**Crossover Experiment**

Graphical user interface, application

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I added another factor of complexity: **Phantom type**

* **Normal** (factory original density inserts and no air)
* **Expanded** (factory inserts + new adapted inserts + air)

Chart, box and whisker chart

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**Statistical test**

ANOVA indicates no difference between crosses, but effect of phantom type used on WeightOffset.

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**Step1**

Filter data to have only Type1 and Type2 crosses to better visualize effects (Figures) and fit similar model with filtered data to check if significant effects remain.

LM showing overall effects on WeightOffset

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It still shows CrossType does not have an effect on WeightOffset, but PhantomType does.

**Step 2:**

Checking assumptions in fitted model before proceeding with figures, conclusions and statistical reporting :

1. **Homogeneity of variance assumption**

Chart, scatter chart

Description automatically generatedFound 3 visual outliers, points 1, 45 and 46. It can be useful to remove to ensure assumptions. But if we run Levene’s test (see below) it can give us some assurance that we can proceed.

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According to Levene’s test we’re good. p-value is not less than the significance level of 0.05. This means that there is no evidence to suggest that the variance across groups is statistically significantly different. Therefore, we can assume the homogeneity of variances in the different treatment groups.

1. **Normality:**

Chart, scatter chart

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As all the points fall approximately along this reference line, we can assume normality.

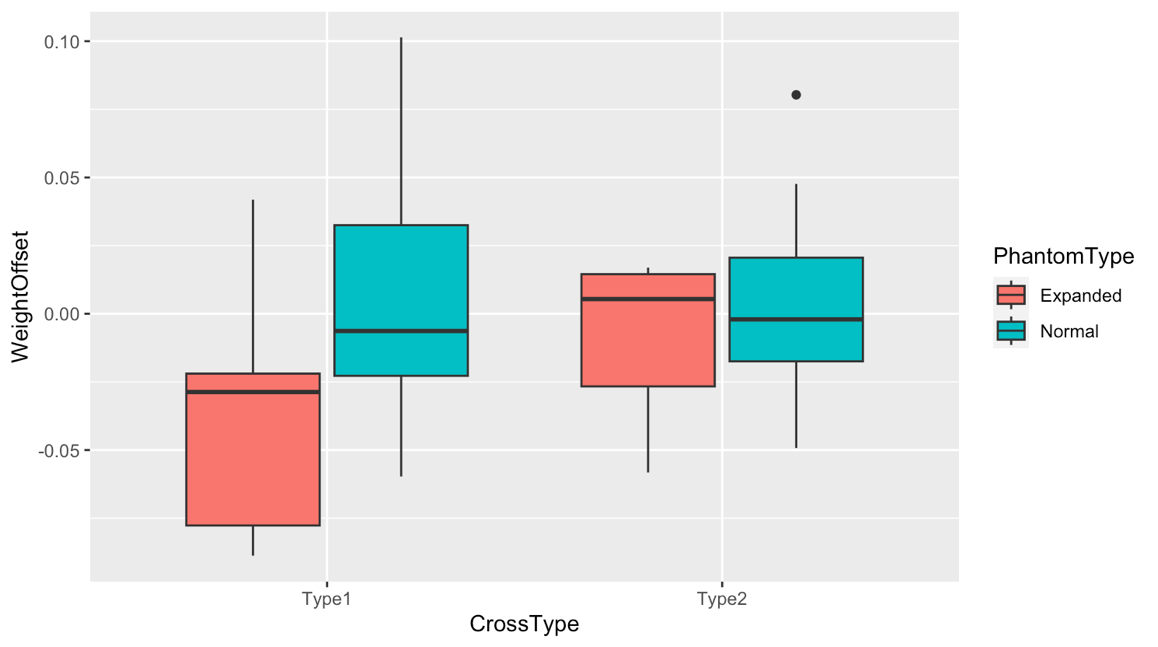
The conclusion above, is supported by the **Shapiro-Wilk test** on the ANOVA residuals which finds no indication that normality is violated.

