

A formalization of one of the main claims of “‘Dunbar’s number’ deconstructed” by Lindenfors et al. 2021¹

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Received 22 June 2021

Accepted 17 November 2021

Abstract. Lindenfors et al. claimed in previous work that the cortex size of humans does not relate to their social group size. We present here a formalization of that claim, stating that all things of class “relative neocortex size” that are in the context of a thing of class “social group” never have a relation of type “affects” to a thing of class “social group size” in the same context.

Keywords: Social group, relative neocortex size, social group size

1. Introduction

Lindenfors et al. [2] state that “A cognitive limit on human group size cannot be derived in this manner.”. We present here a formalization of the main scientific claim from this quote by using a semantic template called the super-pattern [1].

2. Formalization

Our formalization looks as follows:

CONTEXT-CLASS (“in the context of all ...”):	social group
SUBJECT-CLASS (“things of type ...”):	relative neocortex size
QUALIFIER:	never
RELATION-TYPE (“have a relation of type...”):	affects
OBJECT-CLASS (“to things of type...”):	social group size

¹As RDF/nanopublication: http://purl.org/np/RAbWbJCYlLhYBDn9PVxdJP_WUbbi058aRcK-3sOJsRwY

In the context class, we use “social group” (Q874405) from Wikidata. In the subject class, we use a new minted class “relative neocortex size” that is related to the class “size”(Q1152227) and “neocortex” (Q726562) from Wikidata. In the object class, we minted a new class “social group size” that is a subclass of “social group” (Q874405) from Wikidata.

3. RDF code

This is our formalization as a nanopublication in TriG format:

```
@prefix this: <http://purl.org/np/RAbWbJCYlLhLYBDn9PVxdJP_WUbbi058aRcK-3sOJsRwY> .
@prefix sub: <http://purl.org/np/RAbWbJCYlLhLYBDn9PVxdJP_WUbbi058aRcK-3sOJsRwY#> .
@prefix np: <http://www.nanopub.org/nschema#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix nt: <https://w3id.org/np/o/ntemplate/> .
@prefix npx: <http://purl.org/nanopub/x/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix orcid: <https://orcid.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix sp: <https://w3id.org/linkflows/superpattern/terms/> .

sub:Head {
  this: np:hasAssertion sub:assertion ;
  np:hasProvenance sub:provenance ;
  np:hasPublicationInfo sub:pubinfo ;
  a np:Nanopublication .
}
sub:assertion {
  sub:spi a sp:SuperPatternInstance ;
  rdfs:label "The cortex size of humans does not relate to their social group size" ;
  sp:hasContextClass <http://www.wikidata.org/entity/Q874405> ;
  sp:hasSubjectClass <http://purl.org/np/RAhnnsmwVM8M29NixCJfVDLWzRzwwCPnUD7LI2kxT-FME#relative-neocortex-size> ;
  sp:hasQualifier sp:neverQualifier ;
  sp:hasRelation sp:affects ;
  sp:hasObjectClass <http://purl.org/np/RAKYv_sE8qwiSqsRdcr7KrkU1bsqlqiFmhDptPBwpLrM#social-group-size> .
}
sub:provenance {
  sub:activity a sp:FormalizationActivity ;
  prov:used sub:quote , <https://royalsocietypublishing.org/doi/10.1098/rsbl.2021.0158> ;
  prov:wasAssociatedWith orcid:0000-0002-0191-7211 .
  sub:assertion prov:wasGeneratedBy sub:activity .
  sub:quote prov:value "A cognitive limit on human group size cannot be derived in this manner." ;
  prov:wasQuotedFrom <https://royalsocietypublishing.org/doi/10.1098/rsbl.2021.0158> .
}
sub:pubinfo {
  sub:sig npx:hasAlgorithm "RSA" ;
  npx:hasPublicKey "MIGfMA0GCSqGSIb3DQEBQQUAA4GNADCBiQKBgQC3cICbOHZ1ecuL0sgovKwU1FRrvNWNGBJxoxCFAYWtU2OK97i/
SjoIaxFphg9tkv9WxOjtPqYJ4cuM0E76wxerZ7VBMHBrBlyCAGTvaFESWVQZCDgulG46VjffEzXuRmqOka/
C5Ur6beLijfPMtiWEg6I2Mbj8z9vuHPxReIu4JwIDAQAB" ;
  npx:hasSignature "ZFigsQHif/2IZT/QsVTqDThjV1P0Uy4IkGEmOC8W/Iygn8sGpJt4DOBDLDrT2egAwiesYqFqVqSDQnWCeY2C/
yaV1ob6j49CYLZor+VZQo1HdsGvEq3V7xiLobl/w4sMPxA690y9DF5zP8w3wggXaJxMjrAESSCpaPxtnKGht0=" ;
  npx:hasSignatureTarget this: .
  this: dct:created "2021-11-17T18:03:20.686+01:00"^^xsd:dateTime ;
  dct:creator orcid:0000-0002-0191-7211 ;
  npx:introduces sub:spi ;
  npx:supersedes <http://purl.org/np/RA7MgxMCCvYkE2RBJHm-Ou_CuuhPXqfciinswtIfjXReOc> ;
  <https://w3id.org/linkflows/reviews/isUpdateOf> <http://purl.org/np/RAYJelruxzvy8idQGuxziYN4ri80FeKZxzK-QdJpVdug0> ;
  nt:wasCreatedFromProvenanceTemplate <http://purl.org/np/RAB_oy10D3XUP-zYlGz7Uj58AsUXhEKeGgmRFg5LSgDM> ;
  nt:wasCreatedFromPubinfoTemplate <http://purl.org/np/RA2vCBXzf-icBcVRGhulJXugTGxpsV5yVr9yqCI1bQh4A> ,
<http://purl.org/np/RAA2MfQdBczmz9yVwJkLXNbyfBNcwsMm0qcNuxkklmaIM> ,
<http://purl.org/np/RAjpbMlw3owYhJUBo3DtsuDLXsNAJ8cnGeWAutDVjuAuI> ;
  nt:wasCreatedFromTemplate <http://purl.org/np/RAv68imZrEjfcP2rnEglhzoBqEvc0cQMtp9_1Za0BxNM4> .
}
```

