

Online Experiments

Tutorial 01 – Two armed Bandit

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We will build a simple online experiment

This tutorial will cover:

Design of the experiment

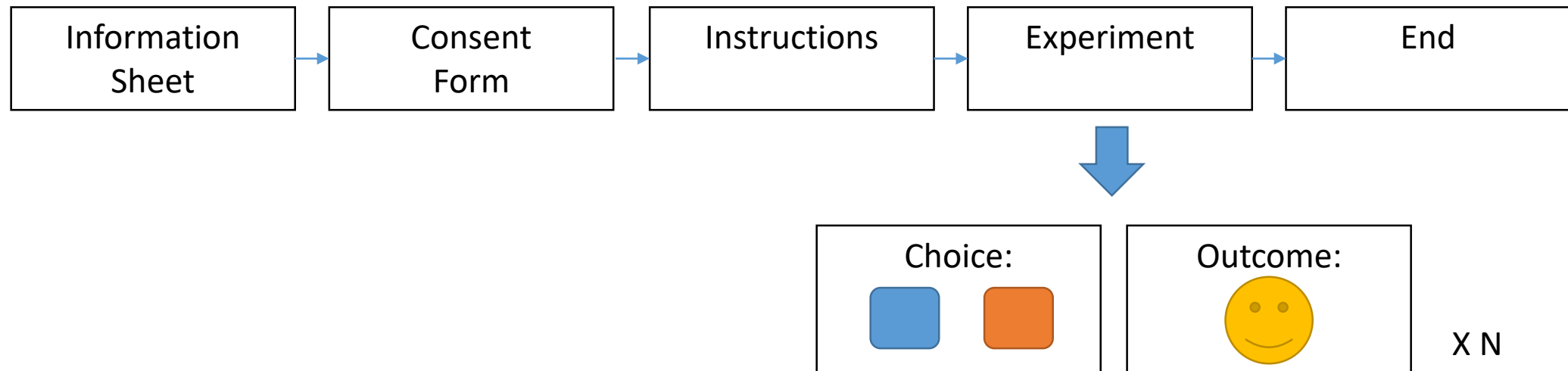
Html and css

Flow in JS

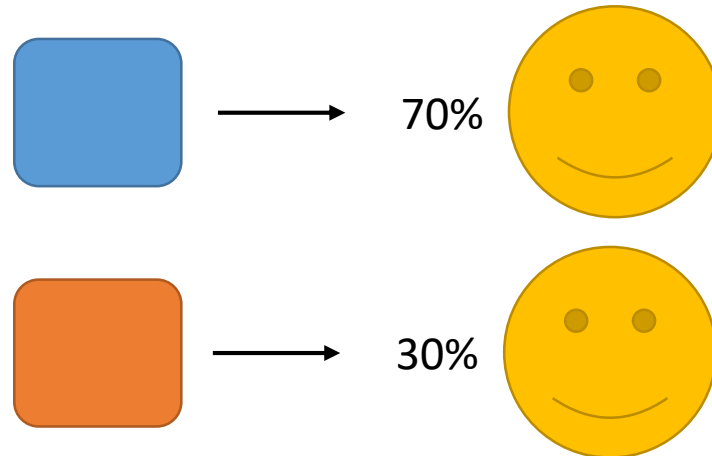
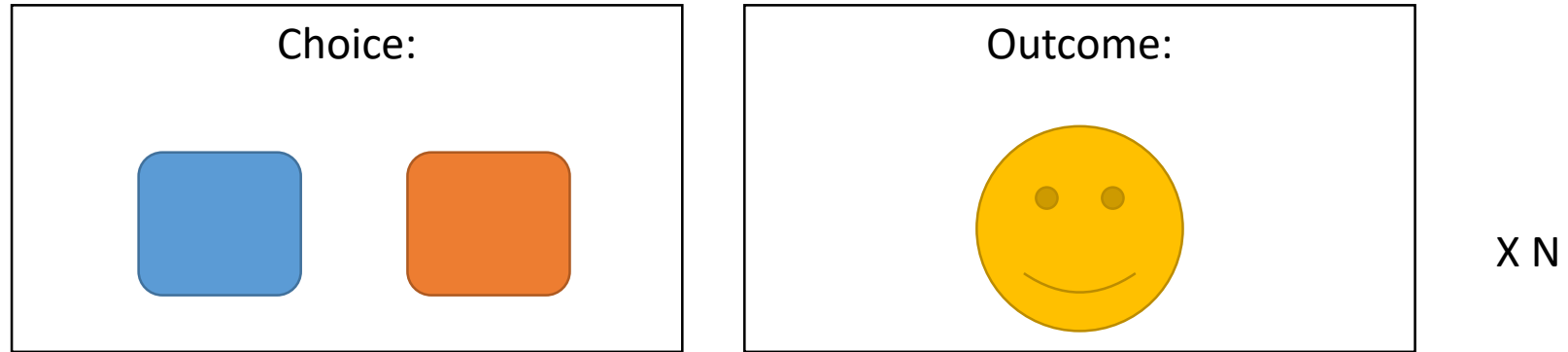
Scripting JS

You can find the resources for this tutorial here:

Design

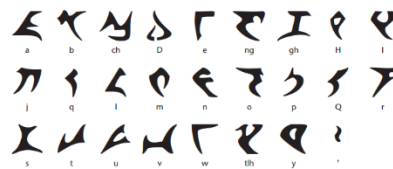
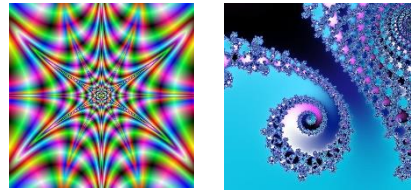
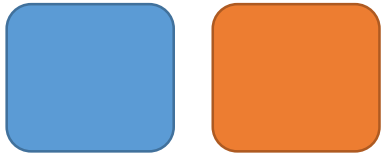


Design



Metaphors

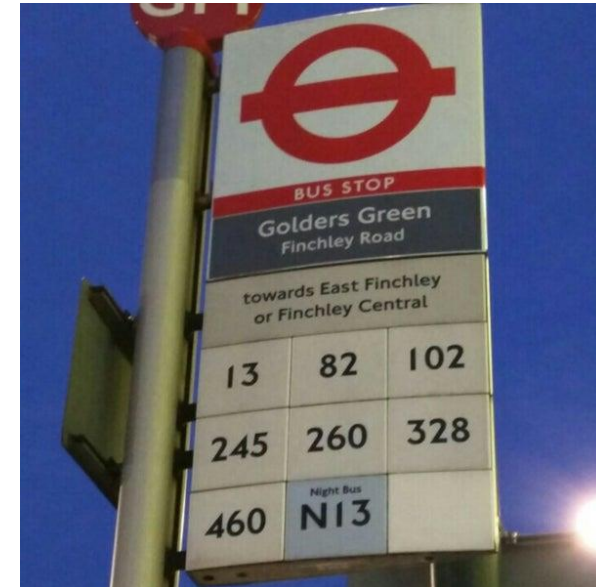
Such a task can be represented in different manners.



Klingon



Tibetan



Web based experiments



Client

Using browser to compile web pages.
Including html, JS, CSS, images and
other files.
Runs client side scripts.



Server

Stores the content.
Stores database.
Run server side scripts.

Web based experiments



Client

Using browser to compile web pages.
Including html, JS, CSS, images and
other files.
Runs client side scripts.

