From Hardware to Software: Evaluating the Swipe Gestures Navigation Feature on Mobile Phones

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Abstract. This paper presents the user experience evaluation of a smartphone feature to allow users to do gestures in a small, pill-shaped button that replaces the typical Android navigation bar. This proposed pill-shaped button, located at the bottom of the screen, allows swipe and tap gestures to do the same functions available on the navigation bar: go back, go to home screen and open the recent apps. However, the pill-shaped button is smaller than the whole navigation bar, which leaves more space to the apps to show their content on screen. In order to evaluate this feature, 252 participants were invited to use it during about 3 months and report any issues using some apps to describe them as well as collect logs remotely. Also, participants were also invited to answer a few user satisfaction surveys after some time using the feature. Based on the findings from this evaluation process, it was possible to fix the issues found and improve the overall usability before the feature hit the market.

Keywords: User trial · User experience · Remote evaluation

1 Introduction

It is nearly impossible to imagine the world without smartphones. Since 2007, when the first iPhone was launched and Google announced Android, smartphones and their apps have become virtual partners of people in everyday life, from the time people wake up until they go to bed, deeply embedded into people's social lives [1]. According to Google Consumer Barometer [2], in 2017, 67% of people in Brazil were smartphone users. In more developed countries, the numbers are even higher: for example, in USA, 78% of population uses a smartphone whereas, in United Kingdom, 77% of population is smartphone users.

Given its small screen size, smartphone apps have adopted some techniques and patterns to prioritize content instead of navigation. One of the most common solution are the hamburger menus [3]. Alternatively, on-screen gestures such as swipe, pinch, tap and hold and others can be adopted to replace the same functionality of buttons, menus and links in an app, although those gestures are hard to discover and learn [3].

Based on those principles to prioritize content, Lenovo Motorola introduced the One Button Nav feature to replace the typical Android navigation bar that appears at the bottom of the screen in the Moto G family released in 2017. The first versions of One Button Nav relied on gestures on the fingerprint sensor of the smartphones to provide the same functionalities present in the Android navigation bar (go back, go home, open recent apps). However, in some of the most recent devices released by Lenovo Motorola, the fingerprint sensor moved from the front-bottom of the device to the back or even to the right edge, making it more difficult to continue use those gestures in the sensor at any time. Thus, Lenovo Motorola proposed a newer version of One Button Nav in 2018, this time creating a simple thin, pill-shaped button that appears the bottom of the screen and allows users to swipe, tap, and long press and, with these gestures, have the same functionalities of the first version of One Button Nav.

This paper continues a research published and presented on HCI International 2018 [4] by evaluating the user experience of this new version of One Button Nav before hit the consumers. Once again, the process involved a remote user experience evaluation through log collection and by providing apps to the users to describe any issues they found as well as to answer user satisfaction surveys. The next sections will describe the One Button Nav, highlighting the similarities and differences between the hardware and the software solutions, the user evaluation process, and the major findings from this evaluation.

2   One Button Nav vs Soft One Nav

The One Button Nav, introduced by Lenovo Motorola in their smartphones in 2017, completely replaces the typical Android navigation bar (back, home and recent apps), providing the same functionality on the fingerprint sensor of the smartphones, as seen in Table 1. As a result, navigation bar is not shown at the bottom of the screen and, consequently, there is an increase of the useful area of the display. Figure 1 shows a Moto G5 Plus, one of the first Lenovo Motorola devices to have a fingerprint sensor capable of recognize One Button Nav gestures.

Table 1. One Button Nav gestures.

Gesture	Function
Tap on the sensor	Go to home screen
Swipe from right to left on the sensor	Go back
Swipe from left to right on the sensor	Open recent apps
Touch and hold the sensor until a short buzz	Turn the screen off (lock the device)
Touch and hold the sensor until a long buzz	Launch Google assistant

Fig. 1. Moto G5 Plus with the fingerprint sensor highlighted.