The following nanopublications introduce the newly minted classes in TriG format.

This is the class definition of “relative neocortex size”:

```
@prefix this: <http://purl.org/np/RAhnnsmwVM8M29NixCJfVDLWzRzwwCPnUD7LI2kxT-FME> .
@prefix sub: <http://purl.org/np/RAhnnsmwVM8M29NixCJfVDLWzRzwwCPnUD7LI2kxT-FME#> .
@prefix np: <http://www.nanopub.org/nschema#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix nt: <https://w3id.org/np/o/ntemplate/> .
@prefix npx: <http://purl.org/nanopub/x/> .
```

```

@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix orcid: <https://orcid.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .

sub:Head {
  this: np:hasAssertion sub:assertion ;
  np:hasProvenance sub:provenance ;
  np:hasPublicationInfo sub:pubinfo ;
  a np:Nanopublication .
}
sub:assertion {
  sub:relative-neocortex-size a <http://www.w3.org/2002/07/owl#Class> ;
  rdfs:label "Relative size of the neocortex" ;
  skos:definition "This class signifies the weight or volume of a part of the brain called neocortex." ;
  skos:relatedMatch <http://www.wikidata.org/entity/Q322481> , <http://www.wikidata.org/entity/Q726562> .
}
sub:provenance {
  sub:assertion prov:wasAttributedTo orcid:0000-0002-0191-7211 .
}
sub:pubinfo {
  sub:sig npx:hasAlgorithm "RSA" ;
  npx:hasPublicKey "MIGfMA0GCsGqSIb3DQEBAQUAA4GNADCBiQKBgQC3cICbOHZ1ecuL0sgovKwU1FRRvNWNGBJxoxCFAYWtU20K97i/
SjoIaxFphg9tkv9WxOjtPgYU4cuM0E76wxeRZ7VBMHBrBIyCAGTVAfESVWQZCDgulg46VjffEzXuRmqOka/
C5Ur6beLijFPMTiWEg6I2Mbj8z9vuHPxReIu4JwIDAQAB" ;
  npx:hasSignature
"NMWYJ3I459BEn7NgKELsfNucMayG4MXMMjOrZm0h+g/5Mbu8vbLVhkSi5C9N+SGc67qW6YtdndVxrMS7qpWfzUTv+FzVOgyGqs30VKUC5F0TNBzvTnTnVt9Bq61
oQ5cNIXUHeF6/Mqte2auchZPLgY8yap3ImLEaNTWwdQpTM=" ;
  npx:hasSignatureTarget this: .
  this: dct:created "2021-10-19T14:07:44.194+02:00"^^xsd:dateTime ;
  dct:creator orcid:0000-0002-0191-7211 ;
  npx:introduces sub:relative-neocortex-size ;
  npx:supersedes <http://purl.org/np/RAIwMZ0StXU9DCY1WGoJmWd2Nac30mijCb0FmL8TXIB0Y> ;
  <https://w3id.org/linkflows/reviews/isUpdateOf> <http://purl.org/np/RAIwMZ0StXU9DCY1WGoJmWd2Nac30mijCb0FmL8TXIB0Y> ;
  nt:wasCreatedFromProvenanceTemplate <http://purl.org/np/RANwQa4ICWS5SOjw7gp99nBpXBasapwTZP1fIM3H2gYTM> ;
  nt:wasCreatedFromPubinfoTemplate <http://purl.org/np/RAA2MfqdBczmz9yVwJkLXNbyfBNcwsMmOqcNuxkk1maIM> ,
<http://purl.org/np/RAOGu9Lh0BD4tbIRB9RG6RGRA_ObDh75NTbIqaWgxxs8M> ,
<http://purl.org/np/RAjpbMlw3owVhJUBo3DtsuDLXsNAJ8cnGeWAutDVjuAuI> ;
  nt:wasCreatedFromTemplate <http://purl.org/np/RAdpgRpigXt8iPV9uOpf3wIT3qzOI8Sg2Q72CNV8g-Yo> .
}

