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Tap or Swipe? Effects of Interaction Gestures for Retrieval of Match Statistics via Second Screen on Watching Soccer on TV

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Accessing match statistics through second screen while watching soccer matches on TV has grown into a popular practice. Although early works have shown how gestures on touch screens performed under distracting environments, little is known regarding how specific gestures (swiping and tapping) to retrieve information on second screen affect the viewing experience of soccer games on TV. For this, a mixed-method user study, which included prototype tests of watching short clips of a soccer match, questionnaires and short interviews, was conducted with 28 participants. The results revealed that the number of people who preferred tapping was more than the number of people who favored swiping under two different second screen activity time scenarios i.e. On-Play or Off-Play. However, neither swiping nor tapping yield better performance of recalling verbatim match stats and exact comparisons in both On-Play and Off-Play. Participant evaluations in On-Play and interviews give us clues regarding such difference.

CCS CONCEPTS • **Human-centered computing~Human computer interaction (HCI)~Interaction techniques~Gestural input • Information systems~Information retrieval~Users and interactive retrieval • Human-centered computing~Interaction design~Interaction design process and methods~Scenario-based design**

Additional Keywords and Phrases: Soccer, second screen, tapping, swiping, TV, interaction, user experience, touchscreen gesture.

1 INTRODUCTION

Use of a second screen while watching soccer matches on TV has been popular [1] [16] [20] [23]. One of the most seen acts in this regard is accessing match-related statistics on second screen [20]. However, the literature pertaining to effects of gestures in second screen interaction for the retrieval of in-game statistics on the watching experience of soccer matches on TV lacks depth although such type of consumption occurs via a plethora of apps. It is important to investigate gestures because, first, seamless interaction on second screen is key for TV watching experience regardless of the type of content [7]. Secondly, soccer audience, especially fans, do not tolerate when their attention is driven away from TV [10]. Besides, they want to access information as quickly as possible to avoid missing important moments in matches [20].

Information retrieval on second screen is dependent on gestural interaction. Tapping has been frequently used on numerous mobile websites and apps such as *Livescore.com* to access match statistics; however, it requires certain level of

concentration that may be distracting. On the other hand, there are other type of gestures such as swiping that could require less eye focus [4]. Additionally, swiping has been used in a few popular mobile apps such as *Snapchat* and *Tinder*, and it was reviewed as a casual way of interaction in earlier research.

A group of early work focused on different interaction gestures and their intrinsic nature on why people prefer one over others [8] [11] [24] [25] [26]. Tapping was found most used for a variety of tasks and swiping was rated as casual and less accident prone [8] [24] [25]. Additionally, several gestures were tested against each other in distracting environments in different studies and they found different gestures work better for specialized tasks [2] [14] [17] [22]. Furthermore, some studies focus on a variety of aspects of second screen interaction such as automated information update on second screen and participant engagement to TV programs via second screen [3] [4] [5] [6] [12] [13] [21]. They highlighted a positive tendency towards such aforementioned aspects of second screen interaction [3] [4] [5] [6] [12] [13] [21].

In the light of our observations and literature, we wonder whether swiping as a casual fashion for retrieval of match statistics through second screen while watching soccer matches on TV might improve the watching experience [1] [18]. Thus, we investigated the following question: How do interaction gestures of tapping and swiping for information retrieval through second screen shape the audience viewing experience of soccer games on TV?

2 METHODOLOGY

2.1 Experiment Design

We performed prototype tests with 28 participants (AA: 30.9, SD: 10.2) in lab setting. For the tests, we asked them to watch two different 2.5-minute-long video segments of a particular soccer match and interact with a second screen prototype to access match-related information on the prototype. Specifically, they interacted with the prototype only by swiping in one video and tapping in another to access the information (Figure 1 & 2). Moreover, half of them watched the videos and performed interaction whilst they were watching the videos (On-Play) whereas the other half did the same after they had watched them (Off-Play). Besides, the menus were different in Figure 1 and 2 because tapping is more related with selection among visible options whereas swiping is more relevant to accessing different dimensions [15]. Furthermore, the information on the screens and the links were displayed through an app on a smartphone (Figure 1 & 2).

2.2 Data Collection

After watching each video and interacting with the prototype, we asked the participants to fill out a questionnaire. Via the questionnaires, we asked participants to answer whether they remember particular details of match-related information. Also, we asked them to evaluate each gesture in terms of ease in application, understandability, learnability, quickness and level of distraction from TV since such aspects are related user experience goals [19]. Additionally, we wanted to know whether the gesture for information retrieval via second screen helped to enhance their watching experience. Besides, after completion of questionnaires, we conducted mini-interviews with participants for further elaboration of their evaluation of each gesture.

