Modern JavaScript and PhoneGap

PhoneGap Day EU 2017

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Hi!

- I've Used PhoneGap for over six years
- I've written five books about PhoneGap
- I work with clients to create various kinds of apps
- I'm an Apache Cordova committer
- I'm one of several moderators on the Cordova Google Group and PhoneGap Adobe Forums — If you haven't checked out the latter, you should!
- I love retro technology! :-)

Modern JavaScript Versions

Remember ECMAScript 5?

Release year: 2009

- The version of JavaScript we all know and love (~ish?)
- Supported by all modern mobile web views[1]
  - iOS 6+, IE 10+, Edge (forever), Android 4.4+
- Reasonably modern (`map` , `reduce` , getters/setters, etc.)
- Things have changed a lot since then...

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1. http://caniuse.com/#feat=es5

2015[1]	Block-scoped `let` & `const`	Destructuring and named parms
	Default parameters	Rest and Spread operator (`...`)
	`for...of` loops and Iterators	Arrow functions (`=>`)
	Template strings & interpolation	Improved literals (object, `0b10`)
	Generators (`*` / `yield`)	Symbols, Maps & Sets, Promises
	`class` syntactic sugar & `super`	Modules (`import` , `export`)
2016[2]	Exponent (`**`)	`Array.prototype.incudes()`
2017[3]	`async` / `await`	String padding 😉
	Shared memory	Atomics

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1. https://github.com/lukehoban/es6features#readme; the list here is not a complete representation of *all* features
2. http://www.2ality.com/2016/01/ecmascript-2016.html
3. http://www.2ality.com/2016/02/ecmascript-2017.html

Before we go any further...

Some Very Important Caveats!

Caveats

- May need training to use / read effictively
- **Not** a performance optimization
- Adds a built step
- Debugging can be difficult
  - Source maps *help*, but they can be quirky
  - Getting better all the time
- Best iOS performance requires `WKWebView`
  - `UIWebView` performance is *abysmal*

Performance Change	Chrome 55	Edge 15	Safari 10
Arrow functions	N/C	+1.2x	N/C
let compound	-1.6x	N/C	N/C
Classes	N/C	-1.5x	N/C
super	-4x	-1.7x	-15x
Destructuring	-16x	-53x	-23x
for ... of array	-17x	-7x	-1.3x
for ... of object	-1.8x	-4x	-2.3x
Map & Set	-4x	-23x	-8x
rest	+1.3x	+14x	-33x
spread	-22x	-1.7x	-5x
Template string	-1.2x	+1.4x	-18x

Source: https://kpdecker.github.io/six-speed/ (2017/01/04) | N/C: "no change"

That said ...

Don't let those numbers scare you!

- Performance will improve as engines improve — ES2015+ is new!
- Outside of tight loops, not that much of a performance penalty
  - ... and ES5 works just fine in tight loops
- Fully capable of running an emulator at full tilt
  - ... on modern devices
  - ... on iOS using `WKWebView` (JIT compilation FTW)

Device	GB4	Web View	Mode	ES6 IPF (mips)	ES5 IPF (mips)	ES3 IPF (mips)
MacBook Pro	3574	Safari 10	reg	75 650 (4.51)	79 783 (4.75)	78 381 (4.67)
			min	-! 72 167 (4.30)	80 301 (4.77)	-! 72 953 (4.35)
iPad Pro 12.9"	3000	Safari 10	reg	81 344 (4.88)	81 720 (4.89)	83 584 (5.01)
			min	80 542 (4.83)	-! 72 315 (4.34)	81 182 (4.87)
iPhone 6s	2474	Safari 10	reg	41 552 (2.49)	43 811 (2.63)	42 912 (2.57)
			min	41 773 (2.50)	41 285 (2.48)	41 411 (2.47)
iPad Mini 4	1638	Safari 10	reg	-! 32 791 (1.97)	36 222 (2.17)	39 195 (2.35)
			min	36 501 (2.19)	38 676 (2.32)	36 715 (2.20)
Tab S 8.4"	783	Chrome 54	reg	2 614 (0.13)	+! 3 350 (0.17)	2 394 (0.11)
			min	2 847 (0.14)	+! 3 557 (0.19)	1 950 (0.09)
iPad Pro 12.9"	3000	UIWebView	reg	100 (0.01)	100 (0.01)	100 (0.01)
			min	100 (0.01)	100 (0.01)	100 (0.01)

Note: Of course, this is *highly sensitive* to the ES2015+ features that you use.
MacBook Pro: Late 2014, 2.2GHz i7 16GB RAM; *GB4* = Geekbench 4 single-core score; *min* = minified & tree shaken