We will start with client side programming, and later introduce how to connect with the server.

We will introduce three file types:

- Html
- CSS
- JS

You can edit these in any text editor.

Some tools provide a more comprehensive environment, helping with debugging, organizing, testing and managing web applications. These are called IDEs ((integrated development environment).

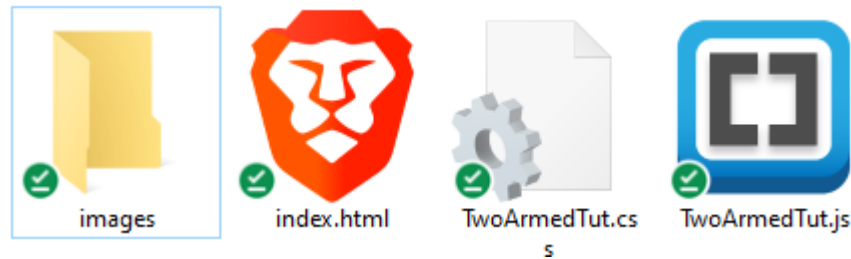
Examples:

Brackets <http://brackets.io/>

Atom <https://atom.io/>

Sublime <https://www.sublimetext.com/>

Local files



- HTML – Hypertext Markup Language (**HTML**) is the standard markup language for documents designed to be displayed in a web browser.
- CSS - Cascading Style Sheets is a style sheet language used for describing the presentation of a document written in a markup language like HTML.
- JS – javascript script file

Local files - HTML

```
<html>
  <head>
    <title>Experiment</title>
    <link rel='stylesheet' type='text/css' href=' TwoArmedTut.css' media =
"screen"/>
    <script type="text/javascript" src="TwoArmedTut.js"></script>
  </head>
  <body >
    <div id= 'Main' class="container">
      Hello!!
    </div>
  </body>
</html>
```

HTML elements

```
<h2>Well done</h2> <br> <a href> <p> <li> <i>
```

```
<div class = 'DivElements' id = 'Top'></div>
```

```

```

```
<input align="center" type="button" class="btn btn-primary btn-lg" id="Next" value="Next" >
```

Style Sheet

Can attribute many elements to different classes. These days it can do quit a lot.

```
.myborder {  
  border-width: 1px;  
  border-color: lightgrey;  
  border-style: solid;  
  cursor: pointer;  
}
```

Style Sheet

I use packages like Bootstrap (<https://getbootstrap.com/>) which include many styling classes to be used to make your web app prettier, easier to control and compatible with many devices.

Their grid system is very useful (see also flexbox <https://css-tricks.com/snippets/css/a-guide-to-flexbox/#flexbox-background>):

One of three columns	One of three columns	One of three columns
----------------------	----------------------	----------------------

```
<div class="container">
  <div class="row">
    <div class="col-sm">
      One of three columns
    </div>
    <div class="col-sm">
      One of three columns
    </div>
    <div class="col-sm">
      One of three columns
    </div>
  </div>
</div>
```

Copy

Our tutorial

1. Download and open the TwoArmedTut folder from here:
https://github.com/socialdecisionlab/JStutorial/tree/master/Tutorials_Code/TwoArmedTut
2. Take a look at the files – what do you recognize?
3. Open the index.html file in a browser – what do you see?
4. Open the index.html file in an editor – what does it contain?

html

```
<!DOCTYPE html>
```

```
<html>
```

```
  <head>
```

```
    <title>Experiment</title>
```

```
    <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/3.3.4/css/bootstrap.min.css">
```

```
    <link rel='stylesheet' type='text/css' href='TwoArmedTut.css' media = "screen"/>
```

```
      <script src="http://code.jquery.com/jquery-1.11.1.js"></script>
```

```
      <script src="TwoArmedTut.js"></script>
```

```
  </head>
```

```
  <body>
```

```
    <div class ='Main' id = 'Main'>
```

```
      <div class = 'DivElements' id = 'Top'></div>
```

```
      <div class ='DivElements' id = 'Stage'> </div>
```

```
      <div class ='DivElements' id = 'Bottom'> </div>
```

```
    </div>
```

```
  </body>
```

```
</html>
```

CSS - TwoArmedTut.css

```
.Main {  
    margin-right: auto;  
    margin-left: auto;  
    background-color: #DDDDDD;  
    font-family: Arial, Helvetica, sans-serif;  
}  
.DivElements {  
    margin-right: auto;  
    margin-left: auto;  
    display: block;  
}
```

JavaScript - TwoArmedTut.js

In the next couple of slides we will go over the flow of the experiment in the js file.

Some elements remain stable across experiments, while others change.

This is the way I program my experiments – there are many other and better ways to do it!!!!

js – setting up

The first thing we will do is to create the main function which will start working as soon as the browser is open on our 'index.html' file:

```
$(document).ready(function() {  
  
});
```

This command tells the computer to start running the function as soon as the document is ready.

Functions in javascript are delineated by curly brackets, {}.

We will add all the other commands and functions *within* the main function brackets. It is possible to declare them *before* the document.ready section.

\$ - jquery package

Js – initializing parameters

We will start by initializing the variables that will be used throughout the experiment. These include the number of trials, the probability of getting a reward from the two options, the number of points the participant got, and the time the experiment starts. We will also create a unique user ID which can be used to store the participant's data (later).

```
var NumTrials = 10;
```

```
var P1 = 0.7;
```

```
var P2 = 0.3;
```

```
var SumReward = 0;
```

```
var Init = (new Date()).getTime();
```

```
var SubID = CreateCode();
```

Js – our first function

Note that the SubID is calling a function called CreateCode. This function is not part of javascript and we will have to write it ourselves. To keep things organized I put all my 'utility functions' together towards the end of the script, just below the 'experiment functions'. Functions can get input parameters and send output parameters. Our function will create a 10 digit random number:

```
function CreateCode() {  
    return Math.floor(Math.random() * 10000000000);  
};
```

js – simple debugging and keeping track

Information about the web application has a console which can be accessed by selecting 'inspect' option from the menu that pops up when you right-click on the browser window in chrome, or via the top-menus.

You will be able to inspect the structure of your html page there, see which files are loaded (images, php, js and so on), the communication of information across the network to the server and see the **console**.

The console is a place where javascript send information such as error messages, or costume made messages.

We can send information to the console by using the `console.log()` function. For example:

```
console.log('Subject ID is:'+SubID)
```

js – simple debugging and keeping track

In addition, you can use the more aggressive 'alert' command.

```
alert('Subject ID is:'+SubID)
```

This command will display the message in a pop screen in the browser, which has to be dismissed by the user. It will stop the code from running until it is dismissed.

Js – setting the screen dimensions

We may want to set up our screen dimensions. We get the screen height from the participant's display, and can adjust the display accordingly.

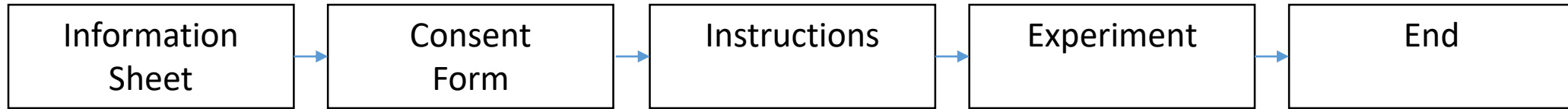
```
var thisHeight = $(document).height() * 0.9;
```

Js – adjusting the class of an html element

Taking advantage of the bootstrap adaptive css package, we will set the main div class to 'container'. Here is how to adjust elements in the html DOM (Document Object Model) elements using jquery:

```
$('#Main').addClass('container')
```

Js flow



We now start the experimental flow. In js we don't simply write the code and expect it to move one line at a time, as it will do its best to run everything in the same time.

