NTNU – Trondheim
Norwegian University of
Science and Technology

Choosing the right type of graph

24 September 2019

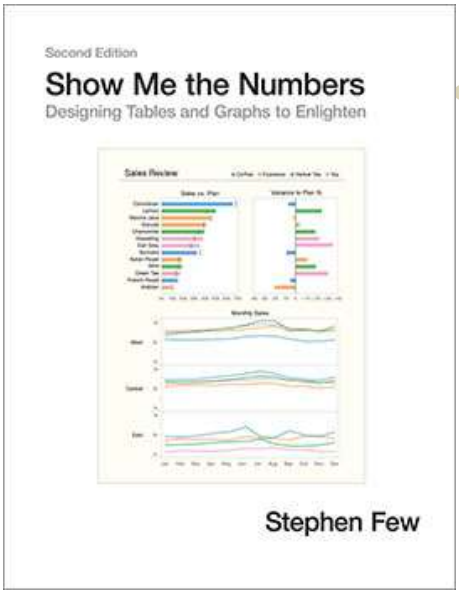
Stian Lydersen
Professor of Medical Statistics

Version 13 sept 2019

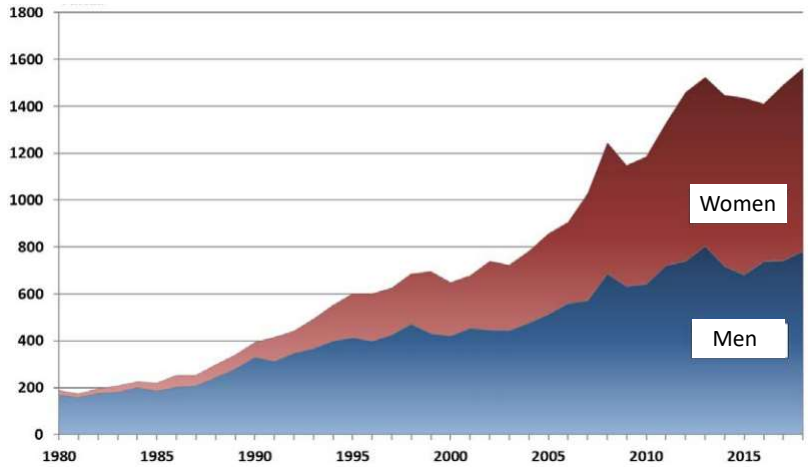
Presentation is based on

Few, Stephen:
«Show me the numbers.
Designing Tables and
Graphs to Enlighten.»
Analytics press, 2012

And my …
Publications in peer
reviewed journals
2 textbooks
Peer review of manuscripts
for medical journals



Number of PhD candidates per year in Norway



From
https://www.nifu.no/wp-content/uploads/2019/03/Figurer-og-tabeller-1980-2018.pdf

Number of PhD candidates per year in Norway 2005 to 2018

Dagens Næringsliv, 30 januar 2015:

15 år foran

Det tar 15 år før drikkevanene fra Oslo vest fanges opp i Trøndelag.

MAT OG DRIKKE

Eliese Lausten
Oslo

- Trendene har en tendens til å starte på Oslos vestkant, sier pressesjef Jens Nordahl i Vinmonopolet.

Han sitter dypt begravet i den ferske salgsstatistikken for 2014, som viser at det «lette og lyse» har tatt enda flere markedsandeler fra det «tunge og mørke» i løpet av året som gikk.

– Polet på Briskeby i Oslo har historisk sett alltid ligget først når det gjelder de store trendene. Normalt ligger det fra tre-fem år foran resten av Oslo, og Oslo ligger omtrent 11 år foran Trøndelag - hvor den siste, store trenden ser ut til å ha truffet sist. Det betyr at Briskeby er omtrent 15 år foran delene av landet hvor trenden har kommet kortest, forklarer Nordahl.

Han har lenge sett at brennevinssalget her har vært nedadgående. Rødvin er også på retur, mens hvitvin, rosévin og musserende vin øker. Foreløpig er det kun én mikrotrend som har spredt seg i de store byene samtidig: økningen i salget av sterkøl. Nordahl tror dette handler om flere ting.

– Trender sprer seg i samfunnet ved hjelp av mekanismer som personlige anbefalinger og sosiale nettverk. Innovatører plukker opp trenden først, og deretter sprer det seg.

Den første store makrotrenden som rørte på seg på Briskeby, oppsto på 60-tallet da folk begynte å bytte ut brennevin med vin.

– I 1967 ble det for første gang i historien solgt mer vin enn brennevin målt i vareliter på Briskeby i Oslo. Først i 1983 skjedde det samme i Tromsø og Bergen. Den trenden brukte rundt 16 år på å nå byene på samme «nivå».

Det siste Nordahl har lagt merke til på Briskeby, er salget av rosévin.

– Det rører på seg på en måte som gjør at vi tror at vi kan få en rosévinsvekst i landet om noen år. Vi ser også at fransk musserende og hvitvin er veldig populært her.

eliese.lausten@dn.no

bisbuzz »

Bisbuzz.no gir deg morsomme, nyttige og engasjerende saker fra Dagens Næringslivs verden – litt annerledes valgt ut – og litt annerledes presentert.

Les også:
- 1 av 3 unge kjøper ting de ikke har råd til
- Slik oppfattes norske sjefer av utlendinger
- 9 tips som gjør deg til en superpendler

Vinmonopolet på Briskeby i Oslo er den store trendsetteren. Foto: Fredrik Varfjell / NTB scanpix

Vinsalget

- Salget av hvitvin, rosévin og musserende vin øker.
- Rødvin er på retur.
- Brennevin er nedadgående.
- Musserende viner danket i 2010 ut brunt brennevin blant landets «de fire store» varegrupper.

Kilde: Vinmonopolet

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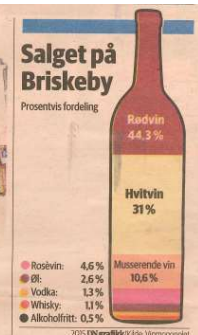
Vinmonopolet på Briskeby i Oslo er den store trendsetteren. Foto: Fredrik Varfjell / NTB scanpix



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Kilde: Vinmonopolet

From www.icmje.org («The Vancouver Guidelines»)

ICMJE INTERNATIONAL COMMITTEE of MEDICAL JOURNAL EDITORS

e. Results

Present your results in logical sequence in the text, tables, and figures, giving the main or most important findings first. Do not repeat all the data in the tables or figures in the text; emphasize or summarize only the most important observations. Provide data on all primary and secondary outcomes identified in the Methods Section. Extra or supplementary materials and technical details can be placed in an appendix where they will be accessible but will not interrupt the flow of the text, or they can be published solely in the electronic version of the journal.

