

Generational Comparison of Simultaneous Internet Activities Using Smartphones and Computers

Andrea Rosales^(✉) and Mireia Fernández-Ardèvol

Internet Interdisciplinary Institute (IN3),
Universitat Oberta de Catalunya (UOC), Barcelona, Spain
{arosalescl,mfernandezar}@uoc.edu

Abstract. Computers and smartphones are multipurpose devices with overlapping capacities. Thus, users end up interacting with the same information through different devices, sometimes simultaneously (or within a short time-frame). As our artifact ecologies grow, it is clear that the use of multipurpose devices cannot be understood in isolation, and diverse uses are widely influenced by personal interests. However, personal interests change over a lifetime. Tracking the online smartphone and computer activities of 178 Spanish users aged 17 to 76, we make an intergenerational comparison of simultaneous activities on both devices. We demonstrate that simultaneous activities are common to people of all ages, tending to happen more during working hours. While age stereotypes say that older people are less active users of technologies, some are also engaged in simultaneous smartphone–computer use, evidence that they are making the most of the devices available to them.

Keywords: Smartphones · Computers · Multitasking · Synchronization · Generational approach

1 Introduction

With the emergence of diverse multipurpose digital devices, it has become clear that the use of one device cannot be understood fully in isolation, but rather as part of its device ecology (or artifact ecology [1]). Similarly, the use of one service (for example, email) cannot be understood fully by only looking at its use on one device; the focus should be on its distributed use across different devices. Moreover, communication and information activities should be understood as a complete structure of “communicative ecologies” [2].

The increasing complexity of device ecologies challenges the formation of new ideas on how different digital devices (we will refer to them simply as “devices”) can be used together to better support communicative ecologies. Some current features for supporting multiple device interaction include cloud computing, to allow content synchronization (e.g. Dropbox); setup synchronization of the same app in multiple devices (e.g. syncing a browser’s history, tabs and settings); or remotely controlling a second device (e.g. using “AllShare Play” to control audio and video content), among others.

Moreover, there are services available on a single device (free phone calls through the fixed line) and multiplatform services (e.g. email). There are single-service devices (e.g. cameras, ebooks or music players) and multipurpose devices (e.g. smartphones, tablets, PCs and smartwatches). Thus, diverse devices are combined in different ways according to personal choices. These combinations of device affordances and available services as well as interests influence how people interact with their device ecology. Research in the area of multiple device interaction includes spatially-aware interactions [3] or using smartphones to interact collaboratively with tablets [4] and using a toolkit to allow rapid setup of device ecologies [5]. However, there is a “need for interfaces, applications, and services that better support multi-device use” [6, p. 3903].

In these complex times of personal device ecology, communication, work and entertainment services are mediated through the same devices. While one can appreciate the pervasiveness of multipurpose devices, there is a tension between the boundaries separating work and private domains [7]. In this sense, time use is becoming less structured and more fragmented and overlapped [8]; however, these practices vary depending on age, occupation and interests, because personal values and interests change over the course of a lifetime [9].

While there is a wide variety of services to support multi-device interaction – either already on the market or currently under research – there are fewer studies focusing on how people actually interact with their device ecology (some exceptions include [6, 10]). Yet, understanding how individuals interact with their device ecology is key when it comes to designing Internet experiences that match individuals’ interests.

In this paper we focus on the simultaneous use of computers and smartphones, as they are the most popular multipurpose devices [11]. Specifically, our research questions are: When and how often does a sample of active Internet users in Spain make simultaneous use of their computers and smartphones? How does this use differ by age and sex?

Previous studies on how individuals interact with their device ecologies either do not involve older people or do not include age in their analysis of different behaviors [6, 10]. We take a generational approach [12] to understanding how age influences a person’s interaction with the device ecology. In addition, while previous studies have focused mostly on qualitative and self-reported data, we use a quantitative approach using activity logs in order to create a dialog between, on the one hand, previous research reporting declarative results collected by means of qualitative techniques and, on the other hand, (presumably) more objective information collected via log data tracking and behavioral data [13]. Thus, we tracked the Internet activities of 178 smartphone and computer users and quantified simultaneous activities on both devices. This combination of methods allows us to show emergent habits that have not been incorporated in the public discourse on the topic.

