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### Final Project Initial Design

**Project Type:** Implement an interactive system

**Design:** Under Munzner's framework, the most important tasks for users of my visualization tool are "summarize" and "compare," both of which fall under the broader "query" category. I imagine that the first comparison users will like to see is between two (or more) people's glucose over time. The standard way to do this in the field is by calculating each person's average glucose at a specific time of day (most CGMs record every 5 minutes, so each timestamp is rounded to the nearest 5-minute interval). This is referred to as the aggregate glucose profile (AGP) and allows physicians to see times of day where a patient may be struggling to control their blood sugar (e.g. overnight lows or post-prandial highs).

I would like to plot multiple participants on the same AGP, so that each person gets their own colored line. Users will be able to select participants of interest by clicking on the lines themselves, or by clicking on certain participants in the legend or in the summary table. This will allow the user to discover trends, outliers, and features, and also to look up and locate specific targets. Selecting lines will cause unselected lines to be greyed out, which will allow for a basic trend comparison between selected subjects. Obviously, this idiom is at risk of overplotting, so I will probably need to limit the number of subjects that can be selected at once. If possible, I would like to include a button that switches the AGP into a radial or small multiples layout and back again, since these are also good ways to present time series data.

Another useful comparison is to look at each participant's time in range (TIR). Users can sort of see this based on the AGP (or at least make a reasonable guess for a single participant)

but accurately comparing subjects' TIR visually can be difficult, particularly when the percentages are small. For comparing TIR between multiple subjects, I think stacked bar charts will work the best. Each bar will be the same height, representing 100 percent of the person's time, and will be split into multiple non-overlapping glucose ranges (with the lowest range at the bottom). This will allow the user to compare TIR using different lengths (each bar will be the same width) on an aligned scale, which is one of the most effective channels for expressing magnitude. Ideally, I would like to allow users to change which range is aligned on the x axis, in order to facilitate comparing multiple ranges.

Time in range could also be visualized using small multiples of bar charts, where the height of each bar represents a person's TIR and each plot is of a different glucose range. This avoids many of the issues with the stacked bar charts and would allow for many more custom glucose ranges. Also, users may want to visualize TIR at night and during the daytime and may need to define their own time periods (e.g. nighttime might be 11pm – 6am for adults but 9pm – 6am for children). This essentially triples the number of plots needed to show TIR, so I would like to have a separate tab in the visualization. Different ranges will be in rows, and overall, night, and daytime will be in columns. If possible, I would like users to be able to move columns around to facilitate direct comparisons (e.g. one could put "overall" in the middle column if the user wants to compare the distribution daytime to overall and nighttime to overall, but are less interested in comparing daytime to nighttime). As with the AGP, I would like to allow the user to split the stacked bar charts into small multiples and back again.

Finally, I would like to provide users with the ability to identify extremes in the data using a sortable table in its own tab. For example, if the user wanted to sort the table by

estimated HbA1c, they would simply click the eA1c column in the table. This sortable table will also connect to the other visualizations and provide a way for the user to select participants in addition to selecting bars in the TIR visualization and lines in the AGP visualization. So, the user could find the 5 participants with the highest estimated HbA1c, select those rows in the table, and drill down on the participants' AGPs and times in range. This table is the easiest part to scale, since there isn't really a limit to the number of rows in the table. Obviously, they wouldn't all be shown at once, but the user could theoretically use the summary table for 1000s of participants, although they would need to select a subset in order for the visualizations to work.

**Infrastructure:** I will implement this visualization in R Shiny, as I'm most familiar with the R programming language. I have made very basic Shiny apps in the past, so I think that I have the coding experience for this project.

AGP	TIR	Summary Stats.
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Tabs allow the user to switch between views.