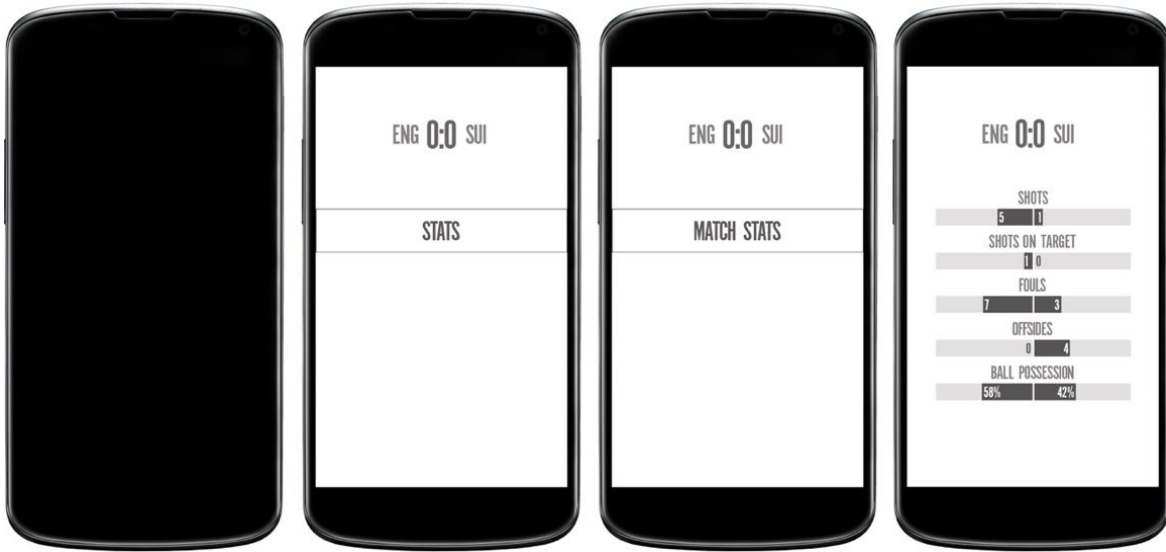


Figure 1: (From left to right) Menu screen order for accessing match statistics on the second screen prototype by swiping.

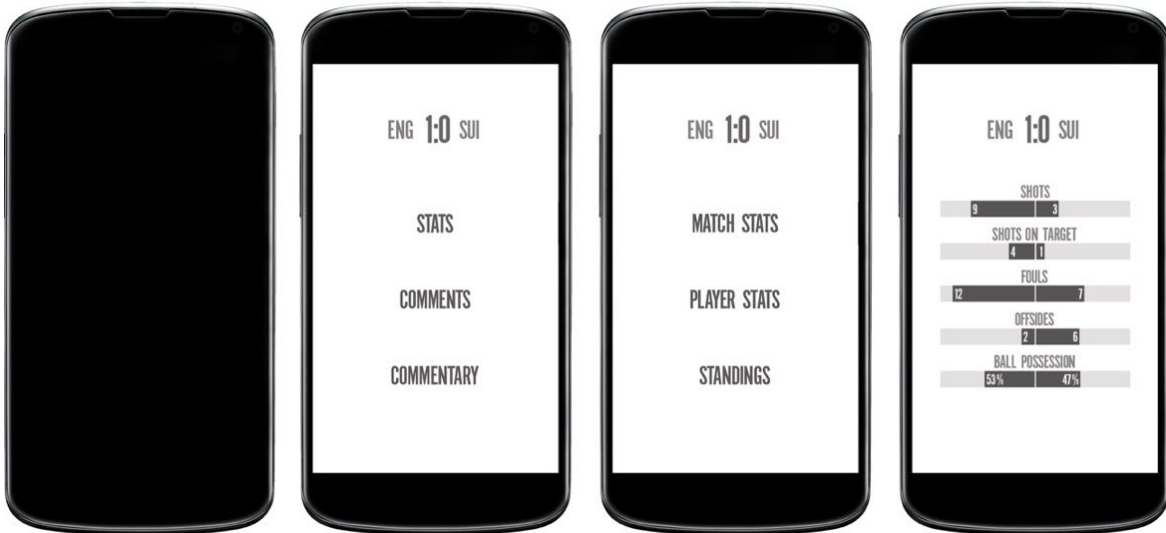


Figure 2: (From left to right) Menu screen order for accessing match statistics on the second screen prototype by tapping.

