Appendix 1

Survey introductory letter

vrije Universiteit amsterdam

Januari 2011

Geachte dame/heer,

Mijn naam is Nico de Graaff en ik ben student aan de Vrije Universiteit van Amsterdam.
Deze studie volg ik naast mijn functie als adviseur Geo-informatie bij unit Geo-informatie, Dienst Persoons- en Geo-informatie van de gemeente Amsterdam.
Voor mijn afstudeerproject onderzoek ik de bruikbaarheid van communiceren over onzekerheid in geografische gegevens. Een van de onderdelen is het houden van een enquête.
Daarvoor wil ik een aantal personen benaderen die vanuit de praktijk hier op kunnen reageren.
Het profiel van de gezochte personen waar ik voor dit onderzoek naar op zoek ben is als volgt beschreven:

De persoon werkt in een gemeentelijke context, en werkt geregeld met geografische gegevens.
In een gemeentelijke context vinden geografische gegevens hun weg vaak via 'ketens' naar eindgebruikers.
In hoofdlijn kan een keten de volgende schakels bevatten:

1) De schakel als producent van basisgegevens (BAG, Topografie, Kadaster,WKPB, etc.), of van thematische (Milieu, Ruimtelijke plannen, etc.) gegevens die ook in andere processen worden gebruikt.
2) Een schakel die de gegevens aanvult of transformeert met behulp van basisgegevens,
3) Een schakel als eindgebruiker.

De persoon is bij voorkeur actief in de eerste twee schakels, of als eindgebruiker in de derde schakel die gegevens analyseert en vertaald naar informatie.

Naar mijn inschatting zou u iemand kunnen zijn die aan dit profiel voldoet, of iemand in uw directe professionele omgeving.
Mijn verzoek is dan ook om deze mail door te sturen naar personen die aan bovengenoemd profiel kunnen voldoen.

Als u bereid bent om mee te werken dan kan ik vermelden dat de resultaten van de enquête uitsluitend worden gebruikt voor mijn afstudeeronderzoek bij UniGIS van de Vrije Universiteit Amsterdam. Als u vragen heeft over dit onderzoek, het invullen van de vragenlijst, of een kopie van het onderzoeksrapport wilt opvragen, dan verzoek ik u mij een mail te sturen naar:
nj.degraaff@gmail.com

Klik **hier** om deel te nemen aan het onderzoek, of plak de onderstaande link in uw webbrowser.
http://basisinformatie-amsterdam.nl/onderzoek_gis/enquete_onzekerheid_introductie.html

Dank voor uw medewerking

Vriendelijke groet,

Nico de Graaff

Appendix 2

Survey

Introductory letter and questionnaire

vrije Universiteit amsterdam

Geachte deelnemer,

Mijn naam is Nico de Graaff en ik ben student aan de Vrije Universiteit van Amsterdam.
Deze studie volg ik naast mijn functie als adviseur Geo-informatie bij de gemeente Amsterdam.
Voor mijn afstudeerproject onderzoek ik de bruikbaarheid van communiceren over onzekerheid in geografische gegevens.
Omdat u voldoet aan het profiel van de groep deskundigen die een significante bijdrage kan leveren aan dit onderzoek is u gevraagd om deel te nemen aan dit onderzoek door het invullen van deze vragenlijst.
Onder aan deze pagina staat een toelichting voor het invullen van de vragenlijst. Omdat het geen alledaags onderwerp is, is het aan te reden om de toelichting zorgvuldig door te lezen.
De vragenlijst bestaat uit 30 vragen en vergt ongeveer 15 minuten om te voltooien. Hoewel er geen persoonlijke gegevens van u worden gevraagd behalve uw mailadres, wordt ervoor gezorgd dat alle informatie vertrouwelijk wordt behandeld.

Bedankt dat u de tijd neemt om mij te helpen bij mijn inspanningen, de verzamelde gegevens zullen nuttige informatie bieden met betrekking tot het onderzoek.
De onderzoeksresultaten worden verstrekt aan UniGIS van de Vrije Universiteit Amsterdam.
Als u vragen heeft over dit onderzoek, het invullen van de vragenlijst, of een kopie van het onderzoeksrapport wilt opvragen, dan kan dit door een mail te sturen naar:

nj.degraaff@gmail.com

Naar de enquete

Toelichting op het invullen van de vragenlijst

De in te vullen enquete is opgebouwd uit vragen en stellingen.
Het eerste deel van de enquete gaat kort in over uw achtergrond als professional en uw ervaring met Geo-informatie, en het tweede deel heeft betrekking op de bruikbaarheid van het communiceren van onzekerheid in Geografische gegevens.

Toelichting op het onderwerp "onzekerheid in geografische gegevens"

Een belangrijk deel van de vragenlijst heeft betrekking op onzekerheid in geografische gegevens. Als u deze term voor het eerst tegenkomt lijkt het wat vaag, maar bij het werken met geografische gegevens kunnen we hier geregeld mee te maken krijgen.

Onzekerheid in geografische gegevens is in te delen in drie groepen:

1. Onduidelijke definities (ambiguiteit)

Wanneer gegevens niet specifiek zijn gedefinieerd, of dubbelzinnig zijn gedefinieerd dan is het onduidelijk tot welke gegevensgroep (entiteit, objectklasse) de gegevens behoren. Dit zou kunnen leiden tot onnauwkeurige- of onjuiste uitkomsten van analyses of onjuist gebruik. Voorbeelden van objecten met niet-specifieke definities zijn b.v. Bos (loof- of naaldbos), of "openbare ruimte" (openbaar, of openbaar toegankelijk?, is een winkelpassage openbaar toegankelijk of is het eenopenbare ruimte?).

2. Vaagheid in objectafbakening

Vaagheid treedt op wanneer begrenzingen van objecten vaag zijn, en niet nauw keurig zijn te definieren. Dit komt bijvoorbeeld voor bij begrenzingen van rietkragen, natuurlijke waterkant,of afbakening van diverse typen begroeiing zoals bos.

3. Nauwkeurigheid

Geografische gegevens bevatten een bepaalde mate van nauwkeurigheid in vorm en ligging (geometrie), attributen, of in tijdsaspecten.
Afhankelijk van het soort gebruik en te stellen eisen aan de gegevens kan onnauwkeurigheid (het tegenovergestelde van nauwkeurigheid) leiden tot onnauwkeurige analyses die ook kunnen doorwerken in het gebruik. Onnauwkeurigheid in geometrie heeft invloed op bijvoorbeeld berekeningen van oppervlakte, het bepalen van maatvoering bij bijvoorbeeld herprofilering van wegen. Onnauwkeurigheid in kwalitatieve attributen zoals classificaties, gebruiksfuncties, en kwantitatieve attributen zoals oppervlakte gebruik, etc kunnen ook leiden tot onnauwkeurigheid in de uitkomsten van analyses.

Naar de enquete

Pagina bijgewerkt: 03-01-2012

Enquête “Onzekerheid in geografische gegevens”

Deze vragenlijst bestaat uit 30 vragen en stellingen, en heeft als doel om een beeld te krijgen van de informatiebehoefte over onzekerheid in geografische gegevens. Dit betreft (on)nauwkeurigheid van geografische gegevens, vaagheid van grenzen, en onvolledige- of dubbelzinnige definities van objecten.
Alle vragen zijn verplicht in te vullen.
Wanneer niet alle vragen zijn ingevuld dan wordt er een scherm getoond met rood gemarkeerde vragen.
U kunt dan het getoonde scherm gebruiken, of 1 pagina terug gaan om de ontbrekende vragen te beantwoorden.

Vragen over uw persoon

1. In welke leeftijdscategorie valt u ?

- Jonger dan 25
- 20 t/m 34
- 35 t/m 44
- 45 t/m 54
- 55 en ouder

2. Wat is uw hoogst genoten opleiding ?

- Lager beroeps onderwijs (LBO/VMBO)
- Middelbaar onderwijs (MBO)
- Hoger onderwijs (HBO)
- Academisch onderwijs (WO)

Vragen over uw werkervaring

Met de vragen in deze sectie wordt getracht een beeld te krijgen van uw ervaring in uw eigen vakgebied, en u werkervaring met Geografische Informatie.

3. Hoeveel jaar werkt u met Geografische Informatie ?

- 0 t/m 5
- 6 t/m 10
- 10 t/m 20
- Meer dan 20

4. Hoe is uw kennis van uw vakgebied ?

Deze vraag gaat over uw kennisniveau over uw eigen vakgebied waarin uw werkzaam bent

- **Expert** : Heeft veel kennis heeft van een bepaald vakgebied en om advies wordt gevraagd door anderen, ook binnen eigen vakgebied
- **Zeer ervaren**: Heeft een grote mate van zelfstandigheid
- **Ervaren** : Kan zelfstandig werken, maar vraagt voor complexe taken ondersteuning
- **Beginner** : Heeft veel begeleiding nodig
- **Geen** : Geen ervaring in het vakgebied

5. Hoe is uw kennis van het zelf opbouwen van Geo-informatie ?

Deze vraag gaat over uw kennisniveau van het opbouwen van geografische gegevens

- **Expert**: Heeft veel kennis heeft van een bepaald vakgebied en om advies wordt gevraagd door anderen, ook binnen eigen vakgebied
- **Zeer ervaren**: Heeft een grote mate van zelfstandigheid
- **Ervaren**: Kan zelfstandig werken, maar vraagt voor complexe taken ondersteuning
- **Beginner**: Heeft veel begeleiding nodig
- **Geen**: Geen ervaring met het opbouwen van geografische gegevens

6. Hoe is uw kennis met het uitvoeren van GIS analyses ?
Deze vraag gaat over uw kennisniveau met ruimtelijke analyses met GIS tools (Hoeveelheden, nabijheidsrelaties, buffers, intersecties)

- ◯ **Expert**: Heeft veel kennis heeft van een bepaald vakgebied en om advies wordt gevraagd door anderen, ook binnen eigen vakgebied
- ◯ **Zeer ervaren**: Heeft een grote mate van zelfstandigheid
- ◯ **Ervaren**: Kan zelfstandig werken, maar vraagt voor complexe taken ondersteuning
- ◯ **Beginner**: Heeft veel begeleiding nodig
- ◯ **Geen**: Geen ervaring met het uitvoeren van ruimtelijke analyses

7. Hoe is uw ervaring op het gebied van het visualiseren van Geografische informatie ?
Deze vraag gaat over uw kennisniveau over het visualiseren met GIS tools zoals thematische visualisaties, kleurkeuze, symboliek, etc.

- ◯ **Expert**: Heeft veel kennis heeft van een bepaald vakgebied en om advies wordt gevraagd door anderen, ook binnen eigen vakgebied
- ◯ **Zeer ervaren**: Heeft een grote mate van zelfstandigheid
- ◯ **Ervaren**: Kan zelfstandig werken, maar vraagt voor complexe taken ondersteuning
- ◯ **Beginner**: Heeft veel begeleiding nodig
- ◯ **Geen**: Geen ervaring met het visualiseren van Geografische informatie

Vragen over de aard van uw werkzaamheden en het gebruik van basisgegevens

Met deze vragen wordt er getracht een beeld te krijgen van de aard van het gebruik. Bij enkele vragen wordt er naar de frequentie gevraagd, het gaat om de volgende:
Zeer vaak : dagelijks
Vaak : meer dan 3 x per week
Gemiddeld : 1 tot 3 keer per week
Weinig : 1 tot 3x per maand
Zeer weinig : minder dan 1 keer per maand

8. Welke registraties gebruikt u ?
N.B.: de hieronder vermelde registraties zijn niet alle registraties, maar die voor dit onderzoek relevant zijn.

- ☐ Adressen en Gebouwen (BAG)
- ☐ Grootschalige topografie (GBKN, GBKA, later BGT)
- ☐ Kleinschalige topografie (bijv. Top10NL)
- ☐ Kadastrale kaart (LKI)
- ☐ Administratieve Kadastrale Registratie (AKR)

9. Hoe vaak gebruikt u bovenstaande registraties als referentie of achtergrondinformatie ?
Ruimtelijke gegevens als achtergrond, administratieve gegevens als naslagwerk.

- ◯ Dagelijks
- ◯ Meer dan 3 x per week
- ◯ 1 tot 3 x per week
- ◯ 1 tot 3 x per maand
- ◯ Minder dan 1 x per maand

10. Hoe vaak gebruikt u bovenstaande registraties voor het afleiden van kwantitatieve informatie ?
Bijvoorbeeld: het bepalen van aantallen, oppervlakte, lengte.

- ◯ Dagelijks
- ◯ Meer dan 3 x per week
- ◯ 1 tot 3 x per week
- ◯ 1 tot 3 x per maand
- ◯ Minder dan 1 x per maand

11. Hoe vaak gebruikt u bovenstaande registraties voor het afleiden van kwalitatieve informatie ?
Gebruik m.b.t. de aard en lokatie van gegevens , Bijvoorbeeld: onderzoek naar gebouwen, kadastrale situatie, gebruiksdoel, enz.

- ○ Dagelijks
- ○ Meer dan 3 x per week
- ○ 1 tot 3 x per week
- ○ 1 tot 3 x per maand
- ○ Minder dan 1 x per maand

12. Hoe vaak integreert u bovenstaande registraties met uw eigen gegevens ?
Met integratie wordt bedoeld het relateren van uw eigen gegevens aan basisregistraties.

- ○ Dagelijks
- ○ Meer dan 3 x per week
- ○ 1 tot 3 x per week
- ○ 1 tot 3 x per maand
- ○ Minder dan 1 x per maand

Stellingen over informatiebehoefte van over onzekerheid in Geografische gegevens

Onder onzekerheid wordt verstaan in welke mate u als gebruiker onvoldoende inzicht heeft in de volgende aspecten:
- Ambiguiteit; Onduidelijke definities, zoals de betekenis van de gegevens
- Vage objecten; zoals onduidelijke begrenzingen of onduidelijk te classificeren objecten
- (On)nauwkeurigheid; van vorm en ligging (lokatie), en kenmerken van objecten

In de praktijk komt het voor dat er gegevens worden gebruikt zonder informatie over onzekerheid.
Om te achterhalen of het verstrekken van informatie over onzekerheid in geografische gegevens bruikbaar is, zijn hieronder stellingen geformuleerd.
Per stelling kunt u uw mening invullen.

13. Stelling: Informatie over vage of dubbelzinnige definities van objecten verbetert de informatiewaarde in mijn werk .
Het kan voorkomen dat een bepaald gegeven niet eenduidig, of niet specifiek genoeg is gedefinieerd voor uw gebruiksdoel. Een voorbeeld is het kenmerk 'gebruiksoppervlakte' van een woning of bedrijf.
Is voldoende bekend wat er wel of niet wordt meegerekend bij het bepalen van de oppervlakte?, wel of geen trapgaten, schuine daken, etc.
Geef hieronder aan hoe u over de bovenstaande stelling denkt.

- ◉ Helemaal mee eens
- ○ Mee eens
- ○ Neutraal
- ○ Mee oneens
- ○ Zeer oneens
- ○ Geen mening

14. Stelling: Informatie over vaag gedefinieerde objectgrenzen leidt tot meer inzicht in de bruikbaarheid .
Vaagheid zegt iets over hoe nauwkeurig de ligging van een begrenzing in het terrein is aan te wijzen. Een kademuur is bijvoorbeeld nauwkeuriger aan te wijzen dan de hartlijn van een sloot, of de rand van een bos.
Geef hieronder aan hoe u over de bovenstaande stelling denkt.

- ○ Helemaal mee eens
- ○ Mee eens
- ○ Neutraal
- ○ Mee oneens
- ○ Zeer oneens
- ○ Geen mening

15. Stelling: Informatie over positionele nauwkeurigheid leidt tot meer inzicht in de bruikbaarheid .
Positionele nauwkeurigheid is de mate waarin de vorm en ligging, of de locatie van een object afwijkt van de 'werkelijkheid'.
In geografische informatie wordt bijvoorbeeld de nauwkeurigheid van een punt vaak uitgedrukt in de standaardafwijking van de X-coördinaat en de Y-coördinaat.
Een voorbeeld is dat de nauwkeurigheid van gemeten punten van een bepaald gebouw b.v. 5 cm bedraagt, en van een bepaalde weg b.v. 10 cm.
Geef hieronder aan hoe u over de bovenstaande stelling denkt.

- ○ Helemaal mee eens
- ○ Mee eens
- ○ Neutraal
- ○ Mee oneens
- ○ Zeer oneens
- ○ Geen mening

16. Stelling: Informatie over attribuutnauwkeurigheid verbetert het inzicht in de bruikbaarheid .
Attribuutnauwkeurigheid geeft informatie over de de mate waarin de gemeten waarde van het attribuut afwijkt van de 'werkelijkheid'.
Bij nominale waarden zoals classificaties van objecten kan dit worden uitgedrukt is het percentage correct geclassificeerde objecten.
Bij interval of ratio zoals bij het kenmerk bouwjaar bij een pand, of gemeten waterstanden bij waterlopen kan de nauwkeurigheid worden uitgedrukt in een standaardafwijking. Een voorbeeld van bouwjaar is dat afhankelijk van de waarde een bepaalde afwijking voor gegevens kunnen gelden;
bouwjaren tussen 1800 en 1900 mogen 10 jaar afwijken, bouwjaren van 1992 en hoger mogen 1 jaar afwijken.
Geef hieronder aan hoe u over de bovenstaande stelling denkt.

- ○ Helemaal mee eens
- ○ Mee eens
- ◉ Neutraal
- ○ Mee oneens
- ○ Zeer oneens
- ○ Geen mening

17. Stelling: Informatie over temporele inconsistentie verbetert het inzicht in de bruikbaarheid .
Wanneer de geldigheid van een tijdvak van opvolgende objectcycli niet aansluit of overlap bevat spreekt men van temporele inconsistentie. Dit kan ontstaan door foute invoer, of een invoer met een verschillende precisie (datum versus datum+tijd). De leverancier van de gegevens kan informatie verstrekken over hoeveel, waar, en in welke periode temporele inconsistentie voorkomt.
Geef hieronder aan hoe u over de bovenstaande stelling denkt.

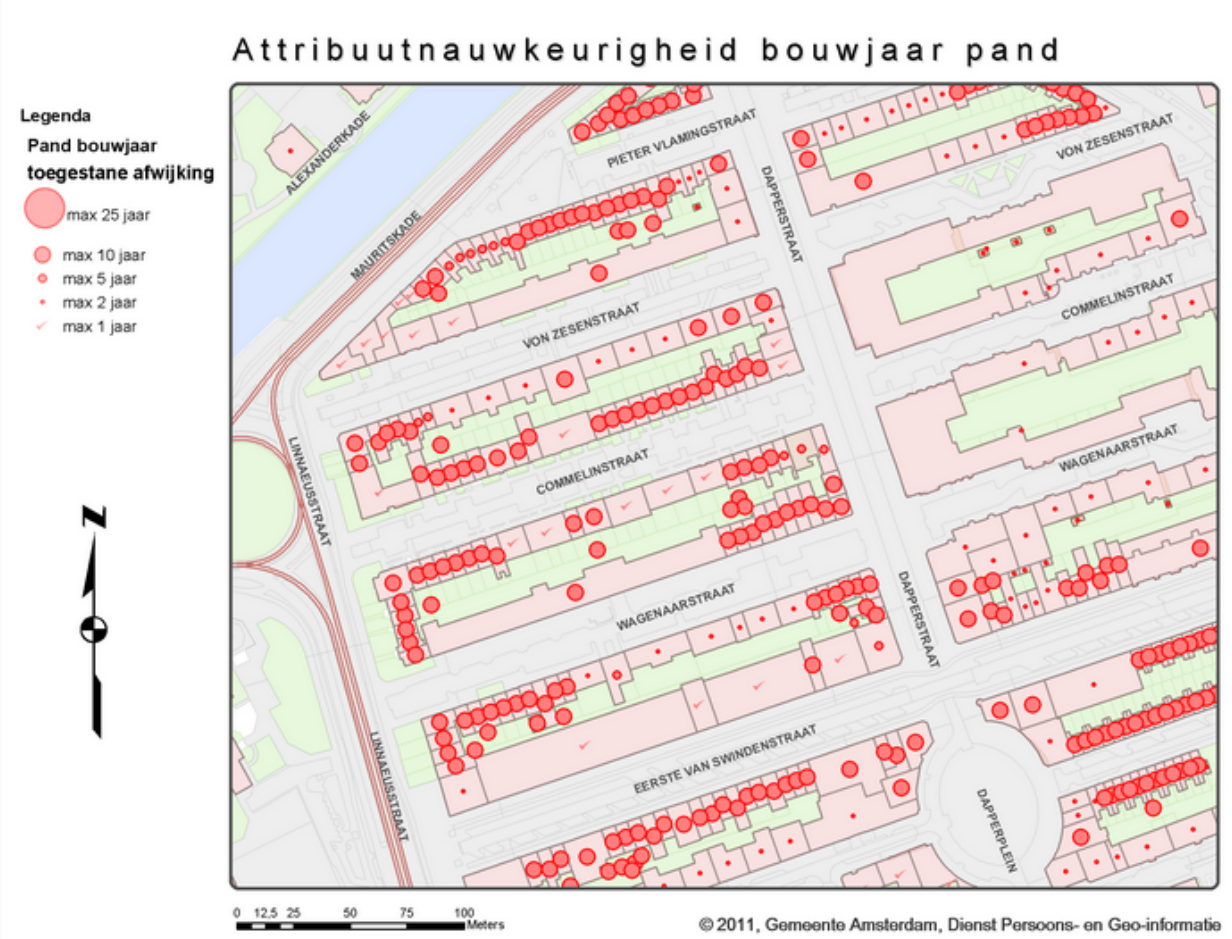
- ○ Helemaal mee eens
- ○ Mee eens
- ○ Neutraal
- ○ Mee oneens
- ○ Zeer oneens
- ○ Geen mening

Bruikbaarheid van het visualiseren van informatie over onzekerheid

Deze sectie betreft vragen over verschillende methodes voor het verstrekken van informatie over onzekerheid in Geografische gegevens. Het doel van de onderstaande vragen is om iets te weten te komen over de bruikbaarheid van deze methodes.

Visualisatie met 1 statische kaart

De onderstaande visualisatie is statisch, en dient als voorbeeld over de mogelijke nauwkeurigheid van een bepaald kenmerk. In dit voorbeeld is de nauwkeurigheid van het oorspronkelijke bouwjaar van een pand weergegeven. De te beantwoorden vraag staat onderaan de afbeelding.



18. Stelling: Het gebruik van een kaart volgens het bovenstaande voorbeeld verbetert mijn inzicht in de nauwkeurigheid van de gegevens .

- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

19. Stelling: De gegevens in de bovenstaande kaart zijn eenvoudig te interpreteren .

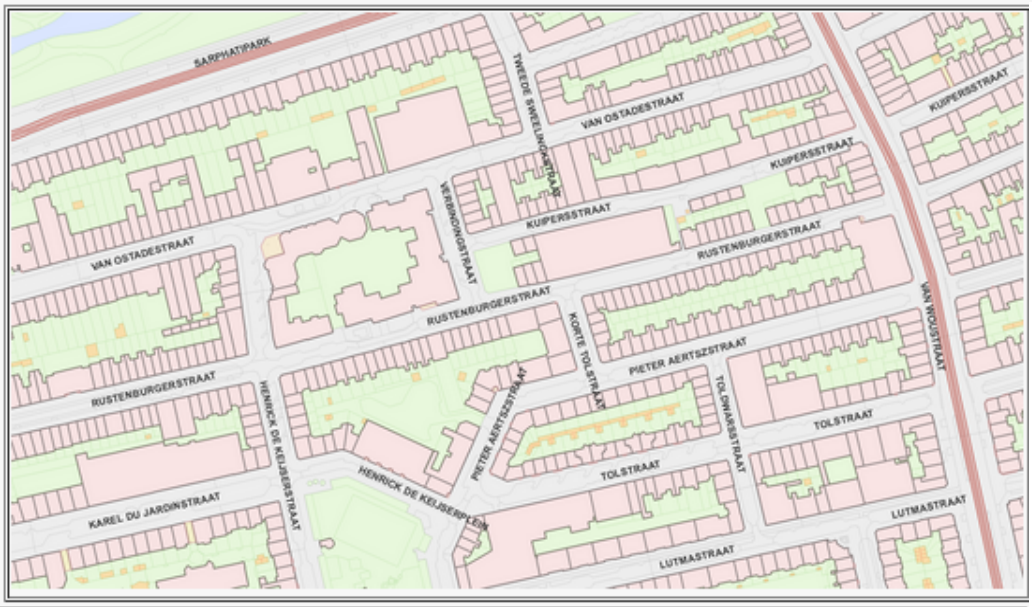
- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

20. Stelling: Het gebruik van een kaart volgens het bovenstaande voorbeeld is in te passen in mijn huidige werkzaamheden .

- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

Visualisatie met 2 kaarten (map pair)

De onderstaande afbeelding wordt ook wel een 'map pair' genoemd. Op de linker afbeelding is topografie afgebeeld zonder informatie over nauwkeurigheid, de rechter afbeelding met informatie over nauwkeurigheid . In dit voorbeeld is weer gebruik gemaakt van het kenmerk "oorspronkelijk bouwjaar bij pand". De te beantwoorden vraag staat onderaan de afbeeldingen.



21. Stelling: Het gebruik van een statische visualisatie met een 'map pair' verbetert mijn inzicht in de nauwkeurigheid van de gegevens .

- (●) Helemaal mee eens
- ( ) Mee eens
- ( ) Neutraal
- ( ) Mee oneens
- ( ) Zeer oneens
- ( ) Geen mening

22. Stelling: De gegevens in de bovenstaande 'map pair' zijn eenvoudig te interpreteren .

- ( ) Helemaal mee eens
- ( ) Mee eens
- ( ) Neutraal
- ( ) Mee oneens
- ( ) Zeer oneens
- ( ) Geen mening

23. Stelling: Het gebruik van een statische visualisatie met een 'map pair' is in te passen in mijn huidige werkzaamheden .

- ( ) Helemaal mee eens
- ( ) Mee eens
- ( ) Neutraal
- ( ) Mee oneens
- ( ) Zeer oneens
- ( ) Geen mening

Interactieve visualisatie van onzekerheid in Geografische gegevens

De voorgaande vragen hadden betrekking statische visualisatie, een kenmerk hiervan is dat deze door de eindgebruiker niet zijn aan te passen. De onderstaande gaan over interactieve visualisatie van Geo-informatie (Geovisualisatie). Met interactieve visualisatie kan de gebruiker de dataset bevragen en kenmerken visualiseren die gegevens bevatten over vaagheid of nauwkeurigheid. Tevens kan de gebruiker verschillende 'lagen' aan- en uitzetten of combineren.

24. Stelling: Het gebruik van interactieve visualisatie verbetert mijn inzicht in de nauwkeurigheid van de gegevens .

- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

25. Stelling: Het gebruik van interactieve visualisatie heeft de voorkeur boven statische kaarten .

- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

26. Stelling: Het gebruik van interactieve visualisatie is in te passen in mijn huidige werkzaamheden .

- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

Gebruik van metadata bij informatie over onzekerheid

Metadata is bedoeld om informatie over datasets vast te leggen. Een van de onderdelen van de metadatastandaard is het beschrijven van de inhoud en het gebruiksdoel van de gepubliceerde gegevens. Onderstaande afbeelding geeft een impressie van metadata. In het voorbeeld is informatie over definities opgenomen, en informatie over gegevenskwaliteit.
Op een extra pagina zijn uitgebreider voorbeelden over **gegevenskwaliteit**, en **gegevensinhoud** te bekijken.

27. Stelling: Het gebruik van metadata verbetert mijn inzicht in de nauwkeurigheid van de gegevens .

- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

28. Stelling: Het gebruik van metadata verbetert mijn inzicht in de definities van de gegevens .

- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

29. Stelling: Het gebruik van metadata is voor mij niet ingewikkeld .

- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

30. Stelling: Het gebruik van metadata is in te passen in mijn huidige werkzaamheden .

- Helemaal mee eens
- Mee eens
- Neutraal
- Mee oneens
- Zeer oneens
- Geen mening

Wanneer niet alle vragen zijn ingevuld dan wordt er een scherm getoond met rood gemarkeerde vragen.
U kunt het getoonde scherm gebruiken, of 1 pagina terug gaan om de ontbrekende vragen te beantwoorden.

Zijn alle vragen ingevuld, klik dan op de onderstaande knop!

Verzenden

Appendix 3

In-depth interview

Invitation letter

vrije Universiteit amsterdam

maart 2012

Geachte dame/heer,

Mijn naam is Nico de Graaff en ik ben student aan de Vrije Universiteit van Amsterdam.
Deze studie volg ik naast mijn functie als adviseur Geo-informatie bij unit Geo-informatie, Dienst Basisinformatie van de gemeente Amsterdam.
Voor mijn afstudeerproject onderzoek ik de bruikbaarheid van communiceren over onzekerheid in geografische gegevens.
Een van de onderzoeksmethoden is het houden van diepte-interviews.
Daarvoor benader ik een aantal personen die vanuit de praktijk hier aan kunnen deelnemen.
Omdat u voldoet aan het profiel van de groep deskundigen die een bijdrage kan leveren wordt u gevraagd om deel te nemen aan dit interview.
De tijdsduur van interview bedraagt c.a. 1 á 1½ uur en zal worden beloond met een bescheiden attentie.
Als u besluit om bij te dragen aan mijn onderzoek kan ik vermelden dat de onderzoeksresultaten worden verstrekt aan UniGIS van de Vrije Universiteit Amsterdam, en dat de verzamelde gegevens geanonimiseerd worden verwerkt en gepubliceerd.
Ter voorbereiding van het interview vind u in in de bijlage een inleidende tekst, en een eerste aanzet van de te stellen vragen.
Het tijdstip en locatie van het interview vind plaats in overleg met de deelnemer.
De voorkeur is dat het interview plaatsvindt voor 14 april.

Als u besluit om deel te nemen aan het interview, of nog vragen heeft, dan kunt u een mail sturen naar:
nj.degraaff@gmail.com

Dank voor uw medewerking

Vriendelijke groet,

Nico de Graaff

Bijlage Interview

Inleiding
De aard van het diepte-interview is informeel van karakter en semi-gestructureerd.
Met semi-gestructureerd wordt bedoeld dat de vragenlijst voorafgaand aan het interview is opgesteld. De opzet van dit type interview geeft de ruimte om bepaalde onderwerpen verder uit te diepen, beperkter te behandelen, of nieuwe gerelateerde onderwerpen te bespreken.

Doel interview
Het doel van het interview is om inzicht te krijgen 2 onderwerpen:

1. Inzicht krijgen in de *ervaring* van gebruikers met betrekking tot *onzekerheid* in geografische basisinformatie in een gemeentelijke *keten*.
2. Inzicht krijgen hoe gebruikers van geografische basisinformatie de *bruikbaarheid* van *informatie* over *onzekerheid* ervaren.

Structuur en eerste aanzet vragenlijst interview.
Aan het begin van het interview zal een korte introductie van het onderwerp worden gegeven. Vervolgens worden er een aantal vragen die aansluiten bij de onderwerpen van het interview. Hieronder staat een eerste aanzet van de vragenlijst:

1. Hoe ervaart u het geografische basisinformatie in een gemeentelijke keten ?
2. Waar in de keten ervaart u onnauwkeurigheid, vaagheid, en vage/dubbelzinnige definities?
3. Welke problemen ervaart u met onnauwkeurigheid, vaagheid, en vage/dubbelzinnige definities?
4. Hoe gaat u om met onzekerheid in geografische gegevens?
5. Hoe wordt u geïnformeerd over onzekerheid in geografische gegevens? (bijv. metadata, rapportages, enz.)
6. Hoe zou u geïnformeerd willen worden over onzekerheid in geografische gegevens en waarom?

Toelichting onderwerp.
Een belangrijk deel van de vragenlijst heeft betrekking op onzekerheid in geografische gegevens. Als u deze term voor het eerst tegenkomt lijkt het wat vaag, maar bij het werken met geografische gegevens kunnen we hier geregeld mee te maken krijgen.
Onzekerheid in geografische gegevens is in te delen in drie groepen:

1. Onduidelijke definities (ambiguiteit)
Wanneer gegevens niet specifiek zijn gedefinieerd, of dubbelzinnig zijn gedefinieerd dan is het onduidelijk tot welke gegevensgroep (entiteit, objectklasse) de gegevens behoren. Dit zou kunnen leiden tot onnauwkeurige- of onjuiste uitkomsten van analyses of onjuist gebruik. Voorbeelden van objecten met niet-specifieke definities zijn b.v. Bos (loof- of naaldbos), of "openbare ruimte" (openbaar, of openbaar toegankelijk?, is een winkelpassage openbaar toegankelijk of is het een openbare ruimte?).

2. Vaagheid in objectafbakening
Vaagheid treedt op wanneer begrenzingen van objecten vaag zijn, en niet nauw keurig zijn te definieren. Dit komt bijvoorbeeld voor bij begrenzingen van rietkragen, natuurlijke waterkant,of afbakening van diverse typen begroeiing zoals bos.

3. Nauwkeurigheid
Geografische gegevens bevatten een bepaalde mate van nauwkeurigheid in vorm en ligging (geometrie), attributen, of in tijdsaspecten.
Afhankelijk van het soort gebruik en te stellen eisen aan de gegevens kan onnauwkeurigheid (het tegenovergestelde van nauwkeurigheid) leiden tot onnauwkeurige analyses die ook kunnen doorwerken in het gebruik. Onnauwkeurigheid in geometrie heeft invloed op bijvoorbeeld berekeningen van oppervlakte, het bepalen van maatvoering bij bijvoorbeeld herprofilering van wegen. Onnauwkeurigheid in kwalitatieve attributen zoals classificaties, gebruiksfuncties, en kwantitatieve attributen zoals oppervlakte gebruik, etc kunnen ook leiden tot onnauwkeurigheid in de uitkomsten van analyses.

Appendix 4

Data quality standards

Appendix 4. Data quality standards

- ISO 19113:2002 Geographic information :Quality principles
- ISO 19114:2003 Geographic information :Quality evaluation procedures
- ISO TS 19138-2006 Geographic information :Data quality measures
- ISO/NP 19157 Geographic information :Data quality (under development)
- ISO/NP TS 19158 Geographic information :Quality assurance of data supply (under development)

Data quality element	Data Quality sub-element	Description
Completeness		*Presence or absence of features, their attributes and relationships*
	Commission	Excess data present in a dataset
	Omission	Data absent from a dataset
Logical consistency		*Degree of adherence to logical rules of data structure, attribution and relationships*
	Conceptual consistency	Adherence to rules of the conceptual schema
	Domain consistency	Adherence of values to the value domains
	Format consistency	Degree to which data is stored in accordance with the physical structure of the data set
	Topological consistency	Correctness of the explicitly encoded topological characteristics of a dataset
Positional accuracy		*Accuracy of the position of features*
	Absolute or external accuracy	Closeness of reported coordinate values to values accepted as or being true
	Relative or internal accuracy	Closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true
	Gridded data position accuracy	Closeness of gridded data position values to values accepted as or being true
Temporal accuracy		*Accuracy of the temporal attributes and temporal relationships of features*
	Accuracy of a time measurement	Correctness of the temporal references of an item (reporting of error in time measurement)
	Temporal consistency	Correctness of ordered events or sequences, if reported
	Temporal validity	Validity of data with respect to time
Thematic accuracy		*Accuracy of quantitative attributes and the correctness of non-quantitative attributes and of the classifications of features and their relationships*
	Classification correctness	Comparison of the classes assigned to features or their attributes universe of discourse (e.g. ground truth or reference data set)
	Non-quantitative attribute correctness	Correctness of non-quantitative attributes
	Quantitative attribute accuracy	Accuracy of quantitative attributes

Appendix 4.A. ISO 19113 Data quality elements

Element	Description
Definitions of objects	what does it mean?
Temporal and spatial Coverage	does it cover my area of interest?
Lineage	history of the origin, a sequence of operations performed on the dataset
Legitimacy	official source, conformation to standards
Accessibility	format, cost, legal issues, standardisations
Relevance	is this data useful for my task?
understandability	is it not too complex?
efficiency	is the data efficient to process?
credibility	criticism of the sources
Timeliness	up to date, time series

Appendix 4.B. Considered elements of external data quality

(Burrough & McDonell 1998)

Appendix 5

Results survey

Information about uncertainty in spatial data

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List of illustrations

List of tables

1. Survey response

This appendix provides a summary of the response of the survey and is similar organized to the questionnaire.
The first part gives an overviews of the response, the subsequent sections are grouped by personal characteristics, tasks of the respondents, information needs, and types of visualizations.
Each section gives a brief overview of relative frequency, and diversity which is explained in section 1.1.

1.1. Response of the questionnaire

Estimated population (all municipalities) : **1975**
Estimated population (large municipalities) : **390**
Sample : ***100***
Response : ***44***

The response rate is computed as : $\frac{nR}{nR+nNR}$

Where nR is the number of responses, and nNR the number of non-responses.

Hence, the computed response rate is : $\frac{44}{44+56}$ = **44**%

The sample is assumed to be representative when there is an equal distribution of personal characteristics of the respondents. The quantification of the diversity of the responses is expressed in Simpson's diversity index (Mcdonald & Dimmick 2003). A perfect homogeneous sample has a diversity index of 1, and a perfect heterogeneous sample has a diversity index of 0. Simpson's index takes the number of categories into account, the number of absent categories, and depends on the sample size. Due to the sample size of this survey a perfect heterogeneous sample has a diversity index of 0.8.
Simpson's diversity index is calculated as:

$$\boldsymbol{D} = 1 - \sum_{\boldsymbol{i}=1}^{\boldsymbol{n}} \boldsymbol{p}^2 \boldsymbol{i}$$

Where ***n*** is the number of categories, and ***p*** is the proportion of responses in a category.

2. Personal characteristics

This section is to provides an overview the distribution and variation of the respondents.

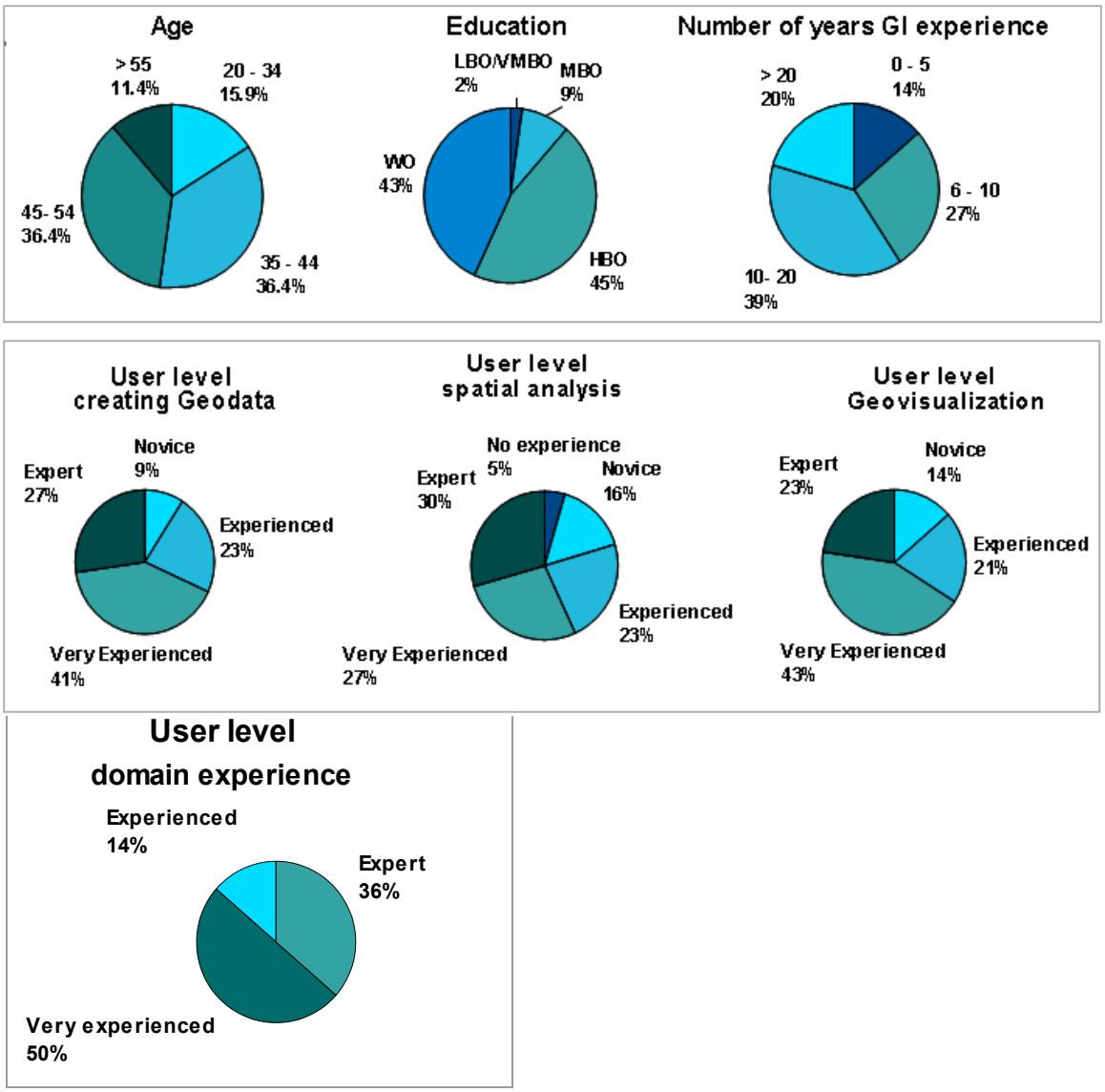

Figure 2.01. Distribution of personal characteristics.

Diversity

Category	Diversity index
Age	**0.697**
Education	**0.598**
Years of experience with geographic information	**0.716**
Level of domain experience	**0.599**
Level of creating geographic data	**0.698**
Level of performing spatial analysis	**0.759**
Level of performing Geovisualisation	**0.701**

Table 2.01. Diversity index of personal characteristics

3. Performed tasks of respondents

The nature and distribution of tasks performed by the respondents may reflect the characteristics of the population. Figure 3.01 illustrates for each type of task the relative frequency.

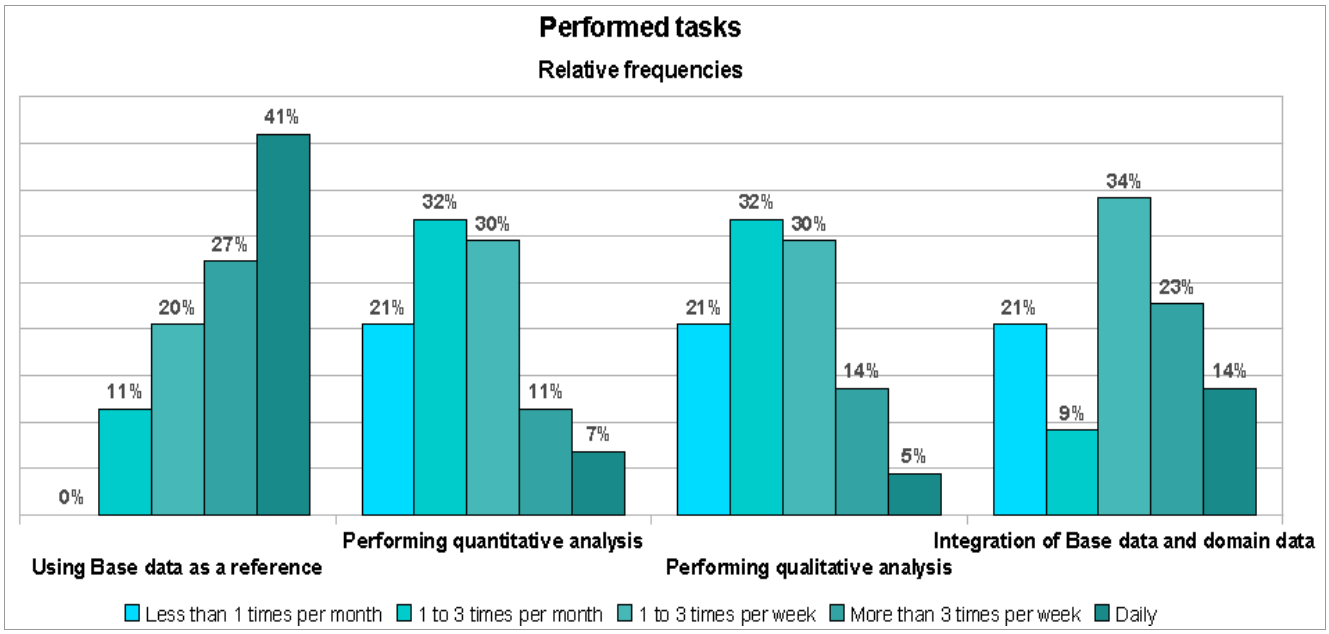

Figure 3.01. Distribution of task characteristics.

Table 3.01 shows the central tendency and the diversity of the outcomes regarding the task characteristics.
The values of median and mode are of ordinal scale:

5 - Very often (daily)
4 - Often (more than than 3 times a week)
3 - Average (1 to 3 times a week)
2 - Few (1 tot 3 times a month)
1 - Very few (Less than 1 time a month)

Category	median	mode	Diversity index
Using base data as a reference	**4**	**5**	**0.704**
Performing quantitative analysis	**2**	**2**	**0.752**
Performing qualitative analysis	**2**	**2**	**0.749**
Integration of base data and domain data	**3**	**3**	**0.763**

Table 3.01. Central tendency of task characteristics

4. Information needs about uncertainty

One of the supportive research questions concerned the information needs about uncertainty in spatial data. To provide insight in the information needs the questionnaire contained five questions which must be answered. Figure 4.01 gives a summary of the response on those questions.

Distribution

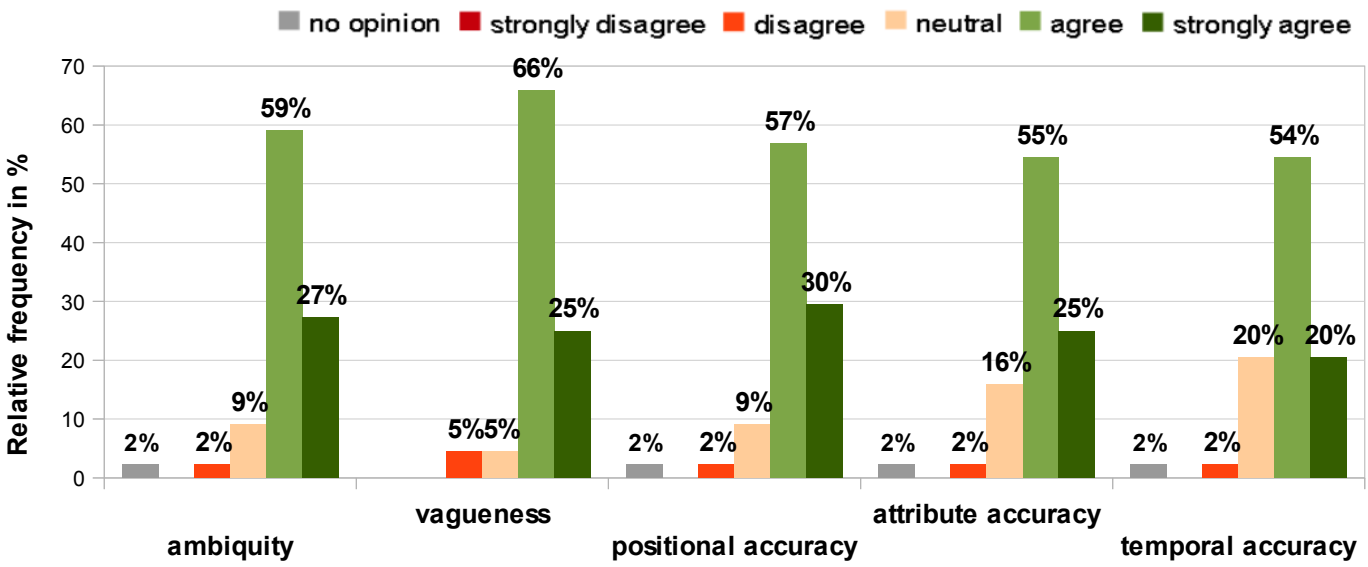

Figure 4.01. Information needs about uncertainty in spatial data.

Central tendency

Proper measures for for central tendency regarding ordinal data are the median and mode. For all variables of the information needs the median is 4 (Agree), the mode varies slightly as showed in table 4.01. For the diversity Simpson's diversity index is calculated.

Category	median	mode	Diversity index
Information needs: ambiguity	**4**	**4**	**0.567**
Information needs: vagueness	**4**	**3**	**0.499**
Information needs: positional accuracy	**4**	**4**	**0.581**
Information needs: attribute accuracy	**4**	**4**	**0.614**
Information needs: temporal consistency	**4**	**4**	**0.618**

Table 4.01. Central tendency of information needs about uncertainty in spatial data

5. Visualization of information about uncertainty

The fourth section of the questionnaire focussed on the usefulness and usability of different methods of visualizing information about uncertainty in spatial data.
Thirteen questions were formulated and covered perceived usefulness and perceived ease of use. The results are grouped by the following categories: insight in accuracy, ease of use, and the applicability in the present tasks of the respondents.

