We want to evaluate different ways of presenting multiple webpages in a web browser on a mobile device (i.e., having multiple views opened at the same time and allow users to switch between them). We first consider the two designs illustrated on Figure 1: Pile and List. We run a first experiment (exp#1). In our experimental task, the participant has to select one highlighted view among four opened views.

1. What is a research hypothesis? Provide a definition and an example of such a hypothesis for the experiment presented above. (1pt)
2. What is the null hypothesis? Provide a definition and an example of such a hypothesis for the experiment presented above. (1pt)
3. Why do we need to formulate the null hypothesis for analyzing empirical results? (1pt)
4. We have collected the log table illustrated on Figure 2. What is our experimental factor? What is our measure? Did we use a within-participant or a between-participant design (say how you can answer this question given the structure of the log table)? (1pt)
5. We ran a t-test for analyzing if the mean selection time for Pile and List is significantly different. We found out that selection time for Pile is significantly lower for Pile than for List. However we now hypothesize that the result could be different depending on the number of views the user has to switch among. We decide to run a second experiment (exp#2). We replicate exp#1 but we introduce an additional factor, the number of opened views. Can we still use a t-test to analyze the data collected in exp#2? If no, why? Which test should we use instead? (1pt)

Figure 1: Techniques for navigating and selecting a webpage on a mobile device  
(Left) Pile: webpages are organised into a pile of perspective views  
(Right) List: webpages are organised into a list of flat views
We want to evaluate the “performance” of two techniques (MG: Magnifying Glass and NK: Navigational Keys) for positioning the caret (insertion point) when editing text on a small mobile device equipped with a tactile screen. Both techniques are illustrated on Figure 3.

**MG:** The user keeps his finger still (dwell) on the text. A magnifying glass, which displays the text that is below the finger, pops up right above the contact point. The user can then slide his fingers to adjust the caret position. The magnifying glass disappears as soon as the user lifts his finger off the surface.

**NK:** The user keeps his finger still (dwell) on the keyboard. The alphanumeric keyboard is turned into a navigational keyboard that features only four arrow keys (up, down, left, right) that can be used to adjust the caret position. The keyboard is turned back into the regular alphanumeric keyboard either (i) when the user taps on empty space on the navigational keyboard (tap on keyboard background) or (ii) when the navigational keyboard has been inactive for one second (no tap on any navigational key).

We formulate the two following research hypotheses:

H\(_1\): NK is *more accurate* than MG when the caret has to be positioned *close to a screen edge*.

H\(_2\): MG is *faster* than NK when the caret has to be positioned *far from a screen edge*. 

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**G. EXPERIMENT DESIGN — CARET POSITIONING ON SMALL DEVICES (6PTS)**

Figure 2: Log table collected in exp#1
1. Formulate the two null hypotheses to falsify in order to support $H_1$ and $H_2$. (2pts)
2. Provide an operationalization of $H_1$ and $H_2$ in order to conduct an experiment:
   a. identify the factors and the measures (1pt)
   b. describe an experimental task: sketch a task scenario and indicate when the values of the measures are set on this scenario. (3pt)

Figure 3: Techniques for caret positioning
(Top) MG: The magnifying glass technique
(Bottom) The navigational keys technique