

# ***Compression and Dynamic Range (DR)***

**Compression and Dynamic Range (DR)** are a difficult topic.

***I believe this may be incorrectly stated in Joseph P Mathew's text 2019 3<sup>rd</sup> ed (chapter 3 page 33).***

In Mathew's book it says: " Compression changes the dynamic range of the ultrasound signal with an inverse relationship" This is correct.

The text then in the next sentence states: " Increasing the compression produces an image with more shades of gray, whereas decreasing the compression provides a highly contrasted image with strong white and black components"

I believe this second statement is potentially misleading, as the DR is what is actually increasing when the knob is turned rightward and decreasing when the knob is turned leftward.

This is annoying because the amount of ultrasound compression is actually decreasing when DR is increasing with a rightward turn!

**The reason for this confusion is as follows: [The compression knob on the Phillips machine actually increasing the dynamic range when one turns it rightward \(clockwise\) and thereby decreasing the amount of compression!](#)**

**This would make the button do the opposite of what one would think, but I think this is what is actually happens and I think this has resulted in my confusion but I would like to know your thoughts.**

# Compression and Dynamic Range (DR)

This is discussed in the 3<sup>rd</sup> edition of Edelman's text on page 260-262.

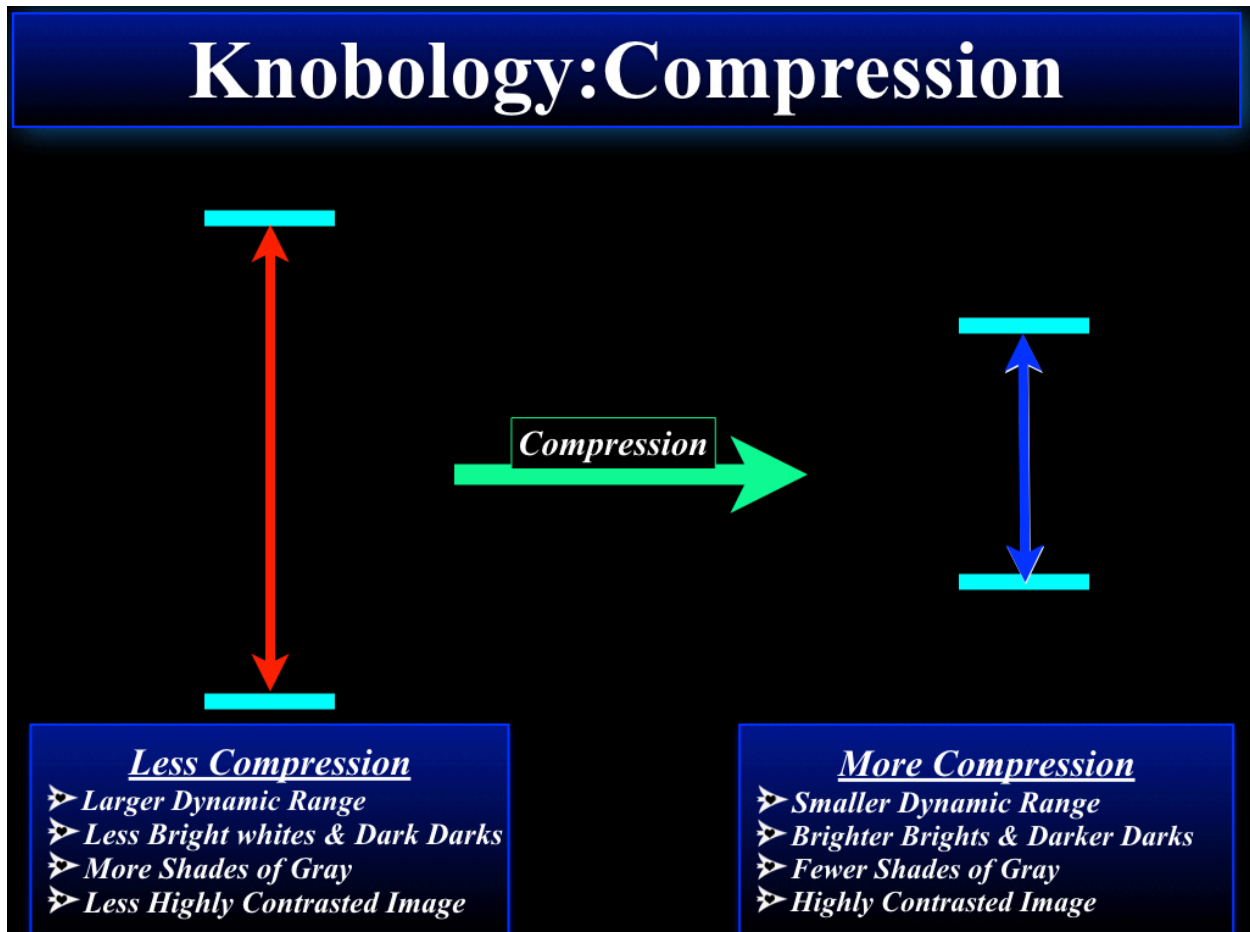
## Compression and Dynamic Range

In Sydney K Edelman's excellent text 3<sup>rd</sup> edition page 260 he states:

**“ Compression is a technique that decreases the dynamic range of a signal”**

Dr. Edelman also on page 262 of this same text goes on to describe dynamic range stating that: **“A narrower dynamic range means fewer gray shades”**

The figure I created here is adapted from information in Edelman and other sources and I believe it to be correct:



## Dynamic Range & Compression

### Decreased Dynamic Range

- Fewer shades of Gray
- More Bright Whites & Dark Darks
- More Highly Contrasted Image
- Harsher image (less soft)
- More Compression

### Increased Dynamic Range

- More Shades of Gray
- Fewer Bright Whites & Dark Darks
- Less Highly Contrasted Image
- Softer image (less harsh)
- Less Compression

### More Compression

- Smaller Dynamic Range
- Brighter Brights & Darker Darks
- Fewer Shades of Gray
- Highly Contrasted Image

### Less Compression

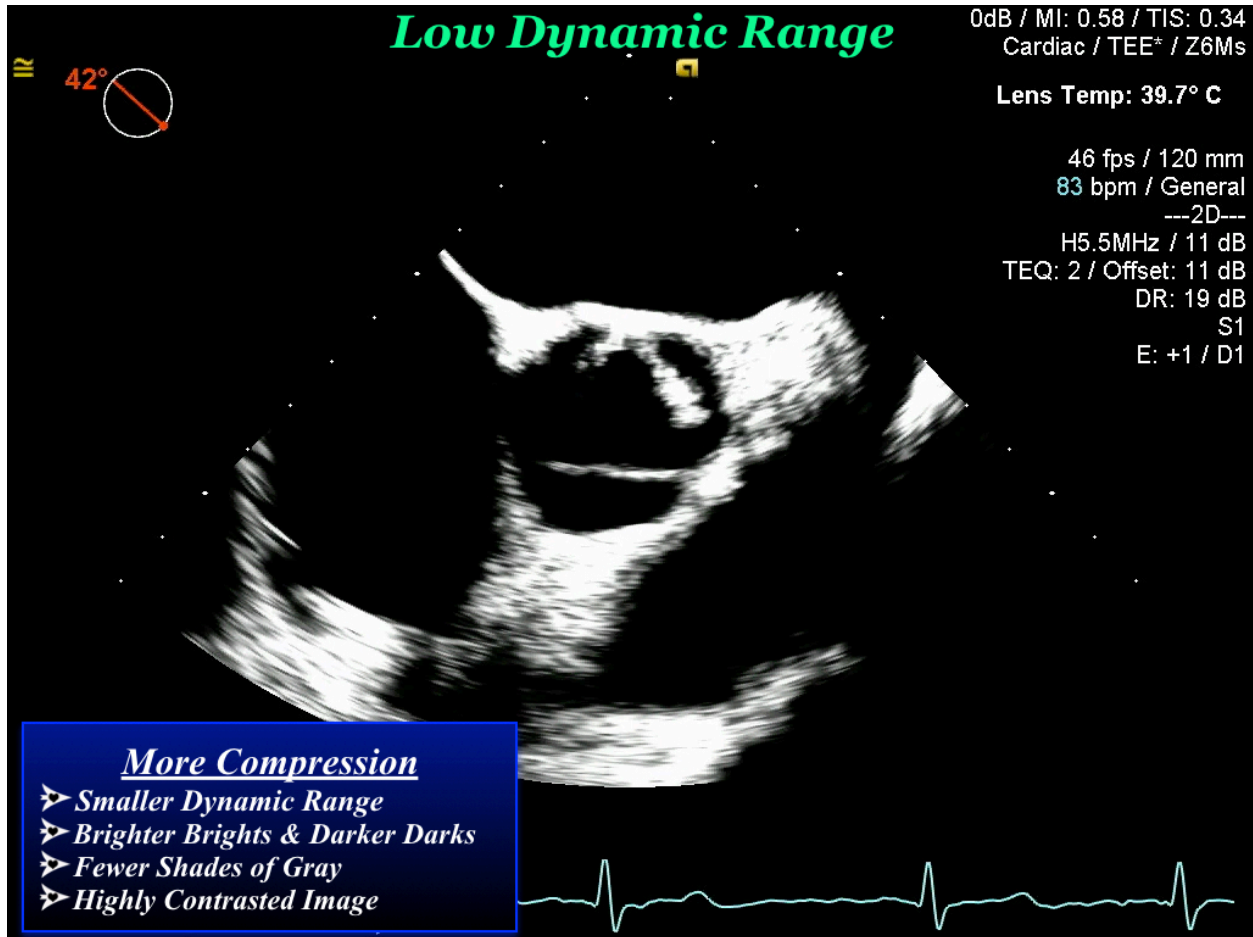
- Larger Dynamic Range
- Less Bright whites & Dark Darks
- More Shades of Gray
- Less Highly Contrasted Image