5.1. Insight in accuracy

Distribution

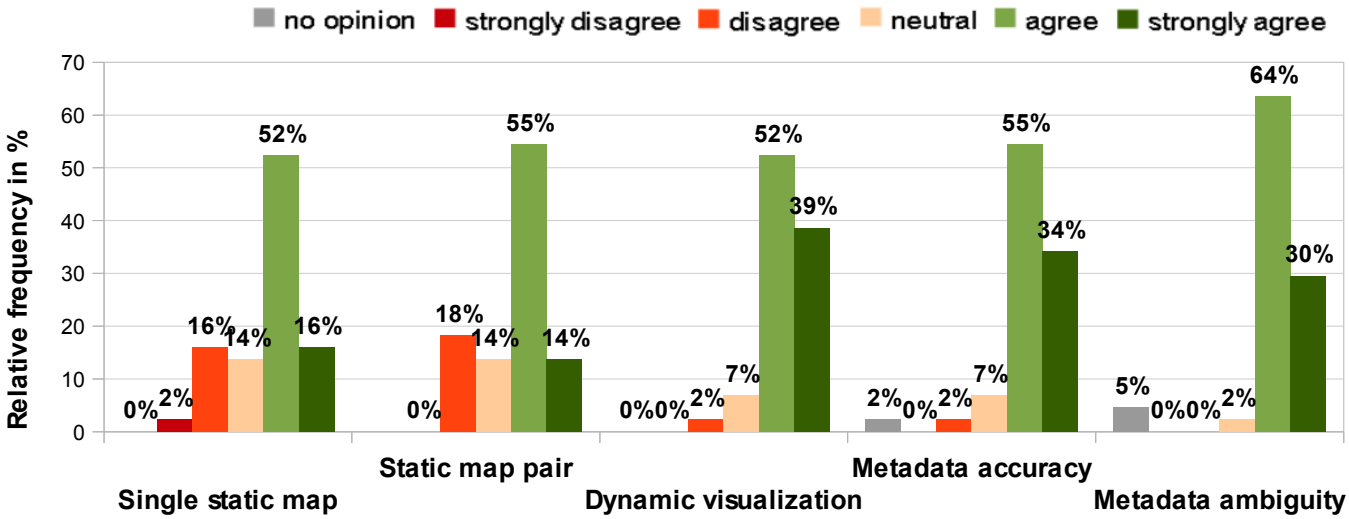

Figure 5.01. Insight in accuracy of spatial data.

Central tendency

For the response about insight in accuracy of spatial data the median, the mode, and Simpson's diversity index are calculated. Table 5.01 shows the median and mode for each category. Two different values occur in the table, 4=Agree, and 3=neutral. For the diversity Simpson's diversity index is calculated.

Category	median	mode	Diversity index
Single static map	**4**	**4**	**0.657**
Static map pair	**4**	**3**	**0.632**
Dynamic visualization	**4**	**3**	**0.572**
Metadata accuracy	**4**	**4**	**0.581**
Metadata ambiguity	**4**	**3**	**0.505**

Table 5.01. Central tendency of insight in accuracy of spatial data

5.2. The ease of use of visualizations (interpretation)

Distribution

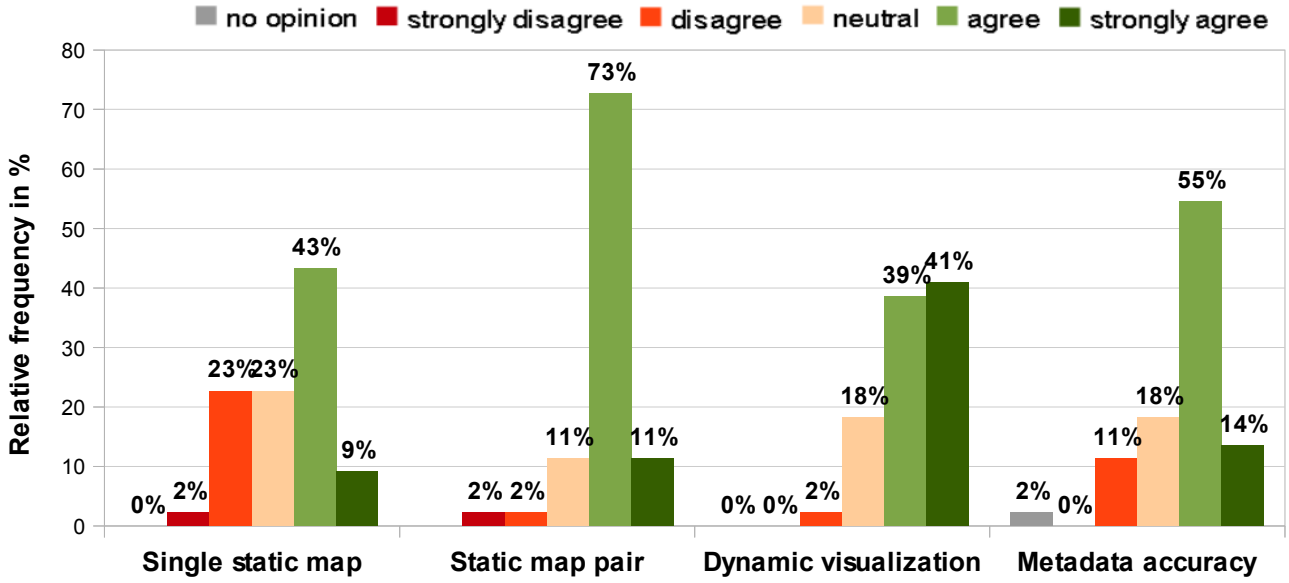

Figure 5.02. Perceived ease of use of different types of visualizations.

Central tendency

For the response about the ease of use (interpretation) the median and mode are calculated. Table 5.02 shows the median and mode for each category. Two different values occur in the table, 4=Agree, and 3=neutral. For the diversity Simpson's diversity index is calculated.

Category	median	mode	Diversity index
Single static map	**4**	**4**	**0.701**
Static map pair	**4**	**4**	**0.444**
Dynamic visualization	**4**	**4**	**0.650**
Metadata	**4**	**4**	**0.637**

Table 5.02. Central tendency of the ease of use (interpretation) of different types of visualisations

5.3. Applicability in the current tasks of the respondents

Distribution

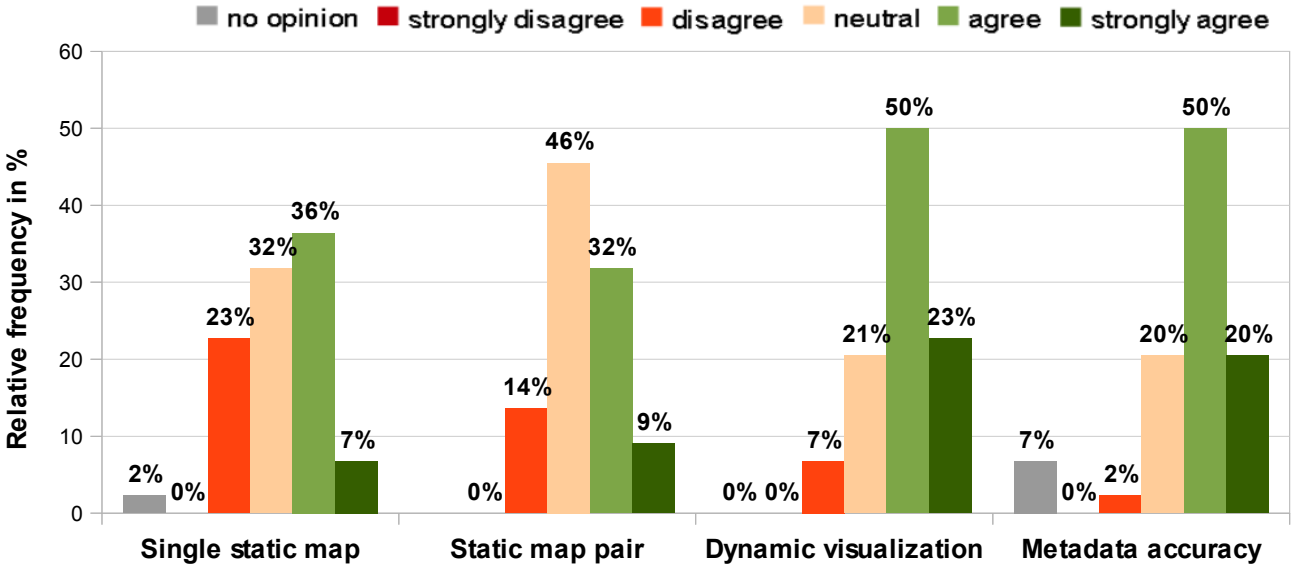

Figure 5.03. Applicability of different types of visualizations.

Central tendency

For the response about insight in accuracy of spatial data the median and mode calculated. Table 5.03 shows the median and mode for each category. Two different values occur in the table, 4=Agree, and 3=neutral. For the diversity Simpson's diversity index is calculated.

Category	median	mode	Diversity index
Single static map	**3**	**4**	**0.710**
Static map pair	**3**	**2**	**0.665**
Dynamic visualization	**4**	**3**	**0.652**
Metadata	**4**	**4**	**0.661**

Table 5.03. Central tendency of insight in accuracy of spatial data

6. Summary of the use of Key Geo-registrations

To determine the use of the Key Geo-registrations and investigate relationships between this use an other variable respondents were asked to provide information about the use of Key Geo-registrations. The measure of this variable is dichotomous (yes/no).
The graph below illustrates a graph with relative frequencies for each registration.

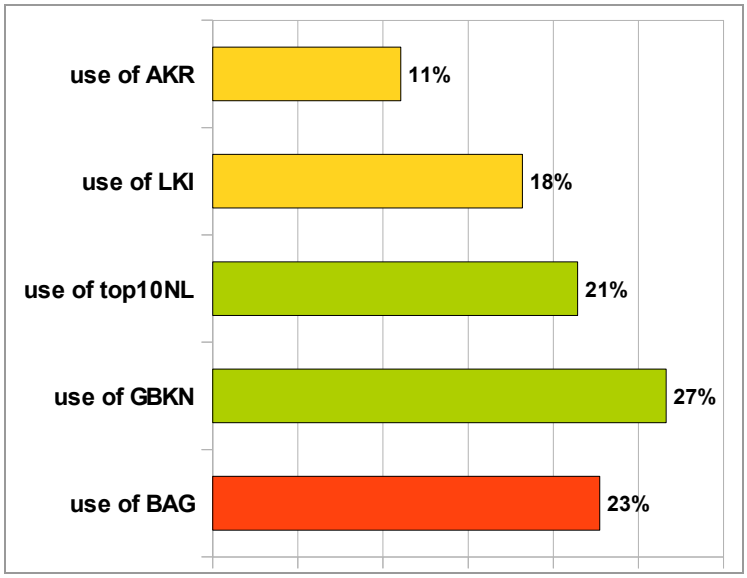

Figure 5.04. Relative frequencies for the use of Key Geo-registrations.

Below the descriptions of the registrations are given:

Registration	Description
AKR	Administrative cadastral registration (juridical facts of real estate)
LKI	Geodetic cartographic system (Cadastral map)
top10NL	Topographic registration scale 1:10,000 (mid-scale)
GBKN	Large scale topographic map of the Netherlands (1:500 – 1:2000)
BAG	Key Registration addresses and buildings

Appendix 6

Statistical models

Spearman's Rank-order correlation

```
#
#==========================================================================================
# Script  : Spearman_R.r
# Purpose : Calculating Spearman's Rank-order correlation (UNIGIS MSc Thesis)
# Author  : N.J. de Graaff
# Date    : june 2012
#==========================================================================================
#Strategy:
# create 4 vectors which consists of:
#1. Names of variables of personal characteristics i  2 to  8
#2. Names of variables of task characteristics     i  9 to 12
#3. Names of variables of information needs        i 13 to 17
#4. Names of variables of types of visualization   i 18 to 30
#==========================================================================================
#
#
#load the MASS package
library(MASS);
#
# 2-Way Cross Tabulation
library(gmodels)
#
# direct output to a file
# Set working directory
setwd("C:/_Nico/_UniGis/_Thesis/survey/Analysis/data/")
#
#Import sign separated data file
survey_unc  <-  read.table(file =  "response_2012-04-28_REG.csv",
                           header  =  TRUE,
                           sep     = ";",
                           dec     =  "." );

# attach a variable to the previously imported data file
attach(survey_unc);
# ==================================================================================
# Spearman's rank-correlation procedure [pers, task, inf, viz]
# ==================================================================================
#
# Determine the critical z-value by a level of significance of 0.05 (95%)
#
sig_level   <- 0.05
#

# Write output to file
#
sink("C:/_Nico/_UniGis/_Thesis/survey/Analysis/correlation/report_spearman_R_method_registrations.tx
t", append=FALSE, split=FALSE)
# print header
print(paste("corr_name","Ro_val","p_value","significance level","independent","dependent",sep=";"))
#
# Correlation with registrations
# Personal, task, info, visualization
# loop through registrations
#
#for (pers in 2:8)
for (reg in 31:35) {
  # loop through types of visualization 19 to 31
  for (pers in 2:8) {
    # define correlated items
    corr_name <- paste(names(survey_unc[reg]), names(survey_unc[pers]),sep=" - ")
    cor_test  <-
cor.test(survey_unc[,reg],survey_unc[,pers],method="spearman",alternative="two.sided")
    #Extract Ro
    Ro_val    <- cor_test$estimate
    #Extract p-value
    p_value   <- cor_test$p.value
    #output row to file
    print(paste(corr_name,Ro_val,p_value,"0.05","registration","Personal",sep=";"))
  }
}
--- continues on the next page ---

#
#for (task in 9:12)
```

```
for (reg in 31:35) {
  # loop through types of visualization 19 to 31
  for (task in 9:12) {
    # define correlated items
    corr_name <- paste(names(survey_unc[reg]), names(survey_unc[task]),sep=" - ")
    cor_test  <-
cor.test(survey_unc[,reg],survey_unc[,task],method="spearman",alternative="two.sided")
    #Extract Ro
    Ro_val    <- cor_test$estimate
    #Extract p-value
    p_value   <- cor_test$p.value
    #output row to file
    print(paste(corr_name,Ro_val,p_value,"0.05","registration","Task",sep=";"))
  }
}
#
# for (info in 13:17)
for (reg in 31:35) {
  # loop through types of visualization 19 to 31
  for (info in 13:17) {
    # define correlated items
    corr_name <- paste(names(survey_unc[reg]), names(survey_unc[info]),sep=" - ")
    cor_test  <-
cor.test(survey_unc[,reg],survey_unc[,info],method="spearman",alternative="two.sided")
    #Extract Ro
    Ro_val    <- cor_test$estimate
    #Extract p-value
    p_value   <- cor_test$p.value
    #output row to file
    print(paste(corr_name,Ro_val,p_value,"0.05","registration","Info needs",sep=";"))
  }
}
#
#for (viz in 18:30)
for (reg in 31:35) {
  # loop through types of visualization 19 to 31
  for (viz in 18:30) {
    # define correlated items
    corr_name <- paste(names(survey_unc[reg]), names(survey_unc[viz]),sep=" - ")
    cor_test  <-
cor.test(survey_unc[,reg],survey_unc[,viz],method="spearman",alternative="two.sided")
    #Extract Ro
    Ro_val    <- cor_test$estimate
    #Extract p-value
    p_value   <- cor_test$p.value
    #output row to file
    print(paste(corr_name,Ro_val,p_value,"0.05","registration","Visualization type",sep=";"))
  }
}
  #
  # close the output file
sink()
# End of R script
```

Kendall's Tau correlation

```
#
#==========================================================================================
# Script  : Kendall_Tau_method.r
# Purpose : Calculating Kendall's Tau correlation (UNIGIS MSc Thesis)
# Author  : N.J. de Graaff
# Date    : june 2012
#==========================================================================================
#Strategy:
# create 4 vectors which consists of:
#1. Names of variables of personal characteristics i  2 to  8
#2. Names of variables of task characteristics     i  9 to 12
#3. Names of variables of information needs        i 13 to 17
#4. Names of variables of types of visualization   i 18 to 30
#==========================================================================================
#
#load the MASS package
library(MASS);
#
# 2-Way Cross Tabulation
library(gmodels)
#
# direct output to a file
# sink("myfile", append=FALSE, split=FALSE)
# Set working directory
setwd("C:/_Nico/_UniGis/_Thesis/survey/Analysis/data/")

#Import sign separated data file
survey_unc  <-  read.table(file =  "response_2012-04-28.csv",
                           header  =  TRUE,
                           sep     = ";",
                           dec     =  "." );

# attach a variable to the previously imported data file
attach(survey_unc);
# ==================================================================================
# kendall's rank-correlation procedure [pers, task, inf, viz]
# ==================================================================================
#
# Determine the critical z-value by a level of significance of 0.05 (95%)
#
sig_level   <- 0.05
#

# Write output to file
#
sink("C:/_Nico/_UniGis/_Thesis/survey/Analysis/correlation/report_Kendall_Tau_method_20120630.txt",
append=FALSE, split=FALSE)
# print header
print(paste("corr_name","T_val","p_value","significance level","independent","dependent",sep=";"))
# loop through personal characteristics
# for each personal and information need
  for (pers in 2:8) {
    # loop through information needs
    for (info in 13:17) {
      # define correlated items
      corr_name <- paste(names(survey_unc[pers]), names(survey_unc[info]),sep=" - ")
      cor_test  <- cor.test(survey_unc[,pers], survey_unc[,info],
method="kendall",alternative="two.sided")
      # extract Ro
      Ro_val    <- cor_test$estimate
      #Extract p-value
      p_value   <- cor_test$p.value
      #output row to file
      print(paste(corr_name,Ro_val,p_value,sig_level,"Personal","info",sep=";"))
    }
  }
#
```

--- continues on the next page ---

```
# loop through personal characteristics again
# for each personal and visualization type
  for (pers in 2:8) {
    # loop through visualization type
    # loop through types of visualization 19 to 31
    for (viz in 18:30) {
      # define correlated items
      corr_name <- paste(names(survey_unc[pers]), names(survey_unc[viz]),sep=" - ")
      cor_test  <-
cor.test(survey_unc[,pers],survey_unc[,viz],method="kendall",alternative="two.sided")
      #Extract Ro
      Ro_val    <- cor_test$estimate
      #Extract p-value
      p_value   <- cor_test$p.value
      #output row to file
      print(paste(corr_name,Ro_val,p_value,sig_level,"Personal","Visualization type",sep=";"))
     }
  }
#
# loop through task characteristics
# for each task
  for (task in 9:12) {
    # loop through information needs
    for (info in 13:17) {
      # define correlated items
      corr_name <- paste(names(survey_unc[task]), names(survey_unc[info]),sep=" - ")
      cor_test  <-
cor.test(survey_unc[,task],survey_unc[,info],method="kendall",alternative="two.sided")
      #Extract Ro
      Ro_val    <- cor_test$estimate
      #Extract p-value
      p_value   <- cor_test$p.value
      #output row to file
      print(paste(corr_name,Ro_val,p_value,sig_level,"Task","Info",sep=";"))
     }
  }
#
# Loop for each task again
  for (task in 9:12) {
    # loop through visualization types
    # loop through types of visualization 19 to 31
    for (viz in 18:30) {
      # define correlated items
      corr_name <- paste(names(survey_unc[task]), names(survey_unc[viz]),sep=" - ")
      cor_test  <-
cor.test(survey_unc[,task],survey_unc[,viz],method="kendall",alternative="two.sided")
      #Extract Ro
      Ro_val    <- cor_test$estimate
      #Extract p-value
      p_value   <- cor_test$p.value
      #output row to file
      print(paste(corr_name,Ro_val,p_value,"0.05","Task","Visualization type",sep=";"))
    }
  }
#
# loop through information needs
  for (info in 13:17) {
    # loop through types of visualization 19 to 31
    for (viz in 18:30) {
      # define correlated items
      corr_name <- paste(names(survey_unc[info]), names(survey_unc[viz]),sep=" - ")
      cor_test  <-
cor.test(survey_unc[,info],survey_unc[,viz],method="kendall",alternative="two.sided")
      #Extract Ro
      Ro_val    <- cor_test$estimate
      #Extract p-value
      p_value   <- cor_test$p.value
      #output row to file
      print(paste(corr_name,Ro_val,p_value,"0.05","Info","Visualization type",sep=";"))
    }
  }
  #
  # close the output file
sink()
# End of R script
```

