In [5]:
```
import pandas as pd

data = pd.read_excel(r'file:///G:\Shared%20drives\People\Yasmin\PhD%202020\VO2_saccades_clean_validation.xlsx')

print(data.info())
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 2105 entries, 1487 to 1907
Data columns (total 52 columns):
s                           2105 non-null int64
e                           2105 non-null int64
evt                         2105 non-null int64
dur_s                       2105 non-null int64
dur                         2105 non-null float64
posx_s                      2105 non-null float64
posx_e                      2105 non-null float64
posy_s                      2105 non-null float64
posy_e                      2105 non-null float64
posx_mean                   2105 non-null float64
posy_mean                   2105 non-null float64
posx_med                    2105 non-null float64
posy_med                    2105 non-null float64
pv                          2105 non-null float64
pv_index                    2105 non-null int64
v_onset                     2105 non-null float64
v_offset                    2105 non-null float64
rms                         2105 non-null float64
std                         2105 non-null float64
ampl_x                      2105 non-null float64
ampl_y                      2105 non-null float64
ampl                        2105 non-null float64
valid                       2105 non-null bool
trial_no                    2105 non-null int64
trial_var                   2105 non-null int64
stimulus_onset              2105 non-null float64
```

```
trial_start                2105 non-null float64
evt_start                  2105 non-null float64
latency                    2105 non-null float64
victors_latency            2105 non-null float64
stimuli_direction          2105 non-null object
evt_direction              2105 non-null object
target_amp_x               2105 non-null int64
target_amp_y               2105 non-null int64
id                         2105 non-null object
session                    2105 non-null object
timepoint                  2105 non-null object
experiment                 2105 non-null object
sex                        2105 non-null object
age                        2105 non-null int64
height                     2105 non-null float64
weight                     2105 non-null float64
vo2_max_abs                2105 non-null float64
w_max                      2105 non-null int64
workload                   2105 non-null int64
vo2                        2105 non-null float64
hr                         2105 non-null int64
rpe                        2105 non-null int64
correct_direction          2105 non-null bool
pv_time_index              2105 non-null int64
amplitude_within_range     2105 non-null bool
kinematic_outlier          2105 non-null int64
dtypes: bool(3), float64(26), int64(16), object(7)
memory usage: 828.4+ KB
None
```

In [25]:
```
#created a dataframe for rest data for all participants at timepoint T0


import pandas as pd

rest = data.loc[data['timepoint'] == 'T0']

rest_data = pd.DataFrame(rest)
print(rest_data.head())
```

```
        s    e  evt  dur_s       dur    posx_s     posx_e     posy_s  \
1487  345  352    2      7  0.077778 -0.820240  13.154168  14.978257
1488  593  602    2      9  0.100000 -0.948232 -12.920771  15.352415
1489  725  733    2      8  0.088889 -0.886426 -13.814982  15.105866
1490  848  854    2      6  0.066667 -0.977737 -13.463902  15.318356
1491  978  985    2      7  0.077778 -1.117424  13.074785  15.196902

         posy_e  posx_mean        ...          vo2_max_abs  w_max  work
load  \
1487  15.183256   6.333262        ...                3.457    290
   0
1488  15.137706  -8.109050        ...                3.457    290
   0
1489  15.047811  -8.698754        ...                3.457    290
   0
1490  15.200603  -7.310747        ...                3.457    290
   0
1491  15.404351   6.473080        ...                3.457    290
   0

       vo2  hr  rpe  correct_direction  pv_time_index  amplitude_within
_range  \
1487  0.56  65    0               True              4
  True
1488  0.56  65    0               True              6
  True
1489  0.56  65    0               True              5
  True
1490  0.56  65    0               True              4
  True
1491  0.56  65    0               True              4
  True

      kinematic_outlier
1487                  0
1488                  0
1489                  0
1490                  0
1491                  0
```

```
[5 rows x 52 columns]
```