Smartphones with large screen sizes are increasingly in the market and become the trend in different regions, as seen in the charts of Fig. 2 [5]. In North America, 44% of users have smartphones with diagonal size between 5.5 and 6", whereas in South America this number is lower, 32%. Asia has the highest number of users with large screen sizes, with 47% of users having a smartphone with screen size between 5.5 and 6". On the other hand, Europe has the lowest number, with 23% [5]. Following this trend, all smartphones released by Lenovo Motorola in 2018 had at least 5.34" of diagonal size. More specifically, Moto Z3 Play, which was the device object of this research, has 6" of screen size.
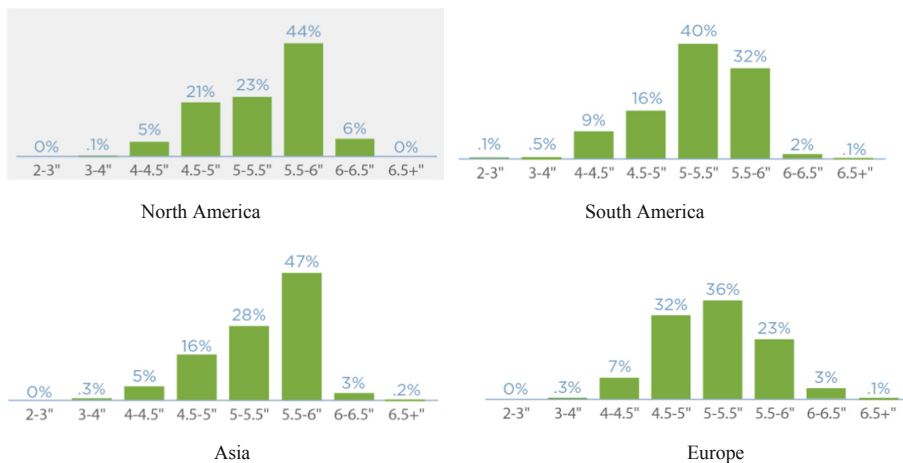

Fig. 2. Smartphone screen sizes in different regions [5].

In order to offer a larger the screen size to consumers, Moto Z3 Play and other smartphones from its generation moved the fingerprint sensor to the right edge of the device, as shown in Fig. 3, so that it became not natural to keep the One Button Nav gestures in the sensor to replace the Android navigation bar.

Fig. 3. Moto Z3 Play smartphone with fingerprint sensor to the right edge.

As many users of previous Lenovo Motorola devices would miss the ability to access the Android navigation bar functions through One Button Nav gestures, "Soft One Nav" was proposed. The "Soft One Nav" is an on-screen, pill-shaped button, placed at the bottom of the screen, which provides the same functions of the original One Button Nav. Although "Soft One Nav" is not exactly the same as the original One Button Nav, which works with the fingerprint sensor, due to marketing decisions, the same name was kept to the consumers (One Button Navigation). Figure 4 shows the onboarding screens of the two versions whereas Fig. 5 shows some screenshots of Moto Z3 Play with the "Soft One Nav" and the Android navigation bar. As seen in Fig. 5, the pill-shaped button of "Soft One Nav" is a very discreet element in the screen and a little bit smaller than the Android navigation bar. In other words, although it is on screen as Android navigation bar, "Soft One Nav" allow users to see more content on screen as it is smaller.
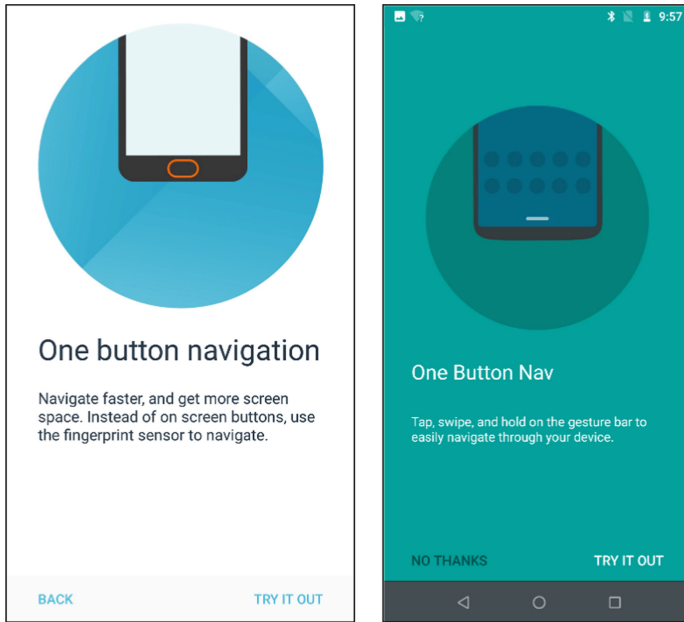
Fig. 4. Onboarding screens of One Nav 1.0 (based on fingerprint sensor) and "Soft One Nav".