According to our analysis, simultaneous activities are common among people of all ages, and they tend to happen more during working hours. Results also show that there are no significant differences in simultaneous activities conducted by men and women, and there is no correlation between age and weighted simultaneous activities with respect to all user Internet activities. It shows that, despite ageist assumptions such as “older people are not interested in” or “are not avid users of”, there are in fact older people who are making the most of the devices available.

2 Related Work

Simultaneous activities are somewhat related to other concepts used in HCI research, including user multitasking [14] and multi-device use or combined use [6]. While Ames uses the concept of “multitasking” to refer to the use of smartphones while carrying out other activities [14], Jokela et al. use the term “multi-device use” to describe “all situations and tasks where users used multiple information devices together” [6, p. 3905]. Although in most cases it is not possible for humans to conduct two divergent activities at the same time, we will use the term “simultaneous activities” to refer to activities conducted on more than one multipurpose device at the same time or within a short timeframe.

Different forms of simultaneous activities have been described, including convergent and divergent activities [15], which is similar to the concept of related and unrelated use [6, 16]. Convergent activities refer to one main task comprising an arrangement of tasks conducted through different devices; for example: “Participants explained that their tablets can enhance the TV experience by extending that activity through, for example, looking up related information about the program that they were watching” [16, p. 6]. Divergent activities refer to different tasks conducted on different devices in a short period of time; for example: some users are “constantly switching their focus between the TV program and their (divergent) tablet activity” [16, p. 6].

According to the reports of participants in previous studies, simultaneous activities are not made fortuitously. Availability, affordances, costs as well as personal choices and opportunity usually account for their decision to combine the use of multiple devices. Thus, users “mixed and adapted existing functions to meet their own priorities” [17, p. 629].

It is possible that the two services required are not available to the user on their different devices. *I googled the phone number of my physiotherapist with the tablet and called with my phone* [6, p. 3907]. Sometimes is more comfortable, convenient or easy to use each device for certain services or situations. *I read email on the computer if I can. The keyboard is better, and there is multitasking. But it is good to know that those things can be done on the iPhone* [10, p. 453]. Due to the service price, users are inclined to use certain services and devices. *I use WhatsApp extensively, as I have a limited number of phone calls a month* [18]. Sometimes it is a personal choice in order to separate activities. *I have decided only to access Facebook from the iPhone. That’s because it used to distract me and take too much of my time. Now I have better control over that* [10, p. 453]. It is possible that the combination of two available devices provides the users with a better service. *My friend called me and asked me to the movies. I checked my calendar and information about the movie with my laptop while talking on the phone* [6, p. 3909]. *While watching TV, I checked the translation of a word with my phone, or While watching a movie on TV, I opened the IMDB page with my phone* [6, p. 3909].

However, most of the activities reported by participants in different studies [6, 18] include the combined use of the smartphone and TV, or phone calls and computers, amongst others. The combined use of other functions of the smartphone and the computer is reported less often, particularly when talking about divergent activities: “It is possible that the participants did not recognize many common situations as Parallel

Use of multiple devices, as the unrelated parallel tasks may not always be conscious” [6, p. 3909]. Divergent activities could be associated with an intrusion of private life in the work routine, and vice versa; engaging in personal chats while trying to write a paper could be a common case of divergent use. Thus, because they could be considered a negative behavior or because users are not conscious of divergent activities, individuals will tend not to include them in subjective reports. Thus, tracked data can help to identify simultaneous use of smartphone and computer activities.