3 FINDINGS

In this section, we provide details of findings from prototype experiments. Additionally, we conduct an analysis of the findings and highlight the trends and patterns within them.

3.1 Recalling Verbatim Match Statistics

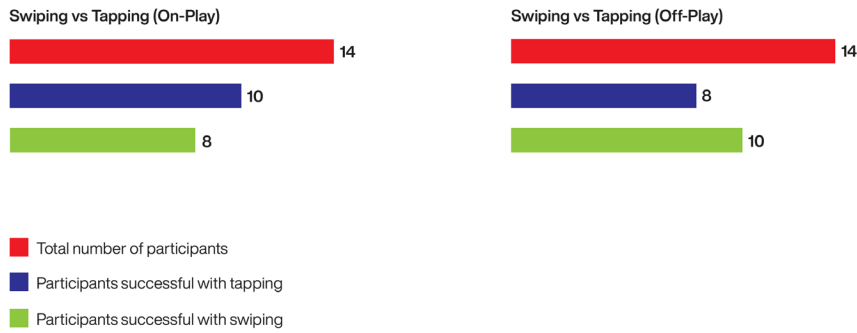


Figure 3: The distribution of participant success of recalling verbatim match statistics in two different prototype tests.

Compared to swiping, participants have a slightly better recollection of verbatim match statistics with tapping for the scenario of interaction during watching (On-Play). However, the opposite is true for the other scenario (Off-Play).

3.2 Recalling Comparison of Match Statistics

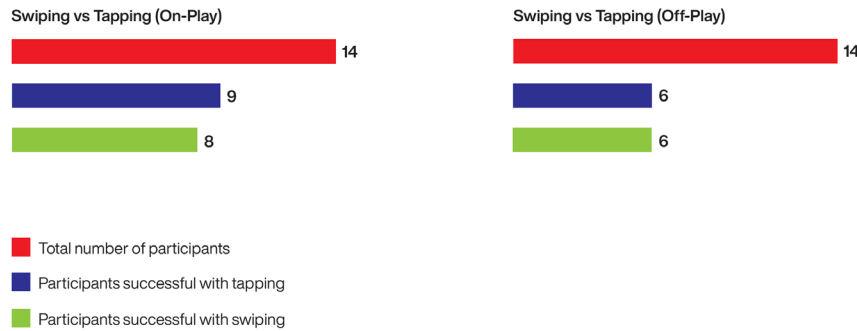


Figure 4: The distribution of participant success of recalling comparison of match statistics in two different prototype tests.

With tapping, participants seem to remember match statistics for comparison better than swiping in On-Play whereas neither gesture made any difference in this respect in Off-Play scenario. Although the participant recalling performances under each gesture has slight differences (Figure 3 & 4), they are not statistically significant via McNemar tests (A.1, A.2).

3.3 Participant Evaluation of Swiping and Tapping

Participants rated tapping higher than swiping in ease in application, understandability, learnability, quickness and level of distraction from TV in On-Play and Off-Play; however, such differences were statistically significant only for ease in application, understandability and quickness in On-Play based on Wilcoxon Signed-Ranks tests (A.3).

3.4 Preference of Gestures



Figure 5: The distribution of participants and their preferred interaction gesture in the experiments of swiping vs tapping.

In both scenarios (On-Play & Off-Play), participants favored tapping over swiping and the difference in this respect is more dramatic for On-Play.

3.5 Analysis of Findings

We analyze the results through interviews and participant video recordings.

3.5.1 Convenience of Tapping

Participants generally preferred tapping over swiping in both experiments, overwhelmingly in On-Play. The reason may have to do with significantly better ratings of tapping compared to the ratings of swiping in ease in application, understandability and quickness in On-Play. Even 6 of 13 who chose tapping mentioned quickness as their liking for this gesture. In fact, when we observed the video recordings of participants, we recognized that 11 of 14 participants in On-Play experiments reached the match statistics in 6 or less seconds with tapping. However, this changed dramatically for swiping that only 2 of 14 participants in the same experiment accessed the statistics in 6 or less seconds with swiping.

Certain themes that we derived from the interviews helped use more in this regard. For instance, 4 of 13 participants who preferred tapping declared that their like for tapping was its intuitiveness. All participants who highlighted quickness implied that tapping caused less distraction. However, there are clues that tapping might not be the ideal in this sense. For example, P7 who preferred tapping stressed that although tapping was less distracting, the level of distraction that it caused was still high for him. P11's comment on tapping could explain P7's complaint on distraction that according to him tapping allows access to more options but requires more concentration. Tapping might be quicker; however, as P4 and P12 said, it may be more accident-prone and need more focus. Control, the feeling that 3 participants received through tapping could be another reason why tapping was favored more.

