see similar files: http://farbe.li.tu-berlin.de/BEU5/BEU5.HTM
technical information: http://farbe.li.tu-berlin.de or http://color.li.tu-berlin.de

sensation scaling functions
lightness L^* and tristimulus value Y
adaptation on surround white W
$L^*_W = 100\ (\ Y\ /\ 100)^{1/2,0}$
adaptation on surround grey Z
$L^*_Z = 100\ (\ Y\ /\ 100)^{1/2,4}$
description with CIELAB 1976
$L^*_{CIELAB} = 116\ (\ Y\ /\ 100)^{1/3,0} - 16$
adaptation on surround black N
$L^*_N = 100\ (\ Y\ /\ 100)^{1/3,0}$

Viewing situations of adjacent greys

BEU5S-1N

Viewing situations of separated greys

BEU5S-2N

Lightness L^*_{JND} for the Just Noticeable Difference (JND)

For adjacent surface colours in the range 3,6<L*<90
or the digital range 100/255=0,39<L*<100 it is valid:

$L^*_{JND} = a\ (L/L_n)^k$ [1] a=100; L_n=142cdm²; k=0,42
$= b\ (L/L_n)^k$ [2] b=a/(L_n/L_n)^k=50; L_n=18

For $L=L_n$ it is valid: L^*_{JND}=50.

Derivation of equation [2] gives with $1-k = 0{,}58$:

$\delta(L^*_{JND})/\delta L = c\ (L/L_n)^{-k}$ [3] $c = (b\ k)/L_n = 21/18 = 1{,}17$

or for the treshold $\delta(L^*_{JND})$=1

$\delta L = d\ (L/L_n)^{1-k}$ [4] $d = L_n(b\ k) = 18/21 = 0{,}86$

For the surround lightness $L^*_{ZN} = 50$ with $L=L_n$ the threshold is: $\delta L_{ZN} = 0{,}86$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_N for surround white W

For separated surface colours in the range 0,0036<R<0,90
or the digital range 1/255=0,0039<R<1,00 it is valid:

$L^*_N = a\ (R/R_n)^k$ [1] a=100; R_n=1,00; k=0,33=1/3,0
$= b\ (R/R_n)^k$ [2] b=a/(R_n/R_n)^k=42; R_n=0,18

For $R=R_n$ it is valid: L^*=42.

Derivation of equation [2] gives with $1-k = 0{,}67$:

$\delta(L^*_N)/\delta R = c\ (R/R_n)^{-k}$ [3] $c = (b\ k)/R_n = 19/18 = 1{,}05$

or for the treshold $\delta(L^*_N)$=1

$\delta R = d\ (R/R_n)^{1-k}$ [4] $d = R_n(b\ k) = 18/19 = 0{,}95$

For the surround lightness $L^*_{WN} = 50$ with $R=R_n$ the threshold is: $\delta R_{WN} = 0{,}95$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_Z for surround mean grey Z (sRGB)

For separated surface colours in the range 3,6<L*<90
or the digital range 100/255=0,39<L*<100 it is valid:

$L^*_Z = a\ (L/L_n)^k$ [1] a=100; L_n=142cdm²; k=0,42
$= b\ (L/L_n)^k$ [2] b=a/(L_n/L_n)^k=50; L_n=18

For $L=L_n$ it is valid: L^*_{WN}=50.

Derivation of equation [2] gives with $1-k = 0{,}58$:

$\delta(L^*_N)/\delta L = c\ (L/L_n)^{-k}$ [3] $c = (b\ k)/L_n = 21/18 = 1{,}17$

or for the treshold $\delta(L^*_N)$=1

$\delta L = d\ (L/L_n)^{1-k}$ [4] $d = L_n(b\ k) = 18/21 = 0{,}86$

For the surround lightness $L^*_{ZN} = 50$ with $L=L_n$ the threshold is: $\delta L_{ZN} = 0{,}86$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_{JND} for the Just Noticeable Difference (JND)

For adjacent surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:

$L^*_{JND} = a\ (L/L_n)^k$ [1] a=572; L_n=142cdm²; k=0,14
$= b\ (L/L_n)^k$ [2] b=a/(L_n/L_n)^k=450; L_n=18

For $L=L_n$ it is valid: L^*_{JND}=450.