In [26]:
```
#created another dataframe but for timepoint T1

exercise = data.loc[data['timepoint'] == 'T1']

exercise_data = pd.DataFrame(exercise)
print(exercise_data.head())
```

```
        s    e  evt  dur_s       dur    posx_s     posx_e    posy_s
posy_e  \
1638   83   93    2     10  0.111111 -4.320309 -16.973104  5.059889  8.
259736
1639  329  337    2      8  0.088889 -4.291832 -17.018538  5.264038  6.
790473
1640  461  470    2      9  0.100000 -4.596207 -17.413744  4.412880  6.
209824
1641  598  606    2      8  0.088889 -5.185440  10.325587  4.476622  8.
638333
1642  863  873    2     10  0.111111 -4.357775   7.561332  5.993687  7.
703406

      posx_mean        ...          vo2_max_abs  w_max  workload   vo2
  hr  \
1638 -12.645826        ...                3.457    290        80  1.71
127
1639 -10.057800        ...                3.457    290        80  1.71
127
1640 -10.509576        ...                3.457    290        80  1.71
127
1641   3.821353        ...                3.457    290        80  1.71
127
1642   2.841859        ...                3.457    290        80  1.71
127

      rpe  correct_direction  pv_time_index  amplitude_within_range  \
1638    1               True              7                    True
```

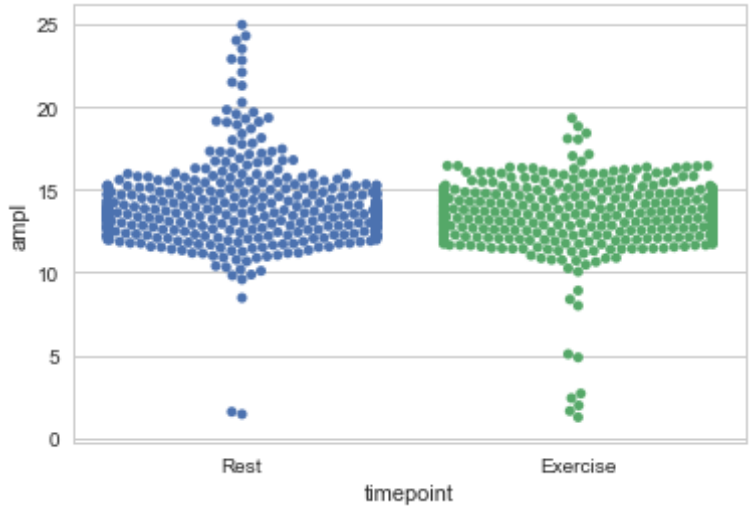
```
1639    1              True             4                   True
1640    1              True             4                   True
1641    1              True             5                   True
1642    1              True             7                   True

      kinematic_outlier
1638                  0
1639                  0
1640                  0
1641                  0
1642                  0

[5 rows x 52 columns]
```

In [27]:
```
rest_exercise_data = rest_data.append(exercise_data)
print(rest_exercise_data.head())

#combined rest and exercise data into one dataframe
```

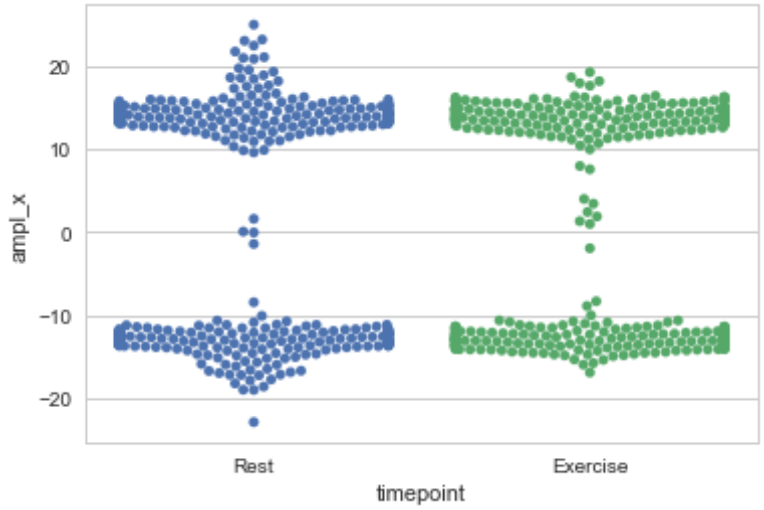
```
        s    e  evt  dur_s       dur    posx_s     posx_e     posy_s  \
1487  345  352    2      7  0.077778 -0.820240  13.154168  14.978257
1488  593  602    2      9  0.100000 -0.948232 -12.920771  15.352415
1489  725  733    2      8  0.088889 -0.886426 -13.814982  15.105866
1490  848  854    2      6  0.066667 -0.977737 -13.463902  15.318356
1491  978  985    2      7  0.077778 -1.117424  13.074785  15.196902

         posy_e  posx_mean        ...          vo2_max_abs  w_max  work
load  \
1487  15.183256   6.333262        ...                3.457    290
   0
1488  15.137706  -8.109050        ...                3.457    290
   0
1489  15.047811  -8.698754        ...                3.457    290
   0
1490  15.200603  -7.310747        ...                3.457    290
   0
1491  15.404351   6.473080        ...                3.457    290
   0
```

```
       vo2  hr  rpe  correct_direction  pv_time_index  amplitude_within
_range  \
1487  0.56  65    0               True              4
  True
1488  0.56  65    0               True              6
  True
1489  0.56  65    0               True              5
  True
1490  0.56  65    0               True              4
  True
1491  0.56  65    0               True              4
  True

      kinematic_outlier
1487                  0
1488                  0
1489                  0
1490                  0
1491                  0

[5 rows x 52 columns]
```