Instead we separate each stage to different functions, and move from one to the other.

We can send data directly to a function, or use global variables – the ones we set up using var outside the function.

To start in the information sheet:

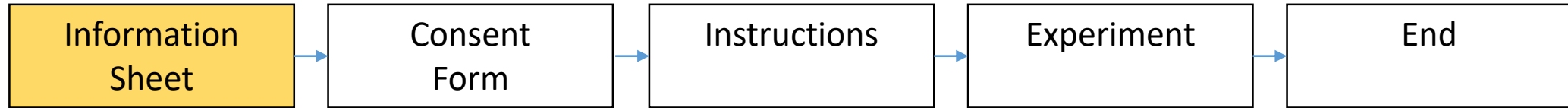
```
Information(); //Start with information sheet
```


Js – utility functions

```
function CreateDiv(ParentID, ChildID) {  
    var d = $(document.createElement('div'))  
        .attr("id", ChildID);  
    var container = document.getElementById(ParentID);  
    d.appendTo(container);  
};
```

```
function Sign(x) {  
    return x > 0 ? 1 : x < 0 ? -1 : 0;  
};
```

Information sheet



Information sheet is where you give general details about the experiment:

Contact details

Ethics approval

What the experiment involves

Risks and benefits (explicit materials?)

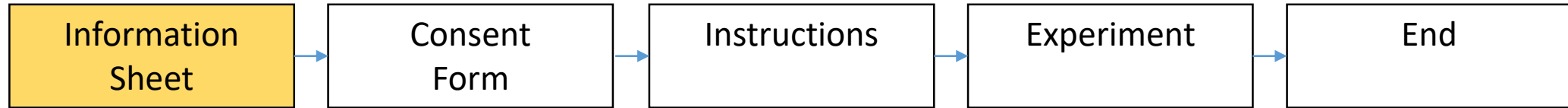
Participation criteria

The ability to stop at any point

Data storage and anonymization

Data usage

Information sheet

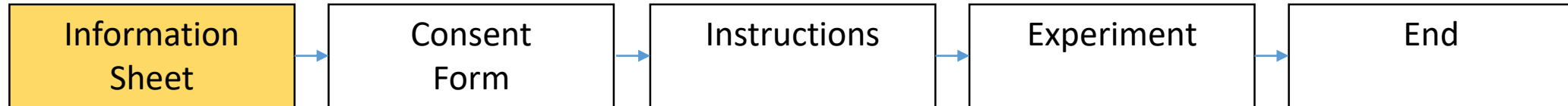


Information page for participants in research studies

Here is a lot of information. It is important.

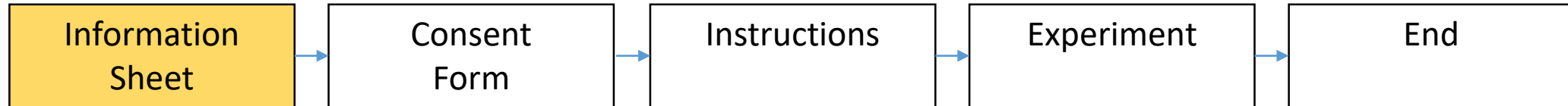
Next

Information sheet



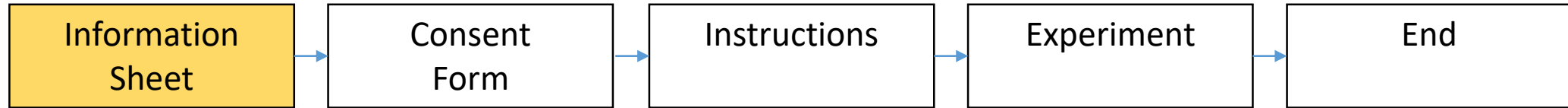
```
function Information() {  
  $('#Top').css('height', thisHeight / 20);  
  $('#Stage').css('min-height', thisHeight * 17 / 20);  
  $('#Bottom').css('min-height', thisHeight / 20);  
  
  CreateDiv('Stage', 'TextBoxDiv');  
  
  var Title = '<H3 align = "center">Information page for participants in research studies</H3>';  
  var Info = 'Here is a lot of information. It is important.';  
  
  $('#TextBoxDiv').html(Title + Info);  
  
  var Buttons = '<div align="center"><input align="center" type="button" class="btn btn-default" id="toConsent" value="Next" ></div>';  
  $('#Bottom').html(Buttons);  
  
  $('#toConsent').click(function() {  
    $('#TextBoxDiv').remove();  
    $('#Stage').empty();  
    $('#Bottom').empty();  
    Consent();  
  });  
};
```

Information sheet



```
function Information() {  
  $('#Top').css('height', thisHeight / 20);  
  $('#Stage').css('min-height', thisHeight * 17 / 20);  
  $('#Bottom').css('min-height', thisHeight / 20);  
  
  CreateDiv('Stage', 'TextBoxDiv');  
  
  var Title = '<H3 align = "center">Information page for participants in research studies</H3>';  
  var Info = 'Here is a lot of information. It is important.';  
  
  $('#TextBoxDiv').html(Title + Info);  
  
  var Buttons = '<div align="center"><input align="center" type="button" class="btn btn-default" id="toConsent" value="Next" ></div>';  
  $('#Bottom').html(Buttons);  
  
  $('#toConsent').click(function() {  
    $('#TextBoxDiv').remove();  
    $('#Stage').empty();  
    $('#Bottom').empty();  
    Consent();  
  });  
};
```

Information sheet

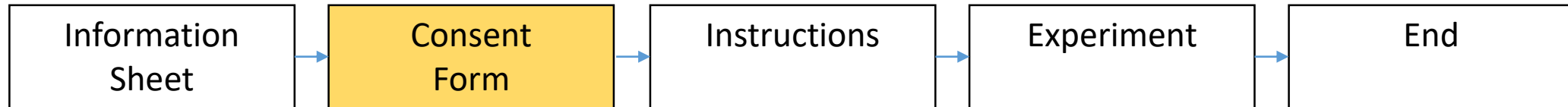


Information page for participants in research studies

Here is a lot of information. It is important.

Next

Consent Form



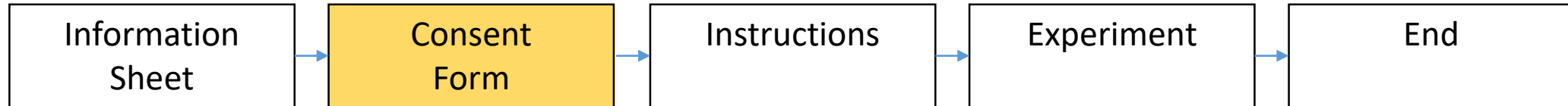
Consent form is where participants indicate that they follow all criteria and agree to participate in the experiment.

It will be very similar to the information sheet screen but we will add some tick boxes to make sure your participant knows what he is in for.

Ticking the boxes is mandatory, so we will have to check that the participant ticked all the boxes when pressing the button before moving to the instructions.

This is done by inserting an 'if' statement, checking that all boxes are ticked before proceeding. If no an alert window will tell you that all boxes must be ticked.

