



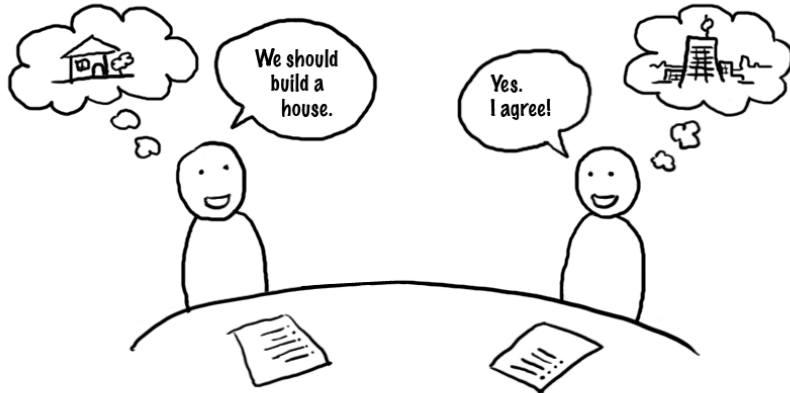
Operator performance in remote sensing image analysis: the impact of human and external factors

Frieke Van Coillie, Soetkin Gardin, Frederik Anseel, Wouter Duyck, Lieven Verbeke and Robert De Wulf



Problem

Human interpretation is highly variable among different operators



Problem

Human interpretation is highly variable among different operators

- (1) Human interpretation still topical in current map-making process
- (2) Virtually no RS research on operator functioning
- (3) Cognitive psychological research: overly confident belief in human judgement and interpretation of RS materials not justified
- (4) Insights from signal detection employed to RS interpretation tasks



Remote sensing meets psychology (WAVARS)

Soetkin
Gardin



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Department of Personnel Management, Work and Organizational Psychology, UGent
Department of Experimental Psychology, UGent



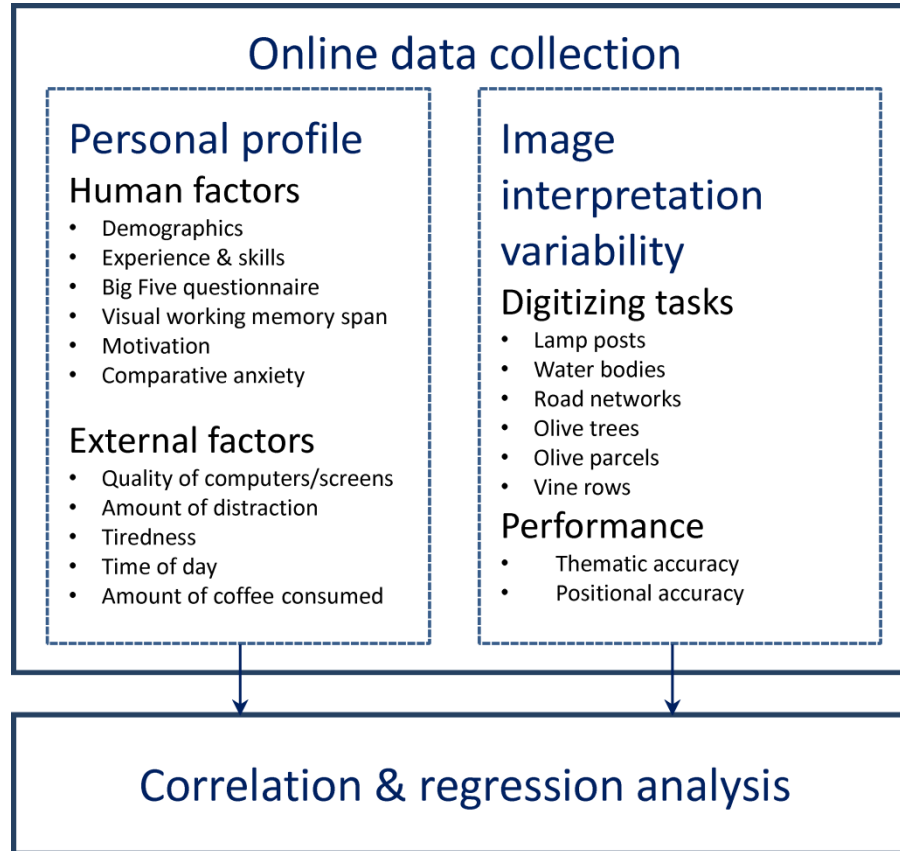
Objectives

- (1) to examine to what extent human performance in RS image analysis was liable to error
- (2) to assess which determinants were appropriate to explain inter-individual differences in performance

Number of experiments were run in which operator performance was examined as a function of time.



