Who is collaborating with whom? Part II. Application of the methods to male and to female networks

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ABSTRACT

The theoretical approach of the mathematical model of Social Gestalts and the corresponding methods for the 3-D visualization and animation of collaboration networks are presented in Part I. The application of these new methods to male and female networks is shown in Part II. After regression analysis the visualized Social Gestalts are rather identically with the corresponding empirical distributions ($R^2 > 0.99$). The structures of female co-authorship networks differ markedly from the structures of the male co-authorship networks. For female co-author pairs' networks, accentuation of productivity dissimilarities of the pairs is becoming visible but on the contrary, for male co-author pairs' networks, accentuation of productivity similarities of the pairs is expressed.

1. Introduction and hypotheses

The theoretical approach of the mathematical model of Social Gestalts and the corresponding methods for the 3-D visualization and animation of collaboration networks are presented in Part I. The application of these new methods to male and to female networks as well as the results and suggestions for future research will be presented in the following sections.

There has been a rapid increase in studies of gender differences in science for many years (Dehdarirad, Villarroya, & Maite, 2014). In a pilot study (Kretschmer, Kundra, Beaver, & Kretschmer, 2012) we were able to compare different shapes of three Gestalts distinguishable by special different characteristic features (gender differences) of the three sets of people. The shapes of the two female overrepresented Gestalts differed markedly from the male overrepresented shape. We supposed it would be interesting to extend the analysis of these three-dimensional collaboration shapes further, to see whether a similar characterization holds, and whether we can find again differences between females and males in new collaboration shapes.

In conclusion – based on the above mentioned pilot study – we have applied this model to the data of the Turkish social sciences community from 2002 to 2007 (Ozel, Hildrun, & Theo, 2014) for comparison of all of the available gender patterns, beginning from the pilot study up to the present paper. Using these data sets the study presented in this paper is focused on gender differences in co-authorship networks.

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Hypothesis 1.   Proof of the theoretical model:

- The shapes of Social Gestalts obtained by regression analysis conform to the shapes obtained by empirical data.
- The strength of visible similarities between two shapes are mirrored in the strength of similarities of their parameter values in the mathematical model. Vice versa, the differences between the parameter values of two shapes increase with the increasing dissimilarities of their shapes.

Hypothesis 2.   Supposing, special different characteristic features of two sets of people are given by female and male networks: different shapes of Social Gestalts can emerge.
      Example:
      The shape of a set of co-authors, overrepresented by male authors looks different from the shape of a set of co-authors, overrepresented by female authors.
      Consequently, the parameter values of the male shapes are different from the parameter values of the female shapes.

2. Data

We were inspired by the gender results of a previous study by Kretschmer et al. (2012) to test further whether there are special principles of gender differences in co-authorship network structures. In conclusion we have applied this model to the data of the Turkish social sciences community from 2002 to 2007 (Ozel et al., 2014) for comparison of the different 3-D patterns showing different shapes.

There are six bibliographies in total with more than 2000 authors per bibliography and $i'(\text{bin}) = j'(\text{bin}) \geq 8$. Three of the bibliographies are already used in Kretschmer et al. (2012) and the three others are obtained from Turkish data.

2.1. Data used by Kretschmer et al. (2012)

- Abbreviated as: *PNAS*
    Data obtained from the journal *PNAS* (1980–1998). Papers: 32,486; authors: 80,058. The data were provided by SCI and already used in (Kretschmer & Kretschmer, 2009).
- Abbreviated as: *PWQ*
    Data obtained from the journal "Psychology of Women Quarterly" (1976–2011). Papers: 1146; authors: 2569.
- Abbreviated as: *Gender ALL 14*
    A collection of data obtained from 14 journals of gender studies are based on a data sample of 8649 papers published during the years 1976–2011 written by 12,691 authors in all; 10,867 of them are females ($\approx$0.856) and 1823 males ($\approx$0.144), which makes $\approx$0.17 male-to-female ratio.

2.2. New Turkish data collected by Ozel et al. (2014)

- Abbreviated as: *Turkish All*
    Data obtained from the Social Sciences bibliography of national level publications, Turkey (2002–2007). Papers: 7835; authors: 6738. There are 2565 female authors ($\approx$0.38) and 4173 male authors ($\approx$0.62), which makes $\approx$1.6 male-to-female ratio. The data were provided by the Turkish Academic Network and Information Centre (ULAKBIM) and already used in the paper by Ozel et al. (2014).
- Abbreviated as *Turkish Female*
    The co-author pairs (female with female) obtained from the 2565 female authors are studied.
- Abbreviated as *Turkish Male*
    The co-author pairs (male with male) obtained from the 4173 male authors are studied.

Table 1 is delivering a short overview regarding the gender overrepresentation in the six bibliographies.

Table 1
The six studied bibliographies separated in male and female overrepresented groups according to the percentages of males.

Overrepresentation	Bibliography	Percentages of males
Male overrepresented	Turkish Male	100
	PNAS	$\approx$75
	Turkish All	$\approx$65
Female overrepresented	PWQ	$\approx$15
	Gender ALL 14	$\approx$15
	Turkish Female	0