Give numeric results not only as derivatives (for example, percentages) but also as the absolute numbers from which the derivatives were calculated, and specify the statistical significance attached to them, if any. Restrict tables and figures to those needed to explain the argument of the paper and to assess supporting data. Use graphs as an alternative to tables with many entries; do not duplicate data in graphs and tables. Avoid nontechnical uses of technical terms in statistics, such as "random" (which implies a randomizing device), "normal," "significant," "correlations," and "sample."

Separate reporting of data by demographic variables, such as age and sex, facilitate pooling of data for subgroups across studies and should be routine, unless there are compelling reasons not to stratify reporting, which should be explained.

EMPIRICAL ARTICLE

Neuropsychological Function in Patients with Anorexia Nervosa or Bulimia Nervosa

Siri Weider, Cand. Psychol[1,2]*
Marit Sæbø Indredavik, MD, PhD[3,4]
Stian Lydersen, PhD[3]
Knut Hestad, PhD[1,5]

ABSTRACT

Objective: This study explored the neuropsychological performance of patients diagnosed with anorexia nervosa (AN) or bulimia nervosa (BN) compared with healthy controls (HCs). An additional aim was to investigate the effect of several possible mediators on the association between eating disorders (EDs) and cognitive function.

Method: Forty patients with AN, 39 patients with BN, and 40 HCs who were comparable in age and education were consecutively recruited to complete a standardized neuropsychological test battery covering the following cognitive domains: verbal learning and memory, visual learning and memory, speed of information processing, visuospatial ability, working memory, executive function, verbal fluency, attention/vigilance, and motor function.

Results: The AN group scored significantly below the HCs on eight of the nine measured cognitive domains. The BN group also showed inferior performance on six cognitive domains. After adjusting for possible mediators, the nadir body mass index (lowest lifetime BMI) and depressive symptoms explained all findings in the BN group. Although this adjustment reduced the difference between the AN and HC groups, the AN group still performed worse than the HCs regarding verbal learning and memory, visual learning and memory, visuospatial ability, working memory, and executive functioning.

Discussion: Patients with EDs scored below the HCs on several cognitive function measures, this difference being most pronounced for the AN group. The nadir BMI and depressive symptoms had strong mediating effects. Longitudinal studies are needed to identify the importance of weight restoration and treatment of depressive symptoms in the prevention of a possible cognitive decline.

Keywords: anorexia nervosa; bulimia nervosa; neuropsychology

(Int J Eat Disord 2014; 00:000–000)

nadir BMI than did the BN group. The level of depressive symptoms was significantly higher in both the AN group and the BN group than in the HC group. Furthermore, the AN group had a significantly higher level of depressive symptoms than did the BN group. Both patient groups also had a significantly higher EDI-2 score than did the HCs; however, there was no difference between the two patient groups.

Cognitive Outcome

The test scores and the summed indexes can be observed in **Figure 1** (data are shown in Supporting Information Table S2). After adjusting for demographic variables (age, sex, and education), the AN group scored significantly lower than did the BN group and the HCs on the composite *Z*-score for the entire battery, and the BN group scored significantly lower than did the HC group. Furthermore, the patients in the ED groups scored significantly below the HCs on the following indices: verbal learning and memory, visual learning and memory, visuospatial ability, working memory, executive functioning, and motor functioning. The two patient groups only differed in visuospatial ability and executive functioning, with the AN group scoring significantly below the BN group. Additionally, the AN group scored below the HCs in the speed of information processing and verbal fluency.

function, and motor function became nonsignificant. Adjusting for depressive symptoms resulted in the elimination of the difference between the AN group and the HCs in the speed of information processing and in verbal fluency. Adjusting for depressive symptoms also led to a loss of all significant differences between the BN group and the HCs.

Analyses were carried out to compare inpatients and outpatients on all summary measures adjusted for demographic variables. There were no differences in any measures between the inpatients and the outpatients with either AN or BN (data not shown).

Discussion

This study explored the neuropsychological functions of patients with AN or BN compared with HCs, using a broad neuropsychological test battery. To determine the association between EDs and cognitive difficulties, we adjusted for three possible confounders: age, sex, and education, and explored the effects of IQ, psychotropic medication: and possible disease-specific mediators, BMI, the nadir BMI, and depressive symptoms. Overall, the patients with EDs scored below the HCs. However, there was a strong, possibly mediating, effect of the nadir BMI and depressive symptoms, which totally

SUPPLEMENTARY TABLE 2. The General Linear Model of performance on the summary scores on the neuropsychological Test Battery Z-Scores in patients with anorexia nervosa and bulimia nervosa compared to healthy controls.

The data in Figure 1 is extracted from this table.

	AN				*BN*			
	N	B	CI	*p-value*	N	B	CI	*p-value*
Verbal learning and memory								
Adjusted for age, sex and education*	40	-1.080	-1.510, -0.651	<0.001	38	-0.550	-0.986, -0.113	0.014
+IQ	40	-0.828	-1.231, -0.425	<0.001	38	-0.482	-0.879, -0.085	0.018
+Medication	40	-1.160	-1.724, -0.597	<0.001	38	-0.747	-1.302, -0.192	0.009
+BMI	40	-1.254	-1.843, -0.664	<0.001	38	-0.572	-1.012, -0.132	0.011
+Nadir BMI	40	-1.075	-1.793, -0,356	0.004	38	-0.547	-1.081, -0.013	0.045
+ Depression	40	-0.703	-1.275, -0.131	0.016	38	-0.278	-0.799, 0.243	0.292
Visual learning and memory								
Adjusted for age, sex and education*	40	-1.027	-1.463, -0.591	<0.001	39	-0.548	-0.988, -0.108	0.015
+IQ	40	-0.642	-0.991, -0.293	<0.001	39	-0.450	-0.792, -0.109	0.010
+Medication	40	-1.372	-1.950, -0.795	<0.001	39	-0.918	-1.477, -0.359	0.002
+BMI	40	-1.305	-1.901, -0.709	<0.001	39	-0.583	-1.025, -0.142	0.010

This is the beginning of table S2. It contains 500 distinct numbers.