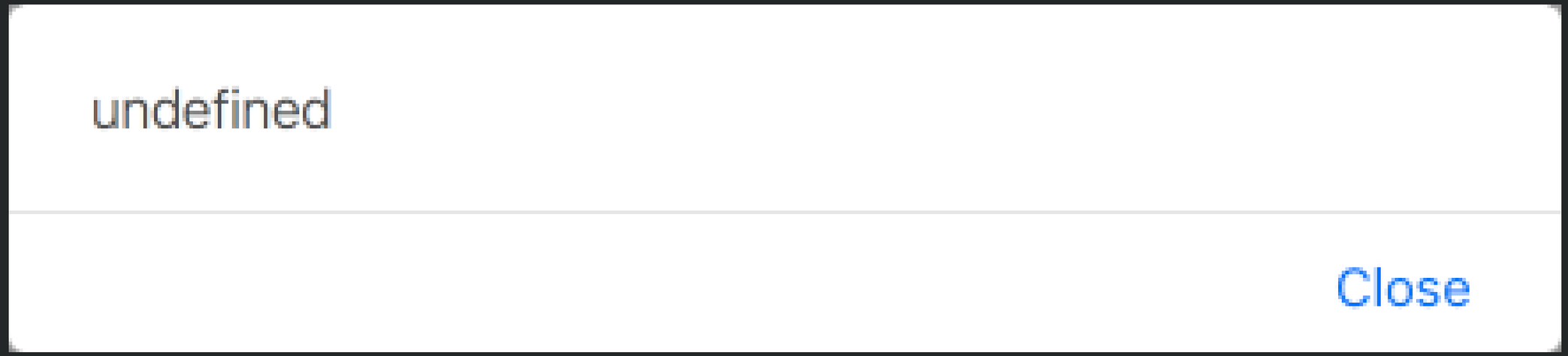
A whirlwind tour

Dang it, *this!*

```
var app = {
  text: "Hello, PhoneGap Day Attendees!",
  sayHi: function() { alert(this.text); },
  start: function() {
    document.getElementById("clickme")
        .addEventListener("click", this.sayHi, false);
  }
}

app.start();
```

Wah wah 🚫

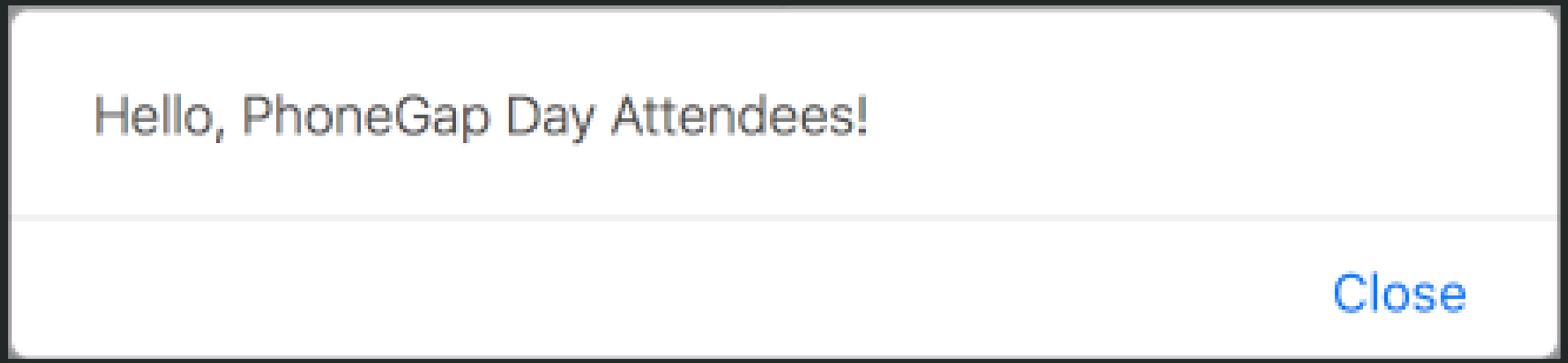


Arrow functions (=>)

```
class App {
  constructor({text = "Hello, world!"} = {}) {
    this.text = text;
  }
  start() {
    document.getElementById("clickme")
        .addEventListener("click", () => this.sayHi(), false);
  }
  sayHi() { alert(this.text); }
}
const app = new App({text: "Hello, PhoneGap Day Attendees!"});
app.start();
```

ES5 equivalent: `(function() { this.sayHi(); }).bind(this)`

Hi! 🎉



Array.from

Remember doing this?

```
var elList = document.querySelectorAll("a"),
    elArr = [].slice.call(elList, 0);
```

Now we can do this:

```
let elArr = Array.from(document.querySelectorAll("a"));
```

Spread/Rest is awesome (...)