**Fig. 5.** "Soft One Nav" and Android navigation bar in Moto Z3 Play.

Table 2 presents all functions available on the "Soft One Nav". Compared to the previous gestures and functions of the original One Button Nav (as shown in Table 1), the only change was with the touch and hold until a short buzz to lock the device.

Given that there were complaints about falsings (some users did this by mistake and ended up having to unlock the device again to continue using it), the decision was to remove it from "Soft One Nav".

Table 2. "Sotf One Nav" gestures.

Gesture	Function
Tap on the software button	Go to home screen
Swipe from right to left on the software button	Go back
Swipe from left to right on the software button	Open recent apps
Touch and hold the software button until a short buzz	*Turn off screen - Removed*
Touch and hold the software button until a long buzz	Launch Google assistant

Not only Lenovo Motorola adopted a solution to replace the default Android navigation bar. Even Google proposed a solution in Android 9.0 (Pie), as seen in Fig. 6. Technical media articles compared these solutions [6] and stated that Lenovo Motorola delivers a better user experience.
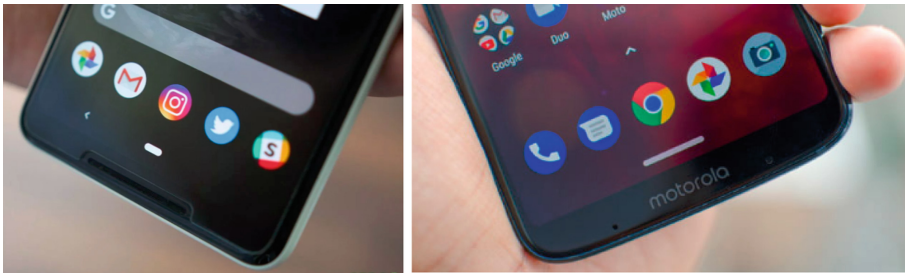
Android Pie gesture navigation   One Button Nav (Lenovo Motorola)

Fig. 6. Android Pie gesture navigation and One Button Nav.

3   Remote Evaluation of User Experience

To evaluate this new version of One Button Nav ("Soft One Nav"), 252 participants from all over the world were recruited and remotely monitored between March and June/2018. In order to test the One Button Nav, all participants received a Moto Z3 with Android O. In addition, a pre-installed tool in the smartphones allowed the participants to report issues, describing what they were doing when an issue occurred and attaching screenshots if they found it useful. By default, One Button Nav was disabled, but participants were asked to enable it and give all feedbacks by using this pre-installed tool or reporting in an online, internal forum, which allowed them to interact with other participants. Furthermore, during the evaluation period, four user satisfaction surveys were applied to rate agreement/disagreement with some user experience statements using a Likert Scale [7].