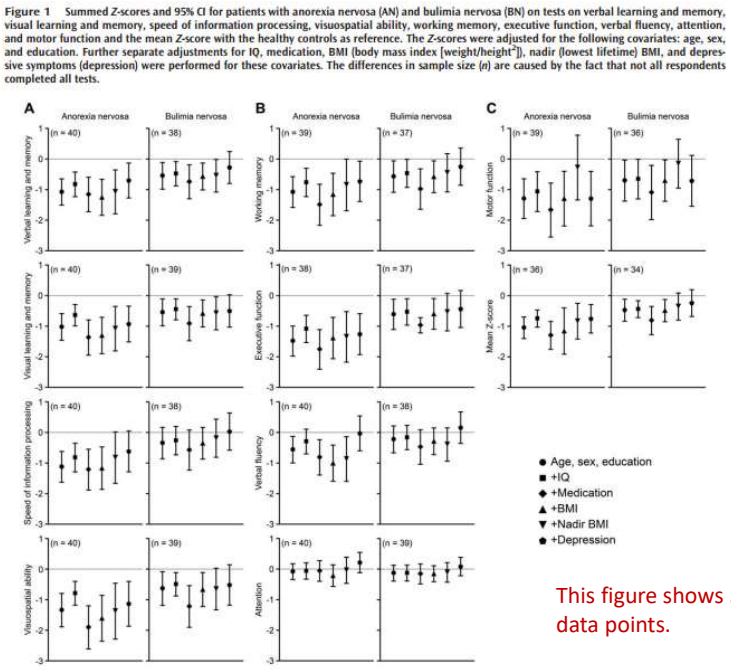


Figure 1 Summed Z-scores and 95% CI for patients with anorexia nervosa (AN) and bulimia nervosa (BN) on tests on verbal learning and memory, visual learning and memory, speed of information processing, visuospatial ability, working memory, executive function, verbal fluency, attention, and motor function and the mean Z-score with the healthy controls as reference. The Z-scores were adjusted for the following covariates: age, sex, and education. Further separate adjustments for IQ, medication, BMI (body mass index [weight/height^2]), nadir (lowest lifetime) BMI, and depressive symptoms (depression) were performed for these covariates. The differences in sample size (n) are caused by the fact that not all respondents completed all tests.

This figure shows 380 data points.

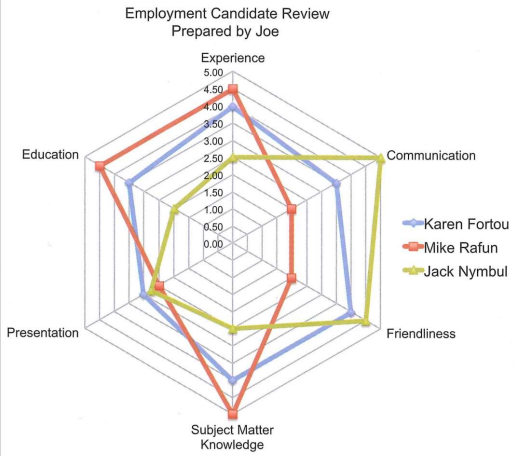


FIGURE 3.6 This radar chart presents aptitudes of job candidates in an overly complicated way.

Few (2012) page 42

Employment Candidate Review

Rating Areas	Candidates		
	Karen Fortou	Mike Rafun	Jack Nymbul
Experience	4.00	4.50	2.50
Communication	3.50	2.00	5.00
Friendliness	4.00	2.00	4.50
Subject matter knowledge	4.00	5.00	2.50
Presentation	3.00	1.50	2.75
Education	3.50	4.50	2.00
Average Rating	3.67	3.25	3.21

FIGURE 3.7 This table presents the same information as Figure 3.6 but in a way that is simple and clear.

Few (2012) page 43

Job Satisfaction By Income, Education, and Age

Income	College Degrees		No College Degrees	
	Under 50	50 & over	Under 50	50 & over
Up to $50,000	643	793	590	724
Over $50,000	735	928	863	662

FIGURE 3.13 This table displays measures of employee job satisfaction, divided into categories.

Few (2012) page 50

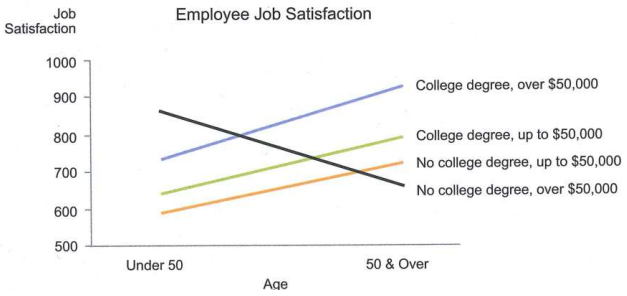


FIGURE 3.14 This graph causes the pattern represented by the black line to pop out.

Few (2012) page 50

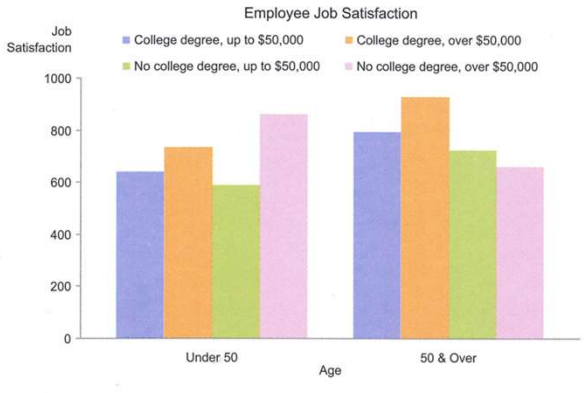


FIGURE 3.15 Unlike the graph in *Figure 3.14*, this graph does not make the pattern of decreasing job satisfaction among the one group of employees obvious.

This example is not based on real data, so if you make more than $50,000 a year but don't have a college degree and will soon turn 50, don't worry, you'll probably do just fine.