3 Methods

We relied upon a market research panel focusing on the Spanish population to track the Internet activities of a set of already registered panelists (to whom we will refer simply as “panelists”) using smartphones and (laptop or desktop) computers. Panelists were active Internet users who, before starting the project, had been invited to join the panel precisely because of this active use. An app was installed on their computers and smartphones that allowed the panel members to track their Internet activities as well as receive non-monetary rewards for their participation in what were mainly surveys and tracking activities. Non-monetary rewards depended on participation in the different studies, accumulating points that could be exchanged for commercial products delivered to the home. The dataset corresponded to one month of activity between November 17 and December 16, 2014. The software registered 4 types of Internet activity: (1) computer website visits; (2) computer searches; (3) smartphone app accesses; and (4) smartphone website visits. Each time users conducted an Internet activity, the system registered the type of activity, the date and access time, session length and connection type (Wi-Fi or mobile data). Here there was one main difference between smartphone and computer activities. While the smartphone registered only one activity at a time, the one shown on the screen, the computer could register multiple activities at the same time, which corresponded to all the URLs open in the browser. For example if a panelist opened a fitness app in their smartphone (i.e. Endomondo) to track their running, the tracking software would count one access when they activated it and then log the length of the session until the panelist moved on to another app or their phone returned to the idle mode. However, on the computer, if a panelist opened their Facebook account it would keep counting them as being active until they closed it. In other words, due to the differences in their respective systems, smartphones have been understood as non-multitasking devices while computers have been tracked as multitasking devices.

The sample reflected the characteristics of active Internet users among the Spanish population [19]. The sample of smartphone and computer users included 178 panelists. There were 84 women (47.2 %) and 94 men (52.8 %) ranging from 17 to 76 years of age. We classified panelists in 5 age cohorts: individuals aged 17 to 24 (32 panelists, 18 % of the total sample); individuals aged 25 to 34 (43 panelists, 24 %); individuals aged 35 to 44 (41 panelists, 24 %); individuals aged 45 to 54 (35 panelists, 19 %); and individuals aged 55 to 76 (27 panelists, 15 %).

There were analytical challenges in lumping together different age cohorts of older people under a unique label [20, 21], but given the current limitations in the demographics of the Spanish online population, with older age cohorts being

underrepresented, the approach proposed here was more appropriate. In addition, there has been extensive debate on what it means to be old or who can be described as being old [22], so we used a quantitative approach as an indicator of a new social and physical context. Thus, we only built one group of older people, individuals 55 and over, since in Spain it is at this age that it is common to start experiencing the first advanced age-related social (e.g. retirement, ageism, widowhood) or health (e.g. physical and cognitive issues) changes. In this sense, people over 55 have special needs and interests that should be taking into account in the design of new ICTs.

3.1 Data Analysis

Within the dataset, we analyzed the emergence of simultaneous activity. Similar to Böhmer’s definition of an app chain [23], simultaneous activities are a sequence of Internet activities conducted on the computer and the smartphone. Such Internet activities could be related or not and are issued by a single user within a short time period. With the tracked data it was impossible to actually know if the user had been interacting actively with and/or watching the webpage or app the entire time that the webpage was open or the app active. Thus, similar to Carrascal, we used a delimiter measured in seconds to characterize when two Internet activities should have happened simultaneously or within a short period of time. While Carrascal used 30” as a delimiter [24], we adjusted the delimiter to the type of Internet activities conducted, namely desktop web session, desktop search session, mobile web session and mobile app session, because the length of activities in the 4 different types of Internet activity varied significantly. We explored three scenarios to define the delimiter to be used, including mean, truncated mean and median. Each scenario led to different simultaneous activities (see Table 1). We selected the second scenario, in order to have a moderated perspective. Moreover, this scenario used the truncated mean, the mean without outliers, which was particularly relevant in regard to desktop web sessions, as

Table 1. Scenarios to identify simultaneous activities

	Scenario 1	Scenario 2	Scenario 3
Activity indicators			
Activities	778,999	778,999	778,999
Simultaneous activities	39,705	21,376	12,838
%	5.10 %	2.74 %	1.59 %
Individuals with simultaneous activities	174	167	161
Criteria for defining scenarios			
	Mean	Truncated mean	Median
Web desktop delimiter	4’01”	1’22”	36”
Search desktop delimiter	30”	15”	10”
Web smartphone delimiter	39”	15”	0”
App smartphone delimiter	1’26”	25”	12”

people could leave email or social network sites open for up to 12 h, a timeframe that could not be considered as active.