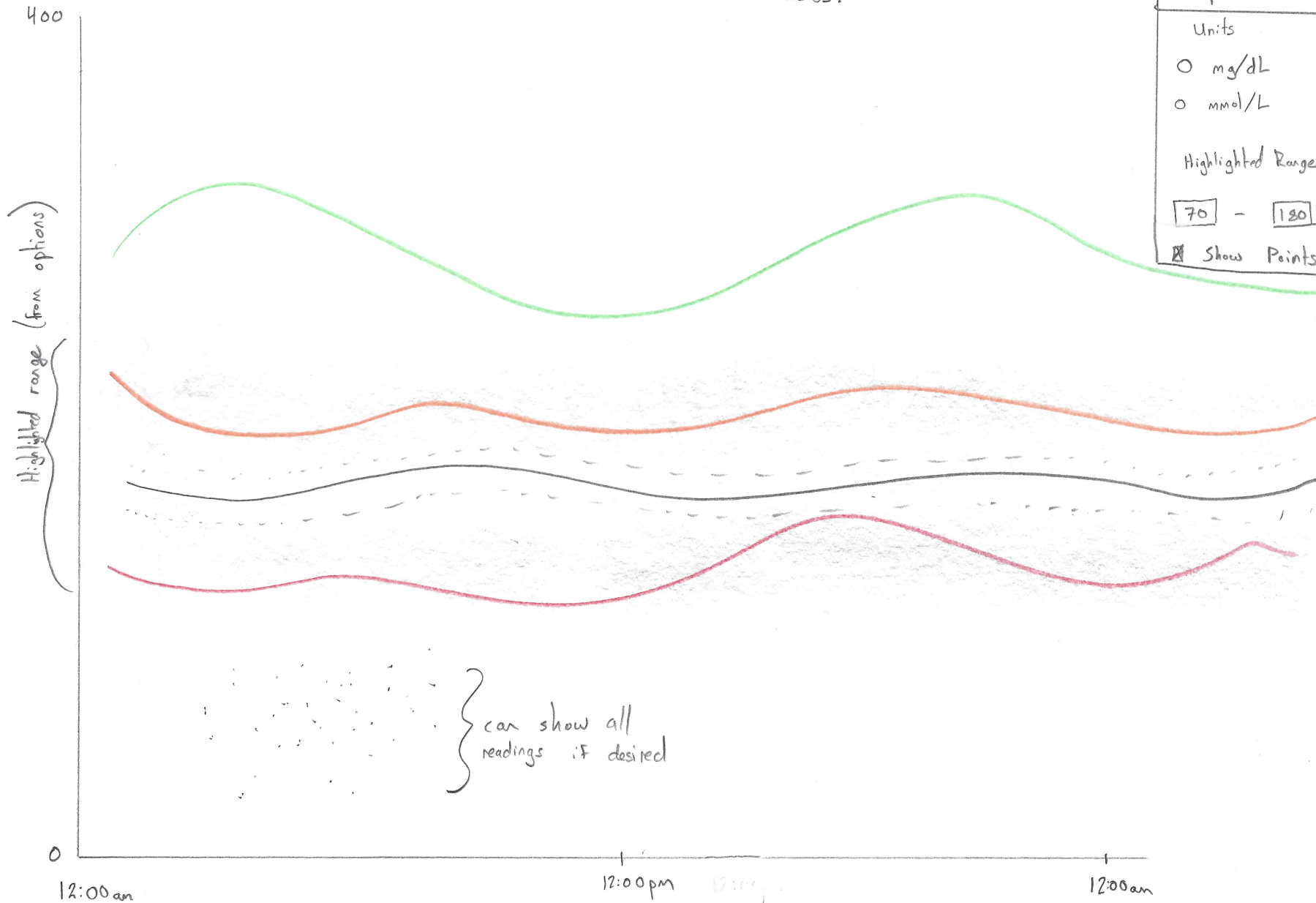
Options
Units
<input type="radio"/> mg/dL
<input type="radio"/> mmol/L
Highlighted Range
<input type="text" value="70"/> - <input type="text" value="180"/>
<input checked="" type="checkbox"/> Show Points