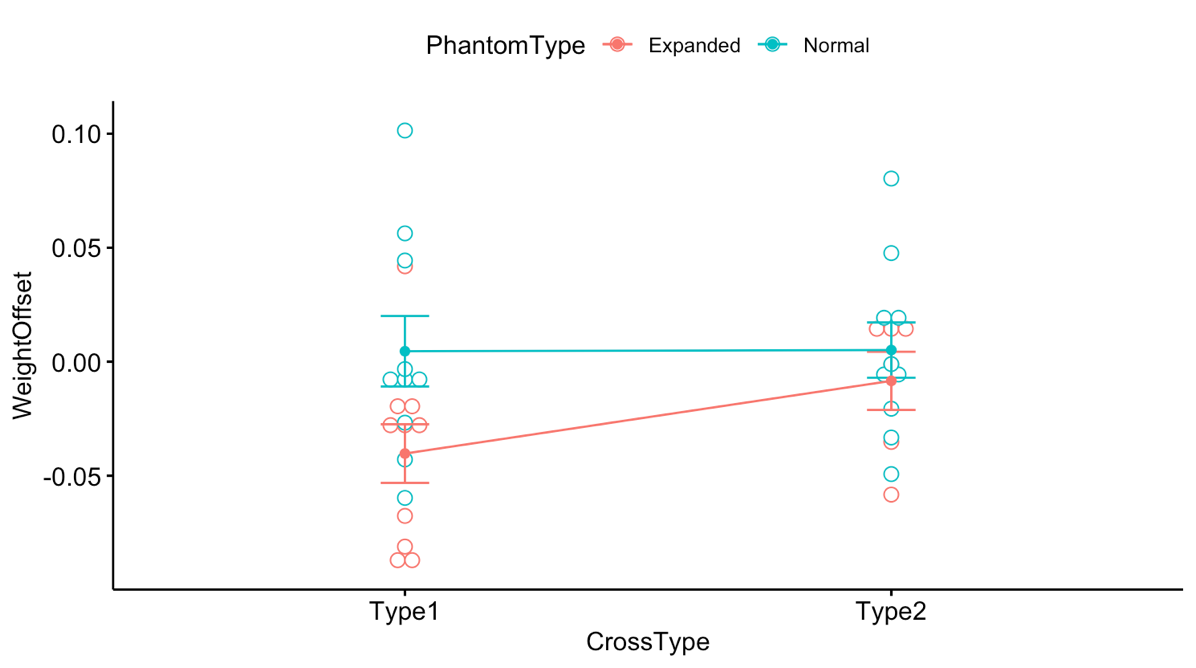
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**Step 3:**

Exploratory figures to better visualize effects





**Step 4:**

**Post hoc analyses to report pairwise effects**

Contrast between Type 1 and Type 2 🡪 not statistically different

*(good – it means we can do internal calibration, but as shown below – PhantomType matters).*Text

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Contrast between Phantom Normal and Expanded 🡪

*statistically different – PhantomType matters.*

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So let’s have a look at pairwise contrasts:  
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We see above that

Within Type1 – the kind of Phantom matters

Within type2 - the kind of phantom does not matter.

**Results:**

**1 )** No significant effect of CrossType on Weight offset (p=0.144). Additionally, Type2 crosses produce offsets that are not statistically different between PhantomType used (p=0.145) *good ! that’s what I wanted to show and proves we can do internal calibration*

**2)** Type1 crosses produce mean offsets that are statistically different between Phantom Types (p-value=0.0209). Leads to think that a type1 cross is not reliable, because if you adopt it you will get different values based on the phantom you use

*(another reason to ditch Coral being separate from Phantom density standard when scanning).*

**Take home message:**

Type1 crosses are discouraged for coral density measurements as significant differences were found depending on phantom types used (p-value=0.0209).

Type2 crosses are better because weight offsets are not significantly different from Type1 crosses (analysis of variance model shows p=0.144 for CrossType factor and post-hoc analysis of CrossType contrasts shows p=0.145).

Further, if one decides to adopt type2 crosses, we found no evidence to support that an Expanded Phantom is better over a normal phantom (Contrast p-value=0.5309)

*(maybe also helps justify scans we did in the past where we did not have an adapted phantom at hand - but we should still prefer Expanded Phantom to cover a wide range of possible density values, thus better constraining calibration curves).*

**Going back to hypotheses on page 1:**

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Calendar

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Data above summarized in one figure:

Chart, line chart

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H1: Offset largest for Type4 cross

**Answer**: Seems true, their boxplots show largest ranges.

H2: Offset is the **smallest** from **Type1 cross**, as Coral and Phantom do not interact. ​

**Answer**: False. Type2 offsets are comparable according to stats (see above, at least when using Expanded Phantom)

H3. The difference between Type1 and Type2 is statistically insignificant. ​

**Answer**: True (at least when using Expanded Phantom, good so can do internal calibration)

H4: Offset is **intermediate**from Type3. I’d expect the offset from Type3< Type4, as phantom volume is less affected by interaction with coral. ​

**Answer**: Not tested (not useful).