Even shorter than `Array.from`:

```
let elArr = [...document.querySelectorAll("a")];
```

Easy variadic arguments:

```
function sum(...nums) {
    return nums.reduce((a, v) => a + v, 0);
}
console.log(sum(1, 5, 10, 99));
```

⇒ 115

Spread/Rest is awesome (...) (2)

Easy sprintf-like:

```
function sprintf(str, ...replacements) {
    return str.match(/\%[0-9]+/g)
        .reduce((a, v) => a.replace(v,
                                    replacements[v.substr(1)]), str);
}
console.log(sprintf ("%1, %0", "world", "hello"));
```

⇒ Hello, world

Destructuring

Easy swap:

```
[a, b] = [b, a]
```

Multiple return values:

```
function someFunction(str) {
  return {result: str + str, error: str === "" ? "no string" : null};
}
let {result, error} = someFunction("that might error");
// renaming:
let {result:r, error:err} = someFunction("that might error");
```

Named Parameters & Defaults

```
class Button {
    constructor({type = "default", text = "",
                 x = 0, y = 0, w = 100, h = 44} = {}) {
        this.type = type;
        this.text = text;
        this.frame = {x, y, w, h};
        this.bounds = {x: 0, y: 0, w, h};
    }
}

let button = new Button ({type: "round", text: "Click me",
                          x: 100, y: 100});
```

Template Strings

```
let x = 4;
let y = 10;
console.log(`x + y => ${x} + ${y} => ${x + y}`);
```

⇒ x + y => 4 + 10 => 14

Allows multi-line strings (preserving ↵):

```
let template=`<ul>
    <li><span></span></li>
</ul>`;
```

Sets and Maps

Easy Dedup:

```
function dedup (arr = []) {
    return Array.from(new Set(arr));
}

let arr = dedup([ 1,  4,  9,  3,  4,  9, 12,
                 20, 12, 32, 94,  9, 12,
                 94, 34,  1]);
```

Promises, promises

Hopefully already familiar to you...

```
function requestFileSystem({type = window.PERSISTENT,
                            quota = 5 * 1024 * 1024} = {}) {
    return new Promise((resolve, reject) => {
        window.requestFileSystem(type, quota,
                                 resolve, reject);
    });
}
```

But ES2017 has something nice in store...

async / await

```
async function readFile(name) {
    const fs = await requestFileSystem({
        type: window.PERSISTENT, quota: 10 * 1024 * 1024});
    const fileEntry = await getFile(name);
    const contents = await readFile(fileEntry);
    return contents;
}
async function start() {
    try {
        const data = await readFile("poem.txt");
        alert (data);
    } catch (err) {
        alert (err);
    }
}
```

Classes

```
const BUTTON_TYPE = Symbol("Button Type");
class Button extends Widget {
    constructor({type = "rounded", frame} = {}) {
        super({frame});
        this[BUTTON_TYPE] = type;
    }
    get buttonType() {
        return this[BUTTON_TYPE];
    }
    set buttonType(type) {
        this[BUTTON_TYPE] = type;
    }
}
```

Modules (friendly to static analysis)

📄 math.js:

```
export function add(a, b) {
    return a+b;
}
```

📄 index.js:

```
import {add} from "math.js";
console.log(add(4, 3));
```

⇒ 7

PhoneGap Examples

Geolocation with ES2017

```
function getLocation(options) {
  return new Promise((resolve, reject) => {
    navigator.geolocation.getCurrentPosition(p => {
        p.coords.timestamp = p.timestamp;
        resolve(p.coords);
    }, reject, options);
  });
}
async function start() {
  try {
    const {timestamp, latitude, longitude} = await getLocation();
    alert(`At ${latitude}, ${longitude} on ${timestamp}`);
  } catch(err) {
    alert(`Error ${err.code}: ${err.message}`);
  }
}
```

File Transfer with ES2017

```
function uploadFile({source, target, options} = {}) {
  return new Promise((resolve, reject) => {
    const ft = new FileTransfer();
    ft.upload(url, to, resolve, reject, options);
  });
}
async function start() {
  try {
   const {responseCode, response, bytesSent} = uploadFile({
      url: "cdvfile://localhost/persistent/test.txt",
      to: "http://www.example.com/upload.php",
      options: { mimeType: "text/plain",
                 fileKey: "file",
                fileName: "test" }});
  } catch (err) { /* do something with the error */ }
}
```

