

In [1]:

```

1 ▾ # Importing required libraries and setting display options
2 import pandas as pd
3 import numpy as np
4 import altair as alt
5 from altair import datum, expr
6 import matplotlib.pyplot as plt
7 import datetime as dt
8 alt.renderers.enable('notebook')
9 pd.set_option('display.max_colwidth', -1)

```

executed in 12.9s, finished 18:12:21 2018-10-30

In [2]:

```

1 ▾ # Reading in data
2 tchrs = pd.read_stata("../src/teacher_data.dta", convert_categoricals=False)
3 csos = pd.read_stata("../src/cso_data.dta", convert_categoricals=False)
4 dirs = pd.read_stata("../src/director_data.dta", convert_categoricals=False)

```

executed in 2.13s, finished 18:12:23 2018-10-30

In [3]:

```

1 ▾ # Reporting interview counts by dataset
2 print(f"The Teacher dataset contains {tchrs.shape[0]} records\nThe CSO datas

```

executed in 12ms, finished 18:12:23 2018-10-30

The Teacher dataset contains 828 records
The CSO dataset contains 153 records
The Director dataset contains 247 records

The main questions we want to ask are documented in the [analysis plan](https://github.com/TSSlade/tusome-d4dm/blob/master/analysis_plan.md) (https://github.com/TSSlade/tusome-d4dm/blob/master/analysis_plan.md), which is an evolving document.

1 Teacher Instrument

Here we begin exploring the data we obtained from interviewing the teachers.

In [4]:

```

1 ▾ # Counting teacher records
2 tchr_ct = tchrs.shape[0]

```

executed in 44ms, finished 18:12:23 2018-10-30

Our dataset contains interviews with 828 teachers.

1.1 Teachers visited previously by CSOs

The underlying assumption of most of the interview protocol is that the teacher has had a coaching interaction with a CSO. The first issue we should then address is the proportion of teachers who have received a visit from a CSO.

In [5]:

```
1 # Counting teachers never visited
2 never = 100 * ((tchr_ct - tchrs.vis_before.sum())/tchr_ct)
```

executed in 22ms, finished 18:12:23 2018-10-30

We see that 7.37% of teachers interviewed had never been previously visited by CSOs.

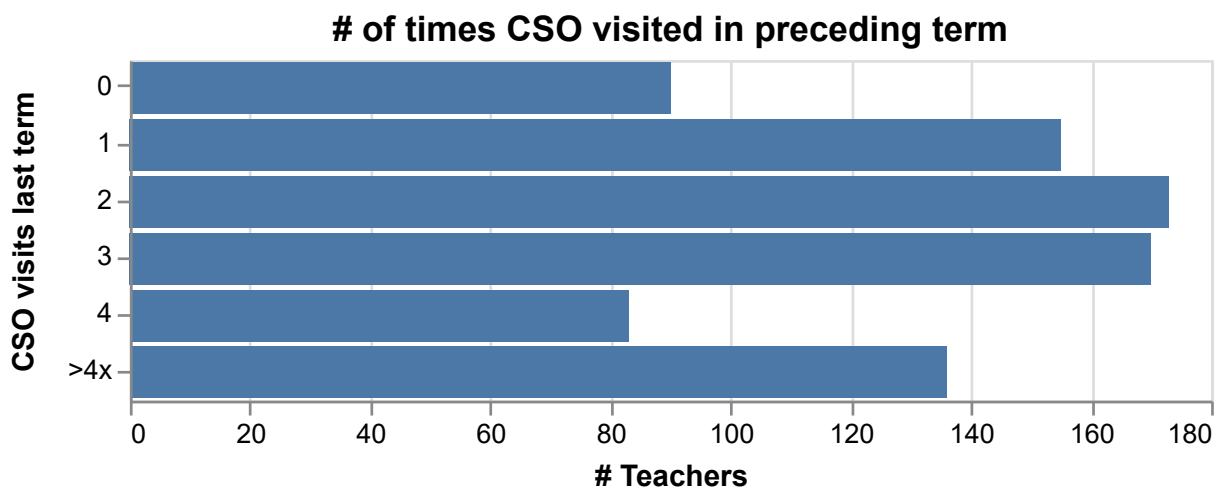
1.2 Number of coaching visits in the last academic term

We have confirmed that the overwhelming majority of our teachers have been visited. We can have greater confidence in the responses they give us over the course of the interview if they have had a visit in the recent past. We therefore asked the teachers to tell us how many times they had been visited by their CSO in the preceding academic term (Term 2 of the Kenyan academic year, running from roughly May-July 2018).

In [6]:

```
1 # Generating CSO visit counts
2 tchrs.vis_before_freq = tchrs.vis_before_freq.replace({55: ">4x"})
3 viscount_df = pd.DataFrame(tchrs.vis_before_freq.value_counts(sort=False)).n
4 viscount_df["pct"] = np.round(100 * (viscount_df.vis_before_freq / tchrs.vis
5 more_than_monthly = viscount_df[viscount_df.prevterm_vis.isin([4, ">4x"])]
6
7 # Generating CSO visit counts
8 alt.Y("prevterm_vis:0", title="CSO visits last term"),
9 alt.X("vis_before_freq:Q", title="# Teachers"),
10 tooltip="pct")
11
12 csovisct_ch.save("../img/csovisct_ch.svg", scale_factor=2.0)
```

executed in 13.7s, finished 18:12:37 2018-10-30



We see that roughly 11% of the respondents, while they'd been visited by a CSO in the past, had not been visited in the preceding term. However, roughly 64% of the respondents were visited between once per term and once per month. Roughly 28% of the teachers were visited by their CSOs more frequently than monthly.

1.3 CSOs' activities during last coaching visit

We are interested in knowing what CSOs are focusing on when they pay a visit to a school. Are they observing a lesson? Are they giving feedback to the teacher? Do they assess pupils' fluency rates? Do they take advantage of their presence at the school to meet with the head teacher (HT)? What kinds of things are they doing *besides* these activities?

```
In [7]: 1 # Generating table of CSOs' activities during visits
2 visact_df = pd.DataFrame.from_dict({"activities": ["Assessed pupils",
3 "Talked to HT",
4 "Provided feedback on les
5 "Had general talk",
6 "Other"],
7 "tchrs_reporting": [tchrs[tchrs.vis_befo
8 tchrs[tchrs.vis_befo
9 tchrs[tchrs.vis_befo
10 tchrs[tchrs.vis_befo
11 tchrs[tchrs.vis_befo
12 visact_df["pct"] = np.round(visact_df.tchrs_reporting.apply(lambda x: 100 *
13 visact_df
```

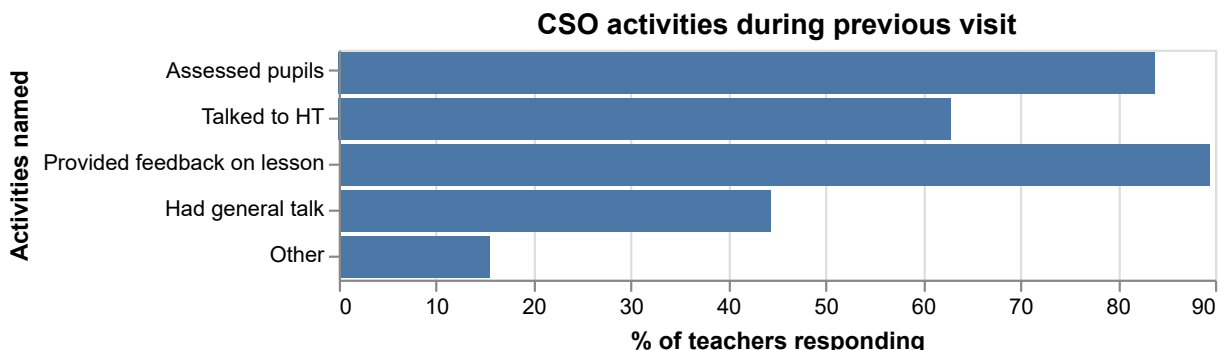
executed in 92ms, finished 18:12:37 2018-10-30