Understanding Ultrasound Physics 3rd ed. page 260-262

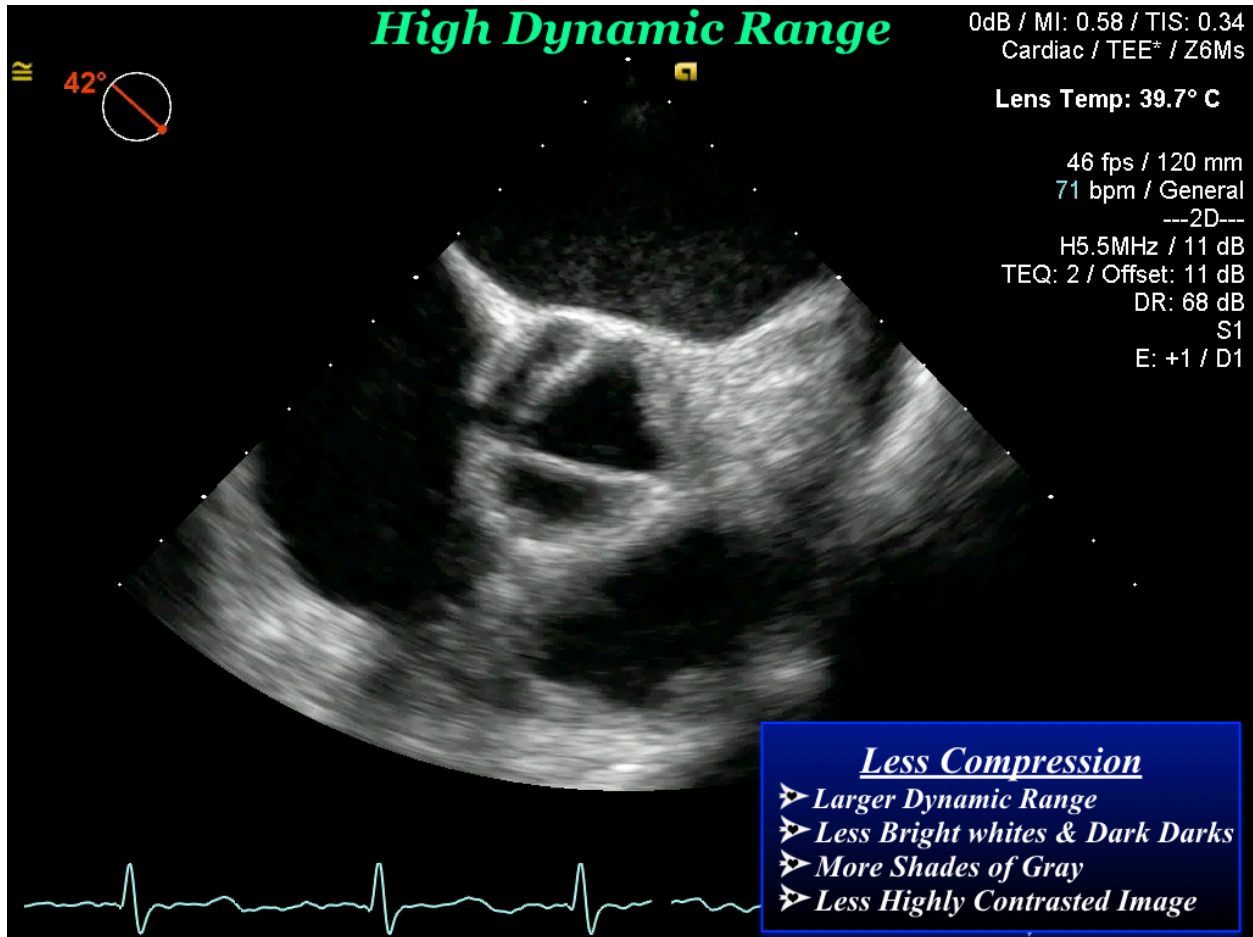
Sidney K. Edelman, PhD

On the Siemens machine there is a dynamic range toggle switch and this is easy to understand: (up increases DR, Down decreases DR):

# Compression and Dynamic Range (DR)

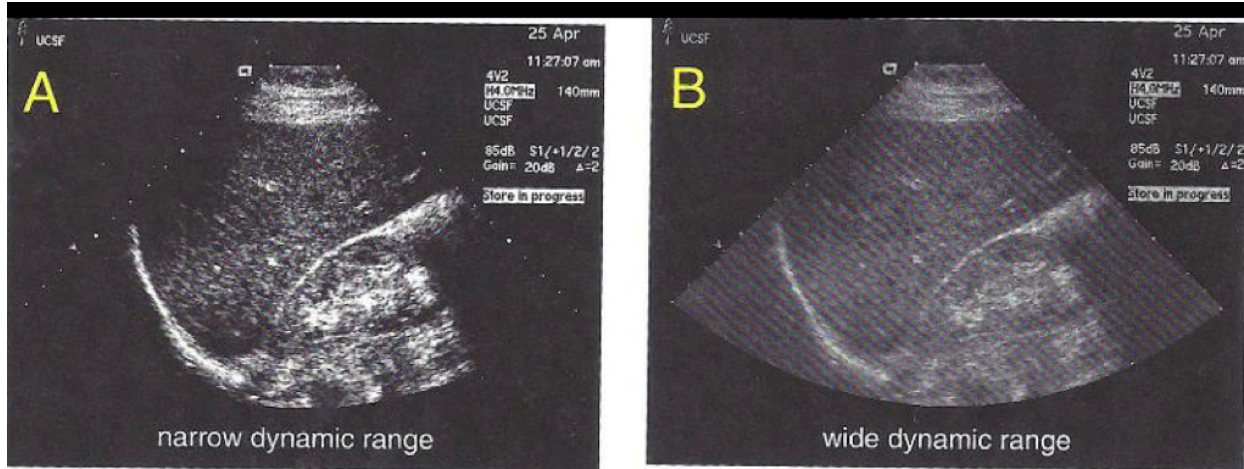


# Compression and Dynamic Range (DR)



Here is an example from Edelman:

# Compression and Dynamic Range (DR)



## More Compression

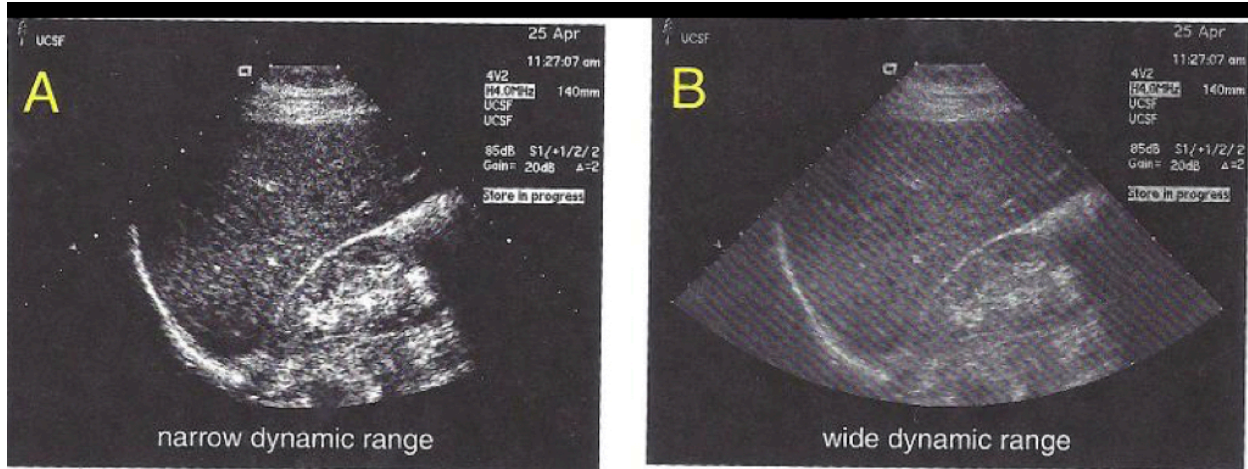
- *Smaller Dynamic Range*
- *Brighter Brights & Darker Darks*
- *Fewer Shades of Gray*
- *Highly Contrasted Image*

## Less Compression

- *Larger Dynamic Range*
- *Less Bright whites & Dark Darks*
- *More Shades of Gray*
- *Less Highly Contrasted Image*

Understanding Ultrasound Physics 3rd ed. page 260-262  
Sidney K. Edelman, PhD

# Compression and Dynamic Range (DR)



## More Compression

- *Smaller Dynamic Range*