Method



Website

Firefox

wavors

wavors.ugent.be/wavarstest/

Most Visited GEOBIA 2010 Auditoriumbeheer Minerva.UGent.be Mappy - plans, itinéraires Learning Path 2010-2011 ISI Web of Knowledge ... Masterproef Academic Bibliograph... GEOBIA 2012

Remote sensing meets Psychology

Welcome

WAVARS is a web tool developed to quantify variability in remote sensing image analysis and to identify the human factors that influence this variability. More information about this research can be found here.

We are still looking for a lot of participants and your help would be highly appreciated. Three reasons why you should go through the web application:

1. The whole (remote sensing) community can benefit from a better understanding of this variability.
2. You receive feedback consisting of a personal profile and a comparison of your performance with other participants.

You don't need any experience to participate in the test.



Most people need around one hour to go through the entire web tool. Make sure you have enough time before you begin (you have to go through the entire website at once, it is not possible to resume later)!

If you would have any questions, suggestions or encounter a problem, please contact the administrator.

Good luck!

Choose your language : English

Next

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Info Contact

Site flow

Introduction

Goal and overview
Registration form
Informed consent



Data collection

Demographics

Personal particulars	6 questions
Digitizing experience	6 questions
Working environment	5 questions
Interpretation skills	quiz (3 questions)

Personality

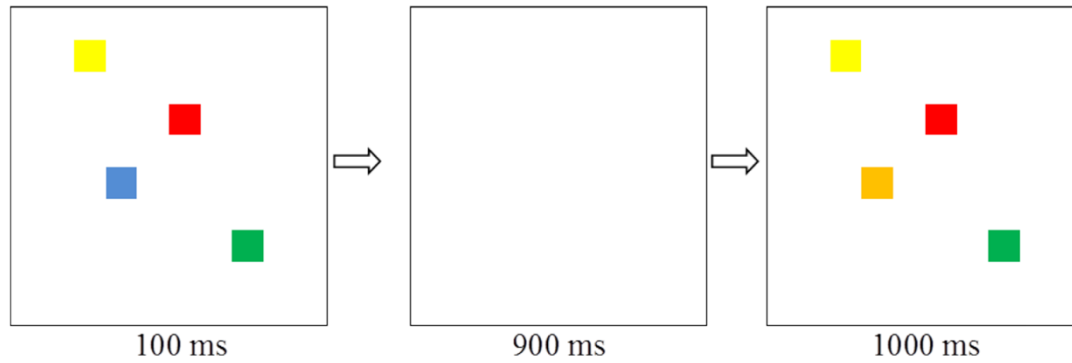
Introduction
Big Five personality test 40 questions

Visual working memory

Introduction
Sample exercises 2 cases
Actual test 56 exercises



Site flow



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Actual test 56 exercises

Image interpretation

Introduction
Sample exercises 2 cases
Digitizing tasks 107 exercises




Site flow

Lamp post

Remote sensing meets Psychology

Example 1 - Points (1/112)

Help



Info

Search all the lampposts in the image and point out their ground point.