Out[7]:

	activities	tchrs_reporting	pct
0	Assessed pupils	688	83.84
1	Talked to HT	516	62.88
2	Provided feedback on lesson	734	89.44
3	Had general talk	364	44.36
4	Other	127	15.48

```
In [8]: 1 # Generating the graph of CSOs' activities during the previous visit
2 csoprevvis_ch = alt.Chart(visact_df, title="CSO activities during previous v
3 alt.Y("activities:0",
4 title="Activities named",
5 sort = alt.EncodingSortField(field="tchrs_reporting", op="values", ord
6 alt.X("pct:Q",
7 title="% of teachers responding"),
8 tooltip = "tchrs_reporting")
9 csoprevvis_ch.save("../img/csoprevvis_ch.svg", scale_factor=2.0)
```

executed in 9.38s, finished 18:12:47 2018-10-30



Nearly 90% of teachers report that when the CSO last visited, s/he provided feedback on a lesson. A fairly comparable proportion said that the CSO assessed pupils. Neither of these is surprising, as those activities are key features of a "reimbursable" or "valid" lesson observation. If anything, it is interesting that these numbers are not higher, given that we have excluded from our denominator those teachers who said they had never received a visit from the CSO.

Of note is the relatively low proportion of teachers reporting the CSO had spoken with the HT. While Tusome encourages CSOs to speak with HTs as part of the standard protocol for visiting a school, it is not explicitly considered as a factor for reimbursement of transportation costs for visiting that school.

That said, it is also possible that teachers may simply not be aware of activities taking place outside of their classroom. They and their classrooms would have been the objects of the lesson observation and fluency assessment; they may not have as much visibility into what happened before or after the CSO entered their classroom.

A little over 15% of teachers reported the CSO conducted an activity that was not listed in the questionnaire. Below we have sampled 20 of the things that they reported which were not captured in the questionnaire.

In [9]:

```
1 ▾ # Generating a list of the 'other' activities CSOs did when visiting
2   print(tchrs[tchrs.vis_act_other_det.notna() & (tchrs.vis_act_other_det != "")])
```

executed in 129ms, finished 18:12:47 2018-10-30

```
512     He tells us through thr HT.He calls us to the office to agree on who
    to be observed in which subject and class.When in class he checks profession
    al document and relevant material I am to use for the lesson..Observes a ful
    l lesson and then conducts a feedback session that is usually very friendly
    and teachers centered.
726     assesed children,spoke to the head teacher and gave me feedback

731     The CSO observed my lessons and gives recommendations regarding what
    went well and areas of improvement.

19     He asks for my professional documents
```

1.4 CSOs using tablets or pen & paper during observation

The *Tangerine:Tutor* app was developed with the intent and belief that CSOs would use it *while observing* the lesson. However, Tusome staff report that not all CSOs find the tablet interface comfortable, and not all use it with ease. So we asked teachers to report whether CSOs use the tablets during the lesson observation, and also whether they use pen and paper.

Roughly 90% of teachers reported that the CSOs use tablets during lesson observation; roughly

81% of teachers reported the CSOs use pen and paper during the lesson observation.

```
In [10]: 1 ▾ # Generating the table about usage of tablets and pencils
2 tabs_n_pencils = pd.crosstab(tchrs.cso_usetab_yn, tchrs.cso_usepcl_yn)
3 tabs_n_pencils = tabs_n_pencils.rename_axis("Uses tablet").rename_axis("Uses
4 tabs_n_pencils = tabs_n_pencils.rename({0: "No", 1: "Yes"}, axis="columns").
5 tabs_n_pencils
```

executed in 2.41s, finished 18:12:49 2018-10-30

Out[10]:

Uses pen and paper	No	Yes
Uses tablet		
No	3	17
Yes	72	657

We see that the overwhelming majority of CSOs are using both tablets *and* pen-and-paper systems when observing the teachers' lesson. There have historically been some instruments/data that CSOs were tasked by TSC to complete that were not rendered in *Tangerine* format on the tablets; as of midway through Term 3 of the 2018 academic year, those instruments (mostly for the TSC's TPAD [Teacher Performance Appraisal and Development] project) are now in *Tangerine*. While the use of pen and paper does not appear to have come at the expense of using the tablets - indeed, it appears to be complementary, as nearly all CSOs are using both - Tusome should nonetheless follow up on these reports of CSOs' usage of pen and paper to understand the roots of the practice.

1.5 CSOs' usage of the tablets to assess pupils' performance

Tusome's coaching protocol requires CSOs to randomly select three children from the classroom at the end of the lesson to assess their reading fluency. The prompt the children are to read from is a laminated sheet of paper with a short passage printed on it; the CSOs are instructed to use the tablet to record the children's responses. The tablet is then able to calculate fluency rates and store those as data associated with that observation.

Approximately 88% of the teachers reported that CSOs use the tablets to assess children's reading fluency.

1.6 Teachers' experience of feedback, and CSOs' use of tablets during feedback

Tusome asked teachers whether the CSO gave feedback on the lesson last time s/he paid a visit, whether s/he used the tablet to do so, and whether the teacher was able to recall specific feedback the CSO provided.

In [11]:

```

1 ▾ # Generating table of CSO use of tablets for feedback
2 ▾ feedback = {"CSO gave feedback": tchrs.cso_gave_fdbk_yn.sum(),
3             "CSO used a tablet for feedback": tchrs.cso_usetab_fdbk_yn.sum(),
4             "Tchr remembers feedback": tchrs.cso_fdbk_remember.sum()}
5 fdbk_df = pd.DataFrame.from_dict(feedback, orient="index", columns=["ct"])
6 fdbk_df["pct"] = 100 * np.round(fdbk_df["ct"] / tchrs.shape[0], decimals=3)
7 fdbk_df = fdbk_df.rename_axis("event").reset_index()
8 fdbk_df

```

executed in 40ms, finished 18:12:49 2018-10-30

Out[11]:

	event	ct	pct
0	CSO gave feedback	757.0	91.4
1	CSO used a tablet for feedback	676.0	81.6
2	Tchr remembers feedback	725.0	87.6

Below we have sampled 20 of the things that they reported which were not captured in the questionnaire.

In [12]:

```

1 ▾ # Sample of details regarding the details of feedback CSOs provided
2 print(tchrs[tchrs.cso_fdbk_det.notna() & (tchrs.cso_fdbk_det != "")].cso_fdb

```

executed in 21ms, finished 18:12:49 2018-10-30

750 N/A

299 There are some sounds such as /ng/ that he corrected me on how to pronounce correctly

597 I was guided on how to cover comprehension the before and after reading story

92 He told me to remember to check prediction after reading the story and put more emphasis on reading since learners were below

101 To improve on teaching vocabulary.

The tablets come equipped with various aids that CSOs could use to help coach teachers. In addition to the contents of the auto-generated feedback, CSOs could use the *Papaya* application to model pronunciation of letter sounds, the videos demonstrating effective lesson delivery, etc. Of the teachers reporting CSOs provided feedback of some kind, 56% indicated that the CSO showed them something directly on the tablet.