- *Brighter Brights & Darker Darks*
- *Fewer Shades of Gray*
- *Highly Contrasted Image*

## Less Compression

- *Larger Dynamic Range*
- *Less Bright whites & Dark Darks*
- *More Shades of Gray*
- *Less Highly Contrasted Image*

Understanding Ultrasound Physics 3rd ed. page 260-262  
Sidney K. Edelman, PhD

So far this makes total sense.

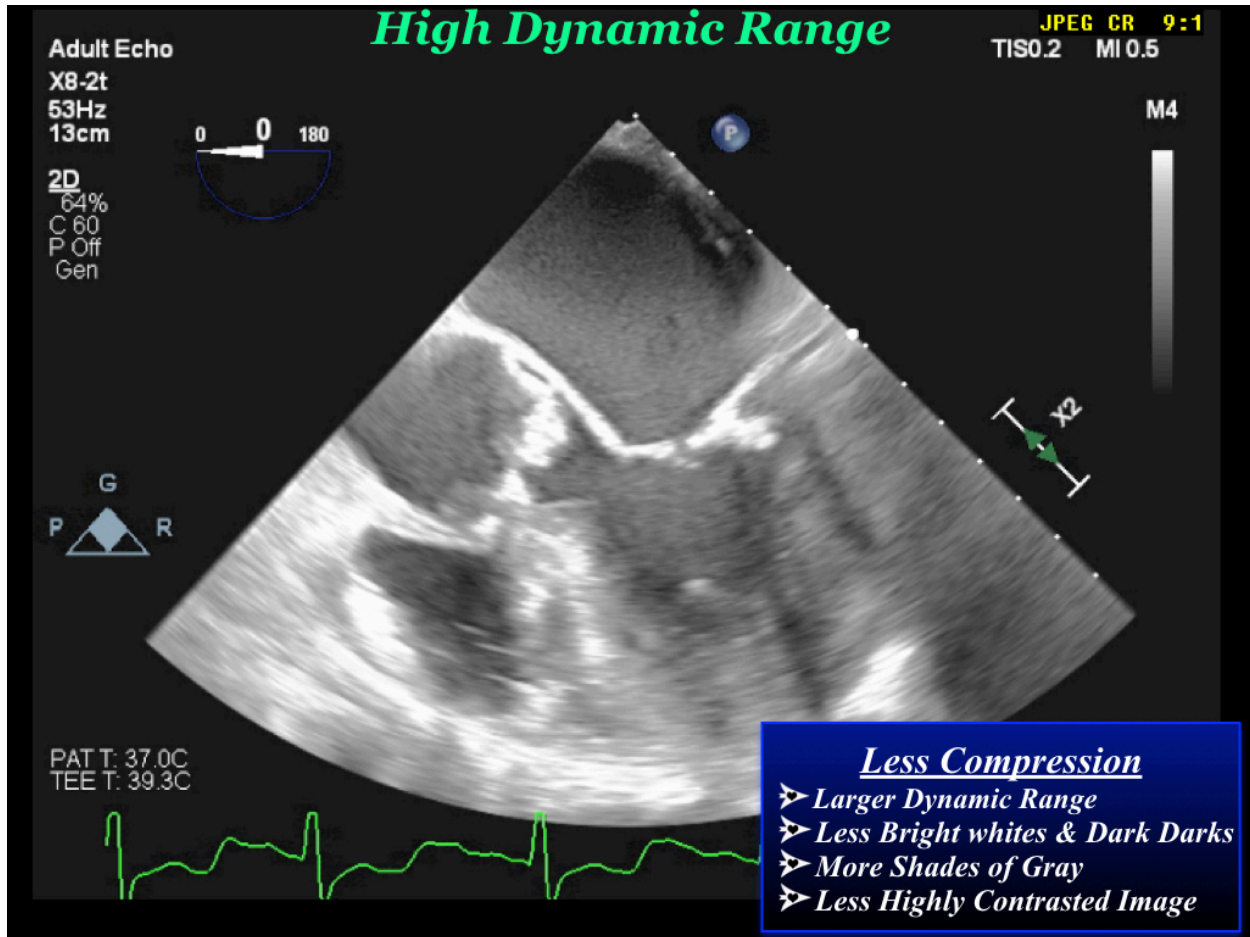
The confusion for me begins when you consider the compression knob on the Phillips machines (the older IE 33 and the newer epic).