Multi linear regression

```
#
#==========================================================================================
# Script  : TAM_MRA_run5.r
# Purpose : Performing multi regression analysis (UNIGIS MSc Thesis)
# Author  : N.J. de Graaff
# Date    : july 2012
#==========================================================================================
#
#load the MASS package
library(MASS);
#
# 2-Way Cross Tabulation
library(gmodels)
#
# library for scatterplot matrices
library(car)
#
# library for performing statisctical operations on matrices
library(matrixStats)
#
#  Global test of linear model assumptions
library(gvlma)
#
# Library containing Doornick-Hansen test for multivariate normality
library("normwhn.test")
#
# Set working directory
setwd("C:/_Nico/_UniGis/_Thesis/survey/Analysis/data/")
#
#Import sign separated data file
survey_unc  <-  read.table(file =  "response_2012-04-28_REG.csv",
                           header  =  TRUE,
                           sep     = ";",
                           dec     =  "." );

# attach a variable to the previously imported data file
  attach(survey_unc);
#
#
# ==========================================================================================
# Steps in analyzing model fits
# 1. Check assumptions
# 2. Evaluate summary
# 3. Perform hypothesis test
#
# ==========================================================================================
#                        MODEL SPECIFICATIONS
#
# ==========================================================================================
#
#
# ------------------------------------------------------------------------------------------
# DEFINING VARIABLES FOR PU AND PEU
# ------------------------------------------------------------------------------------------
#
PU1  <- rowMedians(cbind(inf13_ambiq,inf14_vague,inf15_posacc,inf16_attracc,inf17_time))
PU2  <-
rowMedians(cbind(viz18_single_ins,viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins,viz28_mta_defi))
PEU1 <- rowMedians(cbind(viz19_single_interp,viz22_pair_interp,viz25_dyn_interp,viz29_mta_compli))
PEU2 <- rowMedians(cbind(viz20_single_adapt,viz23_pair_adapt,viz26_dyn_adapt,viz30_mta_adapt))
#
PU   <- rowMedians(cbind(inf13_ambiq,inf14_vague,inf15_posacc,inf16_attracc,inf17_time,
                         viz18_single_ins,viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins,viz28_mta_defi)
)
#
PEU  <- rowMedians(cbind(viz19_single_interp,viz22_pair_interp,viz25_dyn_interp,viz29_mta_compli,
                         viz20_single_adapt,viz23_pair_adapt,viz26_dyn_adapt,viz30_mta_adapt))
```

```
#
# ---------------------------------------------------------------------------------
#
# DEFINING MODELS
#
# ---------------------------------------------------------------------------------
#
# === HYP01A: AGE AFFECTS PU1 (info)       ===
 hyp01A     <- lm(PU1 ~ pers01_agecat)
 gvmodel01A <- gvlma(hyp01A)
#
# === HYP01B: AGE AFFECTS PU2 (adaption)
#
 hyp01B     <- lm(PU2 ~ pers01_agecat)
 gvmodel01B <- gvlma(hyp01B)
#
# Age affects PEU1
hyp01C     <- lm(PEU1 ~ pers01_agecat)
gvmodel01C <- gvlma(hyp01C)
#
# Age affects PEU2
hyp01D     <- lm(PEU2 ~ pers01_agecat)
gvmodel01D <- gvlma(hyp01D)
#
# ------------------------------------------------------------------------------------------
#
# === HYP02A: EDUCATION AFFECTS PU1   ===
 hyp02A     <- lm(PU1~pers02_edu)
 gvmodel02A <- gvlma(hyp02A)
#
# === HYP02B: EDUCATION AFFECTS PU2   ===
 hyp02B     <- lm(PU2~pers02_edu)
 gvmodel02B <- gvlma(hyp02B)
#
# Additional HYPOTHESES
#
# HYP02C: Education affects PEU1
hyp02C     <- lm(PEU1~pers02_edu)
gvmodel02C <- gvlma(hyp02C)
#
#
# Education affects PEU2
hyp02d     <- lm(PEU2~pers02_edu)
gvmodel02d <- gvlma(hyp02d)
#
# ------------------------------------------------------------------------------------------
# === HYP03A: EXPERIENCE AFFECTS PU1   ===
#
 hyp03A     <- lm(PU1 ~ pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp)
 gvmodel03A <- gvlma(hyp03A)
#
# === HYP03B: Experience affects PU2 ===
 hyp03B     <- lm(PU2 ~ pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp)
 gvmodel03B <- gvlma(hyp03B)
#
# === HYP03C: EXPERIENCE AFFECTS PARTIAL PU1   ===
hyp03C      <- lm(inf16_attracc+inf17_time~ pers05_gi_b_exp)
gvmodel03C <- gvlma(hyp03C)
#
#
# === HYP03D: EXPERIENCE AFFECTS PARTIAL PU2   ===
hyp03D     <- lm(viz27_mta_ins+viz28_mta_defi ~
pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp)
gvmodel03D <- gvlma(hyp03D)
#
#
# ------------------------------------------------------------------------------------------
#
# === HYP04A: EXPERIENCE AFFECTS PEU1 (Interpetation) ===
hyp04A     <- lm(PEU1 ~ pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp)
gvmodel04A <- gvlma(hyp04A)
#
# === HYP04B: EXPERIENCE AFFECTS PEU2 (Adaption) ===
hyp04B     <- lm(PEU2 ~ pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp)
gvmodel04B <- gvlma(hyp04B)
#
# ------------------------------------------------------------------------------------------
```

```
# === HYP05A: TASK AFFECTS PU1     ===
 hyp05A     <- lm(PU1 ~
task09_freq_reference+task10_freq_quanty+task11_freq_qualit+task12_freq_integr)
 gvmodel05A <- gvlma(hyp05A)
#
# === HYP05B_2: Partial TASK AFFECTS PU2(viz. insight)     ===
#
 PU2_05B    <- rowMedians(cbind(viz21_pair_ins,viz24_dyn_ins))
 hyp05B_2   <- lm(PU2_05B ~ task09_freq_reference+task11_freq_qualit+task12_freq_integr)
 gvmodel05B_2 <- gvlma(hyp05B_2)
#
# ===  HYP06: TASK AFFECTS PEU     ===
#
 hyp06     <- lm(PEU ~
task09_freq_reference+task10_freq_quanty+task11_freq_qualit+task12_freq_integr)
 gvmodel06 <- gvlma(hyp06)
#
# ===  HYP06A: TASK AFFECTS PEU1   ===
#
 hyp06A <- lm(PEU1 ~ task09_freq_reference+task10_freq_quanty+task11_freq_qualit+task12_freq_integr)
 gvmodel06A <- gvlma(hyp06A)
#
# ===  HYP06B_2: TASK AFFECTS PEU2(partial viz. adapt)   ===
#
 PEU2_06B     <- rowMedians(cbind(viz23_pair_adapt,viz26_dyn_adapt))
 hyp06B_2     <- lm(PEU2_06B ~ task09_freq_reference+task10_freq_quanty+task12_freq_integr)
 gvmodel06B_2 <- gvlma(hyp06B_2)
#
# ---------------------------------------------------------------------------------------------
# === hyp07_2: INFORMATION NEEDS AFFECTS PU2_07(partial viz. insight)   ===
#
 PU2_07      <- rowMedians(cbind(viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins))
 hyp07_2     <- lm(PU2_07 ~ inf13_ambiq+inf14_vague+inf15_posacc+inf16_attracc+inf17_time)
 gvmodel07_2 <- gvlma(hyp07_2)
#
# hyp07A  Information needs affects PEU2
  hyp07A        <- lm(PEU2~inf13_ambiq+inf14_vague+inf15_posacc+inf16_attracc+inf17_time)
  gvmodelhyp07A <- gvlma(hyp07A)
#
# ---------------------------------------------------------------------------------------------
# === HYP08: Type of visualization affects PU1  ===
# Create vector for each type of visualization
v_single <- rowMedians(cbind(viz18_single_ins,viz19_single_interp,viz20_single_adapt))
v_pair   <- rowMedians(cbind(viz21_pair_ins,viz22_pair_interp,viz23_pair_adapt))
v_dyn    <- rowMedians(cbind(viz24_dyn_ins,viz25_dyn_interp,viz26_dyn_adapt))
v_mta    <- rowMedians(cbind(viz27_mta_ins,viz28_mta_defi,viz29_mta_compli,viz30_mta_adapt))
#
# Group by type of visualization
m_single <- cbind(viz18_single_ins,viz19_single_interp,viz20_single_adapt)
m_pair   <- cbind(viz21_pair_ins,viz22_pair_interp,viz23_pair_adapt)
m_dyn    <- cbind(viz24_dyn_ins,viz25_dyn_interp,viz26_dyn_adapt)
m_mta    <- cbind(viz27_mta_ins,viz28_mta_defi,viz29_mta_compli,viz30_mta_adapt)
#
# Group by type of visualization operation
m_ins    <- cbind(viz18_single_ins,viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins)
m_interp <- cbind(viz19_single_interp,viz22_pair_interp,viz25_dyn_interp,viz29_mta_compli)
m_adapt  <- cbind(viz20_single_adapt,viz23_pair_adapt,viz26_dyn_adapt,viz30_mta_adapt)
#
# Linear Regression
# HYP08: PU1 Affected by visualization type
 HYP08 <- lm(PU1 ~ v_single+v_pair+v_dyn+v_mta)
 gvmodelHYP08 <- gvlma(HYP08)
#
#
# HYP08A: PU1 Affected by single static map
 HYP08A <- lm(PU1 ~ v_single)
 gvmodelHYP08A <- gvlma(HYP08A)
#
--- continues on the next page ---
#
# HYP08B: PU1 Affected by map pair
 HYP08B <- lm(PU1 ~ v_pair)
 gvmodelHYP08B <- gvlma(HYP08B)
#
```

```
#
# HYP08C: PU1 Affected by dynamic map
 HYP08C <- lm(PU1 ~ v_dyn)
 gvmodelHYP08C <- gvlma(HYP08C)
#
# HYP08D: PU1 Affected by metadata
 HYP08D <- lm(PU1 ~v_mta)
 gvmodelHYP08D <- gvlma(HYP08D)
#
```

Ordinal regression with cumulative link models

```
#
#==========================================================================================
# Script  : TAM_ORM_run4.r
# Purpose : Performing ordinal regression analysis (UNIGIS MSc Thesis)
# Author  : N.J. de Graaff
# Date    : july 2012
#==========================================================================================
#
#load the MASS package
library(MASS);
#
# 2-Way Cross Tabulation
library(gmodels)
# Libary for 3D scaterplots
library(scatterplot3d)
#
# library for scatterplot matrices
library(car)
#
# library for performing statisctical operations on matrices
library(matrixStats)
#
# Library for performing Ordinal logistic Regression
library("ordinal")
# Set working directory
setwd("C:/_Nico/_UniGis/_Thesis/survey/Analysis/data/")
#
#Import sign separated data file
survey_unc  <-  read.table(file =  "response_2012-04-28.csv",
                           header  =  TRUE,
                           sep     = ";",
                           dec     =  "." );

# attach a variable to the previously imported data file
attach(survey_unc);
#
# ========================================================================================
# Steps in analyzing model fits
# 1. Check assumptions
# 2. Evaluate summary
# 3. Perform hypothesis test
#
# ========================================================================================
#
#                         MODEL SPECIFICATIONS
#
# ========================================================================================
#
# ----------------------------------------------------------------------------------------
# DEFINING VARIABLES FOR PU AND PEU
# ----------------------------------------------------------------------------------------
#
PU1  <- rowMedians(cbind(inf13_ambiq,inf14_vague,inf15_posacc,inf16_attracc,inf17_time))
PU2  <-
rowMedians(cbind(viz18_single_ins,viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins,viz28_mta_defi))
PEU1 <- rowMedians(cbind(viz19_single_interp,viz22_pair_interp,viz25_dyn_interp,viz29_mta_compli))
PEU2 <- rowMedians(cbind(viz20_single_adapt,viz23_pair_adapt,viz26_dyn_adapt,viz30_mta_adapt))
#
PU   <- rowMedians(cbind(inf13_ambiq,inf14_vague,inf15_posacc,inf16_attracc,inf17_time,
                         viz18_single_ins,viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins,viz28_mta_defi)
)
#
PEU  <- rowMedians(cbind(viz19_single_interp,viz22_pair_interp,viz25_dyn_interp,viz29_mta_compli,
                         viz20_single_adapt,viz23_pair_adapt,viz26_dyn_adapt,viz30_mta_adapt))
#
# Transform variables to factors
PU1   <- as.factor(PU1)
PU2   <- as.factor(PU2)
PEU1  <- as.factor(PEU1)
PEU2  <- as.factor(PEU2)
#

PU    <- as.factor(PU)
PEU   <- as.factor(PEU)
```

```
#
# ---------------------------------------------------------------------------------
# DEFINING MODELS
# ---------------------------------------------------------------------------------
#
# === HYP01A: AGE AFFECTS PU1 (info)       ===
#
 hyp01A     <- clm(PU1 ~ pers01_agecat,link="logit")
#
# === HYP01B: AGE AFFECTS PU2 (adaption)
#
 hyp01B    <- clm(PU2~pers01_agecat,link="logit")
#
# Age affects PEU1
hyp01C     <- clm(PEU1 ~ pers01_agecat,link="logit")
#
# Age affects PEU2
hyp01D     <- clm(PEU2 ~ pers01_agecat,link="logit")
#
# ------------------------------------------------------------------------------------------
#
# === HYP02A: EDUCATION AFFECTS PU1   ===
 hyp02A     <- clm(PU1~pers02_edu,link="logit")
#
# === HYP02B: EDUCATION AFFECTS PU2   ===
 hyp02B     <- clm(PU2~pers02_edu,link="logit")
#
# Additional HYPOTHESES
#
# HYP02C: Education affects PEU1
  hyp02C    <- clm(PEU1~pers02_edu,link="logit")

# HYP02D: Education affects PEU2
  hyp02D    <- clm(PEU2~pers02_edu,link="logit")
#
# ------------------------------------------------------------------------------------------
# === HYP03A: EXPERIENCE AFFECTS PU   ===
#
 hyp03A     <- clm(PU1 ~
pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp,link="logit")
#
 hyp03B     <- clm(PU2 ~
pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp,link="logit")
#
# === HYP03C: EXPERIENCE AFFECTS PARTIAL PU1   ===
hyp03C      <- clm(as.factor(rowMedians(cbind(inf16_attracc,inf17_time))) ~
pers05_gi_b_exp,link="logit")
#
#
# === HYP03D: EXPERIENCE AFFECTS PARTIAL PU2   ===
hyp03D     <- clm(as.factor(rowMedians(cbind(viz27_mta_ins,viz28_mta_defi))) ~
pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp,link="logit")
#
# ------------------------------------------------------------------------------------------
#
# === HYP04A: EXPERIENCE AFFECTS PEU1 (Interpetation) ===
hyp04A     <- clm(PEU1 ~
pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp,link="logit")
#
# === HYP04B: EXPERIENCE AFFECTS PEU2 (Adaption) ===
hyp04B     <- clm(PEU2 ~
pers04_domain_exp+pers05_gi_b_exp+pers06_ana_exp+pers07_viz_exp,link="logit")
#
#
# ------------------------------------------------------------------------------------------
#
# === HYP05A: TASK AFFECTS PU1     ===
 hyp05A     <- clm(PU1 ~
task09_freq_reference+task10_freq_quanty+task11_freq_qualit+task12_freq_integr,link="logit")
#
# === HYP05B_2: Partial TASK AFFECTS PU2(viz. insight)     ===
#
 PU2_05B    <- as.factor(rowMedians(cbind(viz21_pair_ins,viz24_dyn_ins)))
 hyp05B_2   <- clm(PU2_05B ~
task09_freq_reference+task11_freq_qualit+task12_freq_integr,link="logit")
```

```
#
# ===  HYP06: TASK AFFECTS PEU     ===
#
 hyp06     <- clm(PEU ~
task09_freq_reference+task10_freq_quanty+task11_freq_qualit+task12_freq_integr,link="logit")
#


# ===  HYP06A: TASK AFFECTS PEU1   ===
#
 hyp06A <- clm(PEU1 ~
task09_freq_reference+task10_freq_quanty+task11_freq_qualit+task12_freq_integr,link="logit")
#
# ===  HYP06B_2: TASK AFFECTS PEU2(partial viz. adapt)   ===
#
 PEU2_06B     <- as.factor(rowMedians(cbind(viz23_pair_adapt,viz26_dyn_adapt)))
 hyp06B_2     <- clm(PEU2_06B ~
task09_freq_reference+task10_freq_quanty+task12_freq_integr,link="logit")
#
# ---------------------------------------------------------------------------------------------------
# === hyp07_2: INFORMATION NEEDS AFFECTS PU2_07(partial viz. insight)   ===
#
 PU2_07      <- as.factor(rowMedians(cbind(viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins)))
 hyp07_2     <- clm(PU2_07 ~
inf13_ambiq+inf14_vague+inf15_posacc+inf16_attracc+inf17_time,link="logit")
#
#
# hyp07A  Information needs affects PEU2
  hyp07A        <-
clm(PEU2~inf13_ambiq+inf14_vague+inf15_posacc+inf16_attracc+inf17_time,link="logit")
#
# ---------------------------------------------------------------------------------------------------
# === HYP08: Type of visualization affects PU1  ===
# Create vector for each type of visualization
v_single <- rowMedians(cbind(viz18_single_ins,viz19_single_interp,viz20_single_adapt))
v_pair   <- rowMedians(cbind(viz21_pair_ins,viz22_pair_interp,viz23_pair_adapt))
v_dyn    <- rowMedians(cbind(viz24_dyn_ins,viz25_dyn_interp,viz26_dyn_adapt))
v_mta    <- rowMedians(cbind(viz27_mta_ins,viz28_mta_defi,viz29_mta_compli,viz30_mta_adapt))
#
# Group by type of visualization
m_single <- cbind(viz18_single_ins,viz19_single_interp,viz20_single_adapt)
m_pair   <- cbind(viz21_pair_ins,viz22_pair_interp,viz23_pair_adapt)
m_dyn    <- cbind(viz24_dyn_ins,viz25_dyn_interp,viz26_dyn_adapt)
m_mta    <- cbind(viz27_mta_ins,viz28_mta_defi,viz29_mta_compli,viz30_mta_adapt)
#
# Group by type of visualization operation
m_ins    <- cbind(viz18_single_ins,viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins)
m_interp <- cbind(viz19_single_interp,viz22_pair_interp,viz25_dyn_interp,viz29_mta_compli)
m_adapt  <- cbind(viz20_single_adapt,viz23_pair_adapt,viz26_dyn_adapt,viz30_mta_adapt)
#
# Linear Regression
# HYP08: PU1 Affected by visualization type
 hyp08 <- clm(PU1 ~ v_single+v_pair+v_dyn+v_mta,link="logit")
#
# HYP08A: PU1 Affected by single static map
 hyp08A <- clm(PU1 ~ v_single,link="logit")
#
# HYP08B: PU1 Affected by map pair
 hyp08B <- clm(PU1 ~ v_pair,link="logit")
#
# HYP08C: PU1 Affected by dynamic map
 hyp08C <- clm(PU1 ~ v_dyn,link="logit")
#
# HYP08D: PU1 Affected by metadata
 hyp08D <- clm(PU1 ~v_mta,link="logit")
#
```

Regression analysis applied on the use of registration

```
#
#load the MASS package
library(MASS);
#
# 2-Way Cross Tabulation
library(gmodels)
# Libary for 3D scaterplots
library(scatterplot3d)
#
# library for scatterplot matrices
library(car)
#
# library for performing statisctical operations on matrices
library(matrixStats)
#
#  Global test of linear model assumptions
library(gvlma)
#
# Library for performing Ordinal logistic Regression
library("ordinal")
#
# Set working directory
setwd("C:/_Nico/_UniGis/_Thesis/survey/Analysis/data/")
#
#Import sign separated data file
survey_unc  <-  read.table(file =  "response_2012-04-28_REG.csv",
                           header  =  TRUE,
                           sep     = ";",
                           dec     =  "." );

# attach a variable to the previously imported data file
attach(survey_unc);
#
#
# ==================================================================================
# Steps in analyzing model fits
# 1. Check assumptions
# 2. Evaluate summary
# 3. Perform hypothesis test
#
# ==================================================================================

# ==================================================================================
#
#                         MODEL SPECIFICATIONS
#
# ==================================================================================
#
#
# ----------------------------------------------------------------------------------
# DEFINING VARIABLES FOR PU AND PEU
# ----------------------------------------------------------------------------------
#
PU1  <- rowMedians(cbind(inf13_ambiq,inf14_vague,inf15_posacc,inf16_attracc,inf17_time))
PU2  <-
rowMedians(cbind(viz18_single_ins,viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins,viz28_mta_defi))
PEU1 <- rowMedians(cbind(viz19_single_interp,viz22_pair_interp,viz25_dyn_interp,viz29_mta_compli))
PEU2 <- rowMedians(cbind(viz20_single_adapt,viz23_pair_adapt,viz26_dyn_adapt,viz30_mta_adapt))
#
PU   <- rowMedians(cbind(inf13_ambiq,inf14_vague,inf15_posacc,inf16_attracc,inf17_time,
                         viz18_single_ins,viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins,viz28_mta_defi)
)
#
PEU  <- rowMedians(cbind(viz19_single_interp,viz22_pair_interp,viz25_dyn_interp,viz29_mta_compli,
                         viz20_single_adapt,viz23_pair_adapt,viz26_dyn_adapt,viz30_mta_adapt))
#
#
# Transform variables to factors
f_PU1   <- as.factor(PU1)
f_PU2   <- as.factor(PU2)
f_PEU1  <- as.factor(PEU1)
f_PEU2  <- as.factor(PEU2)
#
f_PU    <- as.factor(PU)
f_PEU   <- as.factor(PEU)
```

```
#
# ------------------------------------------------------------------------------------
#
# DEFINING MODELS
#
# ------------------------------------------------------------------------------------
#
# Set working directory
setwd("C:/_Nico/_UniGis/_Thesis/survey/Analysis/regression/reports/run5/");

sink("summary_MLR_TAM_REG_OR_RUN5_201200709.txt")
#
print("============ HYP09: Registrations and PU1 ============")
#
print("============ HYP09: Multi linear regression ============")
summary(gvlma(lm(PU1~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)))
#
summary(gvlma(lm(PU1~data_ind_bag)))
summary(gvlma(lm(PU1~data_ind_gbkn)))
summary(gvlma(lm(PU1~data_ind_top10nl)))
summary(gvlma(lm(PU1~data_ind_lki)))
summary(gvlma(lm(PU1~data_ind_akr)))
#
#
print("============ HYP09: Ordinal regression ============")
#
summary(clm(f_PU1~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr,link="logit"
))
#
summary(clm(f_PU1~data_ind_bag,link="logit"))
summary(clm(f_PU1~data_ind_gbkn,link="logit"))
summary(clm(f_PU1~data_ind_top10nl,link="logit"))
summary(clm(f_PU1~data_ind_lki,link="logit"))
summary(clm(f_PU1~data_ind_akr,link="logit"))
#
print("============ HYP10: Registrations and PU2 ============")
#
print("============ HYP10: Multi linear regression ============")
summary(gvlma(lm(PU2~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)))
#
summary(gvlma(lm(PU2~data_ind_bag)))
summary(gvlma(lm(PU2~data_ind_gbkn)))
summary(gvlma(lm(PU2~data_ind_top10nl)))
summary(gvlma(lm(PU2~data_ind_lki)))
summary(gvlma(lm(PU2~data_ind_akr)))
#
#
print("============ HYP10: Ordinal regression ============")
#
summary(clm(f_PU2~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr,link="logit"
))
#
summary(clm(f_PU2~data_ind_bag,link="logit"))
summary(clm(f_PU2~data_ind_gbkn,link="logit"))
summary(clm(f_PU2~data_ind_top10nl,link="logit"))
summary(clm(f_PU2~data_ind_lki,link="logit"))
summary(clm(f_PU2~data_ind_akr,link="logit"))
#
#
print("============ HYP11: Registrations and PEU1 ============")
#
print("============ HYP11: Multi linear regression ============")
summary(gvlma(lm(PEU1~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)))
#
summary(gvlma(lm(PEU1~data_ind_bag)))
summary(gvlma(lm(PEU1~data_ind_gbkn)))
summary(gvlma(lm(PEU1~data_ind_top10nl)))
summary(gvlma(lm(PEU1~data_ind_lki)))
summary(gvlma(lm(PEU1~data_ind_akr)))
#
#
print("============ HYP11: Ordinal regression ============")
#
summary(clm(f_PEU1~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr,link="logit
"))
#
summary(clm(f_PEU1~data_ind_bag,link="logit"))
```

```
summary(clm(f_PEU1~data_ind_gbkn,link="logit"))
summary(clm(f_PEU1~data_ind_top10nl,link="logit"))
summary(clm(f_PEU1~data_ind_lki,link="logit"))
summary(clm(f_PEU1~data_ind_akr,link="logit"))
#
#
print("============ HYP12: Registrations and PEU2 ============")
#
print("============ HYP12: Multi linear regression ============")
summary(gvlma(lm(PEU2~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)))
#
summary(gvlma(lm(PEU2~data_ind_bag)))
summary(gvlma(lm(PEU2~data_ind_gbkn)))
summary(gvlma(lm(PEU2~data_ind_top10nl)))
summary(gvlma(lm(PEU2~data_ind_lki)))
summary(gvlma(lm(PEU2~data_ind_akr)))
#
#
print("============ HYP12: Ordinal regression ============")
#
summary(clm(f_PEU2~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr,link="logit
"))
#
summary(clm(f_PEU2~data_ind_bag,link="logit"))
summary(clm(f_PEU2~data_ind_gbkn,link="logit"))
summary(clm(f_PEU2~data_ind_top10nl,link="logit"))
summary(clm(f_PEU2~data_ind_lki,link="logit"))
summary(clm(f_PEU2~data_ind_akr,link="logit"))
#
#
print("==============================================================")
print("========== Tests grouped by type of visualization ==========")
print("==============================================================")
#
v_single <- rowMedians(cbind(viz18_single_ins,viz19_single_interp,viz20_single_adapt))
v_pair   <- rowMedians(cbind(viz21_pair_ins,viz22_pair_interp,viz23_pair_adapt))
v_dyn    <- rowMedians(cbind(viz24_dyn_ins,viz25_dyn_interp,viz26_dyn_adapt))
v_mta    <- rowMedians(cbind(viz27_mta_ins,viz28_mta_defi,viz29_mta_compli,viz30_mta_adapt))
#
# Transform variables to factors for ordinal regression
f_single <- as.factor(v_single)
f_pair   <- as.factor(v_pair)
f_dyn    <- as.factor(v_dyn)
f_mta    <- as.factor(v_mta)
#
#
print("========== Multivariate regression for all registrations ==========")
print("--")
print("========== HYP13A: Registration affects use of single static map ==========")
summary(gvlma(lm(v_single~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)))
#
kruskal.test(v_single~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)
#
print("  ")
print("========== Ordinal regression ==========")
summary(clm(f_single~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr,link="log
it"))
#
print("========== HYP13B: Registration affects use of map pair ==========")
summary(gvlma(lm(v_pair~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)))
#
kruskal.test(v_pair~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)
#
print("  ")
print("========== Ordinal regression ==========")
summary(clm(f_pair~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr,link="logit
"))
#
print("========== HYP13C: Registration affects use of dynamic map ==========")
summary(gvlma(lm(v_dyn~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)))
#
kruskal.test(v_dyn~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)
#
print("  ")
print("========== Ordinal regression ==========")
summary(clm(f_dyn~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr,link="logit"
))
```

```
#
print("========== HYP13D: Registration affects use of Metadata ==========")
summary(gvlma(lm(v_mta~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)))
#
kruskal.test(v_mta~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr)
#
print("  ")
print("========== Ordinal regression ==========")
summary(clm(f_mta~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+data_ind_akr,link="logit"
))
#
print("========== Statistical tesrs for each registration ==========")
#
# BAG
print("========== HYP14A: Tests performed for BAG ==========")
print(" ")
print("Multivariate regression")
summary(gvlma(lm(v_single~data_ind_bag)))
summary(gvlma(lm(v_pair~data_ind_bag)))
summary(gvlma(lm(v_dyn~data_ind_bag)))
summary(gvlma(lm(v_mta~data_ind_bag)))
print(" ")
#
print("========== Spearman's Rank Order correlation ==========")
cor.test(v_single,data_ind_bag,method="spearman")
cor.test(v_pair,data_ind_bag,method="spearman")
cor.test(v_dyn,data_ind_bag,method="spearman")
cor.test(v_mta,data_ind_bag,method="spearman")
#
print("  ")
print("========== Ordinal regression ==========")
summary(clm(f_single~data_ind_bag,link="logit"))
summary(clm(f_pair~data_ind_bag,link="logit"))
summary(clm(f_dyn~data_ind_bag,link="logit"))
summary(clm(f_mta~data_ind_bag,link="logit"))
print("  ")
#
#GBKN
print("========== HYP14B: Test performed for GBKN ==========")
print(" ")
print("Multivariate regression")
summary(gvlma(lm(v_single~data_ind_gbkn)))
summary(gvlma(lm(v_pair~data_ind_gbkn)))
summary(gvlma(lm(v_dyn~data_ind_gbkn)))
summary(gvlma(lm(v_mta~data_ind_gbkn)))
print(" ")
#
#
print("========== Spearman's Rank Order correlation ==========")
cor.test(v_single,data_ind_gbkn,method="spearman")
cor.test(v_pair,data_ind_gbkn,method="spearman")
cor.test(v_dyn,data_ind_gbkn,method="spearman")
cor.test(v_mta,data_ind_gbkn,method="spearman")
#
print("  ")
print("========== Ordinal regression ==========")
summary(clm(f_single~data_ind_gbkn,link="logit"))
summary(clm(f_pair~data_ind_gbkn,link="logit"))
summary(clm(f_dyn~data_ind_gbkn,link="logit"))
summary(clm(f_mta~data_ind_gbkn,link="logit"))
print("  ")
#
#
#Top10NL
print("========== HYP14C: Test performed for TOP10NL ==========")
print(" ")
print("Multivariate regression")
summary(gvlma(lm(v_single~data_ind_top10nl)))
summary(gvlma(lm(v_pair~data_ind_top10nl)))
summary(gvlma(lm(v_dyn~data_ind_top10nl)))
summary(gvlma(lm(v_mta~data_ind_top10nl)))
print(" ")
#
#
print("========== Spearman's Rank Order correlation ==========")
cor.test(v_single,data_ind_top10nl,method="spearman")
cor.test(v_pair,data_ind_top10nl,method="spearman")
```

```
cor.test(v_dyn,data_ind_top10nl,method="spearman")
cor.test(v_mta,data_ind_top10nl,method="spearman")
#
print("  ")
print("========== Ordinal regression ==========")
summary(clm(f_single~data_ind_top10nl,link="logit"))
summary(clm(f_pair~data_ind_top10nl,link="logit"))
summary(clm(f_dyn~data_ind_top10nl,link="logit"))
summary(clm(f_mta~data_ind_top10nl,link="logit"))
print("  ")
#
#LKI
print("========== HYP14D: Test performed for LKI ==========")
print(" ")
print("Multivariate regression")
summary(gvlma(lm(v_single~data_ind_lki)))
summary(gvlma(lm(v_pair~data_ind_lki)))
summary(gvlma(lm(v_dyn~data_ind_lki)))
summary(gvlma(lm(v_mta~data_ind_lki)))
print(" ")
#
#
print("========== Spearman's Rank Order correlation ==========")
cor.test(v_single,data_ind_lki,method="spearman")
cor.test(v_pair,data_ind_lki,method="spearman")
cor.test(v_dyn,data_ind_lki,method="spearman")
cor.test(v_mta,data_ind_lki,method="spearman")
#
print("  ")
print("========== Ordinal regression ==========")
summary(clm(f_single~data_ind_lki,link="logit"))
summary(clm(f_pair~data_ind_lki,link="logit"))
summary(clm(f_dyn~data_ind_lki,link="logit"))
summary(clm(f_mta~data_ind_lki,link="logit"))
print("  ")
#
#AKR
print("========== HYP14E: Test performed for AKR ==========")
print(" ")
print("Multivariate regression")
summary(gvlma(lm(v_single~data_ind_akr)))
summary(gvlma(lm(v_pair~data_ind_akr)))
summary(gvlma(lm(v_dyn~data_ind_akr)))
summary(gvlma(lm(v_mta~data_ind_akr)))
print(" ")
#
#
print("========== Spearman's Rank Order correlation ==========")
cor.test(v_single,data_ind_akr,method="spearman")
cor.test(v_pair,data_ind_akr,method="spearman")
cor.test(v_dyn,data_ind_akr,method="spearman")
cor.test(v_mta,data_ind_akr,method="spearman")
#
print("  ")
print("========== Ordinal regression ==========")
summary(clm(f_single~data_ind_akr,link="logit"))
summary(clm(f_pair~data_ind_akr,link="logit"))
summary(clm(f_dyn~data_ind_akr,link="logit"))
summary(clm(f_mta~data_ind_akr,link="logit"))
print("  ")
#
#
print("============ END OF RUN ============")
#
sink()
#
#
```