user options within AGP views

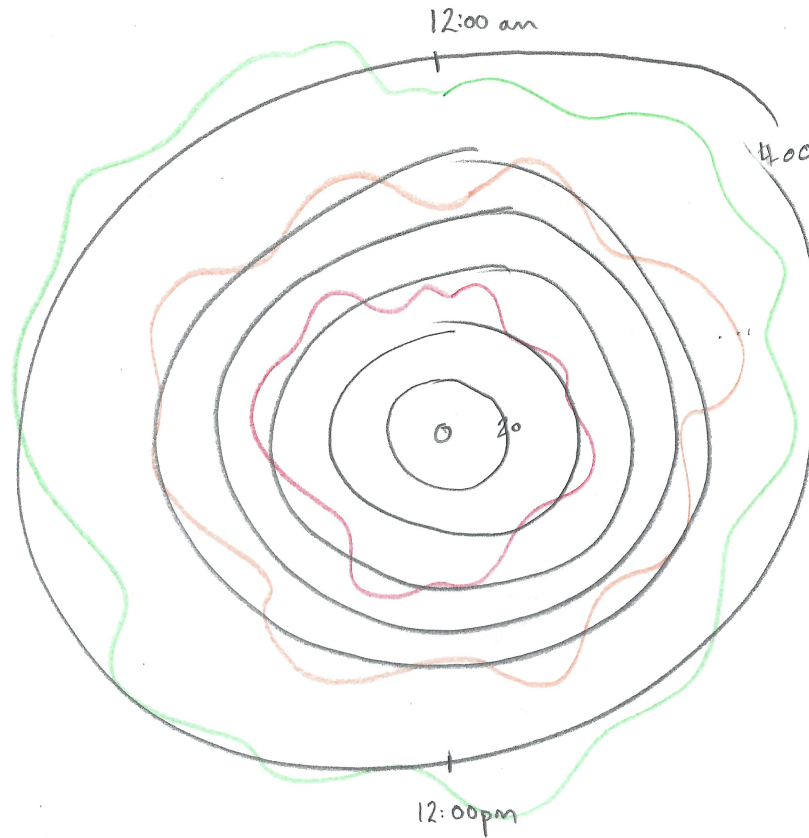
Legend
<span style="color: green;">●</span> ID 1
<span style="color: orange;">●</span> ID 2
<span style="color: red;">●</span> ID 3
<span style="color: black;">●</span> Cohort Avg.
<span style="color: gray;">---</span> Cohort SE

can select IDs here or using lines

Views
<input checked="" type="radio"/> Aggregated
<input type="radio"/> Radial
<input type="radio"/> Multiples



AGP	TIR	Summary
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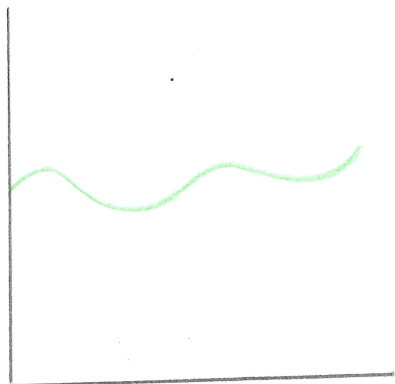


Options
Units
<input type="radio"/> mg/dL
<input type="radio"/> mmol/L
Range
<input type="text" value="170"/> - <input type="text" value="180"/>

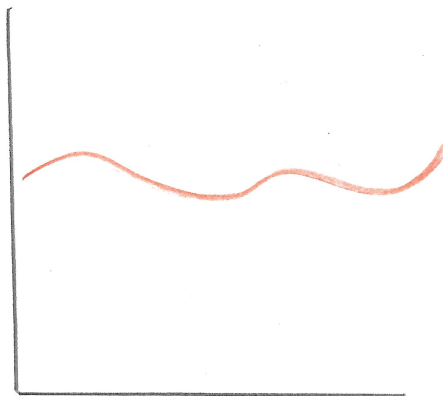
Legend
<input checked="" type="radio"/> ID 1
<input checked="" type="radio"/> ID 2
<input checked="" type="radio"/> ID 3

Views
<input type="radio"/> Aggregated
<input checked="" type="radio"/> Radial
<input type="radio"/> Multiples