I think it is backwards. I think when you turn the Phillips compression knob clockwise the DR increases but the amount of compression actually decreases.

In the images below the number on the screen (next to the letter C) is in my opinion the dynamic range (NOT the compression) since the number is lower in the image with fewer shades of gray and higher in the image with more shades of gray.

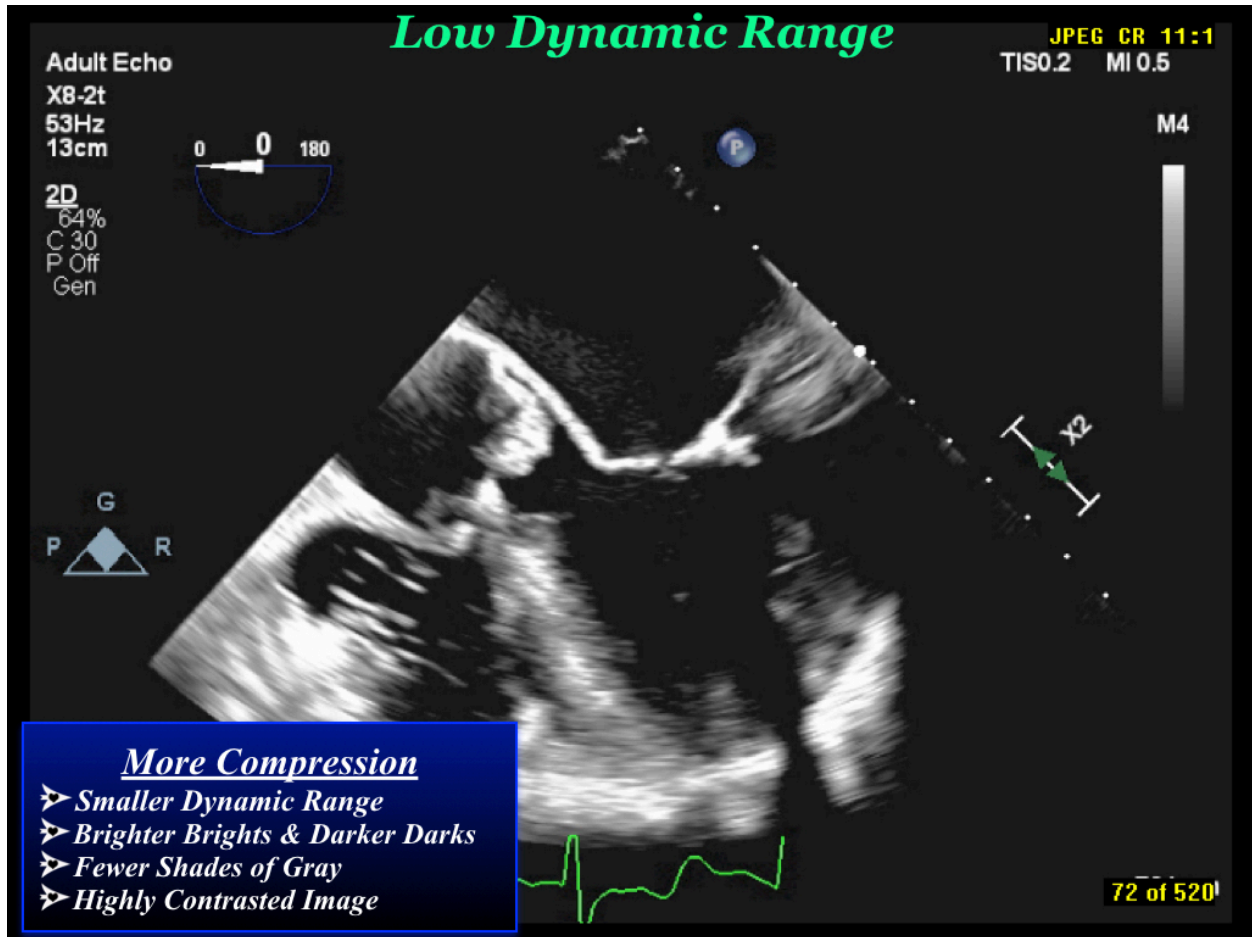
Here are some pics to illustrate:

# Compression and Dynamic Range (DR)

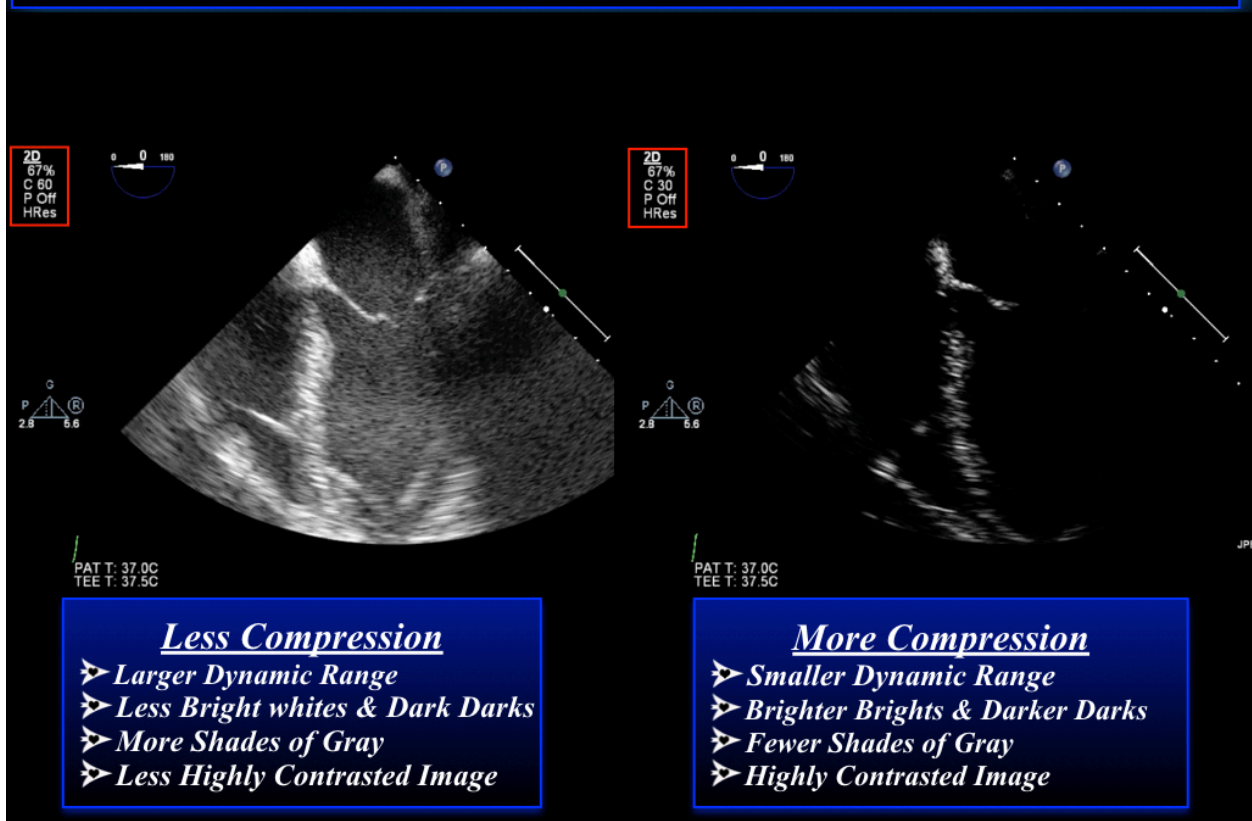




# Compression and Dynamic Range (DR)



## Knobology: Compression



My question again? Is the compression knob on the Phillips machine actually increasing the dynamic range when one turns it rightward (clockwise) and thereby decreasing the amount of compression?

I believe the answer to this YES!

This is confusing because most knobs on most machines when you turn them rightward it increases the parameter. For example, 2D gain on the new Phillip's lives under the 2D knob and turning rightward increases the overall gain.

## ***Compression and Dynamic Range (DR)***

With the compression knob turning it rightward increases the number on the screen.

BUT the image appears to have an increase in the number of shades of gray and therefore this would correspond to an increase in the dynamic range.

Increasing the amount of compression should compress or decrease the range of signals and decrease the dynamic range.

If however the number on the screen is the dynamic range (rather than the amount of compression) then the number makes more sense.

On the Siemens TEE machine (Acuson SC 2000 prime) (latest model and software) there is a toggle for dynamic range. Increasing this will increase the range of signals and make the image have more shades of gray. (smoother, less bright whites and dark darks, less highly contrasted image).

In Sydney K Edelman's excellent text 3<sup>rd</sup> edition page 260 he states:  
"Compression is a technique that decreases the dynamic range of a signal."

He later states that "**A narrower dynamic range means fewer gray shades**"

**My guess is that this is what is going on!**

Update: these are some emails from Phillips!

# Compression and Dynamic Range (DR)

----- Forwarded Message -----

**From:** Jamacochian, Marika <marika.jamacochian@philips.com>  
**To:** Tommy Burch <tburch333@yahoo.com>  
**Sent:** Sunday, January 5, 2020, 01:12:45 PM EST  
**Subject:** Re: Important: Compression Knob on the Phillips machine. Thank You!

Dear Dr Burch  
I talked to engineers at Philips.  