Consent Form



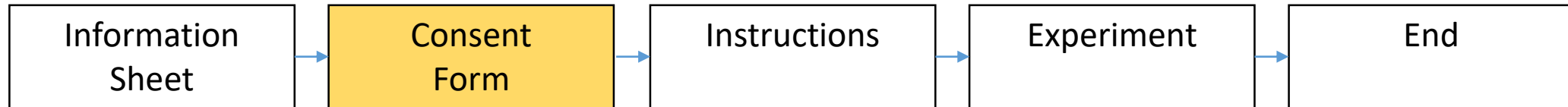
Consent form for participants in research studies

Please read the following criteria and tick all boxes.

- ☐ I have read the information page
- ☐ I have had the opportunity to contact the researcher to ask questions and discuss the study
- ☐ I have received satisfactory answers to my questions or have been advised of an individual to contact for answers to pertinent questions about the research and my rights as a participant
- ☐ I understand that I am free to withdraw at any time, without giving a reason, and without incurring any penalty
- ☐ I am over 18 years of age.

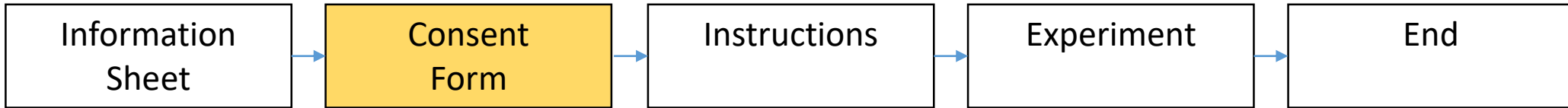
Next

Consent Form



```
var Ticks = '  
<input type="checkbox" name="consent" value="consent1" id= >I have read the  
information page<br>  
<input type="checkbox" name="consent" value="consent2">I have had the  
opportunity to contact the researcher to ask questions and discuss the study<br>  
<input type="checkbox" name="consent" value="consent3">I have received  
satisfactory answers to my questions or have been advised of an individual to  
contact for answers to pertinent questions about the research and my rights as a  
participant<br>  
<input type="checkbox" name="consent" value="consent4">I understand that I  
am free to withdraw at any time, without giving a reason, and without incurring  
any penalty<br>  
<input type="checkbox" name="consent" value="consent5">I am over 18 years  
of age.<br>';
```

Consent Form



```
function Consent() {
```

```
  $('#Top').css('height', thisHeight / 20);  
  $('#Stage').css('min-height', thisHeight * 17 / 20);  
  $('#Bottom').css('min-height', thisHeight / 20);
```

```
  CreateDiv('Stage', 'TextBoxDiv');
```

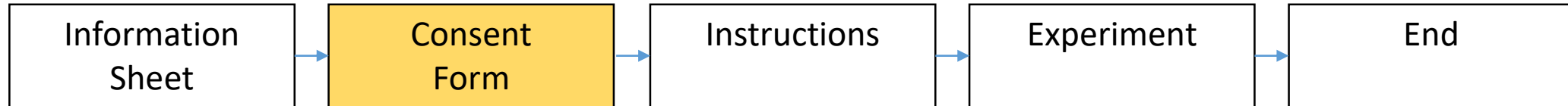
```
  var Title = '<H3 align = "center">Consent form for participants in research studies</H3>';  
  var Info = 'Please read the following criteria and tick all boxes. <br><br>';  
  var Ticks = //paste from previous slide
```

```
  $('#TextBoxDiv').html(Title + Info + Ticks);
```

```
  var Buttons = '<div align="center"><input align="center" type="button" class="btn btn-default" id="toInstructions" value="Next" ></div>';  
  $('#Bottom').html(Buttons);
```

```
  $('#toInstructions').click(function() {  
    if ($("#input:checkbox:not(:checked)").length > 0) {  
      alert('You must tick all check boxes to continue.');    } else {  
      $('#TextBoxDiv').remove();  
      $('#Stage').empty();  
      $('#Bottom').empty();  
      Instructions(1); //move to first page of instructions  
    }  
  });  
};
```

Consent Form



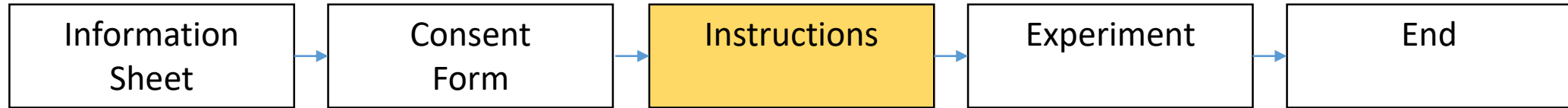
Consent form for participants in research studies

Please read the following criteria and tick all boxes.

- ☐ I have read the information page
- ☐ I have had the opportunity to contact the researcher to ask questions and discuss the study
- ☐ I have received satisfactory answers to my questions or have been advised of an individual to contact for answers to pertinent questions about the research and my rights as a participant
- ☐ I understand that I am free to withdraw at any time, without giving a reason, and without incurring any penalty
- ☐ I am over 18 years of age.

Next

Instructions

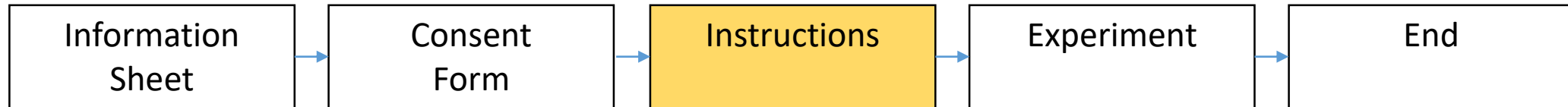


Think carefully about the instructions – don't forget any detail, and break them to small bits.

In my version you can set the number of pages, and each page has text and an image. You move through all of them to start the experiment.

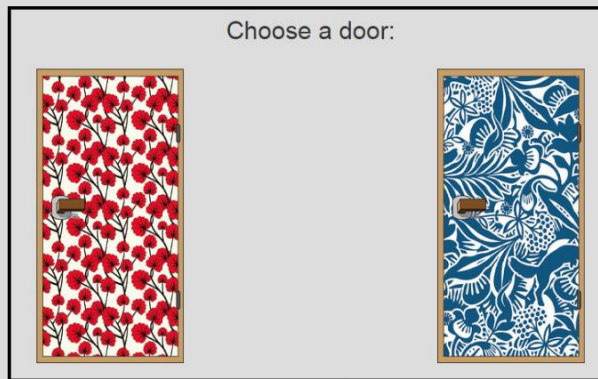
It is also a good idea to use some verification or active training (not now though).

Instructions

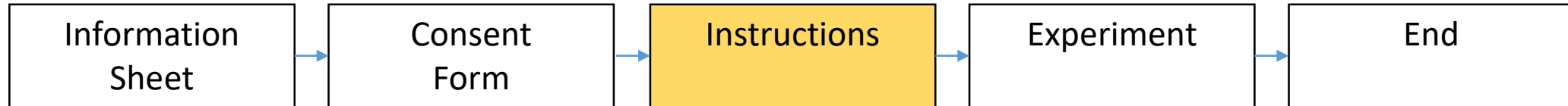


Instructions

In this experiment you have to collect as many coins as possible, hidden behind two doors. On each trial you have to choose between the doors. Each door has some probability of getting a coin. You chose the door by clicking on it with your mouse.
There are 10 trials in this experiment.