Internal forum was used most of the times for positive feedback, announcements or to confirm with other users if they are seeing same behaviors or problems in daily use, like seen in Fig. 7.
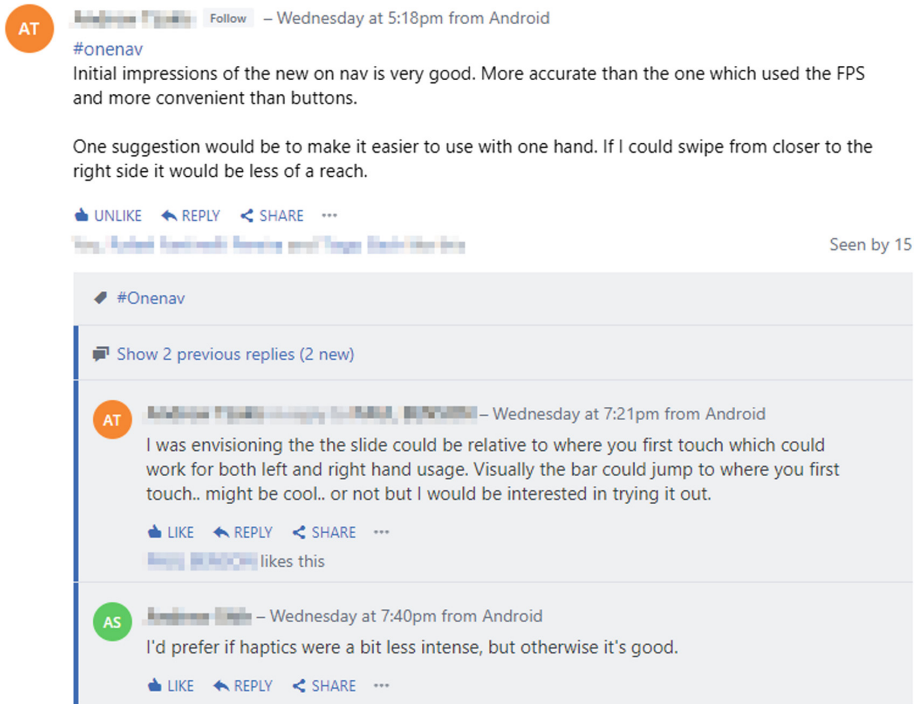

Fig. 7. Internal forum to share issues and feedback about the One Button Nav with other participants.

In total, 40 issues were manually raised by the participants. The distribution of the raised issues through the evaluation period and also how they were classified can be shown in Figs. 8 and 9. The classification of the issues and details about them can be seen in Table 3.
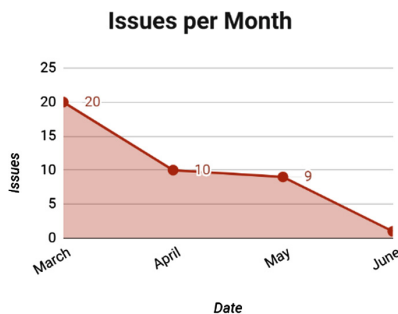

Fig. 8. Issues raised during the evaluation period distributed by months.
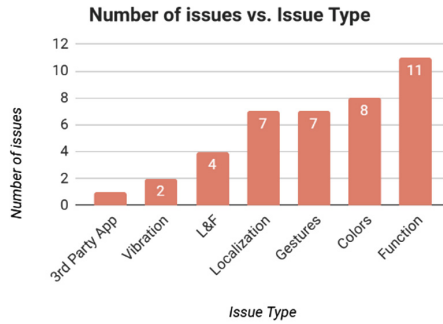
Number of issues vs. Issue Type

Fig. 9. Issues raised during evaluation period according to pre-defined classification.

Table 3. Classification of the issues.