Simultaneous activities included at least two activities, one on the smartphone and the other on the computer, separated according to the time delimiter of the first activity. Panelists could have used other devices during the tracking period, which we were not able to track or analyze. Consequently, this ratio of simultaneous device activities responds to the collected data, the definition we applied and the equation we used to calculate it. In this paper it has been used as an indicator of simultaneity and in order to make gender, hour and generational comparisons.

4 Results

Here we present a selection of descriptive statistics related to simultaneous activities, followed by their analysis according to gender, age and time of the day.

4.1 Frequency of Simultaneous Activities

Out of the 778,999 total Internet activities conducted by the 178 panelists, 21,376 (2.7 % of the total) were part of simultaneous activities. These 21,376 activities were distributed across 9,861 sessions, of which 8,474 included one device change, while the rest included up to 6 device changes. Of the sample of 178 panelists, 167 (93.8 %) conducted simultaneous activities. They conducted a mean of 4.8 simultaneous activities per day (see Table 2).

Table 2. Number of panelists by number of simultaneous activities

Number of panelists	Simultaneous activities during the tracked month	Simultaneous activities per day
11	0	0
23	2–8	0.14
27	9–29	0.63
25	30–59	1.41
30	60–99	2.78
42	100–299	5.79
20	>300	16.51
Total: 167	Mean: 145	Mean: 4.8

Eleven panelists did not conduct simultaneous activities in the tracked devices during the analyzed period. Five were women and six were men aged 28 to 71, and they typically showed a low level of Internet activity on one or both of their devices, that is, below the mean for smartphone activities ($M = 116.06$, $SD = 94.78$), computer activities ($M = 29.82$, $SD = 98.30$) or both.

While we cannot assume any causality direction between simultaneous activities and Internet activities, we proved a one-tailed Pearson correlation between the two variables. According to the Pearson correlation, the greater the use of the Internet, the greater the number of simultaneous activities, and vice versa, and therefore there is a correlation between the number of simultaneous activities ($M = 4.003$, $SD = 5.61$) and Internet accesses (145.88 Internet accesses per person, per day, $SD = 98.30$), $r(159) = 0.680$, $p < 0.001$. This is also true within each age cohort; 18 to 24 ($r(24) = 0.569$, $p < 0.000$), 25 to 34 ($r(36) = 0.736$, $p < 0.000$), 35 to 44 ($r(39) = 0.808$, $p < 0.000$), 45 to 54 ($r(33) = 0.640$, $p < 0.000$), and 55 to x ($r(27) = 0.549$, $p < 0.005$) (Fig. 1).

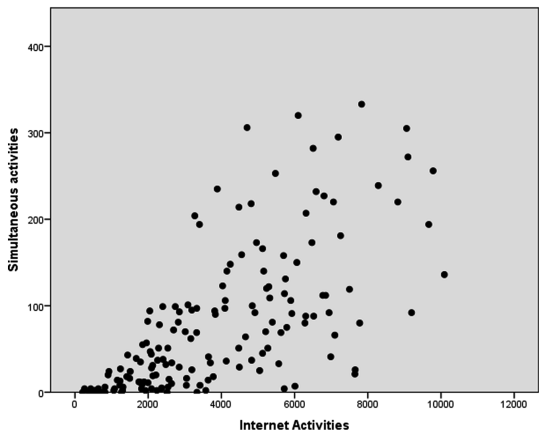


Fig. 1. Simultaneous activities out of all Internet activities by user

4.2 Simultaneous Activities by Gender

There are no significant differences in the amount of Internet activities conducted by men and women ($p\text{-value} = 0.982 > 0.05$). Similarly, there are no significant differences in the amount of simultaneous activities conducted by men and women ($p\text{-value} = 0.636 > 0.05$). Consequently, there are no significant differences in the percentage of simultaneous activities from daily activities by gender ($p\text{-value} = 0.686 > 0.05$), which represents weighted simultaneity according to the level of each panelist's Internet activity (see Table 3).