Derivation of equation [2] gives with $1-k = 0{,}86$:

$\delta(L^*_{JND})/\delta L = c\ (L/L_n)^{-k}$ [3] $c = (b\ k)/L_n = 63/18 = 3{,}5$

or for the treshold $\delta(L^*_{JND})$=1

$\delta L = d\ (L/L_n)^{1-k}$ [4] $d = L_n(b\ k) = 18/63 = 0{,}29$

For the surround lightness $L^*_{JNDN} = 450$ with $L=L_n$ the threshold is: $\delta L_{JNDN} = 0{,}29$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_N for surround white W

For separated surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:

$L^*_N = a\ (Y/Y_n)^k$ [1] a=100; Y_n=100; k=0,33=1/3,0
$= b\ (Y/Y_n)^k$ [2] b=a/(Y_n/Y_n)^k=50; Y_n=18

For $Y=Y_n$ it is valid: L^*=50.

Derivation of equation [2] gives with $1-k = 0{,}67$:

$\delta(L^*_N)/\delta Y = c\ (Y/Y_n)^{-k}$ [3] $c = (b\ k)/Y_n = 19/18 = 1{,}05$

or for the treshold $\delta(L^*_N)$=1

$\delta Y = d\ (Y/Y_n)^{1-k}$ [4] $d = Y_n(b\ k) = 18/19 = 0{,}95$

For the surround lightness $L^*_{WN} = 50$ with $Y=Y_n$ the threshold is: $\delta Y_{WN} = 0{,}95$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_N for surround black N

For adjacent surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:

$L^*_N = a\ (Y/Y_n)^k$ [1] a=100; Y_n=100; k=0,33=1/3,0
$= b\ (Y/Y_n)^k$ [2] b=a/(Y_n/Y_n)^k=56; Y_n=18

For $Y=Y_n$ it is valid: L^*=56.

Derivation of equation [2] gives with $1-k = 0{,}67$:

$\delta(L^*_N)/\delta Y = c\ (Y/Y_n)^{-k}$ [3] $c = (b\ k)/Y_n = 19/18 = 1{,}05$

or for the treshold $\delta(L^*_N)$=1

$\delta Y = d\ (Y/Y_n)^{1-k}$ [4] $d = Y_n(b\ k) = 18/19 = 0{,}95$

For the surround lightness $L^*_{WN} = 50$ with $Y=Y_n$ the threshold is: $\delta Y_{WN} = 0{,}95$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_W for surround white W

For adjacent surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:

$L^*_W = a\ (L/L_W)^k$ [1] a=100; L_n=142cdm²; k=0,33
$= b\ (L/L_n)^k$ [2] b=a/(L_n/L_n)^k=56; L_n=18

For $L=L_n$ it is valid: L^*=56.

Derivation of equation [2] gives with $1-k = 0{,}67$:

$\delta(L^*_W)/\delta L = c\ (L/L_n)^{-k}$ [3] $c = (b\ k)/L_n = 19/18 = 1{,}05$

or for the treshold $\delta(L^*_W)$=1

$\delta L = d\ (L/L_n)^{1-k}$ [4] $d = L_n(b\ k) = 18/19 = 0{,}95$

For the surround lightness $L^*_{WN} = 50$ with $L=L_n$ the threshold is: $\delta L_{WN} = 0{,}95$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_W for surround white W

For separated surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:

$L^*_W = a\ (L/L_W)^k$ [1] a=100; L_n=142cdm²; k=0,50
$= b\ (L/L_n)^k$ [2] b=a/(L_n/L_n)^k=42; L_n=18

For $L=L_n$ it is valid: L^*=42.

Derivation of equation [2] gives with $1-k = 0{,}50$:

$\delta(L^*_W)/\delta L = c\ (L/L_n)^{-k}$ [3] $c = (b\ k)/L_n = 21/18 = 1{,}17$

or for the treshold $\delta(L^*_W)$=1

$\delta L = d\ (L/L_n)^{1-k}$ [4] $d = L_n(b\ k) = 18/21 = 0{,}86$

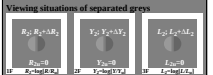
For the surround lightness $L^*_{WN} = 50$ with $L=L_n$ the threshold is: $\delta L_{WN} = 0{,}86$. This threshold is *independent* of k.

BEU5S-1N

Viewing situations of adjacent greys

BEU5S-2N

Viewing situations of separated greys



BEU5S-2N

Lightness L^*_Z for surround mean grey Z (sRGB)

For separated surface colours in the range 0,0036<R<0,90
or the digital range 1/255=0,0039<R<1,00 it is valid:

$L^*_Z = a\ (R/R_n)^k$ [1] a=100; R_n=1,00; k=0,42=1/2,4
$= b\ (R/R_n)^k$ [2] b=a/(R_n/R_n)^k=50; R_n=0,18

For $R=R_n$ it is valid: L^*_{ZN}=50.