Few (2012) page 51

Examples of font types:

	serif	sans serif
proportional	Times New Roman	Calibri
not proportional (monospace)	Courier	SimHei

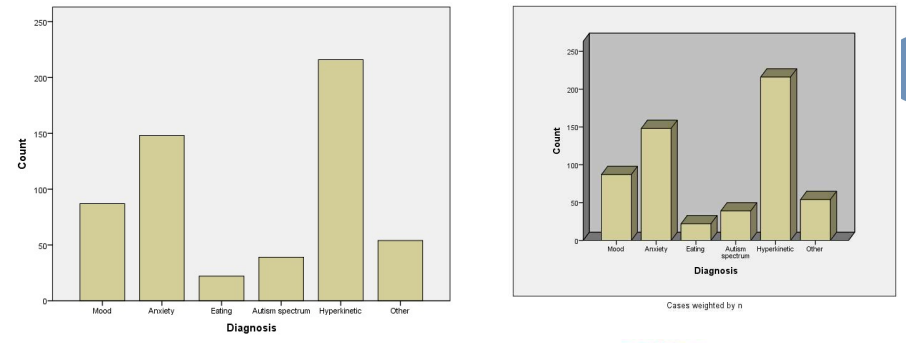
The above examples (except SimHei) have good legibility.

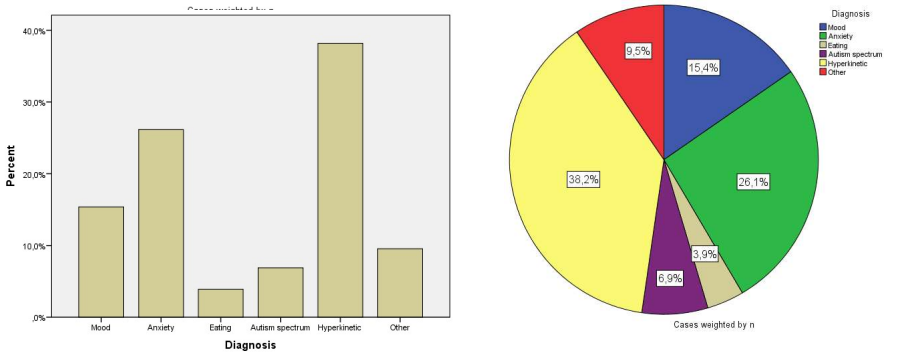
Proportional sans serif (such as calibri) is often recommended.

The CAP study: Diagnosis

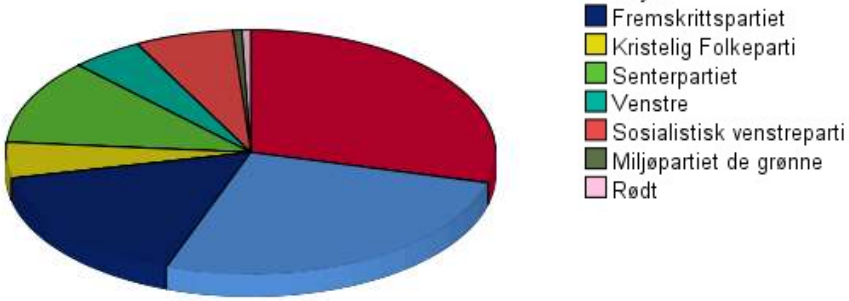
		Frequency	Percent
Valid	Mood	87	15,4
	Anxiety	148	26,1
	Eating	22	3,9
	Autism spectrum	39	6,9
	Hyperkinetic	216	38,2
	Other	54	9,5
	Total	566	100,0

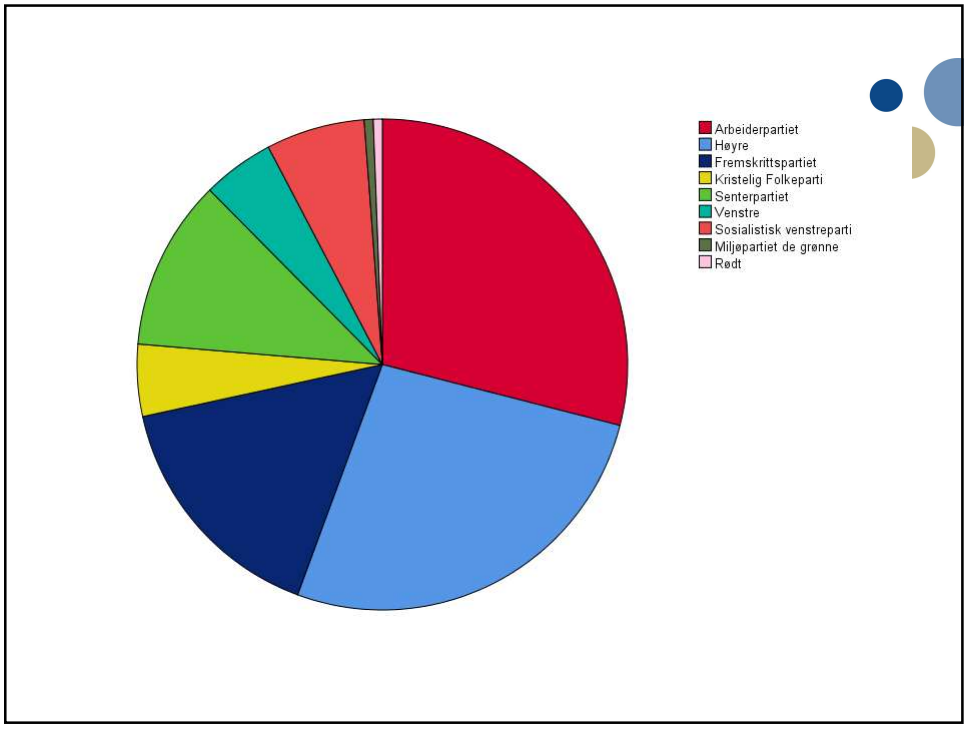
Mangerud, W. L., Bjerkeset, O., Lydersen, S., & Indredavik, M. S. (2014). Physical activity in adolescents with psychiatric disorders and in the general population. Child Adolesc. Psychiatry Ment. Health, 8(1)

