The Sensitivity of Organisational Gender Ratios to Cognitive Bias

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Promotion Bias

"If you have a brain, you are biased." *[Saville J, 2016]*

In 1996, Martell *et al.* published in *American Psychologist* a paper *Male-Female Differences: A Computer Simulation* which gave the following results for an organisation of 1,425 staff comprising 50/50 men/women in 9 levels of hierarchy. In the simulation, staff were promoted until all original staff had been replaced.

- A tiny1% promotion bias towards men in all promotions changed the top management level reporting to the CEO from 5 men and 5 women to 6.5 men and 3.5 women

- A 5% promotion bias towards men in all promotions changed the top management level reporting to the CEO from 5 men and 5 women to 7.1 men and 2.9 women.

This is a surprising result, given the difficulty of detecting such low levels of bias in personal or panel promotion decisions.

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These results show the high sensitivity of an organisation to consistent promotion bias. But his model was unnecessarily complicated and the simulation was simplistic and it over-stated the effect of bias on the gender structure of an organisation.
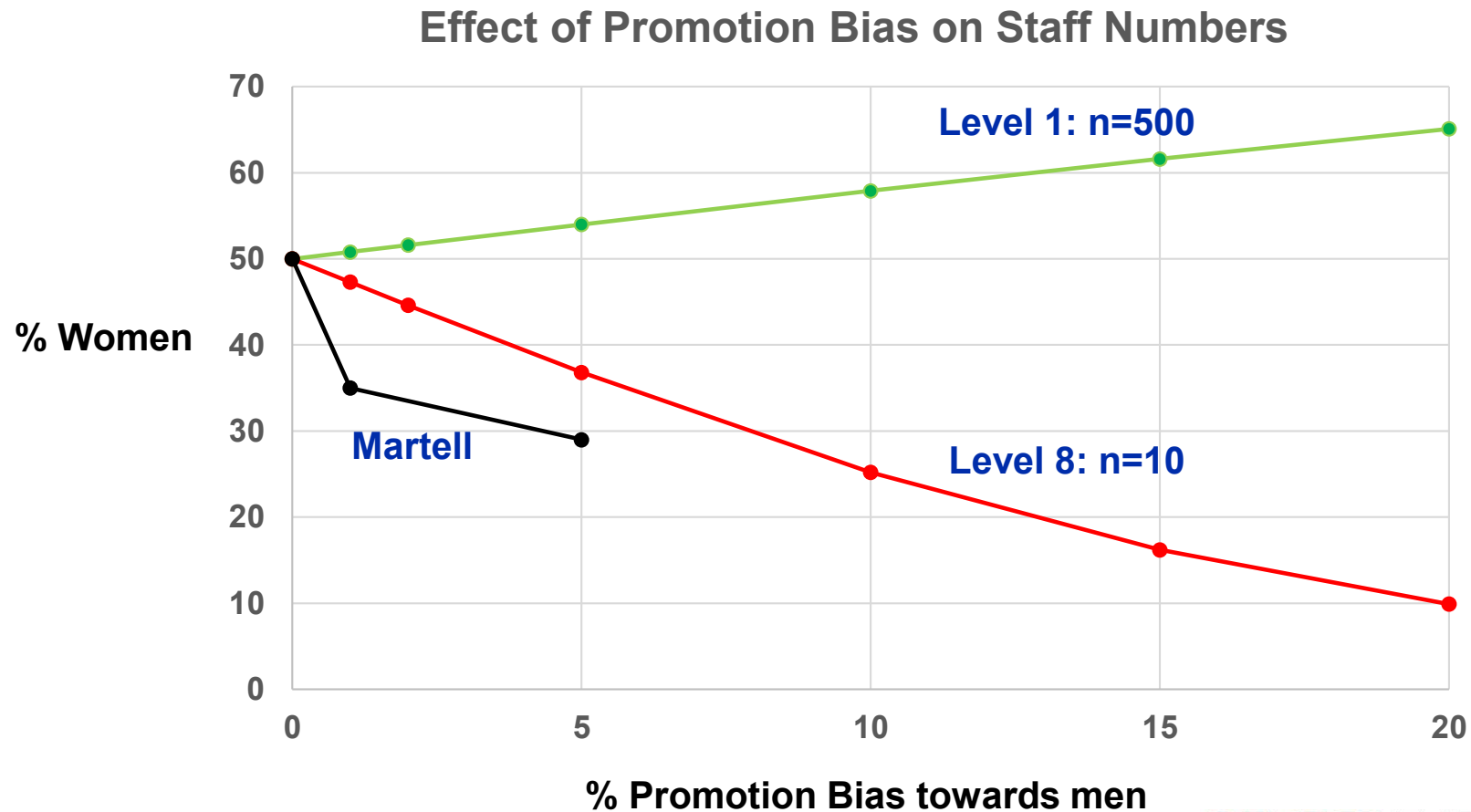
Nevertheless, the gender structure of an organisation <u>is</u> highly sensitive to bias in recruitment and promotion decisions.