Start


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belapo

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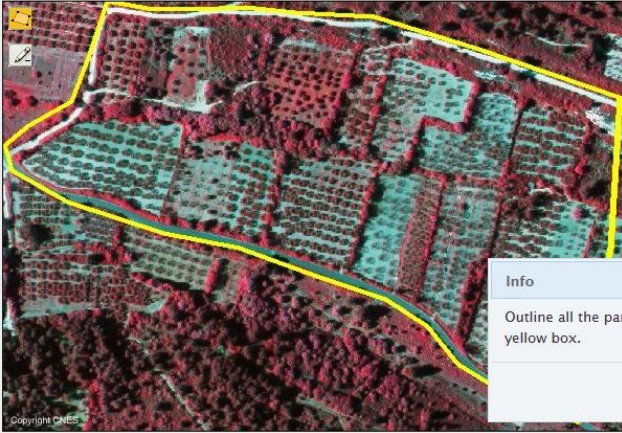
Site flow

Olive parcel

Remote sensing meets Psychology

Image 37 - Polygons (parcels) (39/112)

Help



Info

Outline all the parcels enclosed by the yellow box.

Start


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Site flow

Water body

Remote sensing meets Psychology

Image 41 - Polygons (water) (43/112)

Help





0.00000, 0

Info


Outline all the water you see on the image.

Start

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Site flow


Road network

Remote sensing meets Psychology

Image 43 - Lines (roads)

(45/112)

Help



Info

Draw the complete roadmap. Do this by drawing a line in the middle of the roads.

Start


Next

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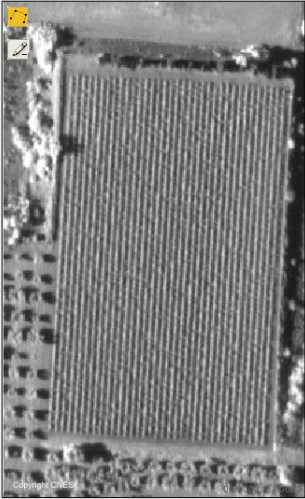
Site flow

Vine row

Remote sensing meets Psychology

Image 48 - Lines (grape vines) (50/112)

Help



© Google Earth

Info

Digitize the grapevines by drawing a line through every row.




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Site flow

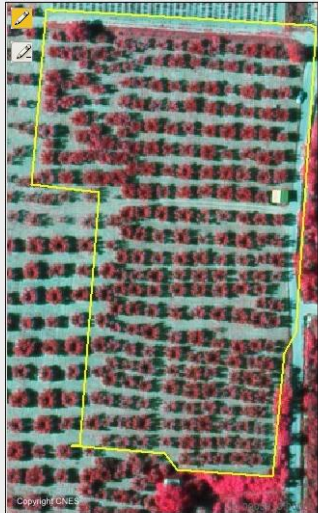
Olive trees

Remote sensing meets Psychology

Image 49 - Points (trees)

(51/112)

Help




Copyright CNES

Info

Digitize all the trees in the outlined parcel by placing a point in the middle of the crown.

Start

Next



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Introduction	
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Actual test	56 exercises

Image interpretation

Introduction	
Sample exercises	2 cases
Digitizing tasks	107 exercises

Test experience

Motivation	10 questions
Comparative anxiety	10 questions

Feedback

Personal results
Project information



Data analysis

(1) Descriptive statistics of the subjects

(number, gender & age distribution, educational level, digitizing/interpretation experience, personality, working conditions, time spent on the experiment → vigilance)

(2) Quantification of operator performance

(thematic and positional accuracy)

(3) Performance effect study

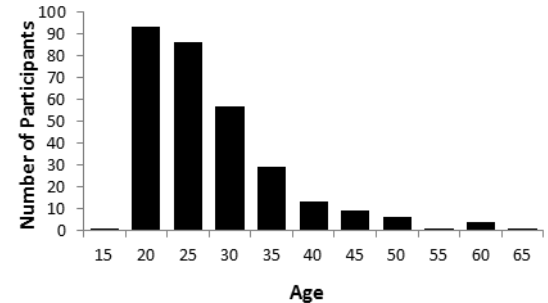
(correlation & regression analysis)