Instructions



```
var NumPages = 2;//number of pages
```

```
CreateDiv('Stage', 'TextBoxDiv');
```

```
var Title = '<H2 align = "center">Instructions</H2>';
```

```
switch (PageNum) {
```

```
case 1:
```

```
var Info = '<H3>In this experiment you have to collect as many coins as possible, hidden behind two doors. \n\
On each trial you have to choose between the doors.<br> Each door has some probability of getting a coin. \n\
You chose the door by clicking on it with your mouse. <br>There are' + NumTrials + ' trials in this experiment.</h3><br><br>';
```

```
break;
```

```
case 2:
```

```
var Info = '<H3>After each decision you will see the outcome – coin or nothing. You will then continue directly\n\
to the next trial. At the end you will see how many coins you earned.<br>Good luck!</h3><br><br>';
```

```
break;
```

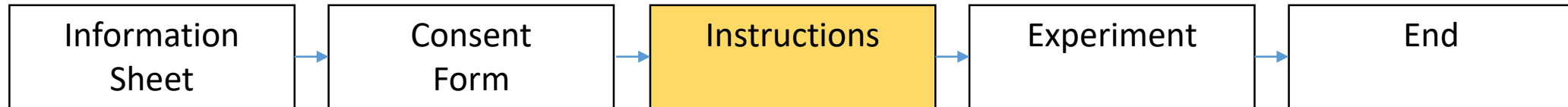
```
default:
```

```
var Info;
```

```
break;
```

```
};
```

Instructions



```
var Buttons = '<div align="center"><input align="center" type="button" class="btn btn-default" id="Back" value="Back" >\n\
<input align="center" type="button" class="btn btn-default" id="Next" value="Next" >\n\
<input align="center" type="button" class="btn btn-default" id="Start" value="Start!" ></div>';
```

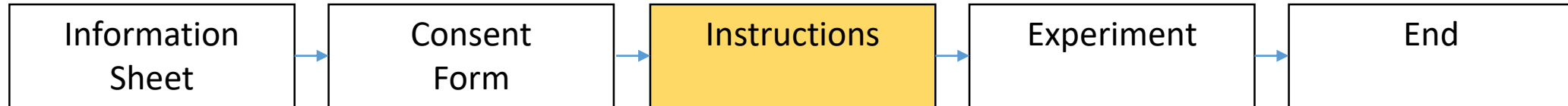
```
$('#Bottom').html(Buttons);
```

```
if (PageNum === 1) {
    $('#Back').hide();
} ;
if (PageNum === NumPages) {
    $('#Next').hide();
} ;
if (PageNum < NumPages) {
    $('#Start').hide();
};
```

```
$('#Back').click(function() {
    $('#TextBoxDiv').remove();
    $('#Stage').empty();
    $('#Bottom').empty();
    Instructions(PageNum - 1);
});
$('#Next').click(function() {
    $('#TextBoxDiv').remove();
    $('#Stage').empty();
    $('#Bottom').empty();
    Instructions(PageNum + 1);
});
```

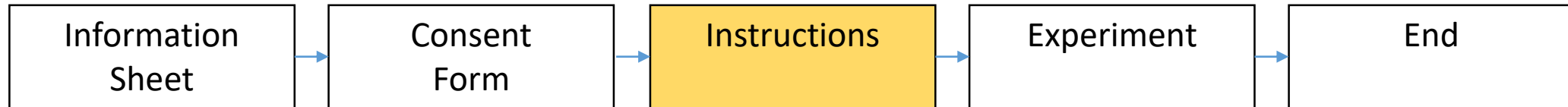


Instructions



```
$('#Start').click(function() {  
  
    $('#TextBoxDiv').remove();  
    $('#Stage').empty();  
    $('#Bottom').empty();  
    setTimeout(function() {  
        $('#Stage').html('<H1 align = "center">Ready</H1>');  
        setTimeout(function() {  
            $('#Stage').html('<H1 align = "center">Steady</H1>');  
            setTimeout(function() {  
                $('#Stage').html('<H1 align = "center">Go!</H1>');  
                setTimeout(function() {  
                    $('#Stage').empty();  
                    Options(1);//Start with the first trial  
                }, 1000);  
            }, 1000);  
        }, 1000);  
    }, 10);  
  
});
```


Instructions

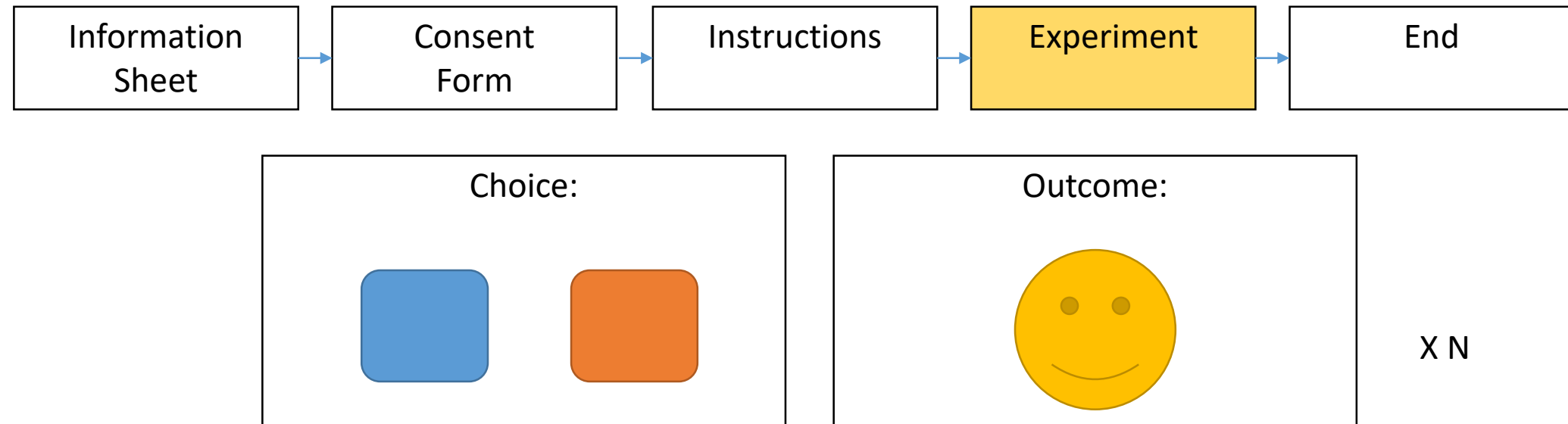


Instructions

In this experiment you have to collect as many coins as possible, hidden behind two doors. On each trial you have to choose between the doors. Each door has some probability of getting a coin. You chose the door by clicking on it with your mouse.
There are 10 trials in this experiment.



Experiment – choice

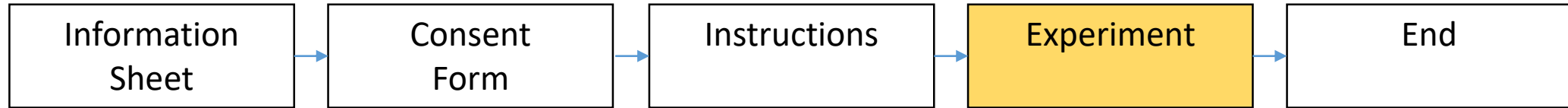


Our experiment includes two steps in every trial. The first is the choice, and the second is the outcome. We will start with the choice stage.