Compared to swiping, tapping's level of accident-proneness seems to be higher; however, its nature of being swifter in application, its higher level of intuitiveness and the feeling of control with this gesture might offset the need for more eye focus for tapping on second screen. As a result, tapping might create a more seamless interaction than swiping; hence, people might get less frustrated to retrieve information through tapping, and such seamless interaction might cause them to lose their focus on the information and the game less likely. Therefore, it may lead them to prefer tapping considerably more than swiping. Furthermore, such seamless interaction might play a role in improving the recollection of both verbatim match statistics and comparison of them through tapping in situations that the level of cognitive load on viewers is higher; however, caution must be applied in this regard since participants' recalling performances in tapping and their likes for tapping do not yield a positive correlation. For instance, none of the 4 people who preferred tapping and liked it due to its intuitiveness nor the 6 participants who preferred tapping and liked it due to its quickness had a perfect record of recalling match statistics with tapping.

3.5.2 Usefulness of Swiping in Off-Play

Unlike the On-Play experiment, tapping did not result in better performance of recalling verbatim or comparison match statistics than swiping in Off-Play experiment. Such a trend occurred even though the number of people who preferred tapping was still more than the number of people who preferred swiping. Nevertheless, the percentage of people (35%) who favored swiping in the Off-Play is bigger than that of participants (7%) who preferred it in the On-Play. Such a rise and the comments of swiping favorers on their choice of gesture might give us hint regarding why swiping was better against tapping in recalling verbatim match statistics and more people preferred swiping in Off-Play experiment. For instance, swiping seems to be intuitive and less distracting for 3 of 5 people who preferred it over tapping. The comments about the less distracting nature of swiping might sound odd since in Off-Play, viewers' focus is relatively more on second screen; however, people may still watch TV, e.g. pundits or other content related to the match, in the long breaks such as half-time or end of match; therefore, retrieval of match statistics on second screen might still require a way of reach that is not too distracting.

Quickness was highlighted by 3 of 5 people who chose swiping over tapping. This might be related to the menu design since participants saw only one option in every screen to reach the match statistics when they interacted with second screen with swiping. Moreover, swiping's nature of being less accident-prone might play a role in why people found it quick. Thus, they might feel that swiping was quicker than tapping although the application of it might be slightly slower than tapping as mentioned by a participant in On-Play experiment.

3.5.3 Ideal Interaction Gesture

Differences in cognitive load on participants between the On-Play and Off-Play experiments might be the main reason why participants who were content with their preferred interaction gesture had a lower ratio in On-Play experiment than Off-Play. In On-Play experiments, a higher number of participants highlighted different gestures for different tasks. For instance, P2 and P3, from the On-Play experiment, who preferred tapping over swiping, wanted the following as his ideal interaction mode. Another couple of participants, from the same experiment, who preferred tapping as well, wanted only single tap implying that the least number of interactions with menus was ideal for their second screen experience. Besides, we may consider the following statement of P4, who took part in the same experiment, as a valid explanation why such difference occurred across the experiments. Although he preferred tapping over swiping, he refused to tell his ideal gesture of interaction and stated what could be his ideal gesture for an Off-Play situation such as half-time break.

4 DISCUSSION

Given the previous research on gestures, we predicted swiping would yield better performance than tapping in recalling information, especially in On-Play, since it would require less focus on second screen to access match-related information. The reason why results are different than our expectation may be related with the fact that swiping from right to left on the screen delayed information retrieval for some participants. As a result, swiping might be seen as nuisance and distraction rather than convenience. In fact, many participants placed emphasis on the quickness of tapping and the observation videos unveiled that they were much quicker accessing the statistics through tapping.

Video recordings showed that several participants attempted to tap on the screen when they were supposed to swipe although we had instructed them to swipe prior to experiments. In this regard, restricting swiping-sensitive area on the screen might play a role that participants could have conceived it as a button to tap on; hence, participants' familiarity with tapping might have led them to forget their pre-experiment instructions. Altogether, frustration that arose due to aforementioned reasons might have caused why swiping was not better than tapping in the matter of recalling verbatim

statistics and comparisons of them and it was favored considerably less than tapping. Actually, the video recordings of participants confirmed that around half of the participants in the On-Play experiment had issues with swiping on the button and such a struggle might have frustrated and distracted them from the match and the information itself. Presuming that participants had all the screen area active to swipe, they might have had a better interaction experience. Therefore, they might also have had a better recalling performance.