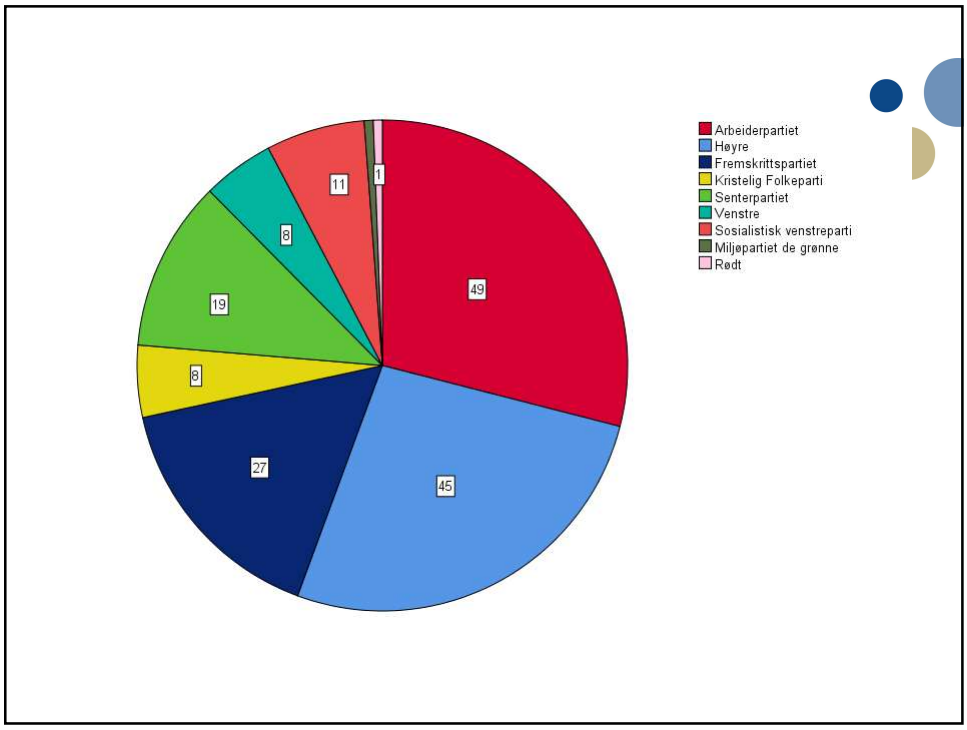




Stortinget representatnter 2017 - 2021




Arbeiderpartiet
Høyre
Fremskrittspartiet
Kristelig Folkeparti
Senterpartiet
Venstre
Sosialistisk venstreparti
Miljøpartiet de grønne
Rødt


Arbeiderpartiet
Høyre
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Senterpartiet
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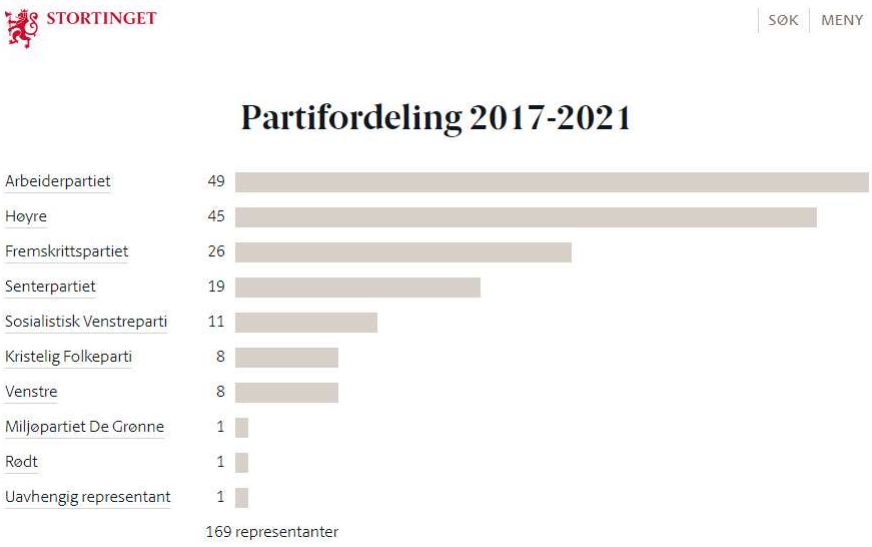


https://www.stortinget.no/no/Representanter-og-komiteer/

Pie charts:

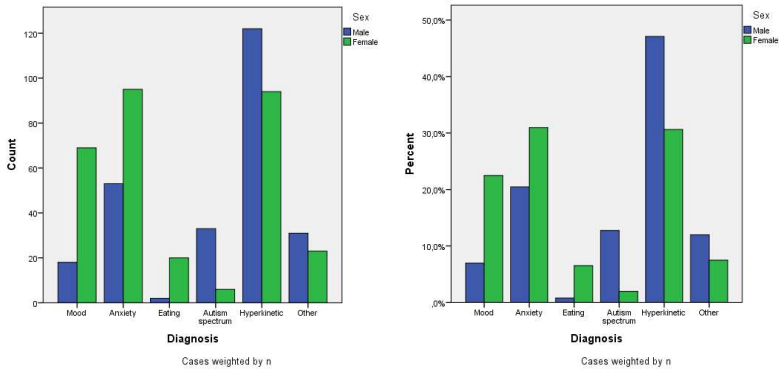
1. Do not use them!
2. Particulary: Do not use 3D pie charts!

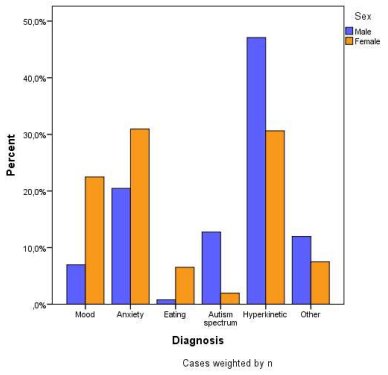
24

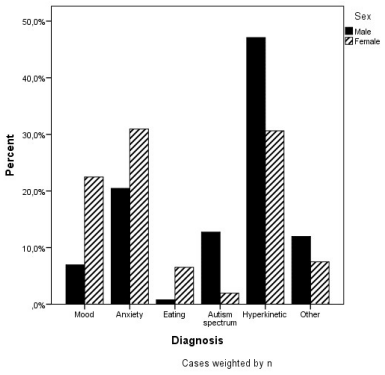
Diagnosis * Female Crosstabulation

Count

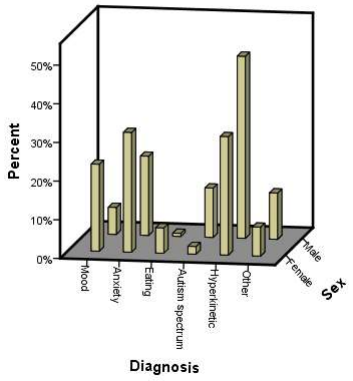
		Female		Total
		0	1	
Diagnosis	Mood	18	69	87
	Anxiety	53	95	148
	Eating	2	20	22
	Autism spectrum	33	6	39
	Hyperkinetic	122	94	216
	Other	31	23	54
Total		259	307	566

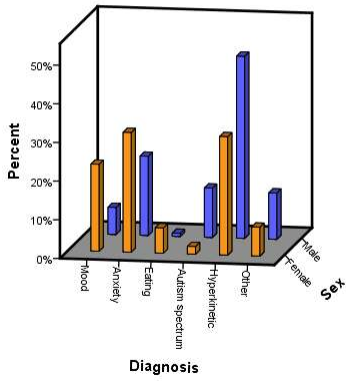






Few (2012) page 100: «Only use fill patterns as a last resort. Not only are they harder for our eyes to distinguish than colors, the van also play real havoc with our vision, causing a dizzying effect called *moiré vibration*.»