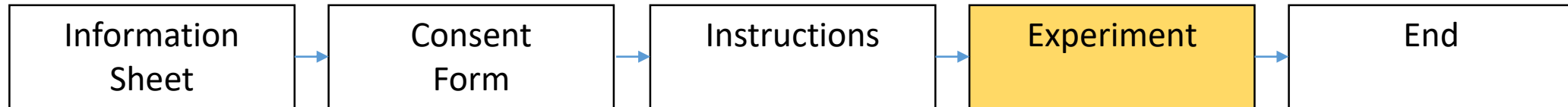
We want to display the options to switch location from time to time.

We want to store the participant's choice, its location, the RT (time it took her to make the decision), and at the later stage the outcome.

Experiment – choice



Experiment – choice



```
function Options(TrialNum) {
```

```
    $('#Top').css('height', thisHeight / 20);  
    $('#Stage').css('min-height', thisHeight * 17 / 20);  
    $('#Bottom').css('min-height', thisHeight / 20);
```

```
    var InitTime = (new Date()).getTime();
```

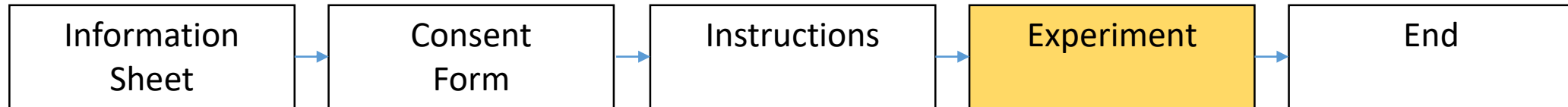
```
    CreateDiv('Stage', 'TextBoxDiv');
```

```
    var Title = '<div id = "Title"><H2 align = "center">Choose a door:</H2></div>';
```

```
    var Door1 = '';
```

```
    var Door2 = '';
```

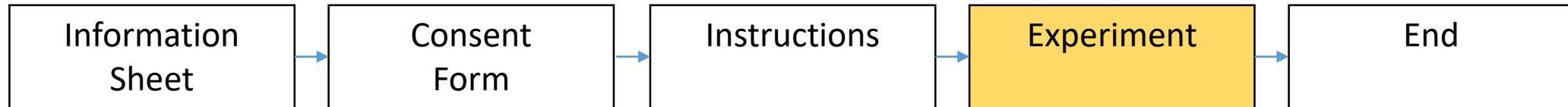
Experiment – choice



```
var RandPosition = Math.random();
if (RandPosition < 0.5) {
    var Images = '<div class="row"> <div class="col-md-1"></div> <div class="col-
md-3">' + Door1 + '</div><div id = "Middle" class="col-md-4"></div><div class="col-
md-3">' + Door2 + '</div><div class="col-md-1"></div></div>';
} else {
    var Images = '<div class="row"> <div class="col-md-1"> </div> <div class="col-
md-3">' + Door2 + '</div><div id = "Middle" class="col-md-4"></div><div class="col-
md-3">' + Door1 + '</div><div class="col-md-1"></div></div>';
}

$('#TextBoxDiv').html(Title + Images);
});
```

Experiment – choice

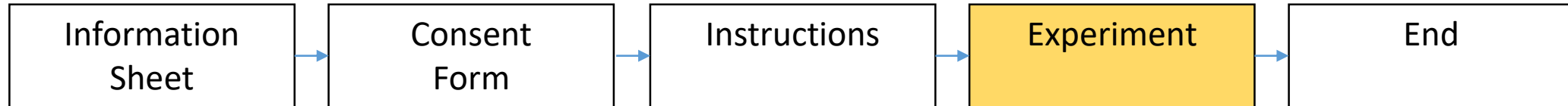


```
var Press=0;
    $('#Door1').click(function() {
        if (Press===0){
            Press=1;

            $(this).css({"border-color": "#CCFF33",
                "border-width": "3px",
                "border-style": "solid"});
            var ThisTime = (new Date()).getTime();

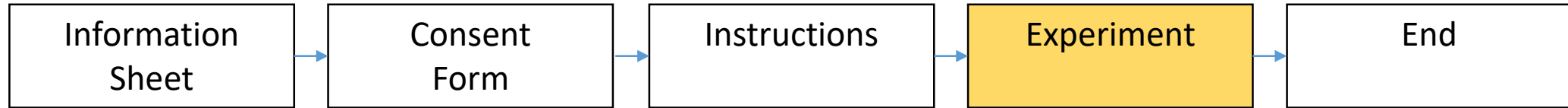
            Reward(TrialNum, 1, Sign(RandPosition-0.5), ThisTime-InitTime);
        }
    })
```

Experiment – choice

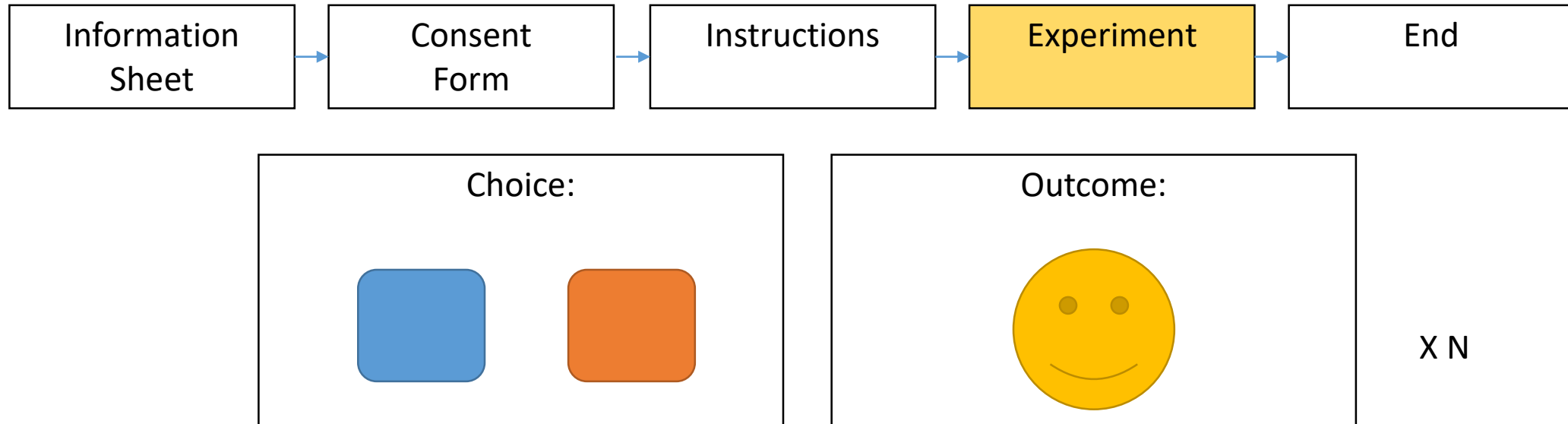


```
$('#Door2').click(function() {  
    if (Press===0){  
        Press=1;  
        $(this).css({"border-color": "#CCFF33",  
                    "border-width": "3px",  
                    "border-style": "solid"});  
        var ThisTime = (new Date()).getTime();  
  
        Reward(TrialNum, 2, Sign(0.5-RandPosition), ThisTime-InitTime);  
    }  
});
```