Table 3. Mean daily activities by gender. Comparing daily activities by gender, including simultaneous, non-simultaneous and total activities and the percentage of simultaneous activities out of total activities. The $p\text{-value}$ refers to the one-way ANOVA, comparing the data for females and males.

Mean daily activities	Female	Male	p-value	Total
All internet activities	146.05	145.73	0.982	145.88
Non-simultaneous activities	141.84	141.91	0.996	141.87
Simultaneous activities	4.21	3.81	0.636	4.003
% of simultaneous activities out of total daily activities	2.8	2.6	0.686	2.7

4.3 Generational Comparison

Age and mean daily simultaneous activities are negatively correlated ($r = -0.215$, $p < 0.01$, $n = 178$); similarly, age and mean daily non-simultaneous activities are negatively correlated ($r = -0.239$, $p < 0.01$, $n = 178$). The younger the panelists are, the more simultaneous and non-simultaneous activities they carry out, and vice versa. However, there is no correlation between age and the percentage of simultaneous activities from daily activities ($r = -0.147$, $p > 0.01$, $n = 178$), which represents weighted simultaneity according to the level of each panelist's Internet activity. Thus, we can conclude that the percentage of simultaneous activities from all Internet activities is not related to age. Breaking activities by age, significant differences can be seen in some cases (Table 4):

Table 4. Daily activities by age cohorts. Comparing daily activities by age cohort, including simultaneous, non-simultaneous and total activities and the percentage of simultaneous activities out of total activities. The p-value refers to the one-way ANOVA, comparing the data for females and males. * Significant at a 0.005 level.

Mean daily activities	17 to 24	25 to 34	35 to 44	45 to 55	55 to 76	p-value	Total
Total	193.81	146.27	141.56	143.71	97.82	0.006*	145.88
Non simultaneous activities	187.89	141.39	137.69	140.69	96.0	0.007*	141.87
Simultaneous activities	5.92	4.88	3.86	3.03	1.82	0.039*	4.00
% of Simultaneous activities from daily activities	3.15	3.45	2.80	2.15	1.89	0.251	2.70

- There are significant differences between mean daily simultaneous activities and age groups ($p\text{-value} = 0.039 < 0.05$). Yet there are two age groups that stand out: individuals aged 17 to 24, with the highest levels of simultaneous activities ($M = 5.91$, $SD = 5.52$); and individuals aged 55 to 76 ($M = 1.82$, $SD = 2.05$), with the lowest levels.
- There are significant differences between mean daily non-simultaneous activities and age groups ($p\text{-value} = 0.007 < 0.05$). However, there are only differences between individuals aged 17 to 24 ($M = 187.89$, $SD = 117.81$) and individuals aged 55 to 76 ($M = 96.00$, $SD = 68.55$). Again, more activity is observed among young users.
- However, there are no significant differences among the percentages of simultaneous activities out of total activities by age cohorts ($p\text{-value} = 0.251 > 0.05$).

4.4 When? Daily Distribution

Daily Internet activities (see total Table 5) are concentrated mostly during active hours (9 h to 24 h) with a considerable decrease late night/early morning (1 h to 8 h). However, simultaneous activities tend to cover typical office hours (9 h to 20 h), while non-simultaneous activities cover office and evening hours (11 h to 22 h) (see Table 5).

Table 5. Hourly percentage of simultaneous and non-simultaneous Internet activities. Each cell value refers to the percentage of simultaneous or non-simultaneous Internet activities by hour. Colors are normalized by row, with black indicating each category’s maximum and white indicating each category’s minimum percentage.