In [10]:
```
import seaborn as sns
import matplotlib.pyplot as plt
sns.set(style="whitegrid")
ax = sns.swarmplot(x=rest_exercise_data["timepoint"], y=rest_exercise_d
ata["ampl"])
labels = ['Rest', 'Exercise']
ax.set_xticklabels(labels)
plt.show()
```



In [11]:
```
import seaborn as sns
import matplotlib.pyplot as plt
sns.set(style="whitegrid")
ax = sns.swarmplot(x=rest_exercise_data["timepoint"], y=rest_exercise_d
ata["ampl_x"])
labels = ['Rest', 'Exercise']
ax.set_xticklabels(labels)
plt.show()
```



In [13]:
```
hg = rest_exercise_data.id.str.contains('HG')
rest_exercise_data[hg].head()
```

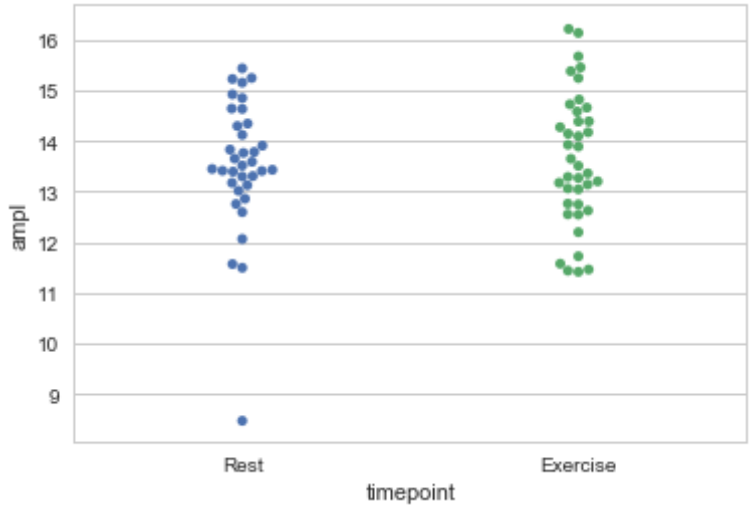
Out[13]:

	s	e	evt	dur_s	dur	posx_s	posx_e	posy_s	posy_e	posx_r
2067	74	81	2	7	0.077778	0.347270	-14.794246	14.243684	14.924355	-7.5712
2068	198	205	2	7	0.077778	0.220565	-14.611074	14.179576	15.837212	-7.1793
2069	330	337	2	7	0.077778	-0.014749	-14.320457	14.062944	15.133260	-7.7627
2070	571	578	2	7	0.077778	0.117747	15.346144	14.134223	14.909875	8.85152
2071	699	709	2	10	0.111111	0.147278	14.757009	14.203921	15.193169	8.75762

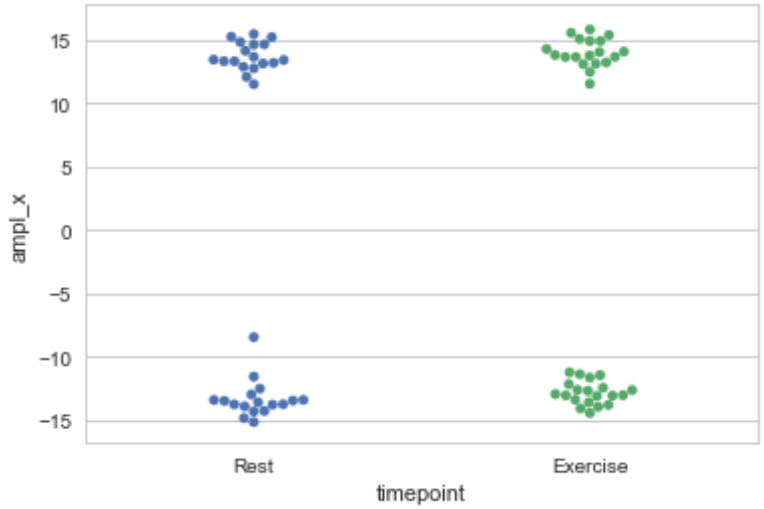
5 rows × 52 columns

In [15]:
```
import seaborn as sns
import matplotlib.pyplot as plt
sns.set(style="whitegrid")
ax = sns.swarmplot(x=rest_exercise_data[hg]["timepoint"], y=rest_exerci
```