Appendix 7

Results survey

Statistical Analysis of relationships

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This appendix is a summary of the statistical analysis of the results of the survey and describes only *hypotheses of which of one of the analysis might be significant or relevant to be reported in this appendix.* The analysis is reported in four parts:

The additional log files and scripts containing the models are provided in appendix IV.
In the reports the names of variables are used, the table below explains the abbreviated names of the variables:

Variable	Description
pers01_agecat	age category
pers02_edu	Level of education
pers03_gi_year	years of experience with the use of spatial data
pers04_domain_exp	Level of domain-specific knowledge
pers05_gi_b_exp	Level of knowledge with creating spatial data
pers06_ana_exp	Level of knowledge with performing spatial analysis
pers07_viz_exp	Level of knowledge with visualizing spatial data
task09_freq_reference	Frequency of using Key-Georegistrations as a reference
task10_freq_quanty	Frequency of using Key-Georegistrations for deriving qualitative information
task11_freq_qualit	Frequency of using Key-Georegistrations for deriving quantitative information
task12_freq_integr	Frequency of using Key-Georegistrations for data integration
inf13_ambiq	The level of information needs about ambiguity
inf14_vague	The level of information needs about vagueness
inf15_posacc	The level of information needs about positional accuracy
inf16_attracc	The level of information needs about attribute accuracy
inf17_time	The level of information needs about temporal consistency
viz18_single_ins	The level of insight in map accuracy using a single static map
viz19_single_interp	The ease of use interpreting uncertainty on a single static map
viz20_single_adapt	The level of adaption of a single static map into current tasks
viz21_pair_ins	The level of insight in map accuracy using a static map pair
viz22_pair_interp	The ease of use interpreting uncertainty on a static map pair
viz23_pair_adapt	The level of adaption of a static map pair into current tasks
viz24_dyn_ins	The level of insight in map accuracy using dynamic visualization
viz25_dyn_interp	The ease of use interpreting uncertainty using dynamic visualization
viz26_dyn_adapt	The level of adaption of dynamic visualization into current tasks
viz27_mta_ins	The level of insight in map accuracy using metadata
viz28_mta_defi	The level of insight in ambiguity using metadata
viz29_mta_compli	The ease of use interpreting uncertainty using metadata
viz30_mta_adapt	The level of adaption of metadata into current tasks

Table 0.01. Abbrevations variables

1. Summary of statistical tests of the hypotheses

Hypothesis	Multi lin. Regression	Spearman's Ro	Ordinal regression	Null hypothesis
Education affects PEU1	**Significant**	**Partial significant**	**Significant**	reject
Task affects PEU1	**Significant**	NOT significant	**Partial significant**	reject
Information needs affects PU2	**Significant**	**Partial significant**	NOT significant	reject
Information needs affects PEU2	**Significant**	**Partial significant**	NOT significant	reject
Use of GBKN affects PU1	NOT significant	NOT significant	**Significant**	reject
Metadata affects PU1	NOT significant	**Significant**	NOT significant	reject
Use of GBKN affects PEU1	Assumptions not met	**Partial significant**	NOT significant	alternative hypothesis
Use of GBKN affects PU2	Assumptions not met	**Partial significant**	NOT significant	alternative hypothesis
Experience affects PARTIAL PU2	Assumptions not met	**Partial significant**	**Partial significant**	alternative hypothesis
Experience affects PEU1	Assumptions not met	NOT significant	**Partial significant**	alternative hypothesis
Use of registrations affect PU1	NOT significant	NOT significant	**Partial significant**	alternative hypothesis
Registration affects use of dynamic map	**Partial significant**	**Partial significant**	NOT significant	alternative hypothesis
Age affects PU2	Assumptions not met	**Partial significant**	NOT significant	alternative hypothesis
Experience affects PU2	NOT significant	**Partial significant**	NOT significant	alternative hypothesis
Experience affects PEU2	NOT significant	**Partial significant**	NOT significant	alternative hypothesis
Task affects PU1	NOT significant	**Partial significant**	NOT significant	alternative hypothesis
Type of visualization affects PU1	NOT significant	**Partial significant**	NOT significant	alternative hypothesis
Single static map affects PU1	NOT significant	**Partial significant**	NOT significant	alternative hypothesis
Dynamic map affects PU1	NOT significant	**Partial significant**	NOT significant	alternative hypothesis
Use of registrations affect PU2	Assumptions not met	**Partial significant**	NOT significant	alternative hypothesis
Use of registrations affect PEU1	Assumptions not met	**Partial significant**	NOT significant	alternative hypothesis
Age affects PU1	NOT significant	NOT significant	NOT significant	accept
Age affects PEU1	NOT significant	NOT significant	NOT significant	accept
Age affects PEU2	Assumptions not met	NOT significant	NOT significant	accept
Education affects PU1	NOT significant	NOT significant	NOT significant	accept
Education affects PU2	Assumptions not met	NOT significant	NOT significant	accept
Education affects PEU2	Assumptions not met	NOT significant	NOT significant	accept
Experience affects PU1	NOT significant	NOT significant	NOT significant	accept
Experience affects PARTIAL PU1	NOT significant	NOT significant	NOT significant	accept
Task affects PU2	NOT significant	NOT significant	NOT significant	accept
Task affects PEU	NOT significant	NOT significant	NOT significant	accept
Task affects PEU2	NOT significant	NOT significant	NOT significant	accept
Map pair affects PU1	NOT significant	NOT significant	NOT significant	accept
Use of BAG affects PU1	NOT significant	NOT significant	NOT significant	accept
Use of Top10NL affects PU1	NOT significant	NOT significant	NOT significant	accept
Use of LKI affects PU1	NOT significant	NOT significant	NOT significant	accept
Use of AKR affects PU1	NOT significant	NOT significant	NOT significant	accept
Use of BAG affects PU2	Assumptions not met	NOT significant	NOT significant	accept
Use of Top10NL affects PU2	Assumptions not met	NOT significant	NOT significant	accept
Use of LKI affects PU2	Assumptions not met	NOT significant	NOT significant	accept
Use of AKR affects PU2	Assumptions not met	NOT significant	NOT significant	accept
Use of registrations affect PEU1	NOT significant	NOT significant	NOT significant	accept
Use of BAG affects PEU1	NOT significant	NOT significant	NOT significant	accept
Use of GBKN affects PEU1	NOT significant	NOT significant	NOT significant	accept
Use of Top10NL affects PEU1	NOT significant	NOT significant	NOT significant	accept
Use of LKI affects PEU1	NOT significant	NOT significant	NOT significant	accept
Use of AKR affects PEU1	NOT significant	NOT significant	NOT significant	accept
Use of BAG affects PEU2	Assumptions not met	NOT significant	NOT significant	accept
Use of Top10NL affects PEU2	Assumptions not met	NOT significant	NOT significant	accept
Use of LKI affects PEU2	NOT significant	NOT significant	NOT significant	accept
Use of AKR affects PEU2	NOT significant	NOT significant	NOT significant	accept
Registration affects use of single static map	NOT significant	NOT significant	NOT significant	accept
Registration affects use of map pair	NOT significant	NOT significant	NOT significant	accept

Table 1.02. List of hypotheses

Legend

Null hypothesis rejected

Alternative hypothesis formulated

Null hypothesis accepted (not significant, not reported in detail)

2. Summary of Spearman's rank-order correlation analysis

corr_name	Ro_val	p_value	independent	dependent	Alpha
pers01_agecat - viz28_mta_defi	**0,31**	0,041	Personal	PU2_viz_ins	5%
pers02_edu - viz25_dyn_interp	**-0,33**	0,027	Personal	PEU1_viz_interp	5%
pers06_ana_exp - viz28_mta_defi	**0,35**	0,019	Personal	PU2_viz_ins	5%
pers06_ana_exp - viz30_mta_adapt	**0,30**	0,050	Personal	PEU2_viz_adapt	5%
task09_freq_reference - inf15_posacc	**0,37**	0,012	Task	PU1_unc_info	5%
task10_freq_quanty - inf15_posacc	**0,33**	0,028	Task	PU1_unc_info	5%
task11_freq_qualit - inf15_posacc	**0,38**	0,011	Task	PU1_unc_info	5%
inf13_ambiq - viz24_dyn_ins	**0,32**	0,031	Info	PU2_viz_ins	5%
inf13_ambiq - viz27_mta_ins	**0,33**	0,026	Info	PU2_viz_ins	5%
inf14_vague - viz18_single_ins	**0,32**	0,033	Info	PU2_viz_ins	5%
inf14_vague - viz27_mta_ins	**0,42**	0,005	Info	PU2_viz_ins	5%
inf14_vague - viz29_mta_compli	**0,33**	0,029	Info	PEU1_viz_interp	5%
inf14_vague - viz30_mta_adapt	**0,45**	0,002	Info	PEU2_viz_adapt	5%
inf15_posacc - viz20_single_adapt	**-0,33**	0,026	Info	PEU2_viz_adapt	5%
inf15_posacc - viz29_mta_compli	**0,34**	0,023	Info	PEU1_viz_interp	5%
inf16_attracc - viz27_mta_ins	**0,37**	0,013	Info	PU2_viz_ins	5%
inf17_time - viz20_single_adapt	**-0,31**	0,043	Info	PEU2_viz_adapt	5%
inf17_time - viz27_mta_ins	**0,42**	0,005	Info	PU2_viz_ins	5%
inf17_time - viz28_mta_defi	**0,35**	0,021	Info	PU2_viz_ins	5%
inf17_time - viz29_mta_compli	**0,36**	0,016	Info	PEU1_viz_interp	5%
inf17_time - viz30_mta_adapt	**0,36**	0,017	Info	PEU2_viz_adapt	5%
data_ind_gbkn - viz24_dyn_ins	**0,36**	0,016	registration	PU2	5%
data_ind_gbkn - viz25_dyn_interp	**0,39**	0,009	registration	PEU1	5%

Table 2.01. Results Rank-order correlation analysis

3. Summary of multivariate regression and correlation

HYP01B: AGE AFFECTS PU2 (insight)

Correlation analysis, Spearman's Rank-order

corr_name	Ro_val	p_value
pers01_agecat - viz28_mta_defi	0,31	**0,04**

Remark: Assumptions for linear regression were not met.

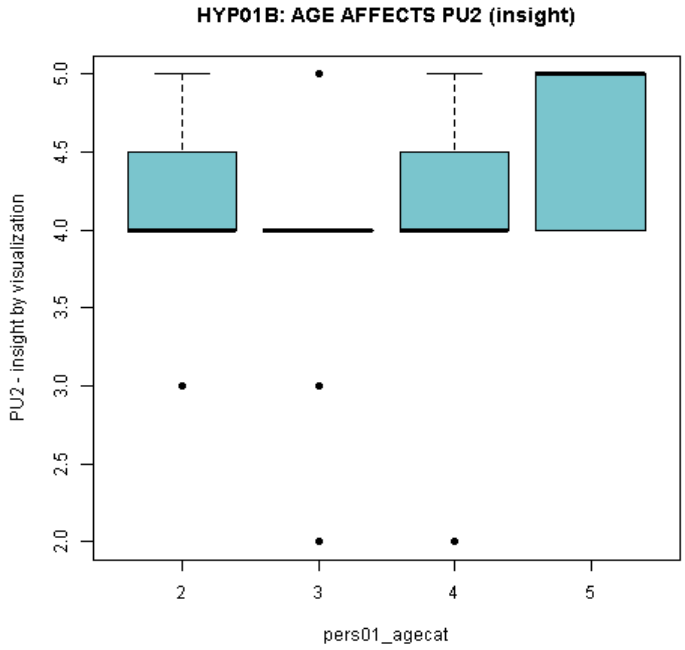

Figure 3.01. Boxplot for PU2 and pers01_agecat.

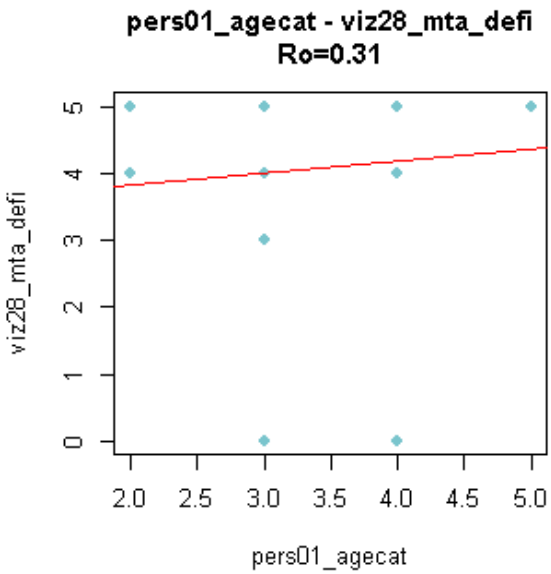

Figure 3.02. Correlation plot for viz28_mta_defi and pers01_agecat.

Analysis: The box plot shows a difference, the correlation analysis shows a significant correlation between age and insight using metadata due to a p-value of 0.04 < 0.05. Therefore: **Age does affect partially PU2**

Hyp02C: Education affects PEU1 (interpretation)

```
Call:
lm(formula = PEU1 ~ pers02_edu)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.94995 -0.19627  0.05005  0.30373  1.05005 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  4.71099    0.31678  14.872  < 2e-16 ***
pers02_edu  -0.25368    0.09388  -2.702  0.00989 ** 
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4518 on 42 degrees of freedom
Multiple R-squared: 0.1481,	Adjusted R-squared: 0.1278 
F-statistic: 7.302 on 1 and 42 DF,  p-value: 0.009893


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp02C)

                     Value p-value                Decision
Global Stat        0.67578  0.9543 Assumptions acceptable.
Skewness           0.18250  0.6692 Assumptions acceptable.
Kurtosis           0.09610  0.7566 Assumptions acceptable.
Link Function      0.09015  0.7640 Assumptions acceptable.
Heteroscedasticity 0.30703  0.5795 Assumptions acceptable.
```

Correlation analysis Spearman's Rank-order

corr_name	Ro_val	p_value
pers02_edu - viz19_single_interp	-0,27	0,07
pers02_edu - viz25_dyn_interp	-0,33	**0,03**

Analysis: Education does partially affect PEU1 for dynamic visualizations. According to the correlation analysis there is a negative correlation.

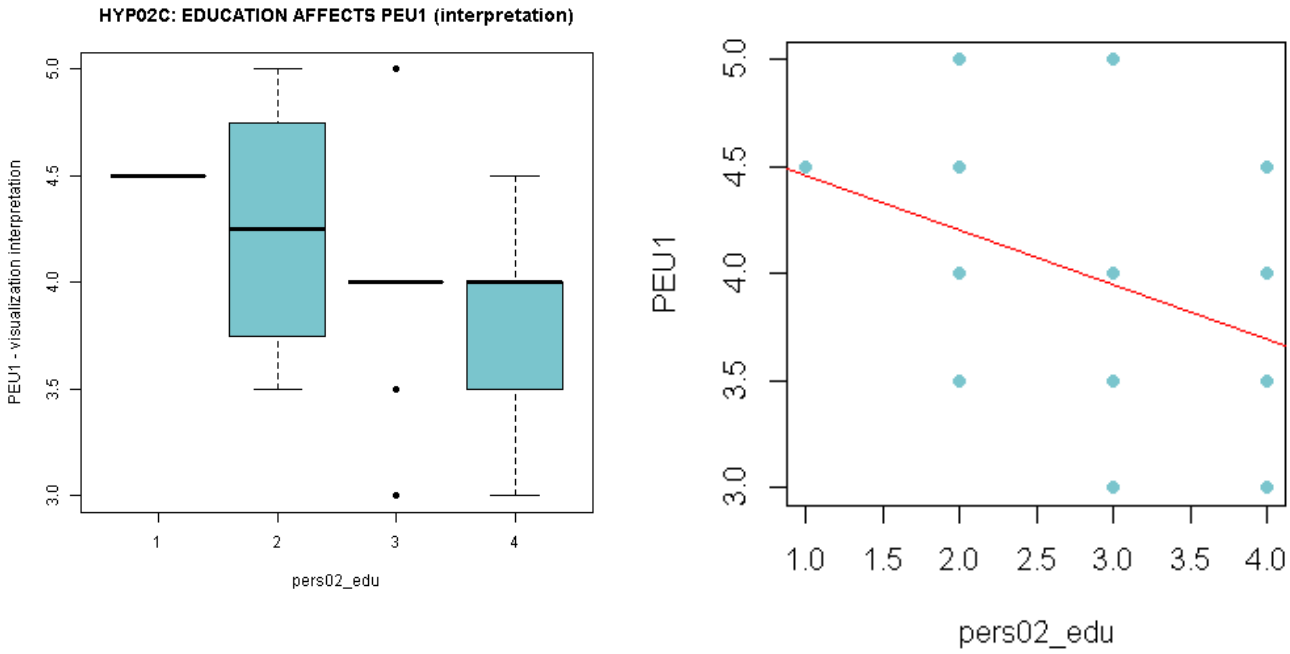

Figure 3.03. Box plot and correlation plot for pers02_edu and PEU1.

Hyp03B: EXPERIENCE AFFECTS PU2 (insight)

```
Call:
lm(formula = PU2 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
    pers07_viz_exp)

Residuals:
     Min       1Q   Median       3Q      Max
-2.00530 -0.31190 -0.07723  0.37347  1.15491

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        2.99353    0.68708   4.357 9.29e-05 ***
pers04_domain_exp  0.21155    0.18991   1.114    0.272
pers05_gi_b_exp   -0.04881    0.18124  -0.269    0.789
pers06_ana_exp     0.09505    0.12747   0.746    0.460
pers07_viz_exp     0.01891    0.18120   0.104    0.917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6939 on 39 degrees of freedom
Multiple R-squared: 0.08093,     Adjusted R-squared: -0.01333
F-statistic: 0.8586 on 4 and 39 DF,  p-value: 0.4973


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp03B)
                     Value p-value                Decision
Global Stat        7.45893 0.11353 Assumptions acceptable.
Skewness           3.68721 0.05483 Assumptions acceptable.
Kurtosis           3.11719 0.07747 Assumptions acceptable.
Link Function      0.58394 0.44477 Assumptions acceptable.
Heteroscedasticity 0.07059 0.79048 Assumptions acceptable.
```

Correlation, Spearman's Rank-order

corr_name	Ro_val	p_value
pers06_ana_exp - viz27_mta_ins	0,26	0,09
pers06_ana_exp - viz28_mta_defi	**0,35**	**0,02**

Analysis: For the relationship between the level of experience in spatial analysis and insight in accuracy using metadata a significant relationship was found.

HYP03D: EXPERIENCE AFFECTS PARTIAL PU2 (insight)

```
Call:
lm(formula = viz27_mta_ins + viz28_mta_defi ~ pers04_domain_exp +
    pers05_gi_b_exp + pers06_ana_exp + pers07_viz_exp)

Residuals:
    Min      1Q  Median      3Q     Max
-5.0784 -0.8020  0.1976  0.8398  3.8397

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)         6.4341     1.4990   4.292 0.000113 ***
pers04_domain_exp   0.4720     0.4143   1.139 0.261570
pers05_gi_b_exp    -0.5391     0.3954  -1.364 0.180532
pers06_ana_exp      1.0837     0.2781   3.897 0.000372 ***
pers07_viz_exp     -0.5427     0.3953  -1.373 0.177646
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.514 on 39 degrees of freedom
Multiple R-squared: 0.3111,      Adjusted R-squared: 0.2404
F-statistic: 4.402 on 4 and 39 DF,  p-value: 0.004941

ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05
                    Value   p-value                   Decision
Global Stat        28.786 8.638e-06 Assumptions NOT satisfied!
Skewness            2.589 1.076e-01    Assumptions acceptable.
Kurtosis           12.834 3.404e-04 Assumptions NOT satisfied!
Link Function      10.116 1.470e-03 Assumptions NOT satisfied!
Heteroscedasticity  3.247 7.153e-02    Assumptions acceptable.
```

Spearman's Rank-order correlation

corr_name	Ro_val	p_value
pers06_ana_exp - viz27_mta_ins	0,26	0,09
pers06_ana_exp - viz28_mta_defi	**0,35**	**0,02**

Analysis: The level of experience with spatial analysis partally affects PU2

HYP04A: EXPERIENCE AFFECTS PEU1 (Interpretation)

```
Call:
lm(formula = PEU1 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
    pers07_viz_exp)

Residuals:
     Min       1Q   Median       3Q      Max
-1.05951 -0.13294 -0.00118  0.26162  1.07988

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        3.07650    0.43734   7.035 1.92e-08 ***
pers04_domain_exp  0.01518    0.12088   0.126   0.9007
pers05_gi_b_exp    0.28084    0.11536   2.434   0.0196 *
pers06_ana_exp    -0.16195    0.08114  -1.996   0.0530 .
pers07_viz_exp     0.06254    0.11534   0.542   0.5908
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4417 on 39 degrees of freedom
Multiple R-squared: 0.2439,   Adjusted R-squared: 0.1664
F-statistic: 3.145 on 4 and 39 DF,  p-value: 0.02468


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp04A)
                    Value  p-value                   Decision
Global Stat        9.5058 0.049629 Assumptions NOT satisfied!
Skewness           0.2158 0.642221    Assumptions acceptable.
Kurtosis           0.4001 0.527034    Assumptions acceptable.
Link Function      8.6134 0.003337 Assumptions NOT satisfied!
Heteroscedasticity 0.2764 0.599042    Assumptions acceptable.
```

No significant correlation for Spearman's Rank-order.