Time of day	6h	7h	8h	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h	24h	1h	2h	3h	4h	5h	Total
Total	0.7	1.9	3.0	4.1	4.8	5.5	5.9	6.2	5.8	6.1	5.8	5.8	6.2	6.4	6.4	6.0	5.8	4.9	3.9	2.0	1.1	0.6	0.5	0.6	100
Simultaneous	0.5	1.5	2.9	5.1	5.9	6.2	6.3	6.5	6.7	6.5	6.0	5.8	6.4	6.0	5.6	4.8	4.8	4.0	3.9	1.7	1.2	0.5	0.4	0.4	100
Non-simultaneous	0.7	1.9	3.0	4.1	4.8	5.4	5.9	6.1	5.8	6.1	5.8	5.8	6.2	6.4	6.4	6.0	5.8	4.9	3.9	2.0	1.1	0.6	0.5	0.5	100

There is little difference in the percentage of simultaneous activities by hour among age cohorts. Individuals aged 17 to 24 tend to start simultaneous activities later in the morning and stay active until later in the night (see Table 6).

Table 6. Hourly percentage of simultaneous Internet activities by age cohort. Each cell value refers to the percentage of simultaneous Internet activities by age cohort and hour. Colors are normalized by row, with black indicating each category’s maximum and white indicating each category’s minimum percentage.

	6h	7h	8h	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h	24h	1h	2h	3h	4h	5h	Total
16 to 24	0.5	1.6	2.2	3.0	4.2	5.2	6.0	6.3	6.2	6.4	5.6	5.3	5.9	6.3	6.2	6.1	5.8	5.6	5.1	2.9	1.9	1.0	0.5	0.4	100
25 to 34	0.9	1.8	2.8	4.1	4.4	5.4	5.7	6.2	5.8	5.7	5.7	5.9	6.5	6.8	6.4	5.5	5.6	5.4	4.2	2.3	1.1	0.7	0.6	0.6	100
35 to 44	0.7	2.0	3.2	4.9	5.5	5.9	6.3	6.1	5.7	6.3	6.3	6.2	6.6	6.3	6.2	6.5	6.0	4.0	2.6	1.1	0.4	0.3	0.3	0.5	100
45 to 54	0.9	2.5	3.8	4.6	4.9	5.5	5.3	6.1	5.8	6.3	5.8	6.0	6.2	6.2	6.6	6.0	5.3	4.4	3.4	1.6	1.0	0.6	0.5	0.7	100
55 to 76	0.6	1.6	3.3	4.1	5.7	5.2	6.1	6.2	5.6	5.6	5.9	5.9	5.7	6.2	6.5	5.9	6.6	5.3	4.0	1.4	0.7	0.7	0.5	0.5	100

5 Limitations

The sample included in the study is not representative of the entire Spanish population, as it only deals with the online Spanish population. In addition, panelists are active Internet users, a fact which under represents the older Spanish population. However,

due to a generational change and the widespread use of mobile devices, active older Internet users are a population segment on the rise with their own particular interests and habits. Thus, HCI should consider the particular interests of active older Internet users when designing future technologies with them in mind.

Moreover, the panelists in this study were all panelists of the market research tool used and common users of other market research tools, a fact that should be considered as a bias of the sample. In a future study, this data could be contrasted with real-life experiences reported by users in order to gain a better understanding of the topic.

6 Discussion, Conclusion and Implications

By tracking the Internet activities of a set of 178 panelists aged 17 to 76, we were able to present a generational study of simultaneous activities, namely Internet activities conducted on smartphones and computers within a short period of time (one month). Specifically, we described when and how often these individuals made simultaneous use of computers and smartphones and how this use was different according to age and sex.

While previous studies have focused mostly on disaggregated use of computers and smartphones [14] or other combinations of multi-device use [6], we have shown that simultaneous activities using smartphones and computers are common for panelists of all ages, as 93 % of participants were involved in simultaneous activities. We have also shown that there are no differences in the percentage of simultaneous activities out of total activities by gender or age. In addition, simultaneous activities were found to be concentrated mostly during central working hours, from 11 h to 16 h.