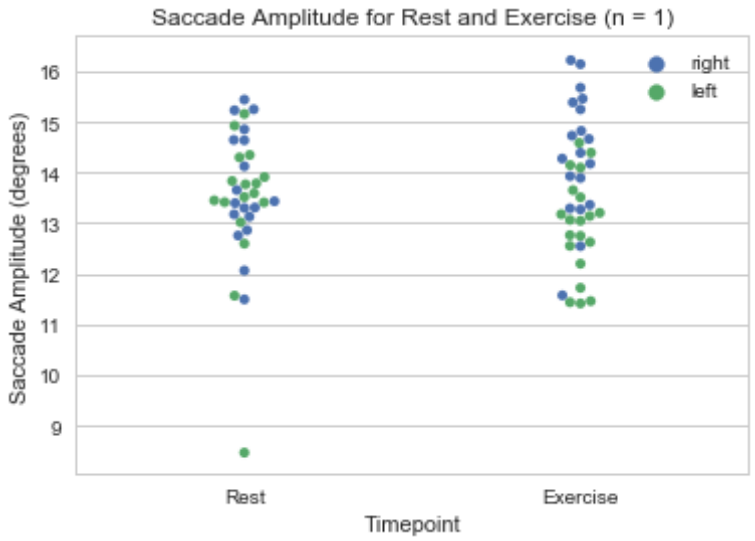
```
se_data[hg]["ampl"])
labels = ['Rest', 'Exercise']
ax.set_xticklabels(labels)
plt.show()
```



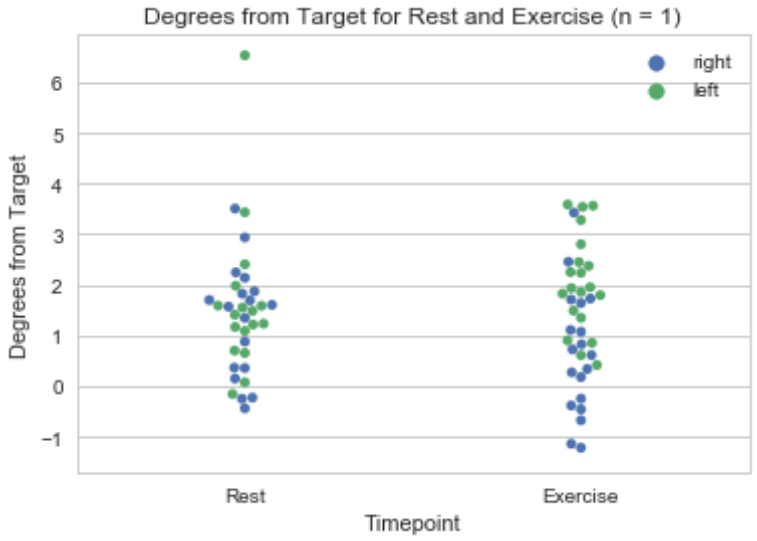
In [16]:
```
import seaborn as sns
import matplotlib.pyplot as plt
sns.set(style="whitegrid")
ax = sns.swarmplot(x=rest_exercise_data[hg]["timepoint"], y=rest_exerci
se_data[hg]["ampl_x"])
labels = ['Rest', 'Exercise']
ax.set_xticklabels(labels)
plt.show()
```