Issue type	Description
3rd party app	Issue related to the usage of One Button Nav with another (3rd party) app. The responsible of the 3rd party app was notified about the issue to work on a fix
Vibration	Two issues were related to a misunderstanding of using Android vibration configuration and One Button Nav
Look and feel (L&F)	Issues related to objects not properly aligned
Localization	Most of them were related to some sentences not translated
Gestures	When some of the gestures were not working properly. Also regarding gesture to turn off screen, which users also complained about this removal
Colors	Issues related to color contrast and color combination
Function	Performance issues; although 5 of them here were related to a specific software build in which One Button Nav stopped working

Compared to the user experience evaluation done for the first version of One Button Nav, the amount of issues decreased, as shown in Fig. 10, although the number of participants were not the same: for the first version, there were 115 participants whereas, for the "Soft One Nav" evaluation, there were 252 participants.
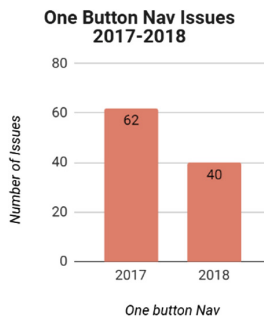
One Button Nav Issues 2017-2018

Fig. 10. Amount of issues of One Button Nav in 2017 (first version) and 2018 (new version, "Soft One Nav").

After the development team analyzed all the issues manually raised by the participants, this number decreased to 10 unique, valid issues – from all issues, 57.5% were duplicated, 22.5% were fixed, 12.5% considered as working as designed, 2.5% cancelled by the development team, 2.5% were invalid and 2.5% were not resolved. Figures 11 and 12 show some charts summarizing how the issues were handled by the development team.
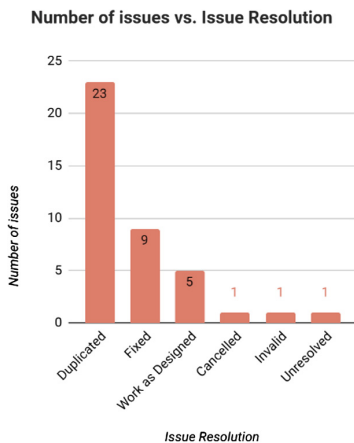

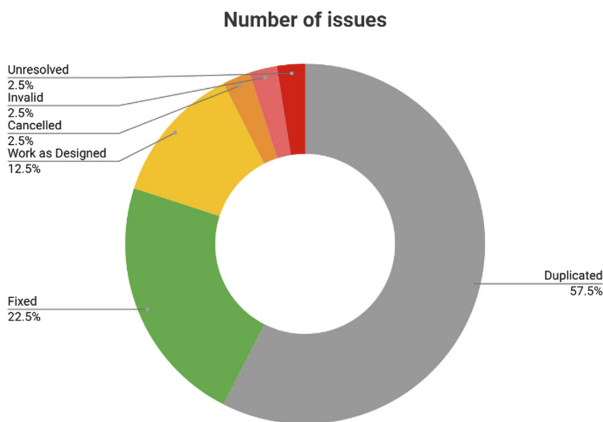**Fig. 11.** One Button Nav issues resolution.

Fig. 12. One Button Nav issues resolution (distribution).

The usage of One Button Nav gestures were tracked over the time and, as seen in Fig. 13, it increased during the weeks. In the first week, 8.7% of the participants used One Button Nav whereas, in the last week, almost 32% of the participants used it. In the previous study of the first version of One Button Nav, less than 24% of the participants were effectively using the feature at the end of the evaluation period [4].

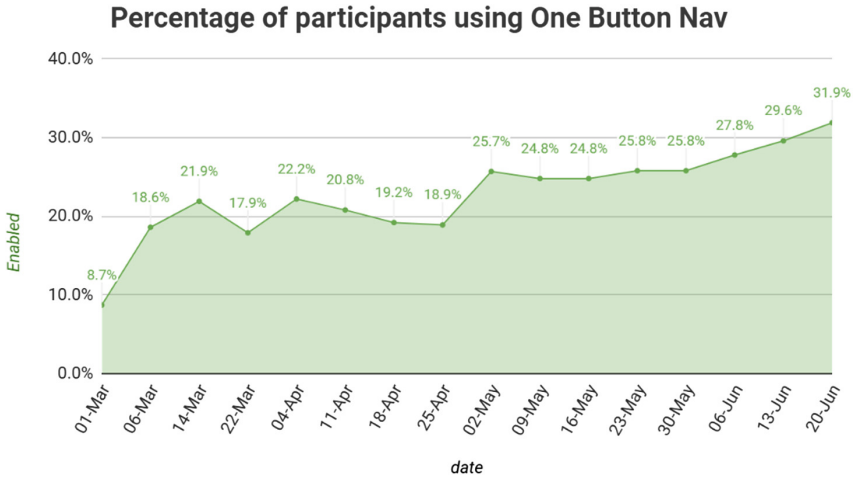**Percentage of participants using One Button Nav**

Fig. 13. One Button Nav Usage by week.