Do you sense a pattern?

```
function promisify(fn, thisArg = this, {split = 0} = {}) {
  return function __promisified__(...args) {
    const afterArgs = args.splice(split), beforeArgs = args;
    return new Promise((resolve, reject) => {
      try {
        fn.apply(thisArg, beforeArgs.concat(resolve, reject,
          ...afterArgs));
      } catch (err) {
        resolve(err);
      }
    });
  }
}
```

Easy wrappers for Cordova plugin APIs! *

```
const getLocation = promisify(
  navigator.geolocation.getCurrentPosition,
  navigator.geolocation // "this" arg
);
const {timestamp, coords:{latitude, longitude}} =
  await getLocation();

const ft = new FileTransfer();
// upload signature: url, to [split], success, error, options
const uploadFile = promisify(ft.upload, ft, {split: 2});
const r = await uploadFile(url, to, options);
```

---

* Applies to Cordova plugin APIs that use the success, error form; could be made more generic

Where can I use this now?

Native support (%coverage)

OS	ES2015	ES2016	ES2017
Android (Chrome)	97% (51+)	100% (55+)	53% (56+)
Edge 15	100%	100%	39%
Edge 14	93%	-	-
iOS 11*	100%	100%	98%
iOS 10	100%	61%	42%
iOS 9	54%	-	-

* Based on current status in Safari Technological Preview 11

Remember Module syntax?

No implementation! 😱

Supporting the syntax doesn't always mean that there is an implementation, or that it is a fully-compliant implementation.

But we can fix that...

But, I want it everywhere!

ES2015+ ⇒ ES5!

or, *The Rise of the Transpilers*

Common Transpilers

These can all transpile ES2015* (feature support may vary)

- Babel (née es6to5)
- TypeScript
- Bublé **
- Traceur

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* **Note:** Not every ES2015+ feature can be transpiled effectively (if at all), such as proxies, shared memory, atomics, built-in subclassing, and tail call elimination
* **Note:** Most transpilers need core-js to polyfill the standard library.
** Doesn't attempt to transform non-performant or non-trivial ES6 features; *also very young*

Module support using Bundling 🛍

Dependency management & `import` / `export` (and CommonJS, AMD, etc.) support

Bundler	Babel	Bublé	Coffee	Typescript	Traceur
Webpack	✓	✓	✓	✓	✓
JSPM	✓	—	—	✓	✓
Browserify	babelify	bubleify	coffeeify	tsify	traceurify

PhoneGap Integration

- You can always do it manually, right?
  - Just run each tool's CLI... *every time*...
  - Error prone — you might forget!
- Developers like automation, right? 🤖
  - `gulp / grunt` task runners
  - `npm run` scripts ← great if you are already comfortable with npm and node
  - Plugin hooks ← *this is really fun!* 😄
  - Project-level hooks work too

Setting up (npm scripts)

- Where to put your ES2015+ code?
  - Sibling (sibling of `www/js`)
  - External (sibling of `www`)
- Install Webpack & Transpiler
- Configure Webpack & Transpiler
- Add build scripts to `package.json`

Sibling Structure

- project-root/
  - config.xml
  - www/
    - index.html
    - (ts|es)/
      - index.(ts|js)
    - js/
      - index.js ← (gen)

External Structure

- project-root/
  - config.xml
  - www.src/
    - index.html
    - (ts|js)/
      - index.(ts|js)
  - www/
    - index.html ← (copied)
    - js/
      - index.js ← (gen)

Install Webpack & Transpiler

```
$ npm install --save-dev webpack
```

Typescript:

```
$ npm install --save-dev ts-loader typescript core-js
```

Babel:

```
$ npm install --save-dev babel-loader babel-core babel-polyfill \
  babel-preset-es2015 babel-preset-es2016 babel-preset-es2017 \
  babel-preset-react babel-plugin-transform-runtime
```

Note: `core-js` is a standard library polyfill; depending on your feature use and targets you may not need it.

Configure TypeScript

Create `tsconfig.json`:

```
{
    "compilerOptions": {
        "allowJs": true,
        "target": "es5",              // es2015, es5, es3
        "module": "es2015",           // required for tree shaking
        "inlineSourceMap": true
    },
    "include": [
        "www.src/es/**/*"             // or www/es/**/* if sibling
    ]
}
```

Configure Babel

Create `.babelrc`:

```
{
    "presets": [
        ["es2015", {
            "loose": true,     // best performance
             "modules": false // required for tree shaking
        }],
        "es2016", "es2017", "react"
    ],
    "plugins": ["transform-runtime"] // reduces repetition in
                                     // output files
}
```