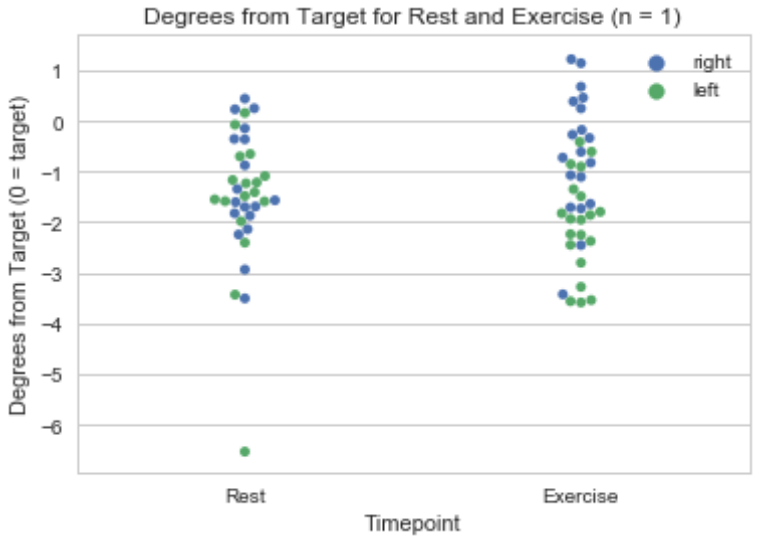
In [23]:
```
import seaborn as sns
import matplotlib.pyplot as plt
sns.set(style="whitegrid")
ax = sns.swarmplot(x=rest_exercise_data[hg]["timepoint"], y=rest_exerci
se_data[hg]["ampl"], hue=rest_exercise_data['stimuli_direction'])
labels = ['Rest', 'Exercise']
ax.set_xticklabels(labels)
ax.set_xlabel('Timepoint')
ax.set_ylabel('Saccade Amplitude (degrees)')
ax.set_title('Saccade Amplitude for Rest and Exercise (n = 1)')
ax.legend(loc = 'best')
plt.show()
```



In [29]:
```
rest_exercise_data['degrees_from_target'] = rest_exercise_data['target_
amp_x'] - rest_exercise_data['ampl']

import seaborn as sns
import matplotlib.pyplot as plt
sns.set(style="whitegrid")
ax = sns.swarmplot(x=rest_exercise_data[hg]["timepoint"], y=rest_exerci
se_data[hg]["degrees_from_target"], hue=rest_exercise_data['stimuli_dir
ection'])
labels = ['Rest', 'Exercise']
ax.set_xticklabels(labels)
ax.set_xlabel('Timepoint')
ax.set_ylabel('Degrees from Target')
ax.set_title('Degrees from Target for Rest and Exercise (n = 1)')
ax.legend(loc = 'best')
plt.show()
```



In [31]:
```
rest_exercise_data['degrees_from_target_switched'] = rest_exercise_data
['ampl'] - rest_exercise_data['target_amp_x']
#degrees from target with 0 being the target, negative undershoots the
 target and positive overshoots the target

import seaborn as sns
import matplotlib.pyplot as plt
sns.set(style="whitegrid")
ax = sns.swarmplot(x=rest_exercise_data[hg]["timepoint"], y=rest_exerci
se_data[hg]["degrees_from_target_switched"], hue=rest_exercise_data['st
imuli_direction'])
labels = ['Rest', 'Exercise']
ax.set_xticklabels(labels)
ax.set_xlabel('Timepoint')
ax.set_ylabel('Degrees from Target (0 = target)')
ax.set_title('Degrees from Target for Rest and Exercise (n = 1)')
ax.legend(loc = 'best')
plt.show()
```