In [13]:

```

1 # Generating dataframe of feedback shown by CSOs to teachers
2 fdbk_shown_df = pd.DataFrame.from_dict({"resources": ["Tips from feedback screen",
3 "Pupils' reading fluency",
4 "Videos of lesson delivery",
5 "Letter sounds in Papaya",
6 "Other"],
7 "tchrs_reporting": [
8 tchrs[tchrs.vis_act_fdbk != 0].cso_s
9 tchrs[tchrs.vis_act_fdbk != 0].cso_s
10 tchrs[tchrs.vis_act_fdbk != 0].cso_s
11 tchrs[tchrs.vis_act_fdbk != 0].cso_s
12 tchrs[tchrs.vis_act_fdbk != 0].cso_s
13 fdbk_shown_df["pct"] = np.round(
14 fdbk_shown_df.tchrs_reporting.apply(
15 lambda x: 100 * (x/visact_df[visact_df.activities=="Provided feedback on
16 decimals=2)
17 fdbk_shown_df

```

executed in 75ms, finished 18:12:50 2018-10-30

Out[13]:

	resources	tchrs_reporting	pct
0	Tips from feedback screen	167	22.75
1	Pupils' reading fluency	260	35.42
2	Videos of lesson delivery	128	17.44
3	Letter sounds in Papaya	230	31.34
4	Other	54	7.36

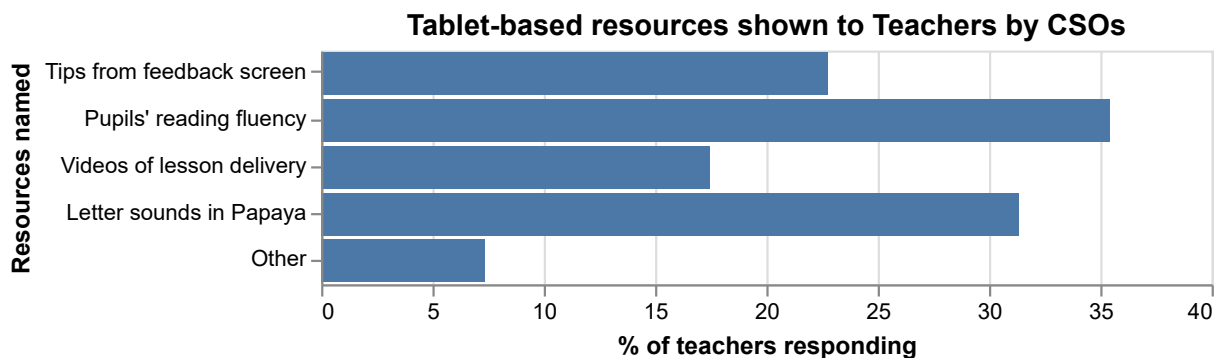
In [14]:

```

1 # Generating chart of tablet-based resources shown to teachers
2 tabres_ch = alt.Chart(fdbk_shown_df, title="Tablet-based resources shown to
3 alt.Y("resources:O",
4 title="Resources named",
5 sort = alt.EncodingSortField(field="tchrs_reporting", op="values", ord
6 alt.X("pct:Q",
7 title="% of teachers responding"),
8 tooltip = "tchrs_reporting")
9 tabres_ch.save("../img/tabres_ch.svg", scale_factor=2.0)

```

executed in 10.3s, finished 18:13:00 2018-10-30



Overall, fewer than 50% of teachers indicated that CSOs showed them something on the tablet as

part of the feedback session. Where the CSO showed something to the teacher, it was most frequently pupils' reading fluency (at 35%), with Papaya letter sounds the next most common (at 31%).

N.B.: Update cell w literate programming re: which activity is in the lead. (Abstract one level further.)

Below we have sampled 20 of the things that they reported which were not captured in the questionnaire.

In [15]:

```
1 # Printing sample of teachers' feedback re: things CSOs showed them on the t
2 print(tchrs[tchrs.cso_shw_other_det.notna() & (tchrs.cso_shw_other_det != "")

executed in 67ms, finished 18:13:00 2018-10-30
```

```
747 HOW TO USE ICONS ON TEACHERS GUIDES
640 fluecny level and played letter sound
275 Lesson duration
782 I was shown the time I took
127 Time management- The time I took to conduct the lesson
392 Yes he uses the tablet to help me get pupils fluency rates,time taken
for the lesson
455 She showed me the story that was supposed to be read by the pupils
325 He showed me the fluency ability of learners
718 Downloaded the letter sounds on my smart phone
728 He showed me the rate at which the pupils have the paper the CSO was
```

1.7 CSOs' use of feedback visit-over-visit

Tusome's theory of change stipulates that smaller, more frequent, and more targeted coaching interactions will shift teacher behavior more effectively than larger-scale, episodic training events that cover a broad range of topics. This is the reason Tusome invests so heavily in supporting CSOs to provide coaching support to teachers in the span between large-scale training events.

Teachers, like most people, will be more likely to alter their behavior if feedback is timely and consistent, and the teachers' response to it is monitored rather than assumed. In this survey, roughly 63% of teachers indicated that when CSOs visited the school and observed the teacher, they follow up on feedback from earlier visits.

T.D.: Update cells so definitions of variable literate programming inputs are visible.

1.8 Teachers self-reported improvement in response to coaching

Effectively measuring the quality of instruction or lesson delivery is a very, very difficult task. (**T.D.:** Provide citations, examples of various approaches.)

The current study was not able to directly assess the quality of teachers' lesson delivery, although Tusome is working on various other studies which attempt to do so. However, we asked teachers whether they felt the coaching received from CSOs had improved the quality of their teaching. We first posed the question in regard to the teaching of reading in Kiswahili and English, and then asked them whether the coaching had improved their teaching in other subjects as well.

```
In [16]: 1 ▾ # Generating dataframe of teacher's self-reported improvement due to coaching
2 ▾ better_tchr_df = pd.DataFrame.from_dict(
3 ▾     {"subject": ["Kiswahili & English reading",
4 ▾                 "Other subjects"],
5 ▾     "tchrs_reporting": [tchrs[(tchrs.vis_act_fdbk != 0) &
6 ▾                               (tchrs.vis_before != 0)].cso_fdbk_better_tus
7 ▾                               tchrs[(tchrs.vis_act_fdbk != 0) &
8 ▾                               (tchrs.vis_before != 0)].cso_fdbk_better_non
9 ▾ better_tchr_df["pct"] = np.round(
10 ▾     better_tchr_df.tchrs_reporting.apply(
11 ▾         lambda x: 100 * (x/tchrs[(tchrs.vis_act_fdbk !=0) & (tchrs.vis_before !=
12 ▾         decimals=2)
13
14 ▾ btrr_tus_pct = better_tchr_df[better_tchr_df.subject=="Kiswahili & English r
15 ▾ btrr_nont_pct = better_tchr_df[better_tchr_df.subject=="Other subjects"].pct
16 ▾ better_tchr_df
executed in 2.91s, finished 18:13:03 2018-10-30
```

Out[16]:

	subject	tchrs_reporting	pct
0	Kiswahili & English reading	732.0	99.86
1	Other subjects	706.0	96.32

Encouragingly, 99.86% and 96.32% - effectively all - teachers have indicated that the feedback they receive from CSOs has enabled them to be better teachers.