During this study, four user satisfaction surveys were applied. The surveys were composed by Likert Scale [7] questions to rate agreement/disagreement with some statements about the One Button Nav user experience. The first survey collected only 60 responses from distinct participants whereas in the last one 159 participants answered. The surveys were applied when the users changed their devices to newer ones containing hardware changes and when a new software version containing One Button Nav improvements was available to the users. Figure 14 shows the number of participants in each survey.
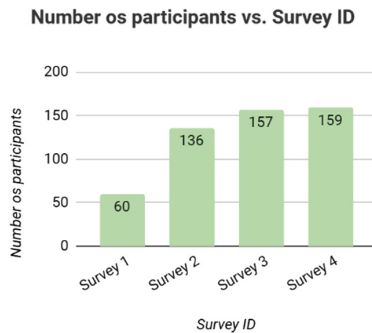

Fig. 14. Number of participants in each survey.

As previously mentioned, from Moto Z2 Play to Moto Z3 Play, the fingerprint sensor moved from the bottom of the screen to the right edge of the device. Also, One Button Nav was moved from the fingerprint sensor to a "software" button pill drawn at

the bottom of the screen. Considering these hardware changes, a comparison between the two devices was made to evaluate overall satisfaction with the fingerprint sensor. For Moto Z2 Play survey, 73 responses were collected whereas for Moto Z3 Play 159 responses were collected. The results from the surveys showed that the fingerprint location at the right edge was not rated as positively as at the bottom of the screen, as seen in Fig. 15.
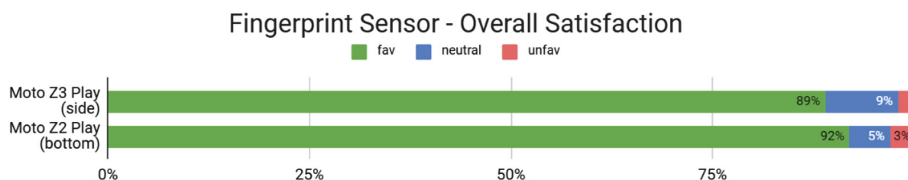

Fig. 15. Overall satisfaction with the Fingerprint sensor.

In addition, One Button Nav was also evaluated in these surveys, as shown in Table 4 and Fig. 16. Overall, there was a more positive response for the newer version of One Button Nav ("Soft One Nav") than for the previous version based on the fingerprint sensor.

Table 4. Overall satisfaction with One Button Nav.

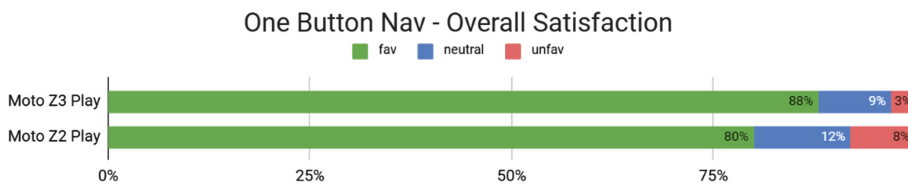| Version	Fav	Neutral	Unfav
"Soft One Nav" (Moto Z3 Play)	88%	9%	3%
One Button Nav 1.0 (Moto Z2 Play)	80%	12%	8%

Fig. 16. Overall satisfaction with One Button Nav in Moto Z3 Play ("Soft One Nav") and in Moto Z2 Play (One Button Nav 1.0).

From the first study [4] to the new one, the questions in the surveys were updated according to the changes in One Button Nav. The updated questions are presented in Table 5.