ID 1



ID2



AGP

TIR

summary

Options

Units

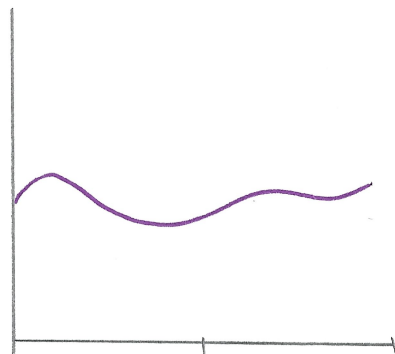
☐ mg/dL

☐ mmol/L

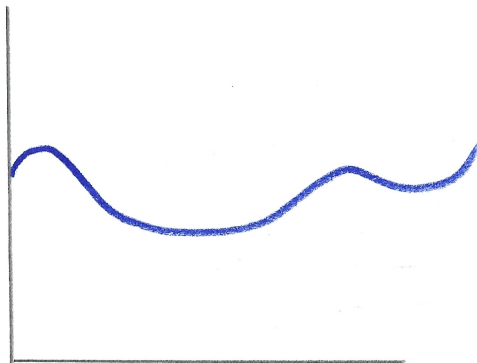
Range

-

ID 4



ID 5



Views

☐ Aggregated

☐ Radial

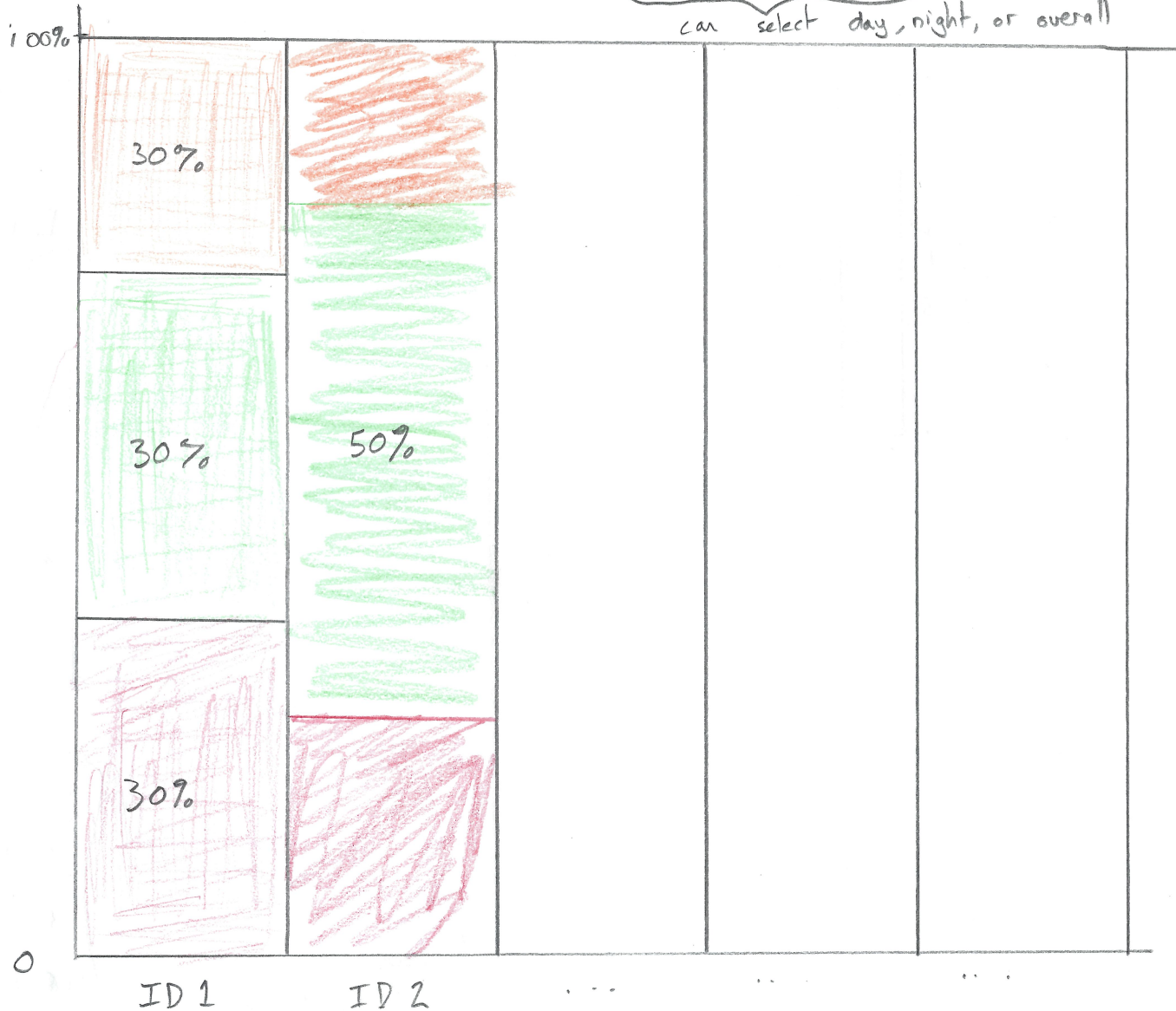
☒ Multiples

# cgmanalysis Shiny App

AGP	<del>TIR</del>	Summary
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<del>Overall</del>	Day	Night
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can select day, night, or overall



can rearrange

Options
Units
<input type="radio"/> mg/dL
<input type="radio"/> mmol/L
Ranges
<input type="text" value="40"/> - <input type="text" value="70"/>
<input type="text" value="70"/> - <input type="text" value="180"/>
<input type="text" value="180"/> - <input type="text" value="250"/>
Day hours
<input type="text" value="6"/> - <input type="text" value="11"/>

Legend
<span style="color: red;">●</span> 40 - 70
<span style="color: green;">●</span> 70 - 180
<span style="color: red;">●</span> 180 - 250

