostas Kallao. Pētnieki 4. augustā iestrēga vienā no neapdzīvotajām Polinēzijas salām, tomēr ekspedīciju uzskatīja par veiksmīgu, jo komandai izdevās sasniegt sava ceļojuma galamērķi.

Vēlāk plostu "Kon-Tiki" franču buru kuģis nogādāja Taiti salā. Pēc tam Norvēģijas kuģniecības kompānija to nogādāja Eiropā. Tūra toreizējā teorija par Peru inku ieceļošanu Polinēzijā tomēr ir apšaubāma. Vēsturnieki šodien uzskata, ka Polinēzijas salas sāka apdzīvot no rietumiem. Vairāk nekā 60 gadus vēlāk pēc šī notikuma stāsts par to tika atveidots filmā "Kon-Tiki", kas iznāca 2012. gadā. Vēsturiskā drāma tika nominēta gan Oskaram, gan Zelta globusam kā "labākā filma svešvalodā".

Alignment 2

Statistika ir zinātne, kas iegūst, apstrādā un analizē dažādus datus. Visbiežāk tos var redzēt atspoguļotus skaitliskās vērtībās. Statistiskos datus izmanto plaši: gan valsts iestādes, gan pētnieki, gan arī vienkārši iedzīvotāji, lai uzzinātu kādus saistošus faktus par apkārt notiekošām lietām. Cilvēkus interesē dažādas tēmas, piemēram, cik grāmatu cilvēkiem ir mājās, kurā mēnesī cilvēki pērk visvairāk saldējumu vai arī, kāds ir ūdenstilpņu vidējais mikrobioloģiskais piesārņojums. Apskatīsim piemēru par mikrobioloģisko piesārņojumu. Baktēriju daudzums ūdenstilpē katru dienu var krasi mainīties. Var gadīties, ka vienā dienā baktēriju īpatsvars ir tikai trīs baktērijas uz 100 ml, citā dienā tajā pašā ūdenstilpnē sasniegt līdz pat 1200 baktērijām uz 100 ml. Lai iegūtu ticamu vidējo vērtību, ir nepieciešams rādītājs, kas būtiski nemainās pie ļoti augstām vai zemām vērtībām. Šādos gadījumos statistikas speciālisti izmanto nevis vidējo aritmētisko, kas ir biežāk pazīstams, bet gan vidējo ģeometrisko vērtību. Lai aprēķinātu vidējo ģeometrisko vērtību, vajag sareizināt mērījumos iegūtos skaitļus un pēc tam no reizinājuma izvilkt n -to sakni (kur n ir mērījumu skaits).

Piemēram, ja sareizina trīs mērījumu vērtības, ģeometriskais vidējais ir kubsakne no šo trīs vērtību reizinājuma. Mūsu gadījumā mēs vēlamies aprēķināt baktēriju piesārņojuma vidējo vērtību Jūrmalas pludmalē no ūdens analīžu rezultātiem, kas veikti četrās secīgās dienās. Pirmdienas ūdens analīzes uzrādīja 5 baktērijas uz 100 ml, otrdien 50 baktērijas uz 100 ml, trešdien - 13 un ceturtdien - 1000 baktērijas uz 100 ml ūdens. Tā kā mums ir četri mērījumi un mēs vēlamies aprēķināt vidējo ģeometrisko vērtību, mēs reizinām četrus novērojumu vērtības, kuru rezultātā iegūstam 3 250 000, un pēc tam izvelkam ceturtais pakāpes sakni no šī reizinājuma.

Tātad, ģeometriskais vidējais lielums ir ceturtais pakāpes sakne no 3 250 000, un tas ir 42,45. Līdz ar to, mēs varam teikt, ka vidējais baktēriju piesārņojums Jūrmalas pludmalē četrās mūsu izmērītajās dienās ir 42,45 uz 100 ml ūdens. Palielināts baktēriju skaits ūdenstilpnē rada bioloģisko piesārņojumu un tas var būt bīstams cilvēka veselībai. Tāpēc svarīgi sekot līdzi regulāro ūdens kvalitātes pārbažu rezultātiem un nepeldēties ūdenstilpnēs, kur atklāts piesārņojums.

Reading comprehension

On Wednesday afternoon, Per Johansson heard a loud and roaring noise coming from the garden of his traveling neighbour. When approaching the garden, to his amazement, the Swede discovered a moose hanging in the treetop of an apple tree, fighting with its branches. Other neighbours in the Gothenburg suburb of Saro saw the animal roaming the area the day before. A police unit rushed to the scene and managed to saw the confused animal out of its wooden prison. Several branches had to be sawed off. The animal had supposedly eaten fermented apples and then got caught in the apple tree.