Results

(1) Descriptive statistics of the subjects

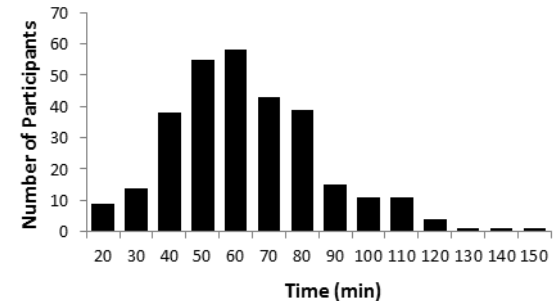
- a) High proportion of students
- b) Time range from 40-80 minutes
- c) Normal distribution of personality factors
- d) VWM typical range: 2-5 objects
- e) Majority of experienced subjects
- f) Large variability in working conditions



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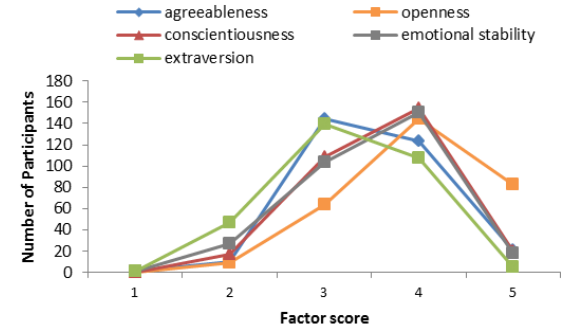
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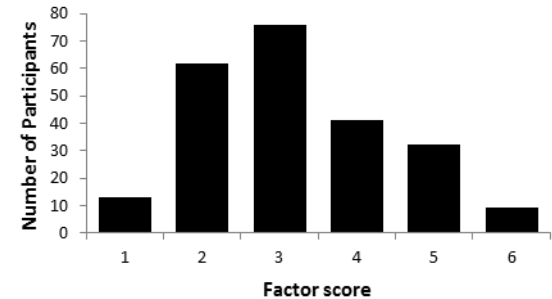
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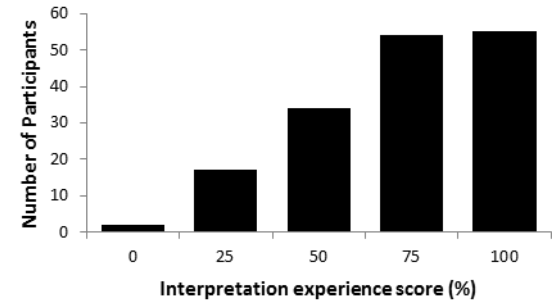
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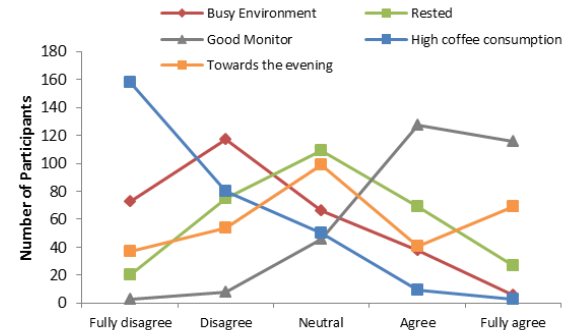
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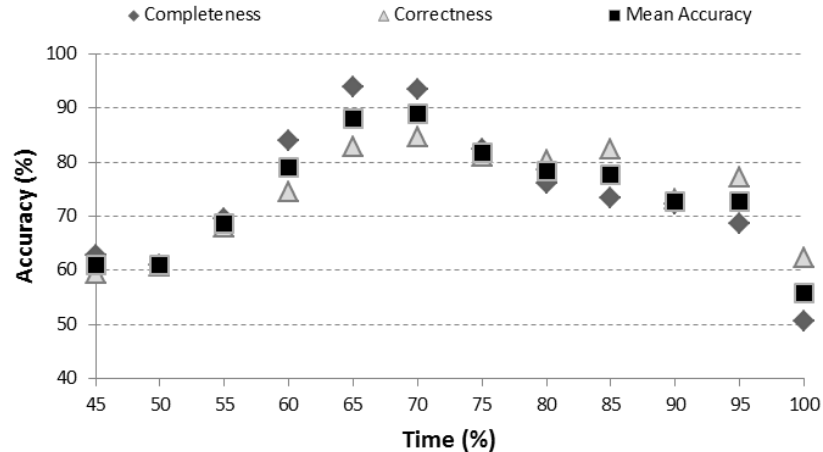
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(1) Descriptive statistics of the subjects