Below we have sampled 20 of the examples teachers gave for how their teaching has improved as a result of the feedback.

In [17]:

```
1 ▾ # Printing sample of things teachers say they do better
2 print(tchrs[tchrs.cso_fdbk_better_det.notna() & (tchrs.cso_fdbk_better_det !
```

executed in 59ms, finished 18:13:03 2018-10-30

403 Use the steps of teaching vocabulary to teach vocabulary terms in other subjects

7 Using of sounds and syllables to read words, Like when am teaching the lords prayer, i use the tusome method which makes it easy for learners to get it easily, that is by using sound/syllables to read difficult words.

718 The CSOs feedback on how to link the words in Tusome like water to use them in other subjects like hygiene in science.

1.9 CSOs' discussion of pupil fluency

The ultimate goal of Tusome is to improve reading outcomes in grades 1-3. Whether the project has been successful is determined by the pupils' reading skills (with an emphasis on *oral reading fluency*, or ORF, and reading comprehension) as demonstrated by their performance on an early grade reading assessment (EGRA).

For a CSO's visit to be considered *complete* or *valid*, one of the criteria is that it include an assessment of the reading skills of three randomly-selected pupils. These pupils are then provided a stimulus that contains a brief reading passage of ~50-100 words. As they read aloud from the stimulus, the CSO uses the *Tangerine* application on the tablet to make note of any inaccurately read words. When the child has finished reading - or when 60 seconds elapses, whichever comes first - the assessment is complete. The child's fluency is then calculated using the formula

$$\frac{\text{\# of correct words}}{\left(\frac{60 - \text{time remaining (s)}}{60} \right)} = \text{correct words per minute}$$

The *Tangerine* software calculates the average fluency in *cwpm* across all three pupils and reports it as part of the lesson feedback. The CSO is able - but not required - to bring up the pupils' fluency as part of their feedback session.

```

In [18]: 1 ▾ # Generating dataframe CSOs' discussions of fluency
2 ▾ fluency_disc_df = pd.DataFrame.from_dict({"response": [
3     "CSO discusses fluency in feedback session",
4     "Teacher finds discussion of fluency useful"],
5 ▾     "tchrs_responding": [
6         tchrs[tchrs.vis_before != 0].cso_fdbk_discfluency.sum(),
7         tchrs[tchrs.vis_before != 0].cso_fdbk_flu_useful.sum()])})
8
9 ▾ fluency_disc_df["pct"] = np.round(100 *
10 ▾     fluency_disc_df.tchrs_responding.apply(
11     lambda x: x / (tchrs.vis_before.sum())), decimal=1)
12
13 flu_cso_disc = fluency_disc_df[fluency_disc_df.response=="CSO discusses flue
14 flu_disc_use = fluency_disc_df[fluency_disc_df.response=="Teacher finds disc
15 fluency_disc_df

```

executed in 65ms, finished 18:13:03 2018-10-30

Out[18]:

	response	tchrs_responding	pct
0	CSO discusses fluency in feedback session	706.0	92.05
1	Teacher finds discussion of fluency useful	710.0	92.57

It appears the overwhelming majority of CSOs (92.05%) discuss the pupils' fluency with the teachers, and the teachers overwhelmingly (92.57%) find it a useful discussion. But how do teachers make use of that insight?

Below we have sampled 20 of the examples teachers gave for what they do with knowledge of their pupils' fluency rates.

```

In [19]: 1 ▾ # Printing a sample of teachers' responses re: what they do with knowledge o
2 ▾ print(tchrs[tchrs.cso_fdbk_flu_dowith.notna() & (tchrs.cso_fdbk_flu_dowith != 0)]["response"])

```

executed in 27ms, finished 18:13:03 2018-10-30

```

568 The fluency level helped me help my pupils on increasing their speed
of reading since they were slow in reading.

546 I am able to know where my learners are

790 I improve depending on the comments.

269 am able to understand the fluency level of my learners so that i enco
urage those who are reading well and also support those who have challenges

418 The information helps me do corrections in my next lesson

746 TO GIVE MORE TIME TO THOSE WHO ARE NON READERS

814 It makes me initiate remedial sessions of which time takers becomes a
ble to achieve the target

```

1.10 Disruption caused by tablet use

Pupils are easily distracted by the presence of unfamiliar adults in the classroom. However, if the adult sits quietly and unobtrusively in the rear of the classroom, the children rapidly become acclimated to the visitor's presence and are able to focus on the lesson.

For many children in rural schools, however, tablet computers are an unfamiliar sight. Tusome was interested to know whether the CSOs' use of tablets to conduct the classroom observation or assess the pupils' fluency is perceived as disruptive.

```
In [20]: 1 ▾ # Generating dataframe re: pupils' distraction due to tablet use
2 ▾ tchr_dist_df = pd.DataFrame.from_dict({
3 ▾     "case": [
4         "CSO tablet use for observation",
5         "CSO tablet use for feedback"],
6 ▾     "distracting": [
7         int(tchrs[tchrs.vis_before != 0].cso_tab_distract_yn.sum()),
8         int(tchrs[tchrs.vis_before != 0].cso_tab_fdbk_distrac.sum())]]})
9
10 ▾ tchr_dist_df["pct"] = 100 * np.round(tchr_dist_df.distracting.apply(
11 ▾     lambda x: x / tchrs.vis_before.sum()),
12     decimals=2)
13
14     distracting_tab_obs = float(tchr_dist_df[tchr_dist_df.case=="CSO tablet use
15     distracting_tab_fdbk = float(tchr_dist_df[tchr_dist_df.case=="CSO tablet use
16
17     tchr_dist_df
executed in 70ms, finished 18:13:03 2018-10-30
```

Out[20]:

	case	distracting	pct
0	CSO tablet use for observation	34	4.0
1	CSO tablet use for feedback	16	2.0

Reassuringly, very few teachers responded that they find it distracting when the CSO used a tablet during observation or during feedback (4.0% and 2.0%, respectively). It is worth considering why they found the tablet use distracting; because the numbers are so low, the lists below present all responses rather than just a sample.

In [21]:

```

1 ▾ # Printing the reasons teachers think the tablets are distracting during obs
2   print(tchrs[(tchrs.cso_tab_distract_why != "") & tchrs.cso_tab_distract_why.

```

executed in 23ms, finished 18:13:03 2018-10-30

```

1      Pupils get attention of the tablet

13      at times it is distracting when the CSO takes a photo using the table
t. This mostly affects the pupils. It was a challenge to me the first time s
he took the photos but now I am used to it.
26      some learners look at the CSO at the back of the class as he he uses
tablet hence distracting their attention

47      The curious one always keep on looking at the tablet instead of liste
ning to me

89      Some of the children sitting next to the children get distraccted and
stop looking and the board.They are are also not comfortable because they ar
e not used to it.
108     N/A s

113     N/As

```

In [22]:

```

1 ▾ # Printing the reasons teachers feel the tablet use during feedback is distr
2   print(tchrs[(tchrs.cso_fdbk_tab_diswhy != "") & tchrs.cso_fdbk_tab_diswhy.no

```

executed in 56ms, finished 18:13:03 2018-10-30

```

35      it arouses curiosity therefore disrupt concentration of the learners

50      I am distracted because i don't know what he will tell me

176     Because i am not aware what he is doing with the tablet but if both a
re looking at it, i will not find it distracting

206     My thinking is that the CSO is recording me and can be used in other
places

241     When he is giving me feedback find it distracting that the CSO has to
keep on looking on the tablet, I wonder what he is looking at or reading fro
m the tablet. I prefer that he uses a a hardcopy of a real book not from his