```

This is the class definition of “social group size”:

```

@prefix this: <http://purl.org/np/RALKYv_sE8qwiSqsRdcr7KrkUlbsqlqiFmhDPTPBwPlrM> .
@prefix sub: <http://purl.org/np/RALKYv_sE8qwiSqsRdcr7KrkUlbsqlqiFmhDPTPBwPlrM> .
@prefix np: <http://www.nanopub.org/nschema#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix nt: <https://w3id.org/np/o/ntemplate/> .
@prefix npx: <http://purl.org/nanopub/x/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix orcid: <https://orcid.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .

sub:Head {
  this: np:hasAssertion sub:assertion ;
  np:hasProvenance sub:provenance ;
  np:hasPublicationInfo sub:pubinfo ;
  a np:Nanopublication .
}
sub:assertion {
  sub:social-group-size a <http://www.w3.org/2002/07/owl#Class> ;
  rdfs:label "Social group size" ;
  rdfs:subClassOf <https://www.wikidata.org/wiki/Q874405> ;
  skos:definition "Social group size is the size of a group of humans that a person socially interacts with (on a regular
basis)." .
}
sub:provenance {
  sub:assertion prov:wasAttributedTo orcid:0000-0002-0191-7211 .
}
sub:pubinfo {
  sub:sig npx:hasAlgorithm "RSA" ;
  npx:hasPublicKey "MIGfMA0GCsGqSIb3DQEBAQUAA4GNADCBiQKBgQC3cICbOHZ1ecuL0sgovKwU1FRRvNWNGBJxoxCFAYWtU20K97i/
SjoIaxFphg9tkv9WxOjtPgYU4cuM0E76wxeRZ7VBMHBrBIyCAGTVAfESVWQZCDgulg46VjffEzXuRmqOka/
C5Ur6beLijFPMTiWEg6I2Mbj8z9vuHPxReIu4JwIDAQAB" ;
  npx:hasSignature
"WBZ10x+hSX0zXoXQAGBkM89SWDOnViMI8NoLH8w1GsJOWSjT/pasNugo6CEDZkwb5ZyHsXSSzG7JDCldnhVQkH64Nuok6C3QvV9+EUVMZaDhByMhObzJ3Pld8p
YNHwT1wNve4xkb91Mzq5zYfBw+Y4ufB5Kqi39zHldr6XRZRo=" ;
  npx:hasSignatureTarget this: .
  this: dct:created "2021-06-22T09:49:42.152Z"^^xsd:dateTime ;
}

```

```
dct:creator orcid:0000-0002-0191-7211 ;
npx:introduces sub:social-group-size ;
nt:wasCreatedFromProvenanceTemplate <http://purl.org/np/RANwQa4ICWS5SOjw7gp99nBpXBasapwtZF1fIM3H2gYTM> ;
nt:wasCreatedFromPubinfoTemplate <http://purl.org/np/RAA2MfqdBcZmz9yVWjKLXNbyfBNcwsMmOgcNUxkk1maIM> ;
nt:wasCreatedFromTemplate <http://purl.org/np/RAdpgRpigXtt8iPV9uOPf3wIT3qzOI8Sg2Q72CNV8g-Yo> .
}
```

References

- [1] C.I. Bucur, T. Kuhn, D. Ceolin and J. van Ossenbruggen, Expressing high-level scientific claims with formal semantics, in: *Proceedings of the 11th Knowledge Capture Conference 2021*, 2021. doi:[10.1145/3460210.3493561](https://doi.org/10.1145/3460210.3493561).
- [2] P. Lindenfors, A. Wartel and J. Lind, 'Dunbar's number' deconstructed, *Biol. Lett.* (2021). doi:[10.1098/rsbl.2021.0158](https://doi.org/10.1098/rsbl.2021.0158).