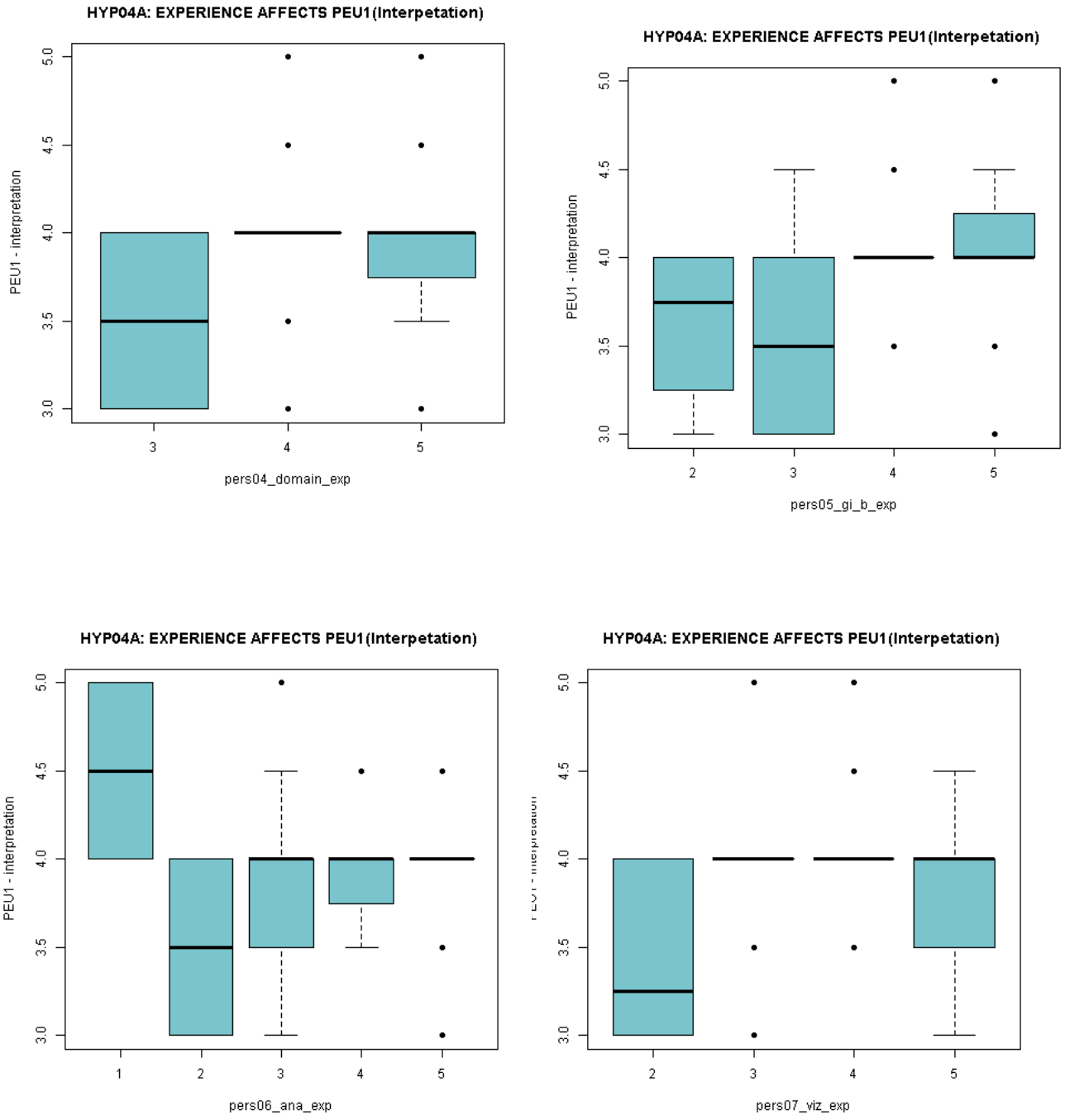

Figure 3.04. Box plots Hypothesis 04A.

Analysis: Experience is partially affected PEU1 by the experience with creating spatial data.

HYP04B: EXPERIENCE AFFECTS PEU2 (Adaption)

```
Call:
lm(formula = PEU2 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
    pers07_viz_exp)

Residuals:
    Min      1Q  Median      3Q     Max
-1.9655 -0.3133  0.1570  0.4316  1.2033

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        2.62804    0.64680   4.063 0.000227 ***
pers04_domain_exp  0.11499    0.17878   0.643 0.523864
pers05_gi_b_exp   -0.05892    0.17061  -0.345 0.731705
pers06_ana_exp    -0.07609    0.12000  -0.634 0.529743
pers07_viz_exp     0.25510    0.17058   1.496 0.142827
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6532 on 39 degrees of freedom
Multiple R-squared: 0.09045,    Adjusted R-squared: -0.002837
F-statistic: 0.9696 on 4 and 39 DF,  p-value: 0.4351


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp04B)
                    Value p-value                   Decision
Global Stat        7.2459  0.1234    Assumptions acceptable.
Skewness           4.8530  0.0276 Assumptions NOT satisfied!
Kurtosis           1.8027  0.1794    Assumptions acceptable.
Link Function      0.2275  0.6334    Assumptions acceptable.
Heteroscedasticity 0.3628  0.5470    Assumptions acceptable.
```

Spearman's Rank-order correlation.

corr_name	Ro_val	p_value
pers06_ana_exp - viz30_mta_adapt	0,30	0,05

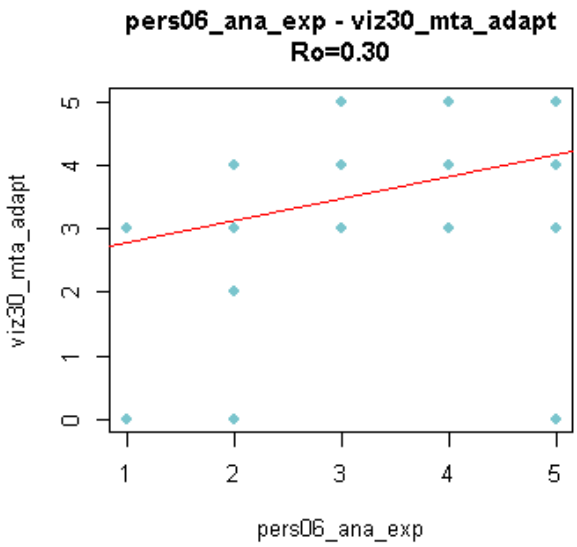

Figure 3.05. Box plots Hypothesis 04B.

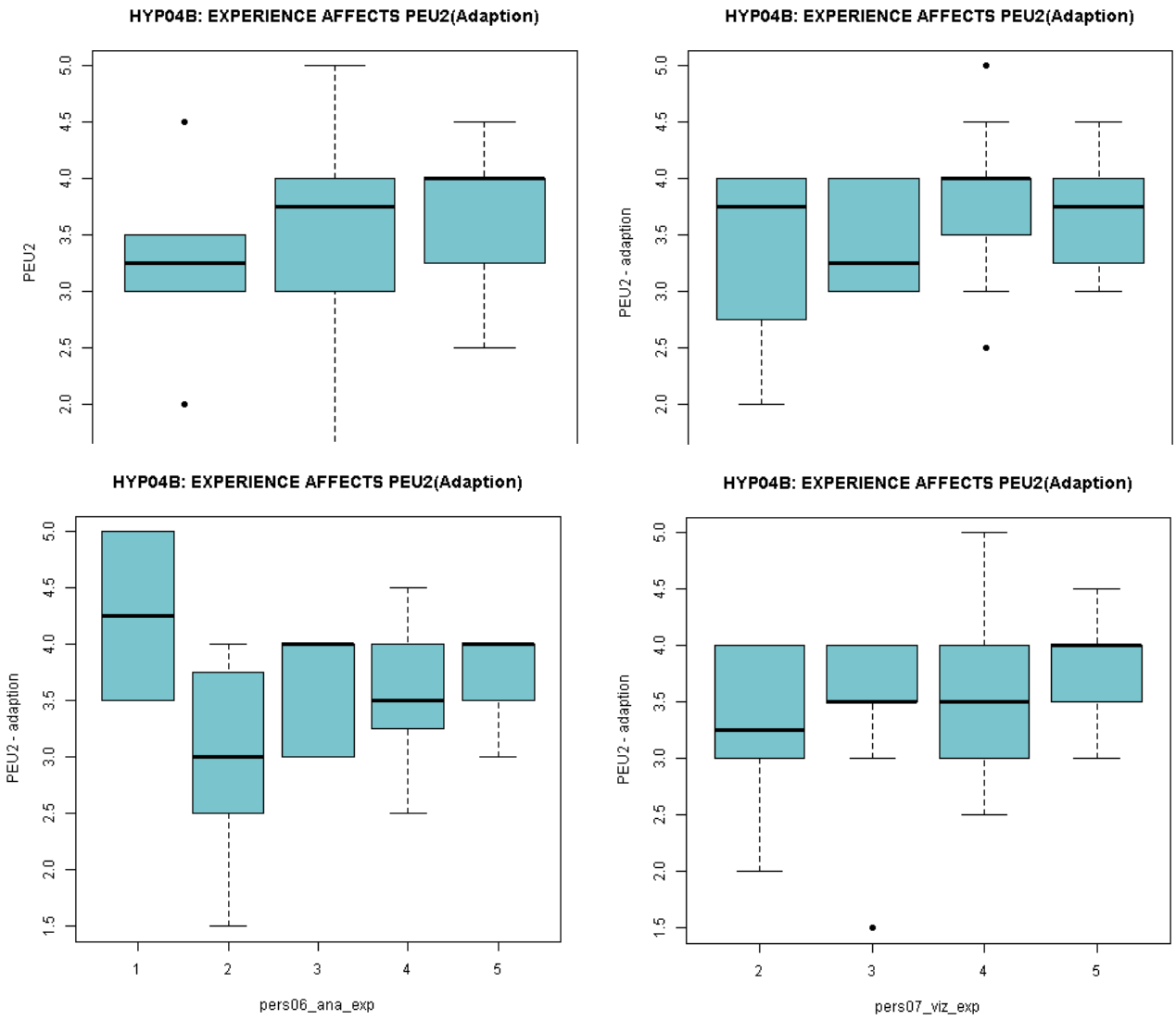

Figure 3.06. Box plots Hypothesis 04B.

Analysis: Experience partally affects PEU1, the level of experience with spatial analysis affects the adaption of metadata.

Hyp05A: TASK AFFECTS PU1

```
Call:
lm(formula = PU1 ~ task09_freq_reference + task10_freq_quanty +
    task11_freq_qualit + task12_freq_integr)

Residuals:
     Min       1Q   Median       3Q      Max
-1.06998 -0.22171 -0.05819  0.13801  0.93525

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)            3.65685    0.31021  11.788 1.99e-14 ***
task09_freq_reference  0.04254    0.07907   0.538    0.594
task10_freq_quanty    -0.04777    0.09161  -0.521    0.605
task11_freq_qualit     0.12231    0.08932   1.369    0.179
task12_freq_integr     0.03410    0.07105   0.480    0.634
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4923 on 39 degrees of freedom
Multiple R-squared: 0.09383,     Adjusted R-squared: 0.0008883
F-statistic:  1.01 on 4 and 39 DF,  p-value: 0.4143

ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp05A)
                    Value p-value                Decision
Global Stat        1.3455  0.8536 Assumptions acceptable.
Skewness           0.3142  0.5751 Assumptions acceptable.
Kurtosis           0.3256  0.5682 Assumptions acceptable.
Link Function      0.1432  0.7051 Assumptions acceptable.
Heteroscedasticity 0.5624  0.4533 Assumptions acceptable.
```

Spearman's Rank-order correlation.

corr_name	Ro_val	p_value
task09_freq_reference - inf15_posacc	0,37	0,012
task10_freq_quanty - inf15_posacc	0,33	0,028
task11_freq_qualit - inf15_posacc	0,38	0,011

Analysis: Task partally is correlated with PEU1.

Hyp05B2: Partial TASK AFFECTS PU2(viz. insight)

```
Call:
lm(formula = viz21_pair_ins + viz24_dyn_ins ~ task09_freq_reference +
    task11_freq_qualit + task12_freq_integr)

Residuals:
    Min      1Q  Median      3Q     Max
-2.7437 -0.6665  0.1840  0.7418  2.1680

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)             7.1606     0.7363   9.725  4.3e-12 ***
task09_freq_reference   0.2440     0.1886   1.294    0.203
task11_freq_qualit      0.2206     0.1839   1.200    0.237
task12_freq_integr     -0.2578     0.1560  -1.653    0.106
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.174 on 40 degrees of freedom
Multiple R-squared: 0.1049,     Adjusted R-squared: 0.03778
F-statistic: 1.563 on 3 and 40 DF,  p-value: 0.2134

ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = lm(viz21_pair_ins + viz24_dyn_ins ~ task09_freq_reference +
task11_freq_qualit + task12_freq_integr))
                    Value p-value                Decision
Global Stat        3.4324  0.4882 Assumptions acceptable.
Skewness           1.6658  0.1968 Assumptions acceptable.
Kurtosis           0.1121  0.7378 Assumptions acceptable.
Link Function      1.0129  0.3142 Assumptions acceptable.
Heteroscedasticity 0.6416  0.4231 Assumptions acceptable.
```

Spearman's Rank-order correlation

corr_name	Ro_val	p_value
task09_freq_reference - viz24_dyn_ins	0,25	0,098
task11_freq_qualit - viz24_dyn_ins	0,26	0,083

Analysis: Partial TASK does not affect PU2.

Hyp06: TASK AFFECTS PEU

```
Call:
lm(formula = PEU ~ task09_freq_reference + task10_freq_quanty +
    task11_freq_qualit + task12_freq_integr)

Residuals:
     Min       1Q   Median       3Q      Max
-0.87015 -0.37859  0.08661  0.28670  1.00947

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)            3.77391    0.30510  12.369 4.48e-15 ***
task09_freq_reference -0.03373    0.07777  -0.434   0.6669
task10_freq_quanty     0.03443    0.09010   0.382   0.7045
task11_freq_qualit     0.16352    0.08785   1.861   0.0702 .
task12_freq_integr    -0.12089    0.06988  -1.730   0.0915 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4842 on 39 degrees of freedom
Multiple R-squared: 0.1476,   Adjusted R-squared: 0.06015
F-statistic: 1.688 on 4 and 39 DF,  p-value: 0.1723


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp06)

                     Value p-value                Decision
Global Stat        1.43621  0.8379 Assumptions acceptable.
Skewness           0.60885  0.4352 Assumptions acceptable.
Kurtosis           0.46325  0.4961 Assumptions acceptable.
Link Function      0.06478  0.7991 Assumptions acceptable.
Heteroscedasticity 0.29932  0.5843 Assumptions acceptable.
```

No significant results in Spearman's Rank-order correlation

Analysis: TASK does not affect PEU

Hyp06A: TASK AFFECTS PEU1

```
Call:
lm(formula = PEU1 ~ task09_freq_reference + task10_freq_quanty +
    task11_freq_qualit + task12_freq_integr)

Residuals:
     Min       1Q   Median       3Q      Max
-0.88733 -0.30751  0.04493  0.30582  0.67527

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)            3.22844    0.27439  11.766 2.11e-14 ***
task09_freq_reference  0.10377    0.06994   1.484   0.1459
task10_freq_quanty     0.06402    0.08103   0.790   0.4343
task11_freq_qualit     0.16637    0.07901   2.106   0.0417 *
task12_freq_integr    -0.11454    0.06285  -1.823   0.0760 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4355 on 39 degrees of freedom
Multiple R-squared: 0.265,    Adjusted R-squared: 0.1896
F-statistic: 3.515 on 4 and 39 DF,  p-value: 0.01523


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp06A)

                    Value p-value                Decision
Global Stat        2.6465  0.6186 Assumptions acceptable.
Skewness           0.7435  0.3885 Assumptions acceptable.
Kurtosis           0.7926  0.3733 Assumptions acceptable.
Link Function      0.9352  0.3335 Assumptions acceptable.
Heteroscedasticity 0.1752  0.6755 Assumptions acceptable.
```

No significant results in Spearman's Rank-order correlation

Analysis: TASK does not affect PEU1

HYP06B: TASK AFFECTS PEU2(partial adaption)

```
Call:
PEU2_06B → viz23_pair_adapt,viz26_dyn_adapt
lm(formula = PEU2_06B ~ task09_freq_reference + task10_freq_quanty +
    task12_freq_integr)

Residuals:
     Min       1Q   Median       3Q      Max
-1.26019 -0.46722  0.03406  0.33876  1.60647

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)            4.08889    0.40628  10.064  1.6e-12 ***
task09_freq_reference -0.15172    0.10198  -1.488    0.145
task10_freq_quanty     0.10507    0.10397   1.011    0.318
task12_freq_integr    -0.04184    0.09314  -0.449    0.656
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6474 on 40 degrees of freedom
Multiple R-squared: 0.0717,   Adjusted R-squared: 0.002076
F-statistic:  1.03 on 3 and 40 DF,  p-value: 0.3897


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp06B_2)

                      Value p-value                Decision
Global Stat        1.0350295  0.9044 Assumptions acceptable.
Skewness           0.4367924  0.5087 Assumptions acceptable.
Kurtosis           0.0009042  0.9760 Assumptions acceptable.
Link Function      0.2708446  0.6028 Assumptions acceptable.
Heteroscedasticity 0.3264882  0.5677 Assumptions acceptable.
```

Spearman's Rank-order correlation

corr_name	Ro_val	p_value
task09_freq_reference - viz23_pair_adapt	-0,26	0,085

Analysis: TASK does not affect PEU2

hyp07_2: INFORMATION NEEDS AFFECTS PU2_07(partial viz. insight)

```
Call:
PU2_07    <- rowMedians(cbind(viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins))
lm(formula = PU2_07 ~ inf13_ambiq + inf14_vague + inf15_posacc +
    inf16_attracc + inf17_time)

Residuals:
    Min      1Q  Median      3Q     Max
-1.6676 -0.1540 -0.1138  0.3408  0.9736

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)    2.1331640  0.7004230   3.046  0.00421 **
inf13_ambiq    0.2449380  0.1131457   2.165  0.03675 *
inf14_vague    0.2414397  0.1510027   1.599  0.11812
inf15_posacc   0.0009323  0.1408328   0.007  0.99475
inf16_attracc -0.0917336  0.1410902  -0.650  0.51949
inf17_time     0.1096235  0.1026026   1.068  0.29207
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5873 on 38 degrees of freedom
Multiple R-squared: 0.2931,      Adjusted R-squared: 0.2001
F-statistic: 3.152 on 5 and 38 DF,  p-value: 0.01777


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp07_2)

                     Value p-value                Decision
Global Stat        5.81590 0.21333 Assumptions acceptable.
Skewness           3.46339 0.06274 Assumptions acceptable.
Kurtosis           2.11269 0.14608 Assumptions acceptable.
Link Function      0.19783 0.65647 Assumptions acceptable.
Heteroscedasticity 0.04199 0.83765 Assumptions acceptable.
```

Relative weights of importance

	Weights (%)
inf13_ambiq	48.854776
inf14_vague	36.329568
inf15_posacc	1.181614
inf16_attracc	1.629639
inf17_time	12.004402

Spearman's Rank-order correlation (< 10%)

corr_name	Ro_val	p_value
inf13_ambiq - viz24_dyn_ins	0,32	0,03
inf13_ambiq - viz27_mta_ins	0,33	0,03
inf14_vague - viz18_single_ins	0,32	0,03
inf14_vague - viz27_mta_ins	0,42	0,01
inf16_attracc - viz27_mta_ins	0,37	0,01
inf17_time - viz27_mta_ins	0,42	0,004
inf17_time - viz28_mta_defi	0,35	0,02
inf14_vague - viz21_pair_ins	0,28	0,07
inf14_vague - viz28_mta_defi	0,27	0,07
inf15_posacc - viz28_mta_defi	0,25	0,10
inf16_attracc - viz28_mta_defi	0,28	0,07

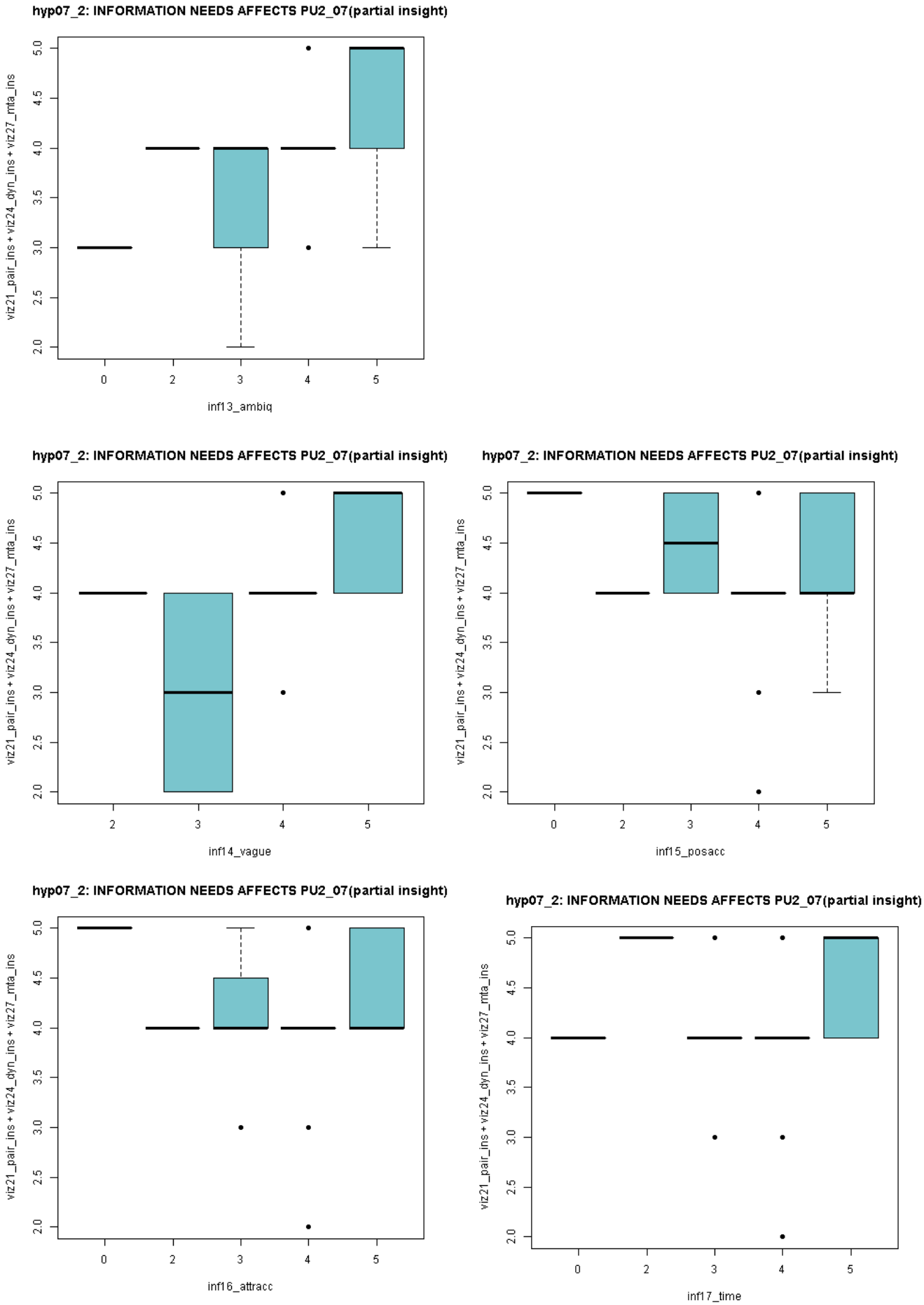

Figure 3.07. Box plots hypothesis 07_2

Hyp07A: Information need affects PEU2

```
Call:
lm(formula = PEU2 ~ inf13_ambiq + inf14_vague + inf15_posacc +
    inf16_attracc + inf17_time)

Residuals:
     Min       1Q   Median       3Q      Max
-1.04867 -0.44425  0.03431  0.36069  1.22919

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)    2.69624    0.67299   4.006 0.000277 ***
inf13_ambiq    0.30497    0.10871   2.805 0.007882 **
inf14_vague    0.17430    0.14509   1.201 0.237050
inf15_posacc  -0.13985    0.13532  -1.034 0.307896
inf16_attracc -0.02013    0.13556  -0.148 0.882736
inf17_time    -0.11137    0.09858  -1.130 0.265702
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5643 on 38 degrees of freedom
Multiple R-squared: 0.3385,      Adjusted R-squared: 0.2515
F-statistic: 3.889 on 5 and 38 DF,  p-value: 0.006054


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = hyp07A)

                     Value p-value                Decision
Global Stat        3.44375  0.4865 Assumptions acceptable.
Skewness           0.28248  0.5951 Assumptions acceptable.
Kurtosis           0.08713  0.7679 Assumptions acceptable.
Link Function      2.64124  0.1041 Assumptions acceptable.
Heteroscedasticity 0.43291  0.5106 Assumptions acceptable.
```