Experiment – choice

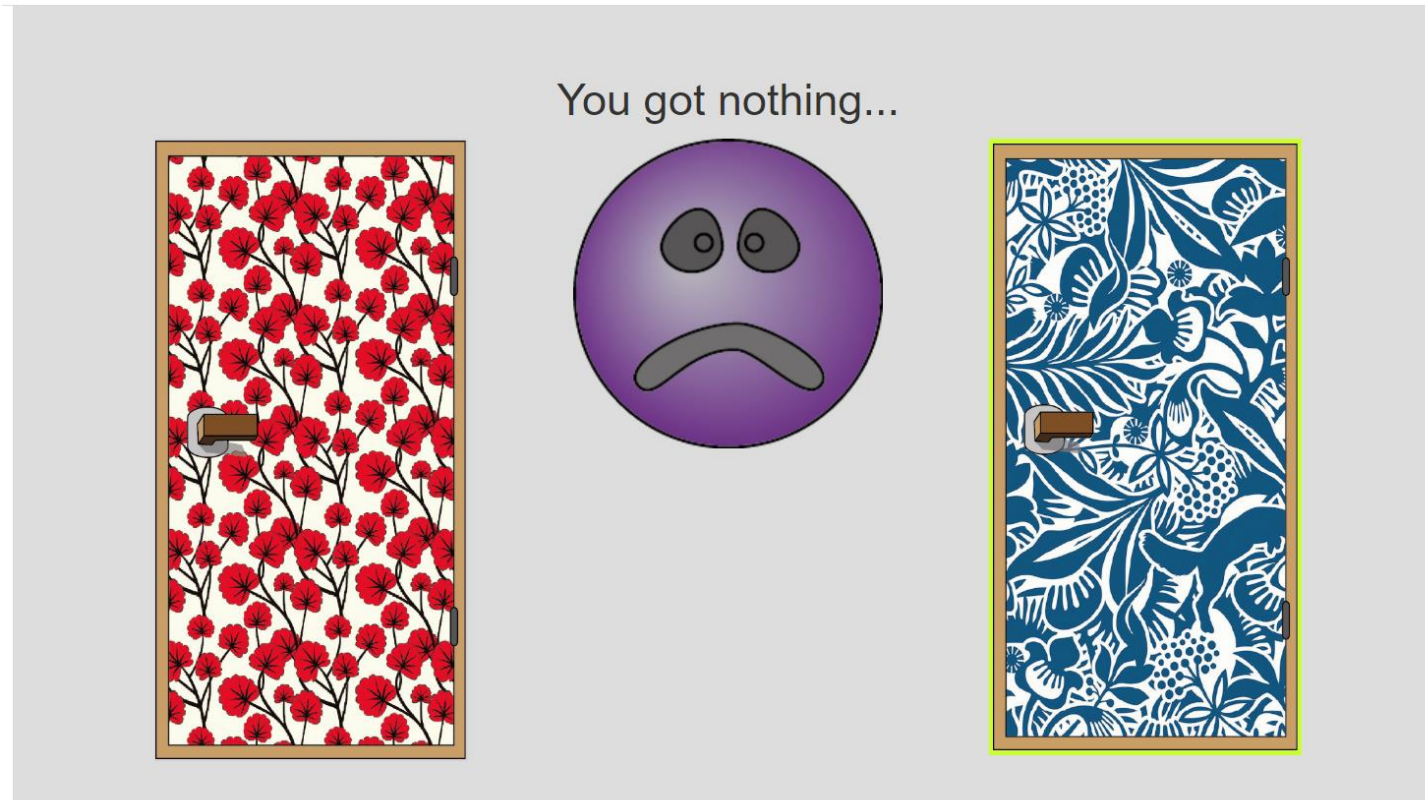
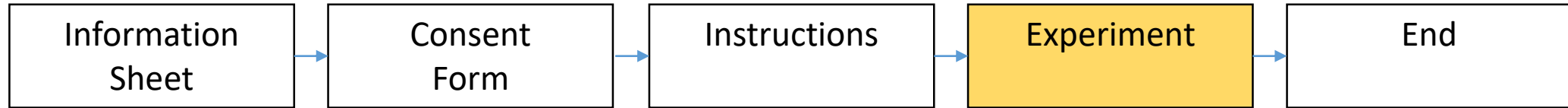


Experiment – choice

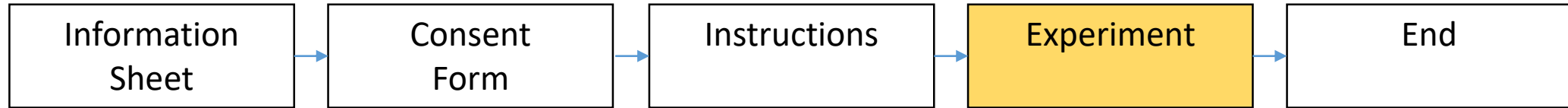


In the outcome stage we will present the outcome according to the participant's choice. We will also send this trial's data to storage (in later stages), and check how many trials are left and continue accordingly.

Experiment – choice



Experiment – choice



```
function Reward(TrialNum, Choice, Side, RT) {
```

```
    $('#Title').empty();
```

```
    var ThisReward = 0;
```

```
    var RandomNum = Math.random();
```

```
    if (Choice === 1) { //Door1
```

```
        if (RandomNum < P1) {
```

```
            ThisReward = 1;
```

```
        }
```

```
    } else { //Door2
```

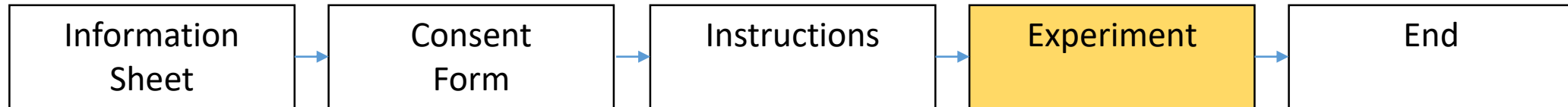
```
        if (RandomNum < P2) {
```

```
            ThisReward = 1;
```

```
        }
```

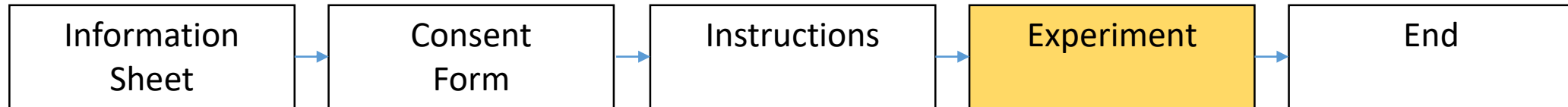
```
    }
```

Experiment – choice



```
if (ThisReward === 1) { //Coin
  $('#Title').html('<H2 align = "center">You got a coin!!</H2>');
  $('#Middle').html('');
  SumReward = SumReward + 1;
  // InsertDataAjax(TrialNum,Choice,Side,RT,ThisReward)
  if (TrialNum + 1 < NumTrials) {
    setTimeout(function() {
      $('#TextBoxDiv').fadeOut(500);
      setTimeout(function() {
        $('#Stage').empty();
        $('#Bottom').empty();
        Options(TrialNum + 1);
      }, 500);
    }, 1500);
  } else {
    $('#TextBoxDiv').remove();
    $('#Stage').empty();
    $('#Bottom').empty();
    End();
  }
}
```

Experiment – choice



```
} else { //no coin
    $('#Title').html('<H2 align = "center">You got nothing...</H2>');
    $('#Middle').html('');