In [34]:
```
#repeat for 3 hour data = three_...
#for participant hg
#code written all together

import pandas as pd

three_data = pd.read_excel(r'file:///G:\Shared%20drives\People\Yasmin\PhD%202020\3_hour_saccades_clean_validation.xlsx')
print(three_data.info())

three_rest = three_data.loc[three_data['timepoint'] == 0]
three_rest_data = pd.DataFrame(three_rest)
three_exercise = three_data.loc[three_data['timepoint'] == 15]
three_exercise_data = pd.DataFrame(three_exercise)

three_rest_exercise_data = three_rest_data.append(three_exercise_data)
print(three_rest_exercise_data.info())

hg = three_rest_exercise_data.id.str.contains('HG')
three_rest_exercise_data[hg].head()
```

```
three_rest_exercise_data['degrees_from_target_switched'] = three_rest_e
xercise_data['ampl'] - three_rest_exercise_data['target_amp_x']

import seaborn as sns
import matplotlib.pyplot as plt
sns.set(style="whitegrid")
ax = sns.swarmplot(x=three_rest_exercise_data[hg]["timepoint"], y=three
_rest_exercise_data[hg]["degrees_from_target_switched"], hue=three_rest
_exercise_data['stimuli_direction'])
labels = ['Rest', 'Exercise']
ax.set_xticklabels(labels)
ax.set_xlabel('Timepoint')
ax.set_ylabel('Degrees from Target (0 = target)')
ax.set_title('Degrees from Target for Rest and Exercise (n = 1)')
ax.legend(loc = 'best')
plt.show()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 23754 entries, 19324 to 23704
Data columns (total 53 columns):
s                           23754 non-null int64
e                           23754 non-null int64
evt                         23754 non-null int64
dur_s                       23754 non-null int64
dur                         23754 non-null float64
posx_s                      23754 non-null float64
posx_e                      23754 non-null float64
posy_s                      23754 non-null float64
posy_e                      23754 non-null float64
posx_mean                   23754 non-null float64
posy_mean                   23754 non-null float64
posx_med                    23754 non-null float64
posy_med                    23754 non-null float64
pv                          23754 non-null float64
pv_index                    23754 non-null int64
v_onset                     23754 non-null float64
v_offset                    23754 non-null float64
rms                         23754 non-null float64
std                         23754 non-null float64
ampl_x                      23754 non-null float64
```

```
ampl_y                    23754 non-null float64
ampl                      23754 non-null float64
valid                     23754 non-null bool
trial_no                  23754 non-null int64
trial_var                 23754 non-null int64
stimulus_onset            23754 non-null float64
trial_start               23754 non-null float64
evt_start                 23754 non-null float64
latency                   23754 non-null float64
victors_latency           23754 non-null float64
stimuli_direction         23754 non-null object
evt_direction             23754 non-null object
target_amp_x              23754 non-null int64
target_amp_y              23754 non-null int64
id                        23754 non-null object
session                   23754 non-null object
timepoint                 23754 non-null int64
experiment                23754 non-null object
sex                       23754 non-null object
age                       23754 non-null int64
height                    23754 non-null float64
weight                    23754 non-null float64
vo2_max_abs               23754 non-null float64
w_max                     23754 non-null int64
session_no                23754 non-null int64
hr                        21961 non-null float64
percieved_effort          21961 non-null float64
valence                   21961 non-null float64
arousal                   21961 non-null float64
correct_direction         23754 non-null bool
pv_time_index             23754 non-null int64
amplitude_within_range    23754 non-null bool
kinematic_outlier         23754 non-null int64
dtypes: bool(3), float64(29), int64(15), object(6)
memory usage: 9.3+ MB
None
<class 'pandas.core.frame.DataFrame'>
Int64Index: 3447 entries, 19324 to 22629
Data columns (total 53 columns):
s                         3447 non-null int64
```

```
e                        3447 non-null int64
evt                      3447 non-null int64
dur_s                    3447 non-null int64
dur                      3447 non-null float64
posx_s                   3447 non-null float64
posx_e                   3447 non-null float64
posy_s                   3447 non-null float64
posy_e                   3447 non-null float64
posx_mean                3447 non-null float64
posy_mean                3447 non-null float64
posx_med                 3447 non-null float64
posy_med                 3447 non-null float64
pv                       3447 non-null float64
pv_index                 3447 non-null int64
v_onset                  3447 non-null float64
v_offset                 3447 non-null float64
rms                      3447 non-null float64
std                      3447 non-null float64
ampl_x                   3447 non-null float64
ampl_y                   3447 non-null float64
ampl                     3447 non-null float64
valid                    3447 non-null bool
trial_no                 3447 non-null int64
trial_var                3447 non-null int64
stimulus_onset           3447 non-null float64
trial_start              3447 non-null float64
evt_start                3447 non-null float64
latency                  3447 non-null float64
victors_latency          3447 non-null float64
stimuli_direction        3447 non-null object
evt_direction            3447 non-null object
target_amp_x             3447 non-null int64
target_amp_y             3447 non-null int64
id                       3447 non-null object
session                  3447 non-null object
timepoint                3447 non-null int64
experiment               3447 non-null object
sex                      3447 non-null object
age                      3447 non-null int64
```

```
height                    3447 non-null float64
weight                    3447 non-null float64
vo2_max_abs               3447 non-null float64
w_max                     3447 non-null int64
session_no                3447 non-null int64
hr                        3447 non-null float64
percieved_effort          3447 non-null float64
valence                   3447 non-null float64
arousal                   3447 non-null float64
correct_direction         3447 non-null bool
pv_time_index             3447 non-null int64
amplitude_within_range    3447 non-null bool
kinematic_outlier         3447 non-null int64
dtypes: bool(3), float64(29), int64(15), object(6)
memory usage: 1.4+ MB
None
```