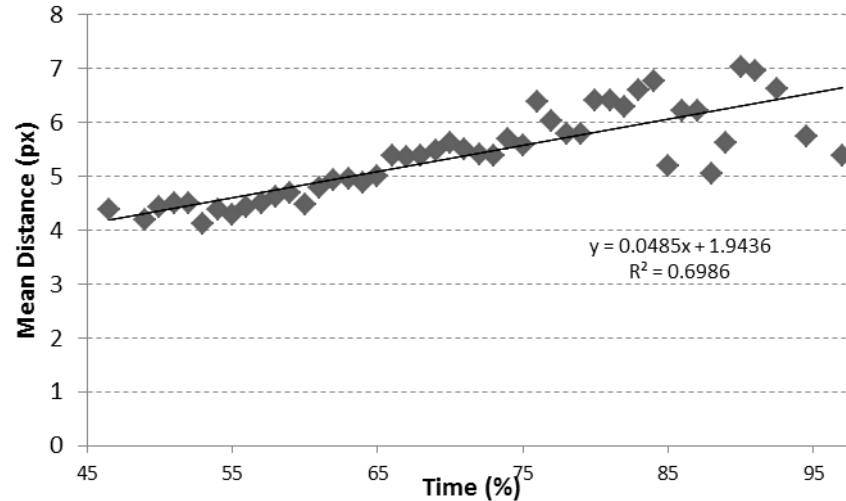
g) Vigilance effect



Results

(1) Descriptive statistics of the subjects

g) Vigilance effect



Results

(2) Quantification of operator performance

- a) Humans seldom perfect in visual interpretation (80%)
- b) Some objects were more complex than others
- c) High inter-operator variability (11-98%)



Results

(3) Performance effect study

a) Correlation analysis

- Subjects who took more time performed better
- Operators with a longer VWM reached higher accuracy levels
- Men performed considerably better than women
- Digitizing/interpretation experience contributed to improved results
- Extraversion negative impact on performance
- Emotional stability positive effect
- Seniors performed better



Results

(3) Performance effect study

a) Correlation analysis

- Highly variable circumstances barely had an impact
- Busy working environment negatively influenced performance
- Consumption of coffee influenced positional results

b) Regression analysis

- 26% operator variability explained by human factors
- 30% covered when external factors were added



Reflections to conclude

- a) Raise RS community awareness
- b) Development of assessment instrument
- c) Long-lasting image interpretation jobs without regular breaks should be avoided



Outcome



EARSeL, 31/05/2010 - 03/06/2010, Paris, France

GEOBIA 2010, Geographic Object-based Image Analysis, 29/06/2010 - 02/07/2010, Ghent, Belgium

ISPRS 100, TC VII Symposium, 5-7/07/2010, Vienna, Austria

Accuracy 2010, 20-23/07/2010, Leicester, UK

ForestSat 2010, Operational tools in forestry using remote sensing techniques, 7-10/09/2010, Lugo and Santiago de Compostela, Spain

GARDIN, S., VAN LAERE, S.M.J., VAN COILLIE, F.M.B., DUYCK, W., ANSEEL, F. & DE WULF, R.R. 2010. Web-based assessment of operator performance and variability in remote sensing image analysis: first results. Proceedings of the Ninth International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences, Leicester 20-23 July 2010.

GARDIN, S., VAN LAERE, S.M.J., VAN COILLIE, F.M.B., DUYCK, W., ANSEEL, F., DE WULF, R.R. & VERBEKE, L.P.C. 2010. Remote sensing meets psychology: a concept for operator performance assessment. Remote Sensing Letters, 2(3), 251-257.

GARDIN, S., VAN COILLIE, F.M.B., DUYCK, W., ANSEEL, F., DE WULF, R.R. & VERBEKE, L. P. C., 2013, Variability of operator performance in remote sensing image interpretation: the importance of human and external fact. International Journal of Remote Sensing (accepted)