Derivation of equation [2] gives with $1-k = 0{,}58$:

$\delta(L^*_N)/\delta R = c\ (R/R_n)^{-k}$ [3] $c = (b\ k)/R_n = 21/18 = 1{,}17$

or for the treshold $\delta(L^*_N)$=1

$\delta R = d\ (R/R_n)^{1-k}$ [4] $d = R_n(b\ k) = 18/21 = 0{,}86$

For the surround lightness $L^*_{ZN} = 50$ with $R=R_n$ the threshold is: $\delta R_{ZN} = 0{,}86$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_{JND} for the Just Noticeable Difference (JND)

For adjacent surface colours in the range 0,0036<R<0,90
or the digital range 1/255=0,0039<R<1,00 it is valid:

$L^*_{JND} = a\ (R/R_n)^k$ [1] a=572; R_n=1,00; k=0,14=1/7,2
$= b\ (R/R_n)^k$ [2] b=a/(R_n/R_n)^k=450; R_n=0,18

For $R=R_n$ it is valid: L^*_{JNDN}=450.

Derivation of equation [2] gives with $1-k = 0{,}86$:

$\delta(L^*_{JND})/\delta R = c\ (R/R_n)^{-k}$ [3] $c = (b\ k)/R_n = 63/18 = 3{,}5$

or for the treshold $\delta(L^*_{JND})$=1

$\delta R = d\ (R/R_n)^{1-k}$ [4] $d = R_n(b\ k) = 18/63 = 0{,}29$

For the surround lightness $L^*_{JNDN} = 450$ with $R=R_n$ the threshold is: $\delta R_{JNDN} = 0{,}29$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_N for surround black N

For adjacent surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:

$L^*_N = a\ (Y/Y_n)^k$ [1] a=572; Y_n=100; k=0,14=1/7,2
$= b\ (Y/Y_n)^k$ [2] b=a/(Y_n/Y_n)^k=450; Y_n=18

For $Y=Y_n$ it is valid: L^*_{JNDN}=450.

Derivation of equation [2] gives with $1-k = 0{,}86$:

$\delta(L^*_{JND})/\delta Y = c\ (Y/Y_n)^{-k}$ [3] $c = (b\ k)/Y_n = 63/18 = 3{,}5$

or for the treshold $\delta(L^*_{JND})$=1

$\delta Y = d\ (Y/Y_n)^{1-k}$ [4] $d = Y_n(b\ k) = 18/63 = 0{,}29$

For the surround lightness $L^*_{JNDN} = 450$ with $Y=Y_n$ the threshold is: $\delta Y_{JNDN} = 0{,}29$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_N for surround white W

For adjacent surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:

$L^*_N = a\ (Y/Y_n)^k$ [1] a=100; Y_n=142cdm²; k=0,33
$= b\ (Y/Y_n)^k$ [2] b=a/(Y_n/Y_n)^k=56; Y_n=18

For $Y=Y_n$ it is valid: L^*=56.

Derivation of equation [2] gives with $1-k = 0{,}67$:

$\delta(L^*_N)/\delta Y = c\ (Y/Y_n)^{-k}$ [3] $c = (b\ k)/Y_n = 19/18 = 1{,}05$

or for the treshold $\delta(L^*_N)$=1

$\delta Y = d\ (Y/Y_n)^{1-k}$ [4] $d = Y_n(b\ k) = 18/19 = 0{,}95$

For the surround lightness $L^*_{WN} = 50$ with $Y=Y_n$ the threshold is: $\delta Y_{WN} = 0{,}95$. This threshold is *independent* of k.

BEU5S-1N

Lightness L^*_W for surround white W

For adjacent surface colours in the range 3,6<L*<90
or the digital range 100/255=0,39<L*<100 it is valid:

$L^*_W = a\ (L/L_W)^k$ [1] a=100; L_n=142cdm²; k=0,50
$= b\ (L/L_n)^k$ [2] b=a/(L_n/L_n)^k=42; L_n=18

For $L=L_n$ it is valid: L^*=42.

Derivation of equation [2] gives with $1-k = 0{,}50$:

$\delta(L^*_W)/\delta L = c\ (L/L_n)^{-k}$ [3] $c = (b\ k)/L_n = 21/18 = 1{,}17$

or for the treshold $\delta(L^*_W)$=1

$\delta L = d\ (L/L_n)^{1-k}$ [4] $d = L_n(b\ k) = 18/21 = 0{,}86$

For the surround lightness $L^*_{WN} = 50$ with $L=L_n$ the threshold is: $\delta L_{WN} = 0{,}86$. This threshold is *independent* of k.

BEU5S-1N

input: *rgb/n*