Compression on our systems actually increases the dynamic range, we simplified it for the users ease of understanding.  
Other vendors who use Dyn Range use the engineers terminology which confuses sonographers.  
Your interpretation of Physics is absolutely right but conventionally HP-Agilent\_Philios stayed consistent with the term "compression" for legacy purposes.  
So, increasing the compression actually increases the DYNAMIC RANGE and adds shades of grey.  
Hope this helps .  
Marika

Sent from my iPhone

On Jan 5, 2020, at 6:24 AM, Tommy Burch <tburch333@yahoo.com> wrote:

Hi Marika,  
THANK YOU for doing all you do!  
OK, attached is a PDF that describes my confusion. Can you look at it and show it to anyone at Phillips that might be able to tell me if I am crazy?  
Thanks and Happy New Year!  
Tommy  
cell: 336-624-5372  
<Compression and dynamic range for Marika.pdf>

**From:** "Rafter, Patrick" <patrick.g.rafter@philips.com>  
**Date:** January 6, 2020 at 10:25:14 AM EST  
**To:** "Jamacochian, Marika" <marika.jamacochian@philips.com>  
**Subject: RE: Important: Compression Knob on the Phillips machine. Thank You!**

Hi Marika,

Happy new year to you! I hope you are doing well.

The Compression control maps the large dynamic range of the ultrasound signal to the smaller dynamic range of the monitor. It is true that as you increase the compression control that increases the ultrasound signal dynamic range that we choose to display on the monitor. For example, at a compression of 50 we would be mapping about 50dB of ultrasound signal into the gray levels of the monitor. If we increase compression to 60 we would then be mapping about 60dB of the ultrasound signal into the same gray levels of the monitor. The term compression means we are compressing more ultrasound signal dynamic range into the same display gray level range.

I hope this makes sense.

|

Pat

Send

Screenshot



Saved



**Here is a link to a video that explains my confusion: (lecture 6) (if you want to see it):**

<https://www.ptemasters.com/lectures/>

# *Compression and Dynamic Range (DR)*