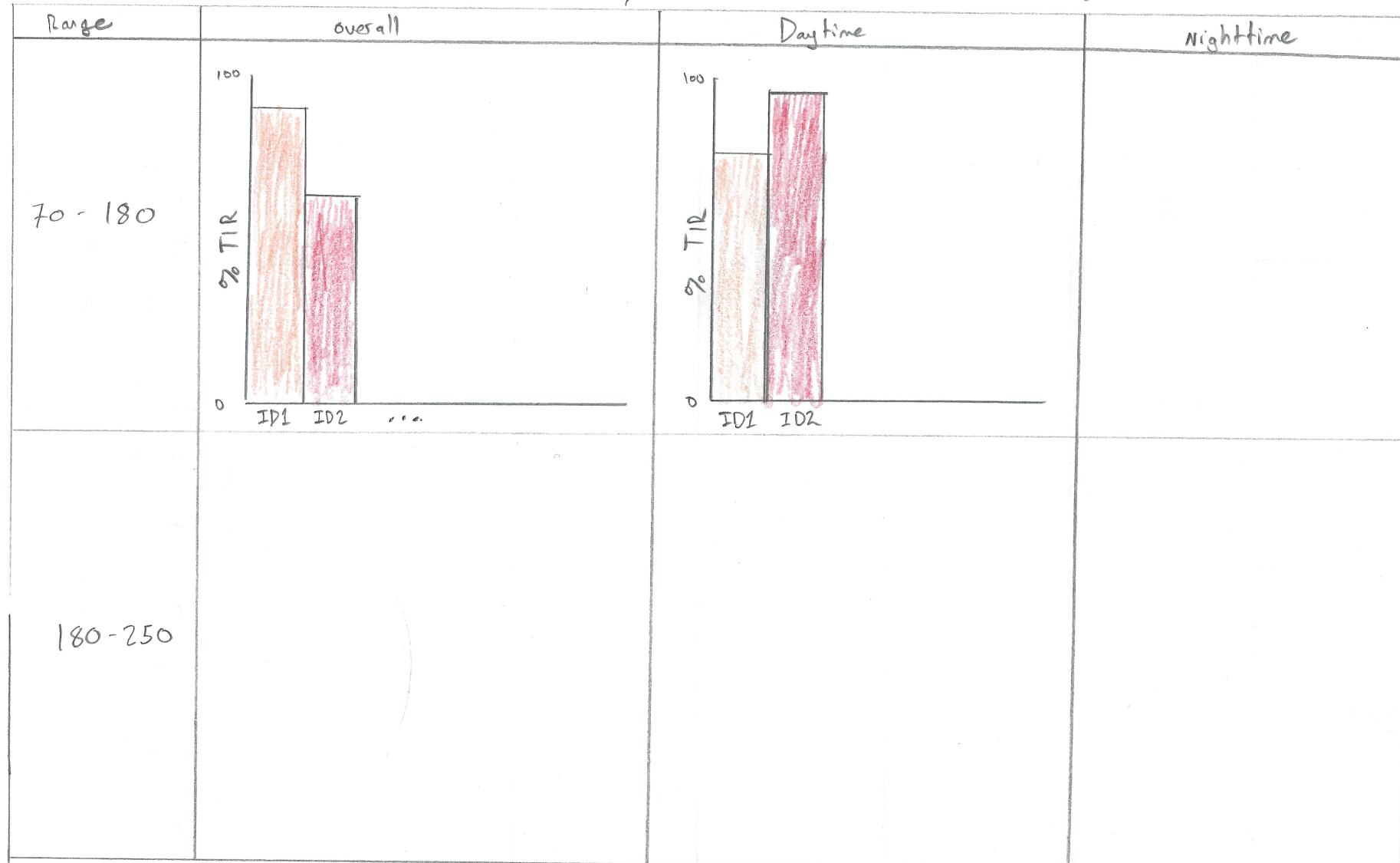
Should match order in bars, whoops!

Views
<input checked="" type="radio"/> Stacked
<input type="radio"/> Multiples

If possible I'd like to be able to select a range the x-axis live those on

AGP	TIR	Summary
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can re-order columns and rows



options
units
0
0
Daytime Hours
6 - 11
Ranges
70 - 180
180 - 250

Views
<input type="radio"/> stacked
<input checked="" type="radio"/> Multiples

Legend
<span style="color: orange;">●</span> ID 1
<span style="color: red;">●</span> ID 2
<span style="color: green;">●</span> ID 3

not sure about this legend since it isn't