Table 5. Survey questions for the new version of One Button Nav.

Question ID	Question
Q.0	Overall how satisfied are you with the Gesture navigation performance of your device?
Q.1	How frequently did you experience issues with Gesture navigation Performance?
Q.2	I prefer to use Gesture Navigation as opposed to using Touch Screen Buttons (TSB soft keys include back, home and recently activity)
Q.3	I experience issues tapping to go home when that is my intent
Q.4	I experience issues swiping left to go back when that is my intent
Q.5	I experience issues swiping right to go to recent activity when that is my intent
Q.6	I experience issues with the long hold to launch Google Assistant when that is my intent
Q.7	I experience issues with the haptics used for Gesture Navigation

Table 6 presents the results from the applied surveys and the charts in Figs. 17 and 18 present the specific results from the first and the last survey. The evolution of favorable responses during the surveys is also shown in Fig. 19.

Table 6. Survey questions for the new version of One Button Nav.

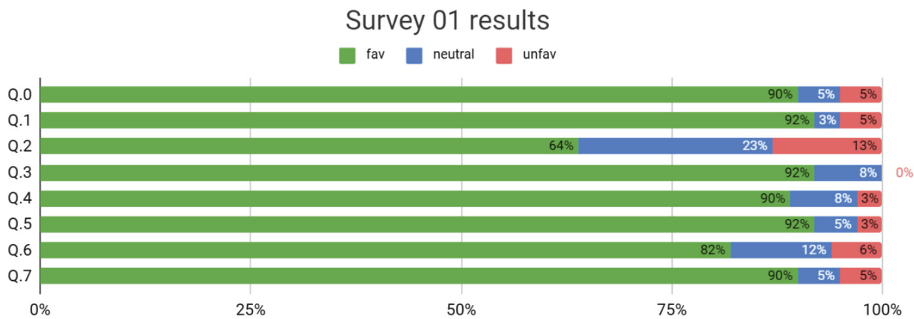|	Survey 01			Survey 02			Survey 03			Survey 04		
	fav	neutral	unfav	fav	neutral	unfav	fav	neutral	unfav	fav	neutral	unfav
Q.0	90%	5%	5%	88%	9%	6%	88%	9%	3%	88%	9%	3%
Q.1	92%	3%	5%	93%	4%	4%	93%	5%	2%	90%	6%	3%
Q.2	64%	23%	13%	86%	2%	13%	71%	14%	16%	82%	9%	9%
Q.3	92%	8%	0%	84%	11%	6%	90%	6%	3%	93%	6%	1%
Q.4	90%	8%	3%	89%	7%	4%	92%	5%	3%	88%	9%	3%
Q.5	92%	5%	3%	93%	6%	2%	92%	5%	3%	93%	6%	1%
Q.6	82%	12%	6%	76%	18%	7%	91%	8%	1%	92%	8%	0%
Q.7	90%	5%	5%	89%	6%	6%	96%	3%	1%	96%	5%	0%

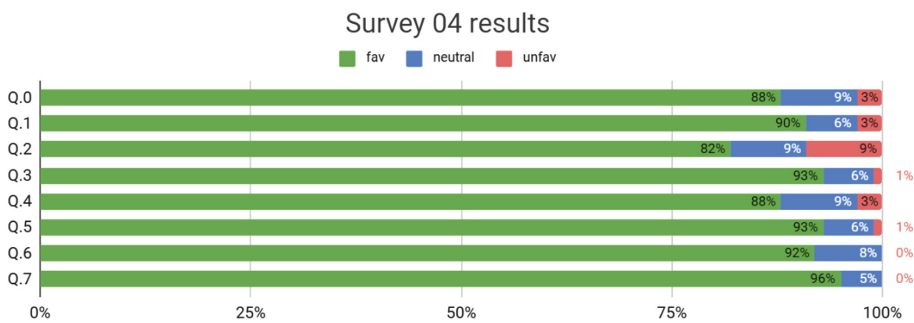**Fig. 17.** Results of the first survey (01).