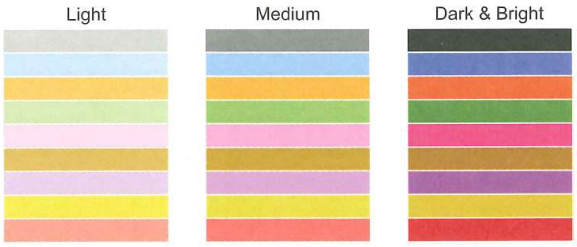




Few (2012) page 203:

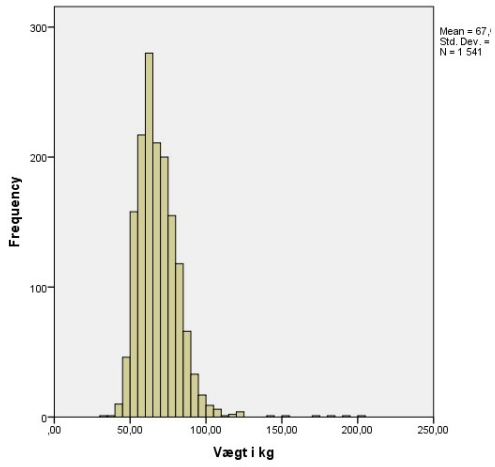
«Avoid 3-D displays of quantative data»

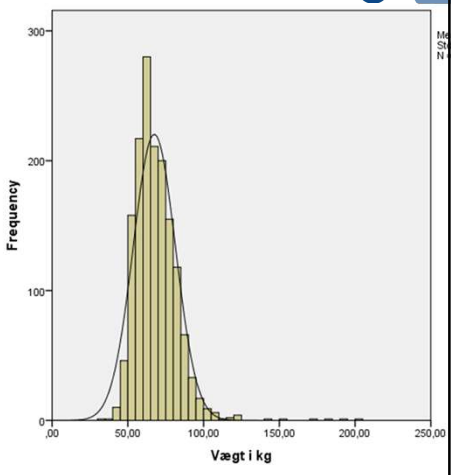
Choose colors that are distinguisable, also for the colorblind:



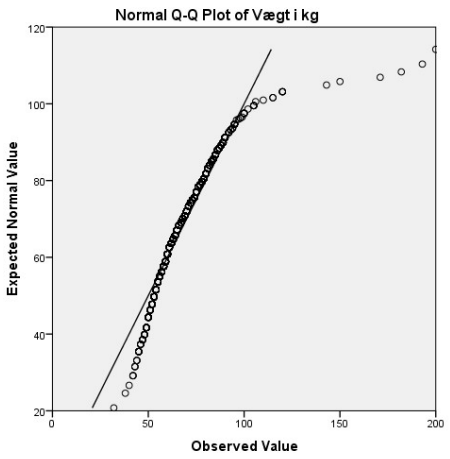
Another consideration when using hues to encode data is that about 10% of males and 1% of females suffer from colorblindness, unable to distinguish certain colors because of a lack of cones (color receptors) in the eye that detect a certain range of hue. Most people who are colorblind lack the cones that enable them to distinguish between red and green so that, to these viewers, both colors appear brown. When your audience is likely to include people who are color-blind, it is best to use only red or green, but not both, unless you are careful to vary their intensities sufficiently so that they appear different from one another.

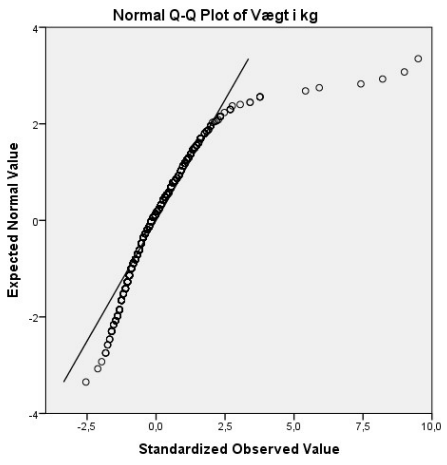
Few (2012), page 79





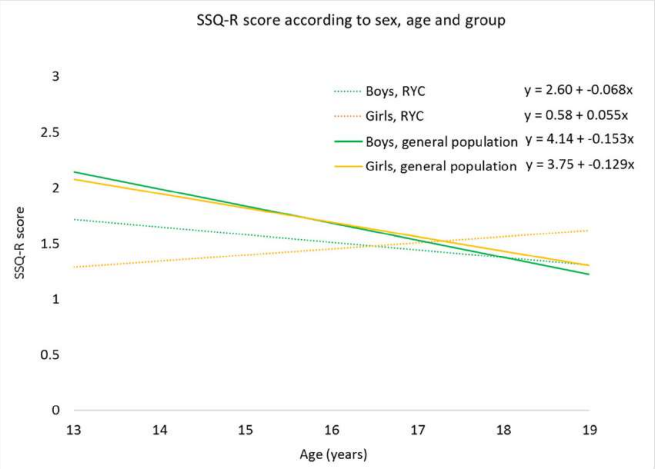
Mean = 64.48
SD = 13.94
N = 1541





Mean = 64.48
SD = 13.94
N = 1541

A Q-Q plot is well suited for detecting deviations from the normal distribution



Four variables:
SSQ-R (dependent variable)
Sex
Age
Group (RYC vs. general pop.)

Singstad, M. T., Wallander, J. L., Lydersen, S., Wichstrøm, L., & Kayed, N. S. (2019) Perceived social support among adolescents in Residential Youth Care. Child & Family Social Work.