Configure Webpack

Create `webpack.config.js`:

```
var path = require("path");
module.exports = {
    devtool: "inline-source-map",
    // if sibling, use   __dirname, "www"
    context: path.resolve(__dirname, "www.src"),
    entry: "./" + path.join("es", "index.js"),   // will fail without ./!
    output: { filename: "bundle.js",
              path: path.resolve(__dirname, "www", "js") },
    module: { loaders: [ {
                test: /\.(ts|js|jsx)$/,          // remove ts for babel
                loader: 'ts-loader',             // or babel-loader
                exclude: /node_modules/,
                options: { entryFileIsJs: true } // only for js with typescript
            } ] }
}
```

Add run script to package.json

(assuming `cordova` and `webpack` are installed locally)

```
"scripts": {
    "cordova": "cordova",
    "webpack": "webpack",
    "build:ios":
        "npm run webpack && npm run cordova -- build ios"
}
```

```
$ npm run build:ios
```

Note: if using *sibling* layout, you might want to delete the duplicate code in the platform `www/es` folders. Otherwise, you'll end up copying your ES2015+ code *and* the resulting bundle to the app bundle.

Webpack Transpiler Plugin 😄

```
$ cordova plugin add cordova-plugin-webpack-transpiler \
  --variable CONFIG=typescript|babel --save
```

- Create your project structure (sibling or external supported)
- Then `cordova prepare`
  - Runs `npm init` and `npm install` for dependencies if needed
  - Creates configuration files if needed
  - Transforms and bundles ES2015+/TS → JS using webpack
  - Transforms SCSS → CSS if present

Fork, translate, and/or improve it: https://github.com/kerrishotts/cordova-plugin-webpack-transpiler

What about tests?

... and code coverage?

... and linting?

Tests

```
$ npm install --save-dev mocha chai
$ npm install --save-dev ts-node          # for TypeScript
$ npm install --save-dev babel-register # for Babel
```

Add `test` to `package.json:scripts` *

```
"test": "mocha" // TypeScript (need ./test/_bootstrap.js)
"test": "mocha --compilers js:babel-register"   // Babel
```

Then `npm test`

---

* Assumes tests are in `./test`
_bootstrap.js: `require("ts-node").register();`

Code coverage (Babel)

`npm install --save-dev instanbul`, then in `.babelrc`:

```
{
  "presets": ["es2015", ...],
  "plugins": ["transform-es2015-modules-commonjs", ...]
  "env": {
    "test": {
      "plugins": ["istanbul"]
    }
  }
}
```

Code coverage (Babel, 2)

`npm install --save-dev cross-env nyc` and configure (in `package.json`):

```
"nyc": {
  "require": ["babel-register"],
  "reporter": ["text", "html"],
  "sourceMap": false,
  "instrument": false // instanbul instrumented already
}
```

And create a `npm run` script:

```
"cover": "cross-env NODE_ENV=test nyc npm test"
```

Linting

`eslint` works just fine with ES2015. It's up to you how strict you want `eslint` to be with regard to mixing ES5 and ES2015.

```
$ npm install --save-dev eslint
```

📄 `package.json`:

```
"scripts": {
    "lint": "eslint src test"
}
```

```
$ npm run lint    # or, write a plugin/platform hook! ;-)
```

Tips

Tips

- Don't assume `=>` functions are drop-in replacements
- Be careful passing arrow functions to `describe` & `it` in your tests
- Use `var` instead of `let` in tight nested loops where performance is critical
- *Do* minify & tree shake — reduces file size and startup time
- But, don't count on minified code as a performance optimization (results highly variable)

Tips (2)

- Don't get carried away — some of the syntax can cause terrible headaches if overused!
  - True especially with descructuring and template strings.
- You don't have to convert overnight — ES5 still works fine.
- **Do** use `const` to identify unchanging *references*.
  - But don't think of the variable as *immutable* — it isn't.
- `var` hasn't gone away; it still works just fine!
- Use `for...of` instead of `for...in & hasOwnProperty()`

Tips (3)

- Try to declare `let` / `const` at the top of each scope (for Chrome's benefit)
- Chrome likes to *deopt* for seemingly odd reasons
  - The inspector will indicate `[deopt]` and the reason

Reason	Workaround
Declaration not at top (TDZ issues)	Move declaration to top of function
Compound assignments	Use `var` in declaration instead

To bundle or not to bundle?

Yes, absolutely.

To transpile or not to transpile?

Yes.*

* Technically, it depends on your targets, and what flavor of Modern JavaScript you intend on using. But usually, yes.

Thanks!

https://github.com/kerrishotts/pgday/2017/modern-javascript-and-phonegap

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