```

While these results are encouraging, it may be that CSOs' tablet use is more distracting when it is the pupils themselves who are the object of the CSO's attention. We asked teachers whether they were present during the assessment of pupils' reading skills, and if so, whether it was their sense that pupils were distracted by the tablet use.

```

In [23]: 1 ▾ # Generating dataframe re: pupils' distraction due to tablet use during asse
2 ▾ pupil_dist_df = pd.DataFrame.from_dict({
3 ▾     "response": [
4         "Teacher observed the assessment",
5         "Pupils found the tablet distracting"],
6 ▾     "tchrs_responding": [
7         int(tchrs[tchrs.vis_before != 0].cso_pres_ass_tab.sum()),
8         int(tchrs[tchrs.vis_before != 0].cso_pup_distract_ass.sum())]]})
9
10 ▾ pupil_dist_df["numerator"] = [
11     int(tchrs.vis_before.sum()),
12     int(pupil_dist_df[pupil_dist_df.response=="Teacher observed the assessme
13
14     pupil_dist_df["pct"] = 100 * np.round(pupil_dist_df.tchrs_responding / pupil
15
16     tchrs_obsd_assmt = int(pupil_dist_df[pupil_dist_df.response=="Teacher observ
17     pupils_distracted = int(pupil_dist_df[pupil_dist_df.response=="Pupils found
18
19     pupil_dist_df

```

executed in 86ms, finished 18:13:03 2018-10-30

Out[23]:

	response	tchrs_responding	numerator	pct
0	Teacher observed the assessment	449	767	59.0
1	Pupils found the tablet distracting	98	449	22.0

Roughly 59% of the teachers said they had observed the CSO's assessment of the pupils' reading skills. Of those, 22% thought the pupils found the tablet distracting. This may suggest a need for Tusome to provide additional training or orientation to CSOs on best practices in assessment administration.

Below we sample 20 of the reasons teachers provided for why they thought pupils found tablet use distracting during the assessment.

In [24]:

```
1 ▾ # Printing a sample of the reasons teachers think pupils find the tablet dis
2   print(tchrs[(tchrs.cso_pup_dist_why != "") & tchrs.cso_pup_dist_why.notna()])
```

executed in 27ms, finished 18:13:03 2018-10-30

35 the tablet was new to the learners and the were attracted to tablet a
nd could not concetrate in the leson and the fact that the CSO is stranger i
n class

814 my pupils become a bit nervous as they are not used to the tablet/s

601 Some learners could not concentrate fully on what they were reading a
nd could look at what the CSO is doing on his tablet.

788 From the environment where most of them come from, most likey it is t
heir first time to see a tablet, and might not concentrate on the reading pa
rt. One of them failed completely to read on the story given

99 They look at the back to check what is happening.

739 some of them fear when a tablet is used during assessment session

752 I saw that some children are eager they want to read

1.11 Teachers' ongoing assessment of pupil fluency

Teachers are fully capable of assessing their pupils' reading fluency without recourse to a tablet. However, RTI has experimented with an Android-based pupil performance tracking tool that might be of use to teachers. Therefore we were interested to understand the extent to which teachers are already assessing pupils' fluency, what tools they are using for the task, whether they have access to phones on which such a tool could be deployed, and whether they would want to use it if so.

In [25]:

```
1 ▾ # Calculating proportion of teachers who assess their pupils' fluency
2   tchrs_assessing = 100 * np.round(tchrs.tchr_ass_pup_flu_yn.sum() / tchrs.sha
```

executed in 6ms, finished 18:13:04 2018-10-30

Roughly 91% of teachers we spoke to indicated they assess their pupils' fluency. When asked to specify what tools they use for the task, they specified the following.

In [26]:

```
1 # Printing sample of tools teachers use to assess pupils' fluency
2 print(tchrs[(tchrs.tchr_ass_pup_flu_yn != 0) & (tchrs.tchr_ass_pup_tools !=
```

executed in 23ms, finished 18:13:04 2018-10-30

469 give them stories

234 I use the stories in the textbooks. I also use flash cards.

706 Books, readers and supplementary materials.

518 I use oral reading exams and time them.

In [27]:

```
1 # Generating dataframe of teachers' access to phones and interest in a tool
2 tang_tool_df = pd.DataFrame.from_dict({
3     "response": ["Teacher has a phone",
4                 "Phone is an Android",
5                 "Teacher would like a tool"],
6     "tchrs_responding": [
7         tchrs.tch_mob_phone.sum(),
8         tchrs.tch_has_android.sum(),
9         tchrs.tch_wants_assess.sum()]]})
10
11 tang_tool_df["pct"] = 100 * np.round(tang_tool_df.tchrs_responding.apply(lam
12 tang_tool_df
```

executed in 46ms, finished 18:13:04 2018-10-30

Out[27]:

	response	tchrs_responding	pct
0	Teacher has a phone	814.0	98.0
1	Phone is an Android	654.0	79.0
2	Teacher would like a tool	813.0	98.0

Nearly all teachers interviewed indicated they have access to a mobile phone; nearly 4 out of 5 teachers indicated their phone is an Android. Nearly all teachers - even those who don't have an Android - said they would like to have access to a tool that would provide them sample assessments they could do with their pupils.

2 CSO Instrument

Here we begin exploring the data we obtained from interviewing the CSOs.

2.1 Length of experience using tablet-based Tangerine

When did you first receive a tablet from Tusome or PRIMR?

We want to convert the year/month CSOs provided into a number so we can work with it easily. We'll make the simplifying assumption that the tablet was received on the first day of the month they provided, and that this interview was conducted on the first day of the month. Neither of those are true, but the marginal days are unlikely to make a practical difference in a CSO's facility with the tool.

In [28]:

```
1 ▾ # Converting date tablet received into duration of tablet usage
2   now = dt.datetime(2018, 10, 1)
3   csos["tab_usage"] = pd.to_timedelta(now - pd.to_datetime({"year": csos.recd_
```

executed in 30ms, finished 18:13:04 2018-10-30

We'll also want to convert the duration to months, since that will be easier to digest, and filter out any missing values.

In [29]:

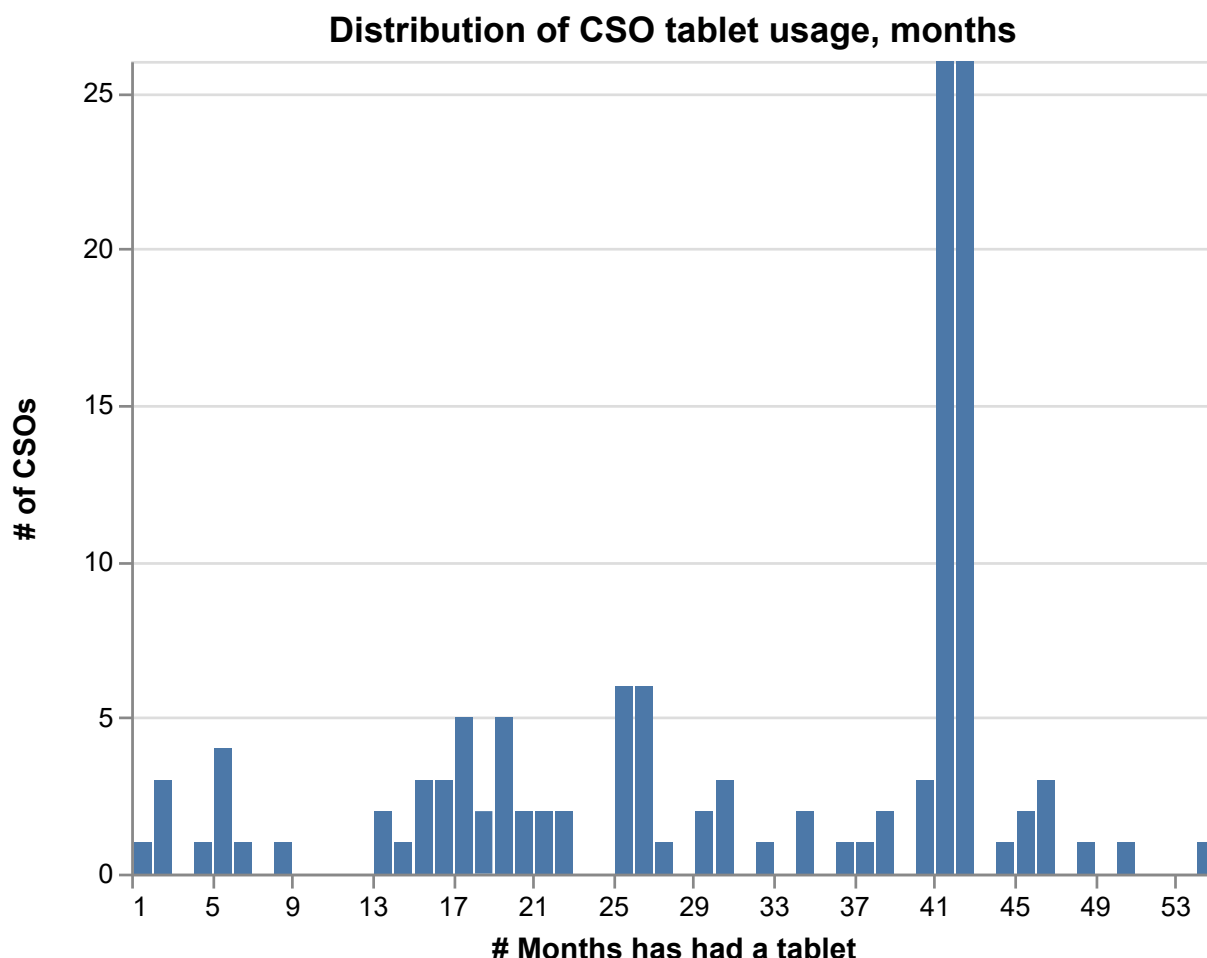
```
1 ▾ # Generating dataframe of CSOs' tablet usage
2   tab_usage = pd.DataFrame(csos[csos.tab_usage.notna()].tab_usage / 30)
```

executed in 16ms, finished 18:13:04 2018-10-30

In [30]:

```
1 ▾ # Generating histogram of CSOs' tablet usage duration
2 ▾ csotabusage_ch = alt.Chart(tab_usage, title="Distribution of CSO tablet usag
3 ▾     alt.X("tab_usage:Q",
4           bin=alt.BinParams(step=1), title="# Months has had a tablet"),
5           alt.Y("count()", title="# of CSOs"))
6
7   csotabusage_ch.save("../img/csotabusage_ch.svg", scale_factor=2.0)
```

executed in 13.3s, finished 18:13:17 2018-10-30



We see that the majority of our CSOs have had their tablets for roughly 41 months (3.5 years). This is in keeping with the beginning of the Tusome program, and is as expected. CSOs who have had their tablets for longer are likely veterans of the PRIMR program (Tusome's predecessor); those who have had tablets for fewer months may have assumed their roles more recently. (CSO turnover due to retirement, promotion, maternity leave, etc. is an issue which Tusome is constantly needing to manage.)

2.2 Proportion of CSOs reporting use of each application

Which applications do you use frequently when supporting teachers? ...After recording unprompted responses, read the list of options and record responses.

- Tangerine Tutor
- Papaya
- Tusome Books (in Adobe Acrobat)
- Tusome Videos (in MX Player)

The CSOs' tablets come equipped with several tools meant to support their efforts as instructional coaches. These include the [Tangerine Tutor](http://www.tangerinecentral.org/tutor/) (<http://www.tangerinecentral.org/tutor/>) application, the [Papaya](http://schoolsnetkenya.com/tusome-early-literacy-programme-sounds-application/) (<http://schoolsnetkenya.com/tusome-early-literacy-programme-sounds-application/>) application, PDF versions of Tusome's instructional materials (pupil's books and teacher's guides), and videos that model effective instructional delivery.

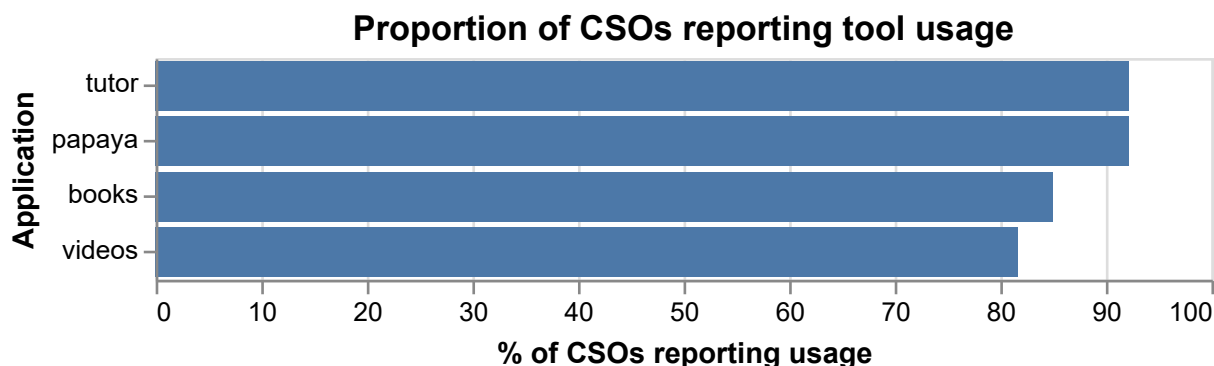
We are interested in which of those tools CSOs use, and how frequently. We will provide an analysis of their unprompted free-response answers to the question above. For the moment, we note the tools they said they use when we explicitly prompted them with the list of tools available.

```
In [31]: 1 # Generating a dataframe of CSOs' application usage
2 app_users = {"tutor": csos.freqapps_tt_promp.sum(),
3             "papaya": csos.freqapps_papaya_promp.sum(),
4             "books": csos.freqapps_bks_promp.sum(),
5             "videos": csos.freqapps_vids_promp.sum()}
6 app_usage = pd.DataFrame.from_dict(app_users, orient="index", columns=["ct"])
7 app_usage["pct"] = 100 * np.round(app_usage["ct"] / csos.shape[0], decimals=
8 app_usage = app_usage.rename_axis("app").reset_index()

executed in 29ms, finished 18:13:17 2018-10-30
```

```
In [32]: 1 # Generating bar chart of CSOs' tablet usage
2 tooluse_ch = alt.Chart(app_usage, title="Proportion of CSOs reporting tool u
3 alt.Y("app:O",
4       title="Application",
5       sort = alt.EncodingSortField(field="pct", op="values", order="asce
6       ),
7 alt.X("pct:Q", title="% of CSOs reporting usage"),
8 tooltip="pct")
9
10 tooluse_ch.save("../img/tooluse_ch.svg", scale_factor=2.0)

executed in 14.3s, finished 18:13:31 2018-10-30
```



The overwhelming majority of the CSOs report using all of the applications. That said, the videos and books are used less frequently.