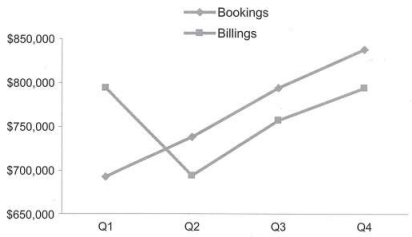


FIGURE 6.18 This graph uses differing symbol shapes to encode categorical subdivisions, in this case diamonds for bookings and squares for billings.

Different point shapes, like the squares and diamonds in the above graph, can be distinguished fairly easily but not as easily and rapidly as different colors. Nevertheless, there are times when using point shapes to encode categorical items comes in handy, such as when you've already used position and color for other categorical distinctions, as in the following graph:

FIGURE 6.19 This graph uses position, color, and symbol shapes to encode categorical items, in this case position for quarters of the year, color for bookings vs. billings, and symbol shapes for direct vs. indirect sales.

LINE STYLE

Varying line styles can be used to encode categorical items when the quantitative values are encoded as lines. Lines may be solid, dashed, dotted, and so on. Here's an example:

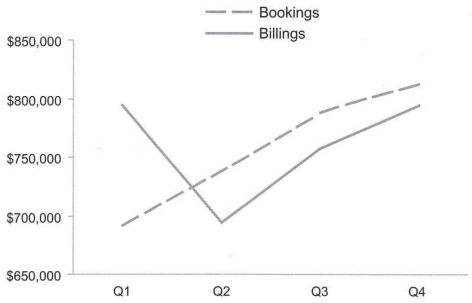


FIGURE 6.22 This graph uses line style, in this case a solid and a dashed line, to encode the categorical items of bookings and billings.

Line styles don't work as well as colors because lines are usually used to represent the pattern in an entire series of values, so breaks in the lines undermine our perception of the continuous series of values as a whole. Consequently, like fill patterns, line styles are best reserved for occasions when color printing is not an option. Differing the color intensity or thickness of lines usually works better.

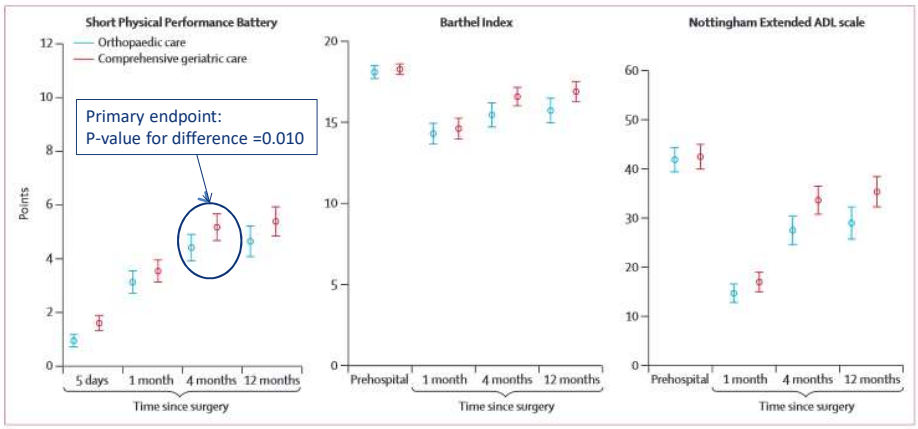
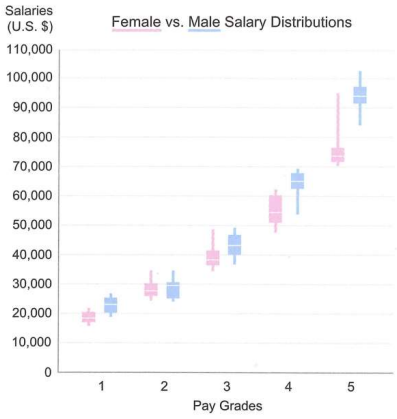


Figure 2: Mobility, activities of daily living, and instrumental activities of daily living
Data are mean, 95% CI. ADL=activities of daily living.

Prestmo, A., Hagen, G., Sletvold, O., Helbostad, J.L., Thingstad, P., Taraldsen, K., Lydersen, S., Halsteinli, V., Saltnes, T., Lamb, S.E., Johnsen, L.G., & Saltvedt, I. 2015. Comprehensive geriatric care for patients with hip fractures: a prospective, randomised, controlled trial. Lancet, 385, (9978) 1623-1633



Box plot:
Boksen angir nedre kvartil, median, og øvre kvartil.
Whiskers (følehår): Forskjellige definisjoner i forskjellig programvare.