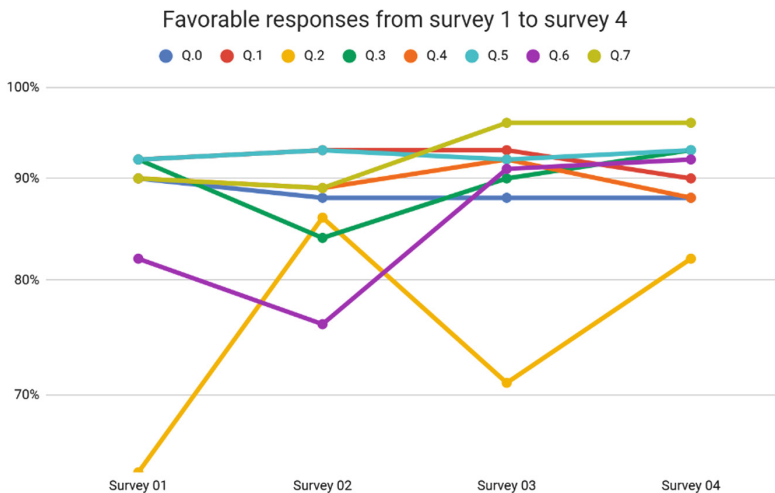**Fig. 18.** Results of the last survey (04).

Fig. 19. Evolution of the favorable responses during the surveys.

All questions had at least 82% of favorable responses in the last Survey. Thus, checking all the gestures in "Soft One Nav", all of them got more than this value and were considered better than the results from the first study with the One Button Nav 1.0 [4]. Moreover, data collected from the last week of the evaluation period showed that accuracy to recognize fingerprint also improved decreasing percentage of failed attempts from 13.66% to 5.76%, as seen in Table 7.

Table 7. Fingerprint failed attempts (%).

Product	Failed (%)	Failed (times)	Attempts (times)
"Soft One Nav" (Moto Z3 Play)	5.76	335	5811
One Button Nav 1.0 (Moto Z2 Play)	13.66	1382	10118

A key point in the user evaluation performed was whether participants would complain about losing screen area, as the previous version of One Button Navigation completely removed the Android navigation bar and did not include anything else at the bottom of the screen. Although "Soft One Nav" is smaller than Android navigation bar, it occupies a space at the bottom of the screen as seen in Fig. 20. However, few users complained about the space used by "Soft One Nav", according to the feedback provided in user satisfaction surveys. Additionally, for most of the users, the gestures were considered easy and preferable than Android navigation bar.
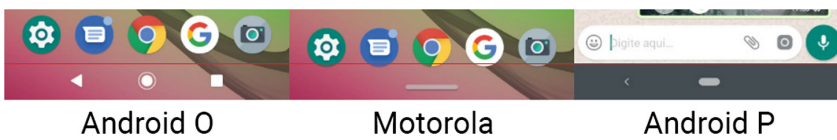

Fig. 20. Navigation comparison among Android navigation bar (Android O), One Button Navigation from Motorola and Android gesture navigation (Android P).

4 Concluding Remarks

This paper presented a new version of the One Button Navigation, a feature which allow users to perform gestures in an, on screen, pill-shaped button and has been shipped in some of the Lenovo Motorola smartphones since mid-2018. One Button Navigation offers the same functionalities of the ordinary Android navigation bar (go back, go to home screen and open recent apps), but using smaller space on screen and having a more modern look and feel. The One Button Navigation version presented and evaluated in this paper is actually the second generation of the feature, as the first version, introduced in some of the 2017 smartphones by Lenovo Motorola, relied on the fingerprint sensor.

The user evaluation performed showed very positive results, indicating high user satisfaction. Moreover, comparing to the first One Button Navigation version, the

favorable responses were even higher. This kind of evaluation was incredibly valuable to assess the feature before hitting the market, making the stakeholders confident about its usability and utility to the users.

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