2.3 Proportion of CSOs who refer to Tangerine to provide post-observation feedback

Do you refer to Tangerine when giving teachers feedback after observing a lesson?

The *Tangerine:Tutor* application analyzes the pattern of the CSO's responses to the observation items and surfaces actionable feedback that could be shared with the teacher to improve her or his instruction. While the auto-generated feedback is intended as a tool to help CSOs give more

effective guidance to teachers, it can be quite extensive and is not prioritized. We were interested to know whether the CSOs make reference to the application's auto-generated feedback when they hold their post-observation debriefing session with the teacher.

```
In [33]: 1 ▾ # Calculating pct of CSOs wo give feedback after a Lesson
        2   cso_ls_fdbk_sc = 100 * np.round(csos.ref_tang_fdbk.sum() / csos.shape[0], de
executed in 6ms, finished 18:13:31 2018-10-30
```

Again, the overwhelming majority of CSOs - 96.7% - report using the auto-generated feedback when holding their debrief session with the teacher. We will separately provide an analysis of their open-ended answers regarding *what* they refer to and what they find most useful.

2.4 Proportion of CSOs who use Tangerine to plan their work

*Do you refer to Tangerine to help you plan your work when you are **not** either observing a teacher or giving the teacher feedback?*

Version 3 of the *Tangerine:Tutor* application features a screen which allows a CSO to see schools they have visited and which they have not. We were interested to know whether the CSOs are leveraging this feature—or others, such as the pupils' fluency rates, which are reported in the feedback—to make decisions about which schools to visit in the future.

```
In [34]: 1 ▾ # Generating proportion of CSOs who use Tangerine to plan their work
        2   cso_tangplanners = 100 * np.round(csos.refer_tang_nonobs.sum() / csos.shape[
executed in 76ms, finished 18:13:32 2018-10-30
```

Fewer than two-thirds of CSOs (59.5%) refer to Tangerine to plan their work. A sampling of the reasons they gave for not using it is provided below:

```
In [35]: 1 ▾ # Generating sample of reasons CSOs don't use Tangerine to plan their work
          2 csos[csos.tang_nonobs_nowhynot.notnull() & (csos.tang_nonobs_nowhynot != "")]
          executed in 87ms, finished 18:13:32 2018-10-30
```

```
Out[35]: 48 I have not been issued with a tablet

          58 There is no form or provision to enter work plans or any other planned

          79 I support two zones with too many schools so I only refer to it when observing a teacher.
          47 I don't think I have any reason because I have my own program. I only use it when I am going to school. We normally prepare our own program of work.
          60 I use my work schedule to monitor my school visits

          6 I think that I only need to use it when I am at a school doing observations
          17 I do not know other useful features that can help me plan my work

          11 I PLAN FOR MY WORK WELL EVEN WITHOUT TANGERINE

          50 The problem is that i don't have enough time to check on it, there is a lot of work nowadays
          85 i just do it casually, no need of using the tangerine information

Name: tang_nonobs_nowhynot, dtype: object
```

This result surfaces a few issues Tusome might consider addressing next time CSOs receive a refresher training on Tangerine's use.

1. A lack of awareness of how the information provided by the tablet (schools visited and not visited) could be operationalized
2. A fear that they would be accused of falsifying observation data, rooted specifically in a misunderstanding of the application's GPS-capture functionality
3. A mental compartmentalization of Tangerine as being a Tusome-specific tool, not for use in broader contexts

Other reasons given suggest that the need which Tangerine might fill is already being addressed separately.

1. The CSO keeps a personal record (outside of the tablet) in which they track school visitation
2. The CSO has prepared a work schedule, and uses that as their guide until the month's activities have concluded.

2.5 Frequency with which CSOs refer to the application

[If the CSO refers to the Tangerine for planning purposes], *how often do you reference the data?*

In [36]:

```

1 # Generating dataframe of how frequently CSOs refer to the Tangerine applica
2 tchk_freq = csos[csos.freq_refer_tang_plan.notna()].freq_refer_tang_plan.sor
3 tchk_freq = tchk_freq.rename_axis("frequency").reset_index()
4 tchk_freq["frequency"] = tchk_freq["frequency"].replace({
5     1: "Daily",
6     2: "Weekly",
7     3: "Monthly",
8     4: "Termly"})
9 tchk_freq["sort_order"] = tchk_freq.index
10 tchk_freq

```

executed in 112ms, finished 18:13:32 2018-10-30

Out[36]:

	frequency	ct	sort_order
0	Daily	23	0
1	Weekly	46	1
2	Monthly	19	2
3	Termly	4	3
4	88	1	4

It appears that among the CSOs who check the application, it is most common to check it at least weekly.

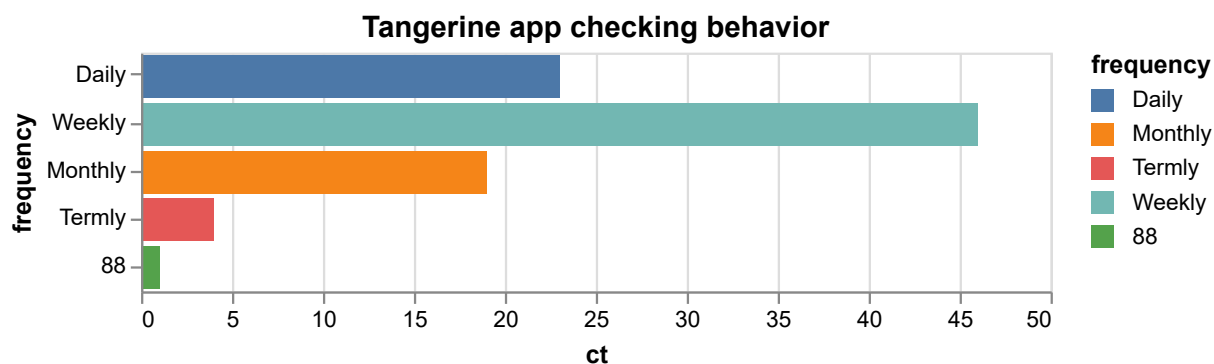
In [37]:

```

1 # Generating chart of Tangerine App checking behavior
2 tappchk_ch = alt.Chart(tchk_freq, title="Tangerine app checking behavior").m
3     alt.X("ct:Q"),
4     alt.Y("frequency:O", sort = alt.EncodingSortField(field="sort_order:Q",
5     color = "frequency"))
6
7 tappchk_ch.save("../img/tappchk_ct.svg", scale_factor=2.0)

```

executed in 19.2s, finished 18:13:51 2018-10-30



2.6 CSO reference to the Tangerine Dashboard

In the last term, how often did you look at the Tangerine Dashboard?

The data that is generated by the CSOs' lesson observations is uploaded to the cloud and reported on the [Tangerine Dashboard](http://tools.tusome.tangerinecentral.org/_csv/report/group-national_tablet_program/00b0a09a-2a9f-baca-2acb-c6264d4247cb,c835fc38-de99-d064-59d3-e772ccefcf7d/2018/1/ep8yqMKT.html#tutor) (http://tools.tusome.tangerinecentral.org/_csv/report/group-national_tablet_program/00b0a09a-2a9f-baca-2acb-c6264d4247cb,c835fc38-de99-d064-59d3-e772ccefcf7d/2018/1/ep8yqMKT.html#tutor). This Dashboard is reviewed by senior management within the Ministry of Education: the Principal Secretary, his Directors, and their deputies. It is also sent to the Directors of MOE and TSC at the County level. As these latter personnel oversee the CSOs, the Dashboard may have an effect ...