Relative weights of importance

```
                Weights
inf13_ambiq   59.444321
inf14_vague   18.445490
inf15_posacc  12.953737
inf16_attracc  3.889057
inf17_time     5.267395
```

Spearman's Rank-order correlation (< 10%)

corr_name	Ro_val	p_value
inf14_vague - viz30_mta_adapt	0,450	0,002
inf15_posacc - viz20_single_adapt	-0,330	0,026
inf17_time - viz20_single_adapt	-0,310	0,043
inf17_time - viz30_mta_adapt	0,360	0,017
inf13_ambiq - viz30_mta_adapt	0,280	0,066
inf14_vague - viz23_pair_adapt	0,260	0,093
inf15_posacc - viz23_pair_adapt	-0,260	0,089
inf16_attracc - viz30_mta_adapt	0,260	0,084

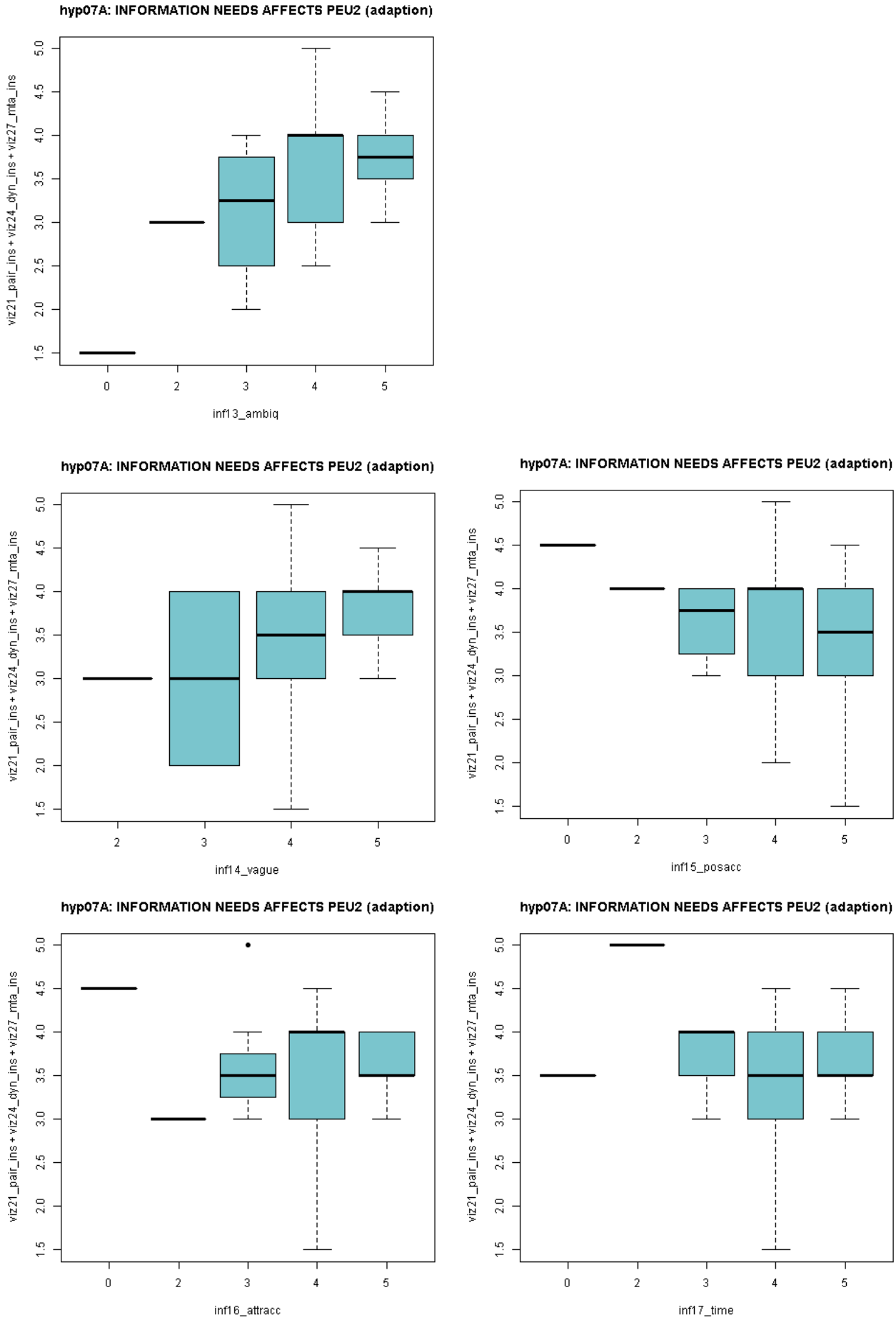

Figure 3.08. Box plots hypothesis 07A.

HYP08: Visualization type affects PU1 (information needs)

```
Call:
lm(formula = PU1 ~ v_single + v_pair + v_dyn + v_mta)

Residuals:
     Min       1Q   Median       3Q      Max 
-1.29912 -0.19670 -0.02626  0.07199  1.01181 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  3.16454    0.74225   4.263 0.000124 ***
v_single    -0.11740    0.08464  -1.387 0.173334    
v_pair       0.03557    0.10280   0.346 0.731200    
v_dyn        0.15547    0.11406   1.363 0.180703    
v_mta        0.14179    0.08850   1.602 0.117198    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 

Residual standard error: 0.4807 on 39 degrees of freedom
Multiple R-squared: 0.136,Adjusted R-squared: 0.04733 
F-statistic: 1.534 on 4 and 39 DF,  p-value: 0.2113 

ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05
Call:
 gvlma(x = HYP08)

                     Value p-value                Decision
Global Stat         6.2256  0.1829 Assumptions acceptable.
Skewness            0.1483  0.7001 Assumptions acceptable.
Kurtosis            2.1450  0.1430 Assumptions acceptable.
Link Function       2.4932  0.1143 Assumptions acceptable.
Heteroscedasticity 1.4391  0.2303 Assumptions acceptable.
```

Corrogram Spearman's Rank order correlation (significance < 5%)

	inf13_ambiq	inf14_vague	inf15_posacc	inf16_attracc	inf17_time
viz18_single_ins	-	0,32	-	-	-
viz19_single_interp	-	-	-	-	-
viz20_single_adapt	-	-	-0,33	-	-0,31
viz21_pair_ins	-	-	-	-	-
viz22_pair_interp	-	-	-	-	-
viz23_pair_adapt	-	-	-	-	-
viz24_dyn_ins	0,32	-	-	-	-
viz25_dyn_interp	-	-	-	-	-
viz26_dyn_adapt	-	-	-	-	-
viz27_mta_ins	0,33	0,42	-	-	0,42
viz28_mta_defi	-	-	-	-	0,35
viz29_mta_compli	-	0,33	0,34	-	0,36
viz30_mta_adapt	-	0,45	-	-	0,36

Table 3.01. Correlation matrix hypothesis 08.

Analysis: Relationships between variables of information needs and type of visualization shows differences. Therefore the null-hypothesis can be rejected.

HYP08D: Metadata affects PU1

```
data:  PU1 and v_mta
(viz27_mta_ins,viz28_mta_defi,viz29_mta_compli,viz30_mta_adapt)
S = 9092.971, p-value = 0.01664
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.3591987
```

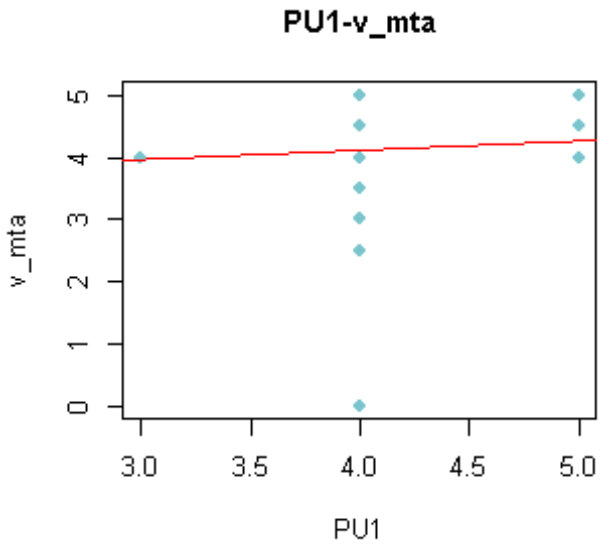

Figure 3.09. Correlation plot hypothesis 08D.

Analysis: Relationships between variables of information needs and metadata shows a difference. Therefore the null-hypothesis can be rejected.

4. Summary of the ordinal regression analysis

Hyp01A: AGE AFFECTS PU1

```
formula: PU1 ~ pers01_agecat (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -31.13 68.27 6(0)  3.47e-09 4.3e+02

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
pers01_agecat   0.1280     0.3851   0.332     0.74

Threshold coefficients:
    Estimate Std. Error z value
3|4   -2.184      1.418  -1.540
4|5    1.945      1.392   1.397
```

```
formula: PU1 ~ pers01_agecat (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -31.05 68.10 6(0)  5.25e-10 4.5e+02

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
pers01_agecat   0.1037     0.1977   0.524      0.6

Threshold coefficients:
    Estimate Std. Error z value
3|4  -2.2998     0.8773  -2.622
4|5   0.8923     0.7043   1.267
```

Analysis: There's no significant relationship between age and perceived usefulness.

HYP01B: AGE AFFECTS PU2 (insight)

```
formula: PU2 ~ pers01_agecat (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -38.59 85.18 6(0)  4.03e-09 7.0e+02

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
pers01_agecat   0.5412     0.3690   1.467    0.142

Threshold coefficients:
    Estimate Std. Error z value
2|3  -1.2925     1.3679  -0.945
3|4  -0.5399     1.2814  -0.421
4|5   3.0160     1.3832   2.180
```

```
formula: PU2 ~ pers01_agecat (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -38.87 85.73 6(0)  2.22e-08 6.6e+02

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
pers01_agecat   0.2506     0.1946   1.288    0.198

Threshold coefficients:
    Estimate Std. Error z value
2|3  -2.2335     0.9462  -2.360
3|4  -1.5136     0.8050  -1.880
4|5   1.1965     0.6845   1.748
```

Analysis: There's no significant relationship between age and perceived usefulness.

Hyp01C: AGE AFFECTS PEU1

```
formula: PEU1 ~ pers01_agecat (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -54.72 119.43 6(0)  2.78e-10 7.9e+02

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
pers01_agecat -0.05055    0.31794  -0.159    0.874

Threshold coefficients:
      Estimate Std. Error z value
3|3.5   -2.017      1.167  -1.729
3.5|4   -1.040      1.129  -0.921
4|4.5    1.674      1.163   1.440
4.5|5    2.873      1.295   2.218
```

```
formula: PEU1 ~ pers01_agecat (clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -54.71 119.42 5(0)  3.24e-08 9.5e+02

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
pers01_agecat  0.04086    0.20062   0.204    0.839

Threshold coefficients:
      Estimate Std. Error z value
3|3.5  -1.7817     0.7897  -2.256
3.5|4  -0.9107     0.7320  -1.244
4|4.5   0.8282     0.7064   1.173
4.5|5   1.2703     0.7303   1.739
```

Analysis: There's no significant relationship between age and perceived ease of use.

Hyp02A EDUCATION AFFECTS PU1

```
formula: PU1 ~ pers02_edu (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -30.95 67.90 6(0)  5.16e-09 5.6e+02

Coefficients:
           Estimate Std. Error z value Pr(>|z|)
pers02_edu   0.3341     0.4877   0.685    0.493

Threshold coefficients:
    Estimate Std. Error z value
3|4   -1.547      1.640  -0.944
4|5    2.618      1.691   1.548
```

```
formula: PU1 ~ pers02_edu (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -30.77 67.54 6(0)  5.82e-10 7.2e+02

Coefficients:
           Estimate Std. Error z value Pr(>|z|)
pers02_edu   0.2608     0.2885   0.904    0.366

Threshold coefficients:
    Estimate Std. Error z value
3|4  -1.8099     1.0765  -1.681
4|5   1.4058     0.9794   1.435
```

Analysis: Education does not affect PU1

Hyp02C: Education affects PEU1

```
formula: PEU1 ~ pers02_edu (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -51.01 112.03 6(0)  4.26e-08 1.1e+03

Coefficients:
           Estimate Std. Error z value Pr(>|z|)
pers02_edu  -1.1546     0.4319  -2.673  0.00751 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
3|3.5  -5.8680     1.6034  -3.660
3.5|4  -4.8093     1.5397  -3.123
4|4.5  -1.7042     1.3482  -1.264
4.5|5  -0.3423     1.3797  -0.248
```

```
formula: PEU1 ~ pers02_edu (clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -51.96 113.92 5(0)  1.23e-08 1.1e+03
```

```
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
pers02_edu  -0.5077     0.2295  -2.212   0.0269 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
3|3.5  -3.6412     0.9014  -4.040
3.5|4  -2.7507     0.8423  -3.266
4|4.5  -0.9182     0.7808  -1.176
4.5|5  -0.3912     0.7540  -0.519
```

Analysis: Education does affects PEU1 (interpretation). In this hypothesis the model with logit link is adapted due to a better fit of the statistical model. The Akaike information criterion (AIC) of the model with the logit link is smaller than the AIC of the model with the clog-log link.

Hyp03A: EXPERIENCE AFFECTS PU1

```
formula: PU1 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
    pers07_viz_exp (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -30.60 73.21 6(0)  8.35e-09 5.5e+03

Coefficients:
                   Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp  0.044831   0.629771   0.071    0.943
pers05_gi_b_exp   -0.359775   0.607303  -0.592    0.554
pers06_ana_exp    -0.066152   0.417568  -0.158    0.874
pers07_viz_exp    -0.009982   0.600732  -0.017    0.987

Threshold coefficients:
    Estimate Std. Error z value
3|4 -4.13619    2.40427  -1.720
4|5  0.08537    2.25743   0.038
```

```
formula: PU1 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
pers07_viz_exp (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -30.87 73.74 6(0)  7.47e-10 7.3e+03

Coefficients:
                   Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp -0.083450   0.371969  -0.224    0.822
pers05_gi_b_exp   -0.050619   0.299666  -0.169    0.866
pers06_ana_exp    -0.065489   0.225000  -0.291    0.771
pers07_viz_exp    -0.006452   0.308645  -0.021    0.983

Threshold coefficients:
    Estimate Std. Error z value
3|4  -3.4682     1.4865  -2.333
4|5  -0.2678     1.3567  -0.197
```

Analysis: No significance. Experience does not affect PU1.

Hyp03B: EXPERIENCE AFFECTS PU2

```
formula: PU2 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
    pers07_viz_exp (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -38.42 90.85 6(0)  9.00e-09 9.0e+03

Coefficients:
                  Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp  0.56586    0.58479   0.968    0.333
pers05_gi_b_exp   -0.17019    0.54451  -0.313    0.755
pers06_ana_exp     0.25658    0.39344   0.652    0.514
pers07_viz_exp     0.07623    0.53614   0.142    0.887

Threshold coefficients:
    Estimate Std. Error z value
2|3  -0.2093     2.1445  -0.098
3|4   0.5566     2.1001   0.265
4|5   4.1348     2.2304   1.854
```

```
formula: PU2 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
pers07_viz_exp (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -38.81 91.63 6(0)  3.40e-08 9.8e+03

Coefficients:
                  Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp  0.30683    0.32518   0.944    0.345
pers05_gi_b_exp   -0.10826    0.30519  -0.355    0.723
pers06_ana_exp     0.08881    0.21343   0.416    0.677
pers07_viz_exp     0.11214    0.33617   0.334    0.739

Threshold coefficients:
    Estimate Std. Error z value
2|3  -1.4774     1.4496  -1.019
3|4  -0.7539     1.3647  -0.552
4|5   1.9667     1.3302   1.479
```

Analysis: Experience does not affect PU2

HYP03C: EXPERIENCE AFFECTS PARTIAL PU1 (uncertainty info)

```
formula:
as.factor(rowMedians(cbind(inf16_attracc, inf17_time))) ~ pers05_gi_b_exp
(logit link function)

 link  threshold nobs logLik AIC    niter max.grad
 logit flexible  44   -71.30 156.60 6(0)  2.60e-13

Coefficients:
pers05_gi_b_exp
        -0.4904

Threshold coefficients:
  2|2.5   2.5|3   3|3.5   3.5|4   4|4.5   4.5|5
-5.7375 -4.5819 -3.2821 -2.6385 -0.8110 -0.1297
```

```
formula: as.factor(rowMedians(cbind(inf16_attracc, inf17_time))) ~
pers05_gi_b_exp
(clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -72.28 158.56 5(0)  2.19e-08 2.2e+03

Coefficients:
                Estimate Std. Error z value Pr(>|z|)
pers05_gi_b_exp  -0.1511     0.1839  -0.821    0.411

Threshold coefficients:
      Estimate Std. Error z value
2|2.5 -4.36383    1.23860  -3.523
2.5|3 -3.23995    0.92998  -3.484
3|3.5 -2.05738    0.79442  -2.590
3.5|4 -1.53523    0.76126  -2.017
4|4.5 -0.30989    0.73146  -0.424
4.5|5  0.03171    0.73761   0.043
```

Analysis: Experience does not affect PU1

HYP03D: EXPERIENCE AFFECTS PARTIAL PU2

```
 === HYP03D: EXPERIENCE AFFECTS PARTIAL PU2      ==
formula: as.factor(rowMedians(cbind(viz27_mta_ins + viz28_mta_defi))) ~
    pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp + pers07_viz_exp
(logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -55.90 131.80 7(0)  3.46e-13 1.7e+04

Coefficients:
                  Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp   0.6323     0.5392   1.173  0.24097
pers05_gi_b_exp    -0.7504     0.5017  -1.496  0.13470
pers06_ana_exp      1.1597     0.4392   2.640  0.00828 **
pers07_viz_exp     -0.2783     0.5206  -0.535  0.59290
---Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Threshold coefficients:
     Estimate Std. Error z value
0|5   -1.4704     2.1006  -0.700
5|6   -0.5883     1.9521  -0.301
6|7    0.2622     1.8875   0.139
7|8    0.8269     1.8900   0.437
8|9    3.7670     2.0306   1.855
9|10   4.3535     2.0421   2.132
```

HYP03D Alternative hypothesis, EXPERIENCE AFFECTS PARTIAL PU2

```
formula: as.factor(rowMedians(cbind(viz27_mta_ins, viz28_mta_defi))) ~
pers06_ana_exp (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -57.80 129.60 6(0)  3.15e-07 1.3e+03

Coefficients:
               Estimate Std. Error z value Pr(>|z|)
pers06_ana_exp   0.7334     0.2907   2.523   0.0116 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
0|2.5  -1.4191     1.3260  -1.070
2.5|3  -0.6538     1.1446  -0.571
3|3.5   0.1389     1.0529   0.132
3.5|4   0.6617     1.0439   0.634
4|4.5   3.4121     1.2041   2.834
4.5|5   3.9872     1.2334   3.233

formula: as.factor(rowMedians(cbind(viz27_mta_ins, viz28_mta_defi))) ~
    pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp + pers07_viz_exp
(clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -58.99 137.99 6(0)  2.89e-08 1.8e+04

Coefficients:
                   Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp  0.333351   0.327466   1.018    0.309
pers05_gi_b_exp   -0.355030   0.305107  -1.164    0.245
pers06_ana_exp     0.369251   0.235220   1.570    0.116
pers07_viz_exp    -0.005088   0.341611  -0.015    0.988

Threshold coefficients:
      Estimate Std. Error z value
0|2.5  -2.4884     1.5348  -1.621
2.5|3  -1.7709     1.3608  -1.301
3|3.5  -1.0406     1.2672  -0.821
3.5|4  -0.5932     1.2406  -0.478
4|4.5   1.4068     1.2210   1.152
4.5|5   1.7239     1.2221   1.411
```

Analysis: Experience does not affect partial PU2. In the alternative hypothesis the model with logit link is adapted due to a better fit of the statistical model. The Akaike information criterion (AIC) of the model with the logit link is smaller than the AIC of the model with the clog-log link.

HYP04A: EXPERIENCE AFFECTS PEU1 (Interpretation)

```
formula: PEU1 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
    pers07_viz_exp (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -48.34 112.68 6(0)  1.70e-07 1.2e+04

Coefficients:
                  Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp  0.05644    0.54402   0.104   0.9174
pers05_gi_b_exp    1.48300    0.59108   2.509   0.0121 *
pers06_ana_exp    -0.87912    0.41146  -2.137   0.0326 *
pers07_viz_exp     0.29966    0.52632   0.569   0.5691
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
3|3.5    1.628      1.954   0.833
3.5|4    2.792      1.980   1.410
4|4.5    6.151      2.176   2.827
4.5|5    7.576      2.298   3.297
```

Alternative hypothesis:

```
formula: PEU1 ~ pers05_gi_b_exp + pers06_ana_exp (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -48.51 109.02 6(0)  1.11e-07 2.9e+03

Coefficients:
                 Estimate Std. Error z value Pr(>|z|)
pers05_gi_b_exp   1.6314     0.4907   3.325 0.000885 ***
pers06_ana_exp   -0.7716     0.3653  -2.113 0.034644 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
3|3.5    1.221      1.316   0.928
3.5|4    2.395      1.352   1.771
4|4.5    5.721      1.592   3.593
4.5|5    7.126      1.735   4.108
```

```
formula: PEU1 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
pers07_viz_exp (clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -50.15 116.31 5(0)  4.21e-08 1.7e+04

Coefficients:
                  Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp   0.1977     0.3495   0.566   0.5716
pers05_gi_b_exp     0.4455     0.2801   1.590   0.1118
pers06_ana_exp     -0.2796     0.1676  -1.669   0.0952 .
pers07_viz_exp      0.1792     0.2995   0.598   0.5497
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Threshold coefficients:
      Estimate Std. Error z value
3|3.5   0.2112     1.4022   0.151
3.5|4   1.1218     1.3873   0.809
4|4.5   3.0083     1.4366   2.094
4.5|5   3.6210     1.4743   2.456
```

Analysis: The alternative hypothesis of the model with the logit link function is accepted. Experience (pers05_gi_b_exp,pers06_ana_exp) affects PEU1.

