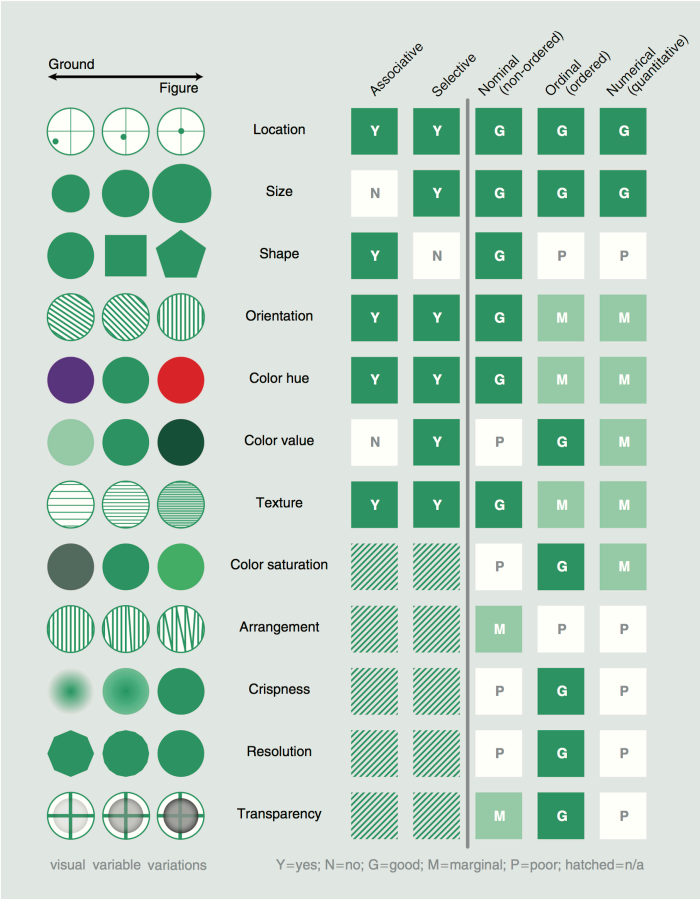


Figure 1 The visual variables and their syntactics. Figure derived from Bertin (1967/1983), MacEachren (1995), and MacEachren *et al.* (2012).

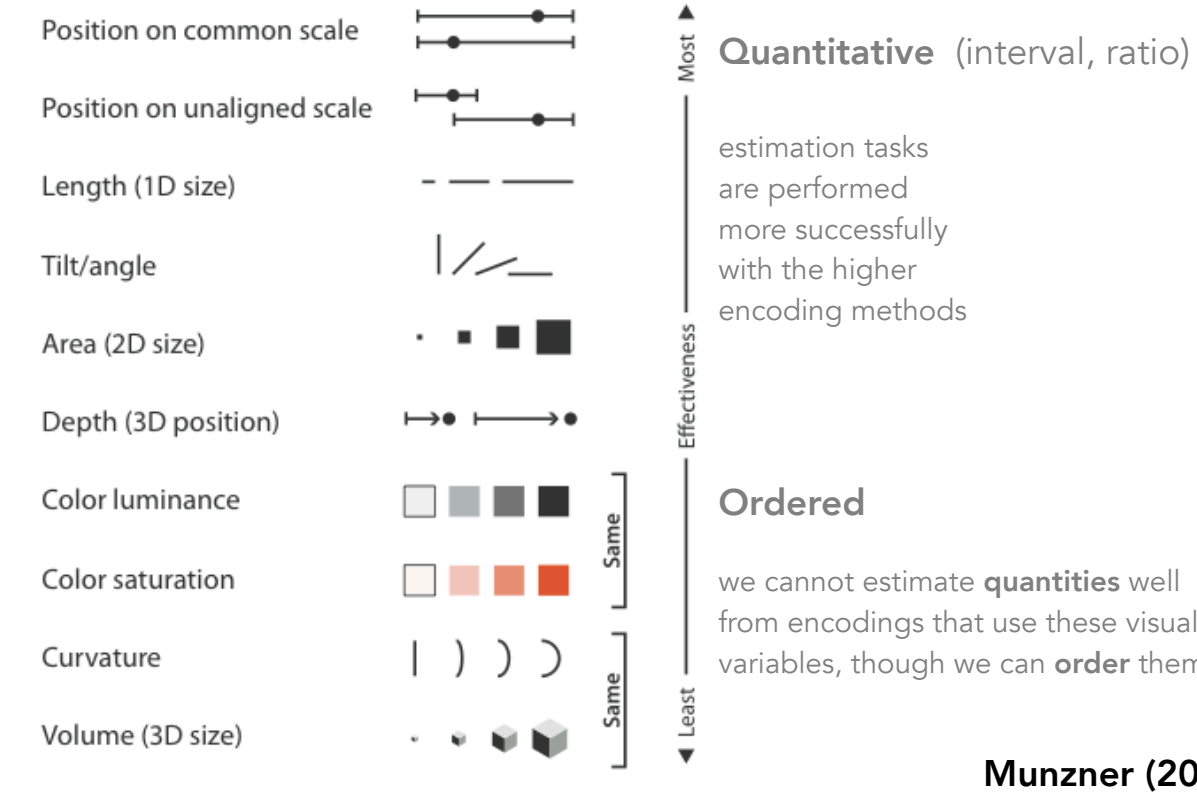
Properties and qualities of Visual Variables