In [38]:

```
1 # Generating a dataframe of CSOs' Tangerine Dashboard viewing patterns
2 cso_db_chk = pd.DataFrame(csos[["refer_tang_nonobs", "db_chk_prevterm_freq"]])
3 # dbchkprevterm_df = pd.DataFrame(csos.refer_tang_nonobs.groupby(csos.db_chk)
4 # dbchkprevterm_df
5 cso_db_chk
```

executed in 40ms, finished 18:13:51 2018-10-30

Out[38]:

	refer_tang_nonobs	db_chk_prevterm_freq
0	0.0	0.0
1	NaN	0.0
2	1.0	2.0
3	0.0	0.0
4	1.0	13.0
5	1.0	10.0
6	0.0	0.0
7	1.0	3.0
8	1.0	2.0
9	1.0	1.0
10	0.0	1.0

In [39]:

```
1 cso_db_chk.rename(columns={"refer_tang_nonobs": "tapp_planning", "db_chk_prev": "db_chk_prev"})
2 cso_db_chk
```

executed in 68ms, finished 18:13:51 2018-10-30

Out[39]:

	tapp_planning	db_check_ct
0	0.0	0.0
1	NaN	0.0
2	1.0	2.0
3	0.0	0.0
4	1.0	13.0
5	1.0	10.0
6	0.0	0.0
7	1.0	3.0
8	1.0	2.0
9	1.0	1.0
10	0.0	1.0

In [40]:

```
1 print(f"There are {csos.refer_tang_nonobs.sum()} CSOs who check tangerine...")
2 print(f"There are {csos.shape[0]} records overall...")
```

executed in 33ms, finished 18:13:51 2018-10-30

There are 91.0 CSOs who check tangerine...
There are 153 records overall...

In [41]:

```
1 csodbchk_ch = alt.Chart()
```

executed in 27ms, finished 18:13:51 2018-10-30

3 Directors

3.1 Roles and designations of respondents

In [42]:

```
1 ▾ # Tabulating `designation`
```

executed in 17ms, finished 18:13:51 2018-10-30

3.2 Duration of experience with the Tangerine Dashboard

In [43]:

```
1 ▾ # Convert `intro_db_yr`, `intro_db_month` into months as we did with CSOs
```

executed in 59ms, finished 18:13:51 2018-10-30

In [44]:

```
1 ▾ # Generate a histogram from the duration of time they've known about the Das
```

executed in 11ms, finished 18:13:51 2018-10-30

3.3 Respondents' decision-making supports pre-Tangerine Dashboard

In [45]: 1 ▾ *# Print a sample of `src_pre_db_decaid`*

executed in 32ms, finished 18:13:51 2018-10-30

In [46]: 1 ▾ *# Tabulate the responses to `diff_mgmt_nodata_yn` and sample the responses t*

executed in 15ms, finished 18:13:51 2018-10-30

3.4 Respondents' receipt of the Tangerine Dashboard link

In [47]: 1 ▾ *# Report % of respondents who receive the dashboard link (`get_lnk_yn`)*

executed in 17ms, finished 18:13:51 2018-10-30

In [48]: 1 ▾ *# Summarize the frequency with which it is received (`get_link_freq`)*

executed in 22ms, finished 18:13:51 2018-10-30

In [49]: 1 ▾ *# Summarize the modality (`get_link_modality`)*

executed in 37ms, finished 18:13:51 2018-10-30

In [50]: 1 ▾ *# Consider faceting the above by `designation`*

executed in 29ms, finished 18:13:51 2018-10-30

In [51]: 1 ▾ *# Generate a stacked bar chart of the prompted dashboard receipt device freq*

```
2
3   ...
4   db_prmp_dev_phone
5   db_prmp_dev_laptop
6   db_prmp_dev_desktop
7   db_prmp_dev_colleague
8   db_prmp_dev_other
9   ...
```

executed in 45ms, finished 18:13:52 2018-10-30

File "<ipython-input-51-331095cc34ee>", line 3

...

^

SyntaxError: invalid syntax

In []: 1 ▾ *# Sample responses to `db_prmp_dev_other_det`.*

executed in 1m 44.7s, finished 18:13:52 2018-10-30

In []: 1 ▾ *# Consider faceting all of the above by `designation`.*

executed in 1m 44.7s, finished 18:13:52 2018-10-30

In []: 1 ▾ *# Report the frequency of `db_lnk_frm_other_yn` by designation, sample the `*

executed in 1m 44.7s, finished 18:13:52 2018-10-30

3.5 Respondents' consumption of the Tangerine Dashboard

In []: 1 ▾ *# Tabulate the frequency of `db_dev_access_na` for those who do not access t*
 executed in 1m 44.5s, finished 18:13:52 2018-10-30

In []: 1 ▾ *# Generate a stacked bar chart from the dashboard Link-checking frequencies:*
 2
 3 *```*
 4 *db_lnk_chk_sday*
 5 *db_lnk_chk_sweek*
 6 *db_lnk_chk_smonth*
 7 *db_lnk_chk_other*
 8 *```*
 executed in 1m 44.5s, finished 18:13:52 2018-10-30

In []: 1 ▾ *# Sample the responses to `db_lnk_chk_dont_why`.*
 executed in 1m 44.5s, finished 18:13:52 2018-10-30

In []: 1 ▾ *# Tabulate the responses to `db_sect_consulted`*
 executed in 1m 44.5s, finished 18:13:52 2018-10-30

In []: 1 ▾ *# Tabulate the responses to `db_chk_freq`.*
 executed in 1m 44.5s, finished 18:13:52 2018-10-30

In []: 1 ▾ *# Sample responses to `mgmt_dec_from_db`.*
 executed in 1m 44.5s, finished 18:13:52 2018-10-30

3.6 Respondents' expressed demand for the Tangerine Dashboard

In []: 1 ▾ *# Tabulate `no_lnk_wnt_yn` and with it the `no_lnk_wnt_freq`.*
 executed in 1m 44.2s, finished 18:13:52 2018-10-30

In []: 1 ▾ *# Tabulate the responses to `db_info_wnt_yn` and sample the responses to `db*
 executed in 1m 44.2s, finished 18:13:52 2018-10-30

3.7 Respondents' preferences for Tangerine Dashboard receipt

In []: 1 ▾ *# Generate a faceted stacked bar chart of the delivery mechanism responses:*
 2
 3 *```*
 4 *del_mech_prp_sms*
 5 *del_mech_prp_wa*
 6 *del_mech_prp_email*
 7 *del_mech_prp_app*
 8 *del_mech_prp_other*
 9 *```*
 executed in 1m 44.0s, finished 18:13:52 2018-10-30

In []:

1 ▾	<i># Sample the responses to `del_mech_prp_det` and `del_mech_unprompted`.</i>
executed in 1m 44.0s, finished 18:13:52 2018-10-30	

3.8 Respondents' preferences for Tangerine Dashboard

In []:

1 ▾	<i># Sample the responses to `db_rev_feat_det`.</i>
executed in 1m 43.8s, finished 18:13:52 2018-10-30	