HYP04B: EXPERIENCE AFFECTS PEU2 (Adaption)

```
formula: PEU2 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
    pers07_viz_exp (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -65.09 152.19 7(0)  1.14e-12 2.0e+04

Coefficients:
                  Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp   0.4177     0.5233   0.798    0.425
pers05_gi_b_exp    -0.1557     0.4880  -0.319    0.750
pers06_ana_exp     -0.3087     0.3804  -0.811    0.417
pers07_viz_exp      0.7376     0.4917   1.500    0.134

Threshold coefficients:
      Estimate Std. Error z value
1.5|2  -1.0990     2.0209  -0.544
2|2.5  -0.3659     1.9059  -0.192
2.5|3   0.0772     1.8725   0.041
3|3.5   1.8637     1.8470   1.009
3.5|4   2.8792     1.8819   1.530
4|4.5   5.5440     2.0274   2.735
4.5|5   6.7202     2.1881   3.071
```

```
formula: PEU2 ~ pers04_domain_exp + pers05_gi_b_exp + pers06_ana_exp +
pers07_viz_exp (clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -64.13 150.25 6(0)  4.27e-09 2.2e+04

Coefficients:
                  Estimate Std. Error z value Pr(>|z|)
pers04_domain_exp  0.005285   0.270763   0.020   0.9844
pers05_gi_b_exp    0.040757   0.319169   0.128   0.8984
pers06_ana_exp    -0.329941   0.192478  -1.714   0.0865 .
pers07_viz_exp     0.524370   0.302274   1.735   0.0828 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
1.5|2  -2.8897     1.5040  -1.921
2|2.5  -2.1831     1.3306  -1.641
2.5|3  -1.7634     1.2689  -1.390
3|3.5  -0.1585     1.1714  -0.135
3.5|4   0.6047     1.1681   0.518
4|4.5   2.0824     1.1839   1.759
4.5|5   2.6123     1.2018   2.174
```

Analysis:Experience does not affects PEU2

Hyp05A: TASK AFFECTS PU1

```
formula:
PU1 ~ task09_freq_reference + task10_freq_quanty + task11_freq_qualit +
    task12_freq_integr (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -29.12 70.24 6(0)  1.07e-07 1.7e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference   0.2255     0.3931   0.574    0.566
task10_freq_quanty     -0.2107     0.4097  -0.514    0.607
task11_freq_qualit      0.5725     0.4087   1.401    0.161
task12_freq_integr      0.1653     0.3455   0.478    0.632

Threshold coefficients:
    Estimate Std. Error z value
3|4  -0.5535     1.4883  -0.372
4|5   3.9633     1.7051   2.324
```

```
formula: PU1 ~ task09_freq_reference + task10_freq_quanty + task11_freq_qualit +
task12_freq_integr (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -28.85 69.69 6(0)  2.17e-09 2.1e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference  0.05902    0.22824   0.259    0.796
task10_freq_quanty    -0.12408    0.26721  -0.464    0.642
task11_freq_qualit     0.37077    0.24924   1.488    0.137
task12_freq_integr     0.16931    0.19238   0.880    0.379

Threshold coefficients:
    Estimate Std. Error z value
3|4   -1.398      1.030  -1.357
4|5    1.981      0.996   1.989
```

Analysis:Task does not affect PU1

Hyp05B2 Partial TASK AFFECTS PU2(viz. insight)

```
formula:
PU2_05B ~ task09_freq_reference + task11_freq_qualit + task12_freq_integr
(logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -65.67 147.33 5(0)  1.98e-07 3.3e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference   0.3895     0.3110   1.252   0.2105
task11_freq_qualit      0.4415     0.3059   1.443   0.1489
task12_freq_integr     -0.4280     0.2551  -1.678   0.0934 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
2.5|3  -2.5558     1.5074  -1.696
3|3.5  -0.6283     1.2048  -0.522
3.5|4   0.4674     1.1868   0.394
4|4.5   2.2269     1.2431   1.791
4.5|5   3.8325     1.3472   2.845
```

```
formula: PU2_05B ~ task09_freq_reference + task11_freq_qualit +
task12_freq_integr (clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -64.12 144.24 5(0)  2.16e-07 3.4e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference   0.1814     0.1709   1.061   0.2885
task11_freq_qualit      0.3964     0.1910   2.076   0.0379 *
task12_freq_integr     -0.3604     0.1548  -2.328   0.0199 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
2.5|3  -3.2624     1.2012  -2.716
3|3.5  -1.4047     0.7803  -1.800
3.5|4  -0.4418     0.7197  -0.614
4|4.5   0.8293     0.7161   1.158
4.5|5   1.6960     0.7298   2.324
```

Analysis:Partial Task does affect PU2

Hyp06: TASK AFFECTS PEU

```
formula:
PEU ~ task09_freq_reference + task10_freq_quanty + task11_freq_qualit +
    task12_freq_integr (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -53.46 124.93 7(0)  1.12e-12 3.7e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference -0.05973    0.31662  -0.189   0.8504
task10_freq_quanty     0.07597    0.35627   0.213   0.8311
task11_freq_qualit     0.62710    0.35366   1.773   0.0762 .
task12_freq_integr    -0.54519    0.28215  -1.932   0.0533 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
2.5|3  -4.0877     1.5823  -2.583
3|3.5  -1.7422     1.2426  -1.402
3.5|4  -0.7451     1.2022  -0.620
4|4.5   2.4258     1.2862   1.886
4.5|5   4.0201     1.5977   2.516
```

```
formula: PEU ~ task09_freq_reference + task10_freq_quanty + task11_freq_qualit +
task12_freq_integr (clog-log link)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -53.41 124.81 6(0)  9.04e-12 4.2e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference  0.08340    0.18404   0.453   0.6504
task10_freq_quanty     0.03849    0.23003   0.167   0.8671
task11_freq_qualit     0.38098    0.22407   1.700   0.0891 .
task12_freq_integr    -0.30732    0.18902  -1.626   0.1040
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
2.5|3  -3.3953     1.2215  -2.780
3|3.5  -1.2155     0.7753  -1.568
3.5|4  -0.3886     0.7287  -0.533
4|4.5   1.4845     0.7607   1.952
4.5|5   2.0925     0.8607   2.431
```

Analysis: Task does not affect PEU

Hyp06A: TASK AFFECTS PEU1

```
formula:
PEU1 ~ task09_freq_reference + task10_freq_quanty + task11_freq_qualit +
    task12_freq_integr (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -48.96 113.92 6(0)  6.96e-08 3.5e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference   0.4662     0.3281   1.421   0.1554
task10_freq_quanty      0.2768     0.3593   0.770   0.4410
task11_freq_qualit      0.7388     0.3714   1.989   0.0467 *
task12_freq_integr     -0.5213     0.2848  -1.830   0.0672 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
3|3.5   0.6363     1.2883   0.494
3.5|4   1.7502     1.2841   1.363
4|4.5   4.9702     1.4965   3.321
4.5|5   6.3864     1.6729   3.818
```

Alternative hypothesis

```
formula: PEU1 ~ task11_freq_qualit (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -51.28 112.56 6(0)  8.50e-09 2.8e+02

Coefficients:
                    Estimate Std. Error z value Pr(>|z|)
task11_freq_qualit   0.7930     0.3092   2.565   0.0103 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
3|3.5  -0.0608     0.7929  -0.077
3.5|4   1.0076     0.7804   1.291
4|4.5   3.9861     0.9987   3.991
4.5|5   5.3097     1.2232   4.341
```

```
formula: PEU1 ~ task09_freq_reference + task10_freq_quanty + task11_freq_qualit
+ task12_freq_integr (clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -48.07 112.14 6(0)  2.10e-13 4.1e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference   0.3593     0.2096   1.714   0.0865 .
task10_freq_quanty      0.2124     0.2213   0.960   0.3372
task11_freq_qualit      0.4063     0.2129   1.908   0.0563 .
task12_freq_integr     -0.3569     0.1924  -1.855   0.0636 .
---
```

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

Threshold coefficients:
      Estimate Std. Error z value
3|3.5  -0.1965     0.8729  -0.225
3.5|4   0.7239     0.8262   0.876
4|4.5   2.7792     0.9156   3.036
4.5|5   3.4989     1.0160   3.444
```

Analysis: Qualitative analysis does affect PEU1. The alternative hypothesis with the logit link function provides signficant results.

HYP06B: TASK AFFECTS PEU2(partial adaption)

```
formula:
PEU2_06B ~ task09_freq_reference + task10_freq_quanty + task12_freq_integr
(logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -69.96 155.92 5(0)  5.77e-09 2.8e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference -0.55259    0.29003  -1.905   0.0567 .
task10_freq_quanty     0.27520    0.29410   0.936   0.3494
task12_freq_integr    -0.05043    0.25082  -0.201   0.8406
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
2.5|3  -4.0897     1.2542  -3.261
3|3.5  -2.5920     1.1613  -2.232
3.5|4  -1.3292     1.0901  -1.219
4|4.5   0.1714     1.0661   0.161
4.5|5   1.5615     1.2261   1.273
```

```
formula: PEU2_06B ~ task09_freq_reference + task10_freq_quanty +
task12_freq_integr (clog-log function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -71.09 158.19 6(0)  4.37e-13 3.3e+03

Coefficients:
                      Estimate Std. Error z value Pr(>|z|)
task09_freq_reference  -0.1249     0.1657  -0.754    0.451
task10_freq_quanty      0.2229     0.1744   1.278    0.201
task12_freq_integr     -0.1611     0.1626  -0.991    0.322

Threshold coefficients:
      Estimate Std. Error z value
2.5|3  -2.7919     0.8514  -3.279
3|3.5  -1.4806     0.7350  -2.014
3.5|4  -0.5909     0.6919  -0.854
4|4.5   0.2331     0.6762   0.345
4.5|5   0.7597     0.7176   1.059
```

Analysis: Task does affect PEU2.

hyp07_2: INFORMATION NEEDS AFFECTS PU2_07(partial viz. insight)

```
PU2_07 as.factor(rowMedians(cbind(viz21_pair_ins,viz24_dyn_ins,viz27_mta_ins)))
formula: PU2_07 ~ inf13_ambiq + inf14_vague + inf15_posacc + inf16_attracc +
    inf17_time (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -33.28 82.56 7(0)  4.15e-13 1.7e+04

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
inf13_ambiq    0.88232    0.38405   2.297   0.0216 *
inf14_vague    0.93227    0.59064   1.578   0.1145
inf15_posacc  -0.03851    0.53419  -0.072   0.9425
inf16_attracc -0.43194    0.55956  -0.772   0.4402
inf17_time     0.48824    0.37495   1.302   0.1929
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
    Estimate Std. Error z value
2|3    2.690      2.718   0.990
3|4    4.388      2.595   1.691
4|5    8.542      2.861   2.986
```

```
formula: PU2_07 ~ inf13_ambiq + inf14_vague + inf15_posacc + inf16_attracc +
inf17_time (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -32.43 80.85 7(0)  4.37e-11 1.8e+04

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
inf13_ambiq    0.79570    0.29240   2.721   0.0065 **
inf14_vague    0.66337    0.40947   1.620   0.1052
inf15_posacc  -0.06091    0.34536  -0.176   0.8600
inf16_attracc -0.37287    0.39852  -0.936   0.3495
inf17_time     0.27766    0.26480   1.049   0.2944
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
    Estimate Std. Error z value
2|3   0.7968     1.9132   0.416
3|4   2.3750     1.7191   1.382
4|5   5.6615     1.8999   2.980
```

Analysis: Information needs (ambiguity) does affect partial PEU2. The model with the clog-log link probably fits better due to the smaller value of the AIC.

Hyp07A: Information need affects PEU2

```
formula: PEU2 ~ inf13_ambiq + inf14_vague + inf15_posacc + inf16_attracc +
    inf17_time (logit link function)

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -59.48 142.96 7(0)  8.78e-10 3.4e+04

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
inf13_ambiq    0.81359    0.40379   2.015   0.0439 *
inf14_vague    0.69338    0.47974   1.445   0.1484
inf15_posacc  -0.73968    0.44596  -1.659   0.0972 .
inf16_attracc  0.06204    0.42513   0.146   0.8840
inf17_time    -0.31451    0.31090  -1.012   0.3117
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
1.5|2  -2.4232     2.2864  -1.060
2|2.5  -1.4114     2.1966  -0.643
2.5|3  -0.8777     2.1757  -0.403
3|3.5   1.2484     2.2260   0.561
3.5|4   2.4102     2.2437   1.074
4|4.5   5.4686     2.2923   2.386
4.5|5   6.8940     2.4482   2.816
```

Alternative hypothesis

```
formula: PEU2 ~ inf13_ambiq + inf15_posacc

 link  threshold nobs logLik AIC    niter max.grad cond.H
 logit flexible  44   -60.69 139.37 7(0)  1.28e-10 1.0e+04

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
inf13_ambiq    1.0378     0.3573   2.905  0.00367 **
inf15_posacc  -0.6279     0.2956  -2.124  0.03363 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
1.5|2  -3.0364     1.9731  -1.539
2|2.5  -1.8642     1.9180  -0.972
2.5|3  -1.3070     1.8990  -0.688
3|3.5   0.7298     1.9238   0.379
3.5|4   1.8326     1.9355   0.947
4|4.5   4.7759     1.9489   2.451
4.5|5   6.1246     2.0820   2.942
```

```
formula: PEU2 ~ inf13_ambiq + inf14_vague + inf15_posacc + inf16_attracc +
inf17_time (clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -62.74 149.48 6(0)  7.72e-08 4.3e+04
```

```
Coefficients:
               Estimate Std. Error z value Pr(>|z|)
inf13_ambiq    0.668627   0.394128   1.696   0.0898 .
inf14_vague    0.052850   0.431764   0.122   0.9026
inf15_posacc   0.004316   0.279975   0.015   0.9877
inf16_attracc -0.250918   0.320729  -0.782   0.4340
inf17_time    -0.166805   0.193258  -0.863   0.3881
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
1.5|2  -2.6678     1.6909  -1.578
2|2.5  -1.8837     1.5475  -1.217
2.5|3  -1.4363     1.4992  -0.958
3|3.5   0.2443     1.4470   0.169
3.5|4   1.0287     1.4464   0.711
4|4.5   2.4518     1.4700   1.668
4.5|5   2.9076     1.4659   1.984
```

Analysis: According to the alternative hypothesis with the logit link function Information needs (ambiguity and positional accuracy) does affect partial PEU2.

HYP08: Visualization type affects PU1 (information needs)

```
formula: PU1 ~ v_single + v_pair + v_dyn + v_mta (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -27.82 67.64 6(0)  2.62e-07 1.3e+04

Coefficients:
         Estimate Std. Error z value Pr(>|z|)
v_single  -0.6450     0.4361  -1.479   0.1391
v_pair     0.2438     0.4870   0.501   0.6166
v_dyn      0.8934     0.6007   1.487   0.1369
v_mta      0.7023     0.4167   1.685   0.1919 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
    Estimate Std. Error z value
3|4    2.239      3.598   0.622
4|5    6.982      3.804   1.835
```

```
formula: PU1 ~ v_single + v_pair + v_dyn + v_mta (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -26.84 65.68 6(0)  3.70e-08 1.3e+04

Coefficients:
         Estimate Std. Error z value Pr(>|z|)
v_single  -0.3965     0.2539  -1.562   0.1183
v_pair     0.2400     0.2969   0.808   0.4189
v_dyn      0.3538     0.3182   1.112   0.2662
v_mta      0.5962     0.2775   2.148   0.0317 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
    Estimate Std. Error z value
3|4   0.4704     2.1671   0.217
4|5   4.1056     2.2062   1.861
```

Alternative hypothesis

```
formula: PU1 ~ v_mta
 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -28.57 63.15 6(0)  1.36e-08 9.7e+02
Coefficients:
      Estimate Std. Error z value Pr(>|z|)
v_mta   0.6019     0.2607   2.309   0.0209 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
    Estimate Std. Error z value
3|4  -0.4665     0.9846  -0.474
4|5   3.0494     1.1062   2.757
```

Analysis: According to alternative hypothesis with the clog-log link function visualization type (metadata) affects PU1.

HYP08A: PU1 Affected by single static map

```
formula: PU1 ~ v_single (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -30.29 66.58 6(0)  1.04e-08 4.0e+02

Coefficients:
         Estimate Std. Error z value Pr(>|z|)
v_single  -0.5098     0.3859  -1.321    0.187

Threshold coefficients:
    Estimate Std. Error z value
3|4  -4.4365     1.5473  -2.867
4|5  -0.1553     1.2750  -0.122
```

Analysis: PU1 is not affected by single static map

HYP08B: PU1 Affected by map pair

```
formula: PU1 ~ v_pair (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -31.18 68.36 6(0)  3.54e-09 7.8e+02

Coefficients:
       Estimate Std. Error z value Pr(>|z|)
v_pair  -0.0609     0.4722  -0.129    0.897

Threshold coefficients:
    Estimate Std. Error z value
3|4   -2.839      1.838  -1.545
4|5    1.282      1.763   0.727
```

```
formula: PU1 ~ v_single (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -30.24 66.48 6(0)  8.28e-10 5.0e+02

Coefficients:
         Estimate Std. Error z value Pr(>|z|)
v_single  -0.2847     0.2120  -1.343    0.179

Threshold coefficients:
    Estimate Std. Error z value
3|4  -3.6455     0.9591  -3.801
4|5  -0.4059     0.7367  -0.551
```

Analysis: PU1 is not affected by map pair

HYP08C: PU1 Affected by dynamic map

```
formula: PU1 ~ v_dyn (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -30.65 67.31 6(0)  9.00e-09 1.8e+03

Coefficients:
      Estimate Std. Error z value Pr(>|z|)
v_dyn   0.5725     0.5588   1.024    0.306

Threshold coefficients:
    Estimate Std. Error z value
3|4  -0.2791     2.3197  -0.120
4|5   3.9382     2.4413   1.613
```

```
formula: PU1 ~ v_dyn (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -30.72 67.44 6(0)  7.16e-10 1.6e+03

Coefficients:
      Estimate Std. Error z value Pr(>|z|)
v_dyn   0.2686     0.2774   0.968    0.333

Threshold coefficients:
    Estimate Std. Error z value
3|4   -1.540      1.270  -1.213
4|5    1.667      1.176   1.418
```

Analysis: PU1 is not affected by dynamic map

HYP08D: PU1 Affected by metadata

```
formula: PU1 ~ v_mta (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -29.67 65.35 6(0)  9.29e-08 7.5e+02

Coefficients:
      Estimate Std. Error z value Pr(>|z|)
v_mta   0.7057     0.4041   1.746   0.0807 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
    Estimate Std. Error z value
3|4 -0.01566    1.53935  -0.010
4|5  4.38994    1.73313   2.533
```

```
formula: PU1 ~ v_mta (clog-log link function)

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -28.57 63.15 6(0)  1.36e-08 9.7e+02

Coefficients:
      Estimate Std. Error z value Pr(>|z|)
v_mta   0.6019     0.2607   2.309   0.0209 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
    Estimate Std. Error z value
3|4  -0.4665     0.9846  -0.474
4|5   3.0494     1.1062   2.757
```

Analysis: According to the model with the clog-log link function PU1 is affected by metadata.

5. Influence of the usage of different registrations

This section reports the results of the relevantant hypotheses. Most of the tested hypotheses where not significant and can be consulted in the log files provided in APPENDIX IV.

HYP09: Type of registration affects PU1 (Info needs)

```
Ordinal regression

formula:
f_PU1 ~ data_ind_bag + data_ind_gbkn + data_ind_top10nl + data_ind_lki +
    data_ind_akr (logit link function)

 link  threshold nobs logLik AIC   niter max.grad cond.H
 logit flexible  44   -27.32 68.63 7(0)  1.34e-09 3.4e+02

Coefficients:
                 Estimate Std. Error z value Pr(>|z|)
data_ind_bag       1.7252     1.3145   1.312   0.1894
data_ind_gbkn      3.7433     1.7157   2.182   0.0291 *
data_ind_top10nl  -0.1302     0.9525  -0.137   0.8913
data_ind_lki      -0.6971     1.0550  -0.661   0.5087
data_ind_akr       0.9614     1.1452   0.839   0.4012
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
    Estimate Std. Error z value
3|4    1.372      1.881   0.729
4|5    6.522      2.482   2.627
```

```
formula: f_PU1 ~ data_ind_bag + data_ind_gbkn + data_ind_top10nl + data_ind_lki
+      data_ind_akr

 link    threshold nobs logLik AIC   niter max.grad cond.H
 cloglog flexible  44   -26.72 67.44 7(0)  1.92e-09 6.9e+02

Coefficients:
                 Estimate Std. Error z value Pr(>|z|)
data_ind_bag       1.2598     1.0057   1.253   0.2104
data_ind_gbkn      3.1078     1.4568   2.133   0.0329 *
data_ind_top10nl  -0.2750     0.5990  -0.459   0.6462
data_ind_lki      -0.4638     0.6323  -0.734   0.4632
data_ind_akr       0.7048     0.7114   0.991   0.3218
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
    Estimate Std. Error z value
3|4   0.5547     1.4780   0.375
4|5   4.5135     1.9975   2.260
```

Analysis: The frequency of use of large scale topography affects information needs (PU1). The model with the clog-log link probably fits better due to the smaller value of the AIC.

HYP10: Type of registration affects PU2 (Insight in map accuracy)

```
Spearman's rank correlation rho

data:  data_ind_gbkn and viz24_dyn_ins
S = 9063.025, p-value = 0.01597
alternative hypothesis: true rho is not equal to 0
sample estimates:
     rho
0.361309
```

Analysis: Frequency of use of large scale topography partially affects insight in map accuracy through dynamic visualization

HYP10: Type of registration affects PEU1 (interpretation)

```
Spearman's rank correlation rho

data:  data_ind_gbkn and viz25_dyn_interp
S = 8675.345, p-value = 0.009133
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.3886297
```

Analysis: Frequency of use of large scale topography partially affects the perceived ease of use of dynamic visualization

HYP11: The use of registrations affect PEU1

```
formula: f_PEU1 ~ data_ind_bag + data_ind_gbkn + data_ind_top10nl + data_ind_lki
+      data_ind_akr (clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -50.63 119.27 5(0)  2.80e-07 4.8e+02

Coefficients:
                 Estimate Std. Error z value Pr(>|z|)
data_ind_bag       0.6245     0.5658   1.104   0.2697
data_ind_gbkn      0.3956     0.7629   0.519   0.6040
data_ind_top10nl   0.3553     0.5475   0.649   0.5164
data_ind_lki       1.3118     0.6168   2.127   0.0334 *
data_ind_akr      -1.2589     0.6203  -2.029   0.0424 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Threshold coefficients:
      Estimate Std. Error z value
3|3.5  -0.6107     0.9872  -0.619
3.5|4   0.3053     0.9723   0.314
4|4.5   2.2825     1.0565   2.160
4.5|5   2.9141     1.0883   2.678
```

Analysis: Frequency of use of large Cadastral data affects the perceived ease of use of dynamic visualization.

HYP12: Type of Registration affects PEU2:adaptability of visualizations

```
 summary(clm(f_PEU2~data_ind_bag+data_ind_gbkn+data_ind_top10nl+data_ind_lki+dat
a_ind_akr,link="cloglog"))
formula: f_PEU2 ~ data_ind_bag + data_ind_gbkn + data_ind_top10nl + data_ind_lki
+ data_ind_akr (clog-log link function)

 link    threshold nobs logLik AIC    niter max.grad cond.H
 cloglog flexible  44   -65.69 155.39 7(0)  1.38e-07 7.5e+02

Coefficients:
                 Estimate Std. Error z value Pr(>|z|)
data_ind_bag      0.09826    0.50355   0.195    0.845
data_ind_gbkn     1.15367    0.73173   1.577    0.115
data_ind_top10nl -0.23519    0.47731  -0.493    0.622
data_ind_lki      0.01647    0.51191   0.032    0.974
data_ind_akr      0.22233    0.48392   0.459    0.646

Threshold coefficients:
      Estimate Std. Error z value
1.5|2  -2.7580     1.3138  -2.099
2|2.5  -2.0538     1.1092  -1.852
2.5|3  -1.6381     1.0333  -1.585
3|3.5  -0.0240     0.9128  -0.026
3.5|4   0.7627     0.9142   0.834
4|4.5   2.1179     0.9322   2.272
4.5|5   2.4798     0.9423   2.632
```

Analysis: Type of registration does not affect PEU2

HYP13C: Type of Registration affects use of dynamic map

```
Multivariate linear regression
Call:
v_dyn    <- rowMedians(cbind(viz24_dyn_ins,viz25_dyn_interp,viz26_dyn_adapt))
lm(formula = v_dyn ~ data_ind_bag + data_ind_gbkn + data_ind_top10nl +
    data_ind_lki + data_ind_akr)

Residuals:
    Min      1Q  Median      3Q     Max
-1.4176 -0.2191 -0.1793  0.5620  0.8706

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)       2.90385    0.45438   6.391 1.66e-07 ***
data_ind_bag      0.08419    0.25851   0.326   0.7464
data_ind_gbkn     1.14139    0.37476   3.046   0.0042 **
data_ind_top10nl  0.30856    0.22715   1.358   0.1823
data_ind_lki      0.06384    0.24653   0.259   0.7971
data_ind_akr     -0.32254    0.26336  -1.225   0.2282
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.585 on 38 degrees of freedom
Multiple R-squared: 0.2987,   Adjusted R-squared: 0.2065
F-statistic: 3.238 on 5 and 38 DF,  p-value: 0.01565
```

```
ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = lm(v_dyn ~ data_ind_bag + data_ind_gbkn + data_ind_top10nl +
data_ind_lki + data_ind_akr))

                     Value p-value                Decision
Global Stat        1.25103  0.8696 Assumptions acceptable.
Skewness           0.51486  0.4730 Assumptions acceptable.
Kurtosis           0.04176  0.8381 Assumptions acceptable.
Link Function      0.57602  0.4479 Assumptions acceptable.
Heteroscedasticity 0.11838  0.7308 Assumptions acceptable.
```

```
Spearman's rank correlation rho

data:  v_dyn and data_ind_gbkn
S = 7782.426, p-value = 0.002093
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.4515556
```

Analysis: The usage of type of registration partially affects the perceived the use of dynamic visualization