SYNTACTICS

Roth (2017)

Channels: Expressiveness Types and Effectiveness Ranks

Magnitude Channels: Ordered Attributes



Quantitative (interval, ratio)

estimation tasks are performed more successfully with the higher encoding methods

Ordered

we cannot estimate **quantities** well from encodings that use these visual variables, though we can **order** them

Munzner (2014)

Channels: Expressiveness Types and Effectiveness Ranks

Selective / Associative / Dissociative
Identity
Qualitative
(nominal)

identity tasks
are performed
more successfully
with the higher
encoding methods

so we associate symbols that are grouped together
more than we associate symbols
that have the same shape …
and color hue works well to
'make things look the same'
when we are trying to associate symbols
with the same quality

Most ▲ Effectiveness ▼ Least

Identity Channels: Categorical Attributes

Spatial region

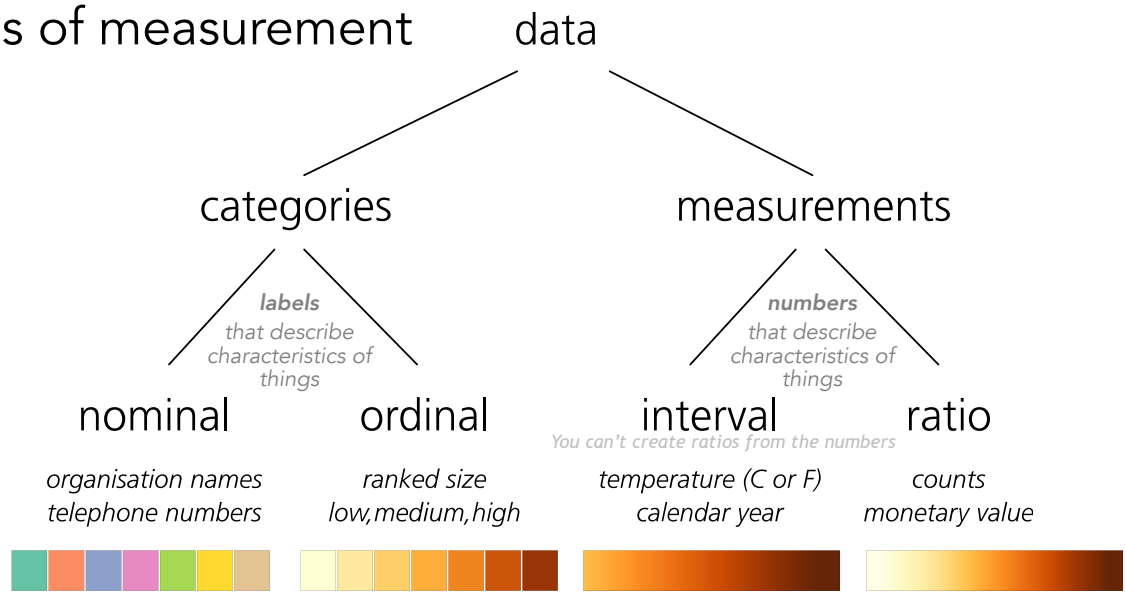
Color hue

Motion

Shape

Munzner (2014)

levels of measurement



COLORBEWER SCHEMES	qualitative	sequential	sequential	sequential
BICYCLE EXAMPLE	brand trek, canyon, cube	frame size XS, S, M, L, XL, XXL	year made 2015, 2016, 2017, 2018	price £1,699 ; £799 ; £1,475
MUNZNER TERMINOLOGY	identity	order	magnitude	magnitude