Another interesting point was the relative rise in the number of people who chose swiping over tapping in the Off-Play experiment despite the fact that the same number of people (9) struggled with swiping in both On-Play and Off-Play experiments. We can associate this result with the experience of the participants. Some might have found that swiping allowed them to interact in a more casual way in a less distractive environment.

Surprisingly, the number of participants who failed to recall comparisons of match statistics under both gestures rose from 1 in On-Play to 5 in Off-Play and the ratio of overall success in recalling match statistics fell in Off-Play. Since cognitive load on participants is more in On-Play than Off-Play, we did not expect such outcome. The reason could be that the participants' act of information retrieval in On-Play might have created a better complementary watching experience for them compared to Off-Play situation. Therefore, such a supportive experience might have offset the detrimental effects of a higher cognitive load in On-Play. The reason why the interaction in On-Play might have created a better complementary experience could be related to the fact that all links and match statistics colored in grey had no meaningful connection with the clips. Such disconnection between second screen and TV in terms of color might have played a negative role in such complementary experience.

5 CONCLUSION

In this paper, we investigated how different gestures to access match stats on second screen shaped our watching experience of soccer matches on TV. The differences between the interaction gestures in both situations are not statistically significant. In addition, tapping was remarkably preferred by the majority of participants. Moreover, in few aspects, it was rated significantly better than swiping. Furthermore, tapping seemed to be favored due to quickness and intuitiveness whereas less distraction and less accident-proneness seemed to be reasons for people who preferred swiping.

Participants' evaluations of gestures were partially correlated with their preferences of gestures. Overall, tapping was always rated better than swiping in terms of ease in application, understandability, level of distraction from TV and quickness in On-Play and Off-Play. However, based on the test results, the differences in participant ratings significantly differed only for ease in application, understandability and quickness in On-Play.

Regarding tapping, we spotted easiness and intuitiveness as main likes whereas accident-proneness was the most popular dislike. We saw the likes above and control as the most common reasons among the same people who chosen tapping over swiping how tapping enhanced their watching experience. Additionally, we encountered most with less distracting nature as a reason from people who preferred swiping thought the gesture enhanced their experience; however, this was not a common like among their likes regarding swiping.

Further research can be testing combinations of gestures, testing gestures in authentic setting i.e. full match at home, a variety of comparisons e.g. home vs pub, level of socialization e.g. alone vs with friends, importance level of soccer match e.g. friendly vs competitive and long array of testing such as a tournament.

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A APPENDICES

A.1 McNemar Test Results for Participant Performance of Recalling Verbatim Match Statistics

On-Play: McNemar's chi-squared = 0.25, df = 1, p-value = 0.6171.

Off-Play: McNemar's chi-squared = 0.25, df = 1, p-value = 0.6171.

A.2 McNemar Test Results for Participant Performance of Recalling Comparison of Match Statistics

On-Play: McNemar's chi-squared = 0, df = 1, p-value = 1.

Off-Play: McNemar's chi-squared = 0, df = 1, p-value = 1.

A.3 Wilcoxon Signed-Ranks Test Results for Participant Evaluation of Interaction Gestures

A.3.1 Ease in Application

On-Play: Median=4.0, 4.0, W=3.5, Z=-2.3804, p=0.02734, r=0.4498533.

Off-Play: Median=4.5, 5.0, W=6.5, Z=-1.6956, p=0.125, r=0.3204383.

A.3.2 Understandability

On-Play: Median=4.0, 5.0, W=0, Z=-2.7739, p=0.007812, r=0.5242178.

Off-Play: Median=5.0, 5.0, W=2.5, Z=-1, p=0.625, r=0.1889822.

A.3.3 Learnability

On-Play: Median=4.0, 5.0, W=0, Z=-1.7321, p=0.25, r=0.3273361.

Off-Play: Median=5.0, 5.0, W=3.5, Z=-1.2963, p=0.3125, r=0.2449777.

A.3.4 Quickness

On-Play: Median=3.0, 4.0, W=0, Z=-2.9231, p=0.003906, r=0.552414.

Off-Play: Median=4.0, 5.0, W=7.5, Z=-1.8782, p=0.07031, r=0.3549464.

A.3.5 Level of Distraction from TV

On-Play: Median=2.0, 3.0, W=8, Z=-2.0386, p=0.0625, r=0.3852592.

Off-Play: Median=3.5, 4.0, W=11, Z=-1.559, p=0.1562, r=0.2946233.