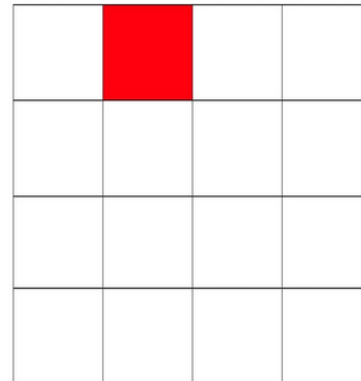
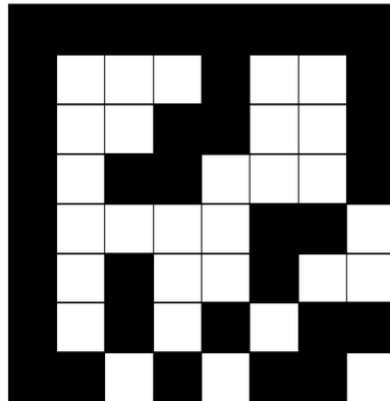
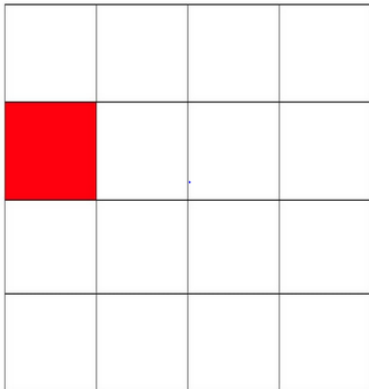
Questions for reading comprehension test based on following principles

- Factual information in non-central places
- Implicit information
- Similarity of sentence structure

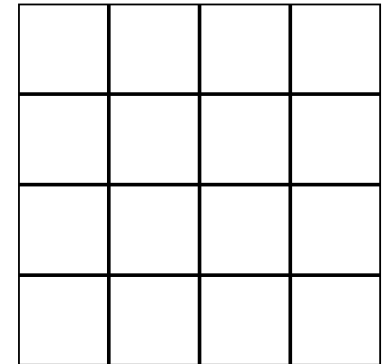
Working memory tests

Symmetry span test

Iegaumējiet otrā kvadrāta atrašanās vietu!



Atzīmējiet pirmā kvadrāta atrašanās vietu!



Foster et al. (2015)
Hicks, Foster & Engle (2016)

Working memory tests

n-back test

F

N

F

Pelegrina et al. (2015)

Demographic items

- Age
- Gender
- Learning disabilities
- Grades in relevant subjects
- SES
- number of siblings
- language(s)
- exposure to digital media etc.

Preliminary analysis¹ of Pilot study

34 participants, 23 female 11 male

```
Call:
glm(formula = text_score ~ align + domain + symm_score + moose_score +
     n_score + gender, data = data)
```

Deviance Residuals:

Min	1Q	Median	3Q	Max
-2.37658	-0.88434	0.01096	0.80264	2.77694

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-1.67808	3.11100	-0.539	0.5940
align	-0.21048	0.54056	-0.389	0.7000
domain	-0.62439	0.68991	-0.905	0.3734
symm_score	0.01947	0.07502	0.259	0.7972
moose_score	1.02768	0.36267	2.834	0.0086 **
n_score	0.22383	0.26529	0.844	0.4062
gender	0.45552	0.58337	0.781	0.4417

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```
> as.data.frame(anova(null, full, test="F"))
  Resid. Df Resid. Dev Df Deviance      F      Pr(>F)
1         29   63.87343 NA        NA      NA        NA
2         27   61.45512  2  2.418312 0.5312366 0.5938962
```

```
Call:
glm(formula = text_score ~ symm_score + moose_score + n_score +
     gender, data = data)
```

¹ Forstmeier & Schielzeth (2011)

Preliminary analysis of Pilot study

- Theoretical background
- Stimuli
- Item reliability of Reading comprehension + Text comprehension
- Proportion of time needed for WM tests

Outlook

Refining experimental design

- Text – alignments
- Items
- Add behavioural measure (Eye-tracking)
- Preparing **Registered Report** for submission

Registered Report

Original research article which undergoes a **two-stage peer review** process

Stage 1 - Methods and proposed analyses are peer-reviewed prior to the data collection and analysis

→ Peer review - and provisionally acceptance for publication
research is pre-registered before data collection

Stage 2 - Finalising of article: Results and Discussion

The complete manuscript is peer-reviewed again to ensure no unjustified deviation of pre-registered protocol.

Integrated projects



Furhat Robotics



Integrated projects

IP2- Designing of App
for language learning

- Target population:
Migrant children
- Participatory design

IP3 - The pros and cons
of digital technology

- Video for parents
- White Paper
- Policy brief

See also

Baltic J. Modern Computing, Vol. 9 (2021), No. 3, pp. 303–332
<https://doi.org/10.22364/bjmc.2021.9.3.06>

Learning during the COVID-19 Pandemic The Use, Features and Acceptance of Digital Learning Tools

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Thank you
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Questions for discussion

What affordances and opportunities does the digital format bring about and how can we tap into that?

How can the development of early language skills be fostered in children of all genders alike, and from all strata of society?