```

```
// InsertDataAjax(TrialNum,Choice,Side,RT,ThisReward);
```

```
if (TrialNum + 1 < NumTrials) {
    setTimeout(function() {
        $('#TextBoxDiv').fadeOut(500);
        setTimeout(function() {
            $('#Stage').empty();
            $('#Bottom').empty();
            Options(TrialNum + 1);
        }, 500);
    }, 1500);

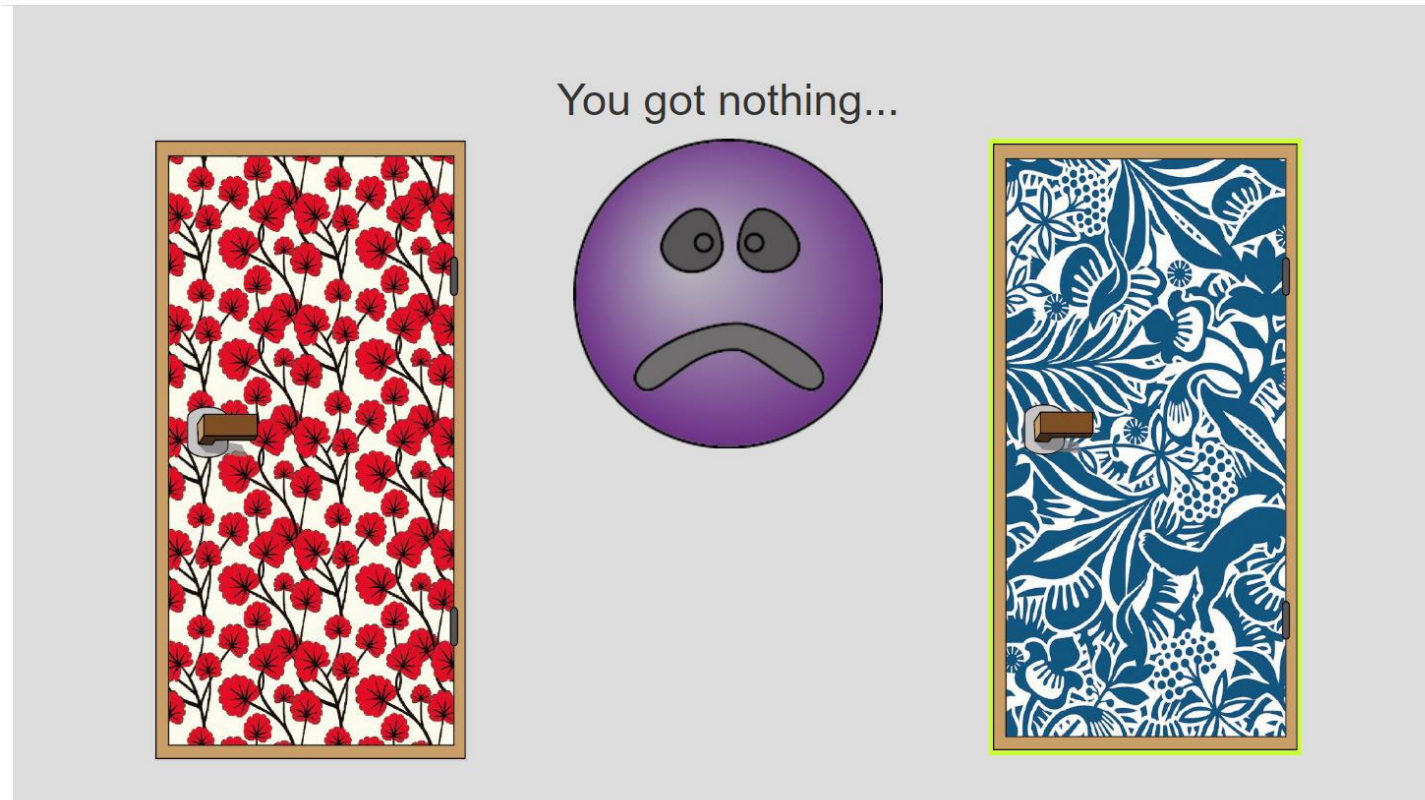
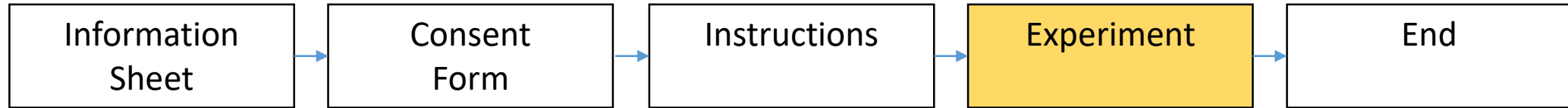
```

```
} else {
    $('#TextBoxDiv').remove();
    $('#Stage').empty();
    $('#Bottom').empty();
    End();

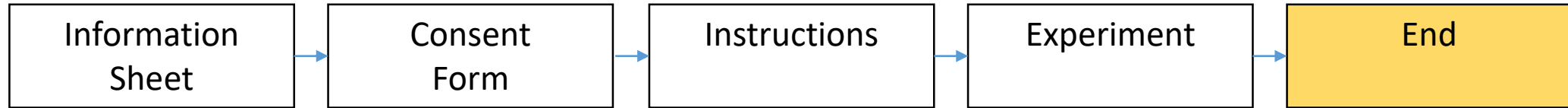
```

```
}
```

Experiment – choice



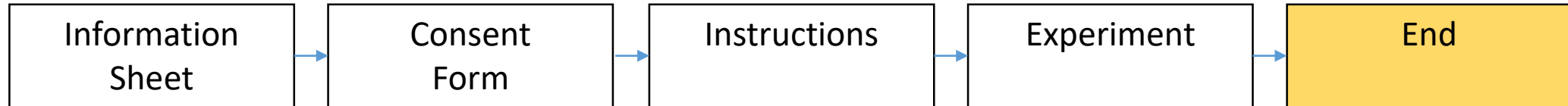
End



When the experiment is over we may want to thank the participant, and let him know how he did.

When I am using Amazon mechanical turk I usually open a HIT with a link to my experiment, and ask the turkers to fill in a completion code when they're done. The completion code is usually the random user ID.

End



```
function End() {
```

```
    $('#Top').css('height', thisHeight / 20);  
    $('#Stage').css('min-height', thisHeight * 17 / 20);  
    $('#Bottom').css('min-height', thisHeight / 20);
```

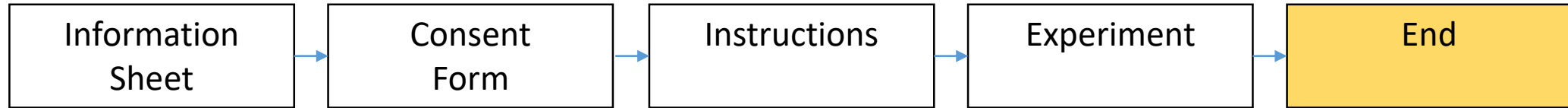
```
    CreateDiv('Stage', 'TextBoxDiv');
```

```
    var Title = '<H2 align = "center">You have finished the experiment!<br> <br> You earned  
' + SumReward + ' coins!<br><br> Thanks for participating!</H2><br> <p align = "center"> Your  
completion code is: ' + SubID + '</p>';
```

```
    $('#TextBoxDiv').html(Title );
```

```
};
```


End



You have finished the experiment!

You earned 1 coins!

Thanks for participating!

Your completion code is: 9734550038

That's it for now...

Well done, you now have a working experiment.

Next – how do we store data (and get it)?