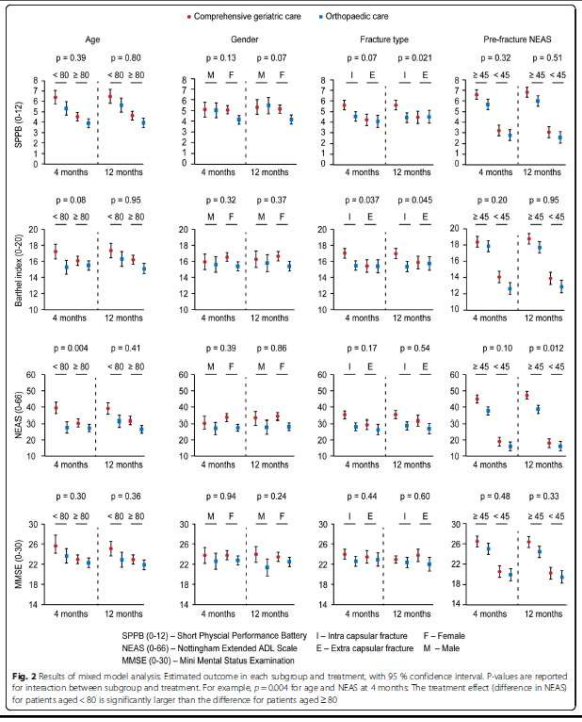
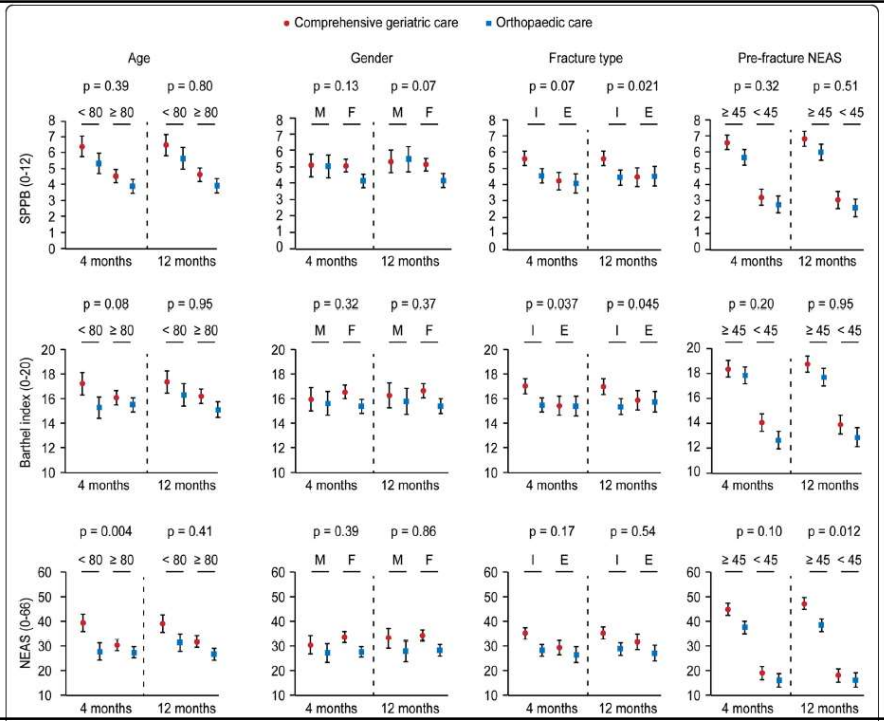
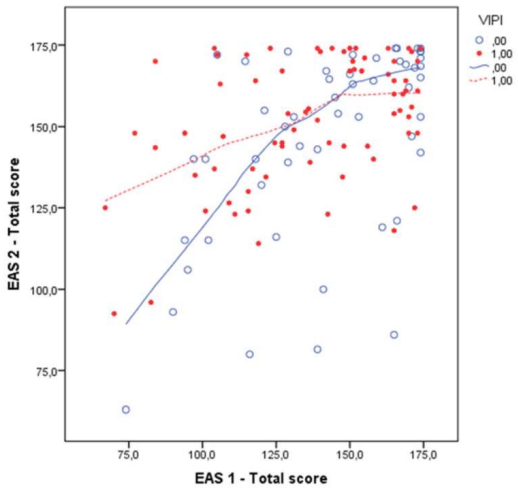


Fig. 2 Results of mixed model analysis. Estimated outcome in each subgroup and treatment, with 95 % confidence interval. P-values are reported for interaction between subgroup and treatment. For example, $p = 0.004$ for age and NEAS at 4 months. The treatment effect (difference in NEAS) for patients aged < 80 is significantly larger than the difference for patients aged ≥ 80

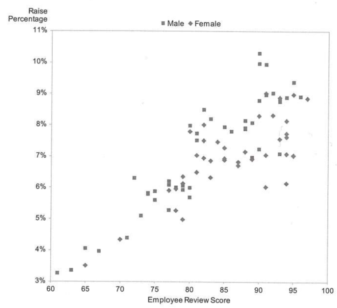
Prestmo, A., Saltvedt, I., Helbostad, J.L., Taraldsen, K., Thingstad, P., Lydersen, S., & Sletvold, O. 2016. Who benefits from orthogeriatric treatment? Results from the Trondheim hip-fracture trial. BMC.Geriatr., 16, (1) 49

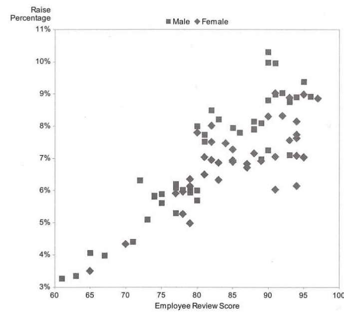


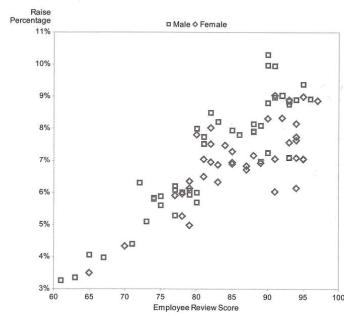
Scatter plot (spredningsplott) med LOESS regresjonslinjer for hver gruppe:



Emotional Availability Scales score at inclusion (T1) and after treatment (T2).
VIPI = 1(0) for the treatment group (TAU). (Høivik et al, 2015)

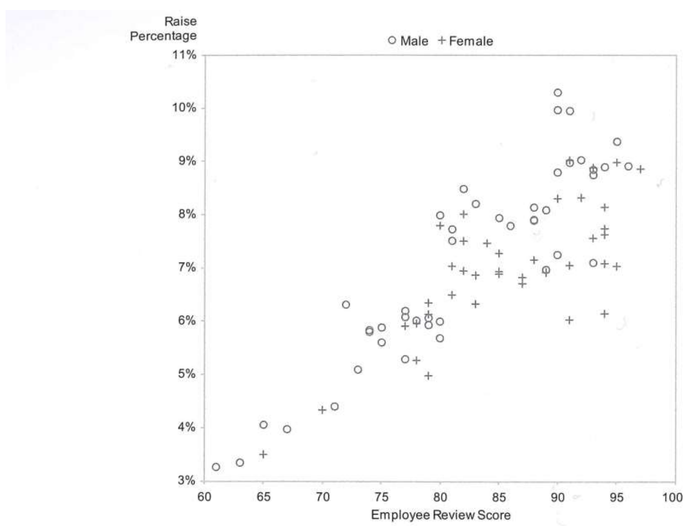






Plottesymboler:

Øke størrelsen og fjerne fyllfarge kan øke lesbarheten.



Some shapes that are easiest to distinguish from one another are the following:

Software:

- Statistics:
  - SPSS
  - Stata
  - R
  - …
- Excel
- Sigmaplot
- GraphPad Prism
- … and others which I have not used …

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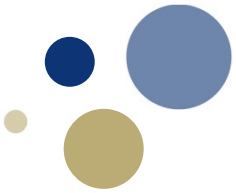
Thank you!



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