To illustrate this, a mathematical model of an organisation of any size and shape at steady state was developed. The organisation in Martell's paper was modelled, with the following assumptions:

- gender is a binary concept (an oversimplification of reality)
- no recruitment bias, i.e. equal numbers of men and women joined
- no leaving bias, i.e. equal numbers of men and women left.

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Results of steady-state mathematical modelling of Martell's organisation with 9 management levels and 1,425 staff, with Martell's published results:

Effect of Promotion Bias on Staff Numbers

% Women (y-axis: 0 to 70)

% Promotion Bias towards men (x-axis: 0 to 20)

Level 1: n=500

Level 8: n=10

Martell

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Using the steady-state mathematical model, the table below shows the effect of consistent, small promotion biases favouring men on the composition of the top executive team of 10 staff.

Promotion Bias %	# Men at exec level	# Women at exec level
0	5	5
4	6	4
8	7	3
13	8	2
20	9	1

Even a 20% bias could be difficult to detect in personal or panel promotion decisions when you consider the number of relevant cognitive biases (5+) and how such promotion decisions are actually made.

These results explain how patriarchal systems have continued to run countries, businesses, universities, religions, etc. over millennia!

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In principle, with some assumptions, mathematical or simulation models of the staff structure of any organisation could be used to estimate the amount of bias in each of staff recruitment, promotion and departure decisions.

Accordingly, a simulation model was developed in *Python* to represent an organisation of any size and gender profile. The model starts with the exact gender composition of each level of the organisation and:

- ejects a person from a weighted randomly chosen level
- using promotion bias, promotes a man or woman from the level below to fill the vacancy
- repeats the process until the bottom level is reached, where a new person is recruited to fill that vacancy, using recruitment bias
- repeats the above processes in many iterations to convergence
- averages the above converged results in many more iterations.

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As an example, the actual gender profile from a few years ago of a large Australian resource company (with 2,531 men and 1,065 women across 6 levels) was simulated, and overall recruitment and promotion biases varied until they reflected the actual profile.

The *Python* simulation model compared random numbers to pre-set biases (probabilities) for every recruitment and promotion decision. The model converges using:

- a "warm-up" run of 1 million promotion iterations, then
- 2,000 iterations averaged 2,000 times.

This modelling assumed:

- equally suitable men and women were available in equal numbers for recruitment and there was no gender bias re staff who left
- all staff members were equally keen to be promoted to all levels
- recruitment occurred only at the bottom level.

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Level	# men actual	# men simulation	# women actual	# women simulation	Total
1	1109	1110	599	598	1708
2	878	878	351	351	1229
3	509	486	105	128	614
4	30	32	8	6	38
5	5	6	2	1	7

The results in the table above were obtained using:
- a recruitment bias of 48% favouring men, i.e. 74 men in 100
- a promotion bias of 21% favouring men, ie. 60.5 men in 100.

If needed, promotion biases at each level could be varied to model more exactly an organisation's gender profile, eg. at level 3 above.

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- equally suitable men and women were available in equal numbers for recruitment and there was no gender bias re staff who left
- all staff members were equally keen to be promoted to all levels
- recruitment occurred only at the bottom level.

Since the above assumptions could not be validated, it is inappropriate to estimate recruitment and promotion biases from outside the organisation. However both the mathematical and simulation models could be used within organisations to check whether such biases might be present in their recruitment and promotion processes.

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Conclusions:

- The gender profiles of organisations are very sensitive to consistent recruitment and/or promotion bias

- This can be demonstrated by mathematical or simulation modelling of an organisation of any size and gender profile

- Modelling of actual organisations should be done only from within where all relevant data and information can be used to accurately estimate recruitment and promotion biases

- Staff making recruitment and promotion decisions should undertake training in mitigation of bias (both unconscious and conscious) for less-biased decision making.

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