By means of simple descriptive indicators, we were able to demonstrate the richness of the data and the nuances brought about by each indicator. We would highlight that, while common age stereotypes depict older people as less avid users of technologies, with many HCI studies portraying them accordingly [18], there are also older people who engage in simultaneous use of smartphones and computers, which shows how some older people are making the most of the devices available to them. Results show that, regardless of the level of Internet activity, simultaneous activity practices have the same relative importance at any age.

Moreover, simultaneous activities are a part of everyday life. Therefore, providing better support for this transition among different devices will be a key factor in supporting divergent and convergent activities in devices commonly used simultaneously. Future research could include an analysis of the most popular categories of apps or websites used during simultaneous activities to characterize the activities related with simultaneous use of multipurpose devices.

References

1. Jung, H., Stolterman, E., Ryan, W., Thompson, T., Siegel, M.M.: Toward a framework for ecologies of artifacts: how are digital artifacts interconnected within a personal life? In: Proceedings of the 5th Nordic Conference on Human-Computer Interaction, pp. 201–210, Lund (2008)

2. Tacchi, J.A., Slater, D., Hearn, G.N.: *Ethnographic action research: a user's handbook*. New Delhi, India (2003)
3. Rädle, R., Jetter, H., Schreiner, M., Lu, Z., Reiterer, H., Rogers, Y., Raedle, R., Schreiner, M., De, H.R.: Spatially-aware or spatially-agnostic ? elicitation and evaluation of user-defined cross-device interactions. In: *Proceedings of CHI 2015*, pp. 3913–3922 (2015)
4. McAdam, C., Brewster, S.: Using mobile phones to interact with tabletop computers. In: *Proceedings of the ACM International Conference on Interactive Tabletops and Surfaces ITS*, vol. 11, pp. 232–241 (2011)
5. Bellucci, A., Aedo, I., Diaz, P.: ECCE toolkit: prototyping UbiComp device ecologies. In: *Proceedings of 2014 International Working Conference on Advanced Visualisation and Interfaces - AVI 2014*, pp. 339–340 (2014)
6. Jokela, T., Ojala, J., Olsson, T.: A diary study on combining multiple information devices in everyday activities and tasks. In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems - CHI 2015*, pp. 3903–3912, Seoul (2015)
7. Lowry, D., Moskos, M.: *Hanging on the Mobile Phone: Experiencing Work and Spatial Flexibility*. Working Paper Series, National Institute of Labour Studies, Flinders University, Australia, 153, 0–19 (2005)
8. Castells, S., Fernández-Ardèvol, M., Linchuan Qiu, J., Sey, A.: *Mobile Communication and Society: A Global Perspective*. MIT Press, Cambridge (2006)
9. Neugarten, B.L., Neugarten, D.A.: *The Meanings of Age: Selected Papers of Berenice L. Neugarten*. University of Chicago Press, Chicago (1996)
10. Bødker, S., Klokmoose, C.N.: Dynamics in artifact ecologies. In: *Proceedings of the 7th Nordic Conference on Human-Computer Interaction Making Sense Through Design*, pp. 448–457 (2012)
11. Clarke, J., Montesinos, M., Montanera, R., Bermúdez, A.: *Estudio Mobile*. Interactive Advertising Bureau - Spain. Retrieved December 8, 2015. <http://www.iabspain.net/wp-content/uploads/downloads/2015/09/Estudio-Mobile-2015.pdf>
12. Loos, E., Haddon, L., Mante-Meijer, E. (eds.): *Generational Use of New Media*. Ashgate, Burlington (2012)
13. Möller, A., Kranz, M., Schmid, B., Roalter, L., Diewald, S.: Investigating self-reporting behavior in long-term studies. In: *Proceedings of SIGCHI Conference on Human Factors in Computing Systems - CHI 2013*, pp. 2931–2940 (2013)
14. Ames, M.: Managing mobile multitasking: the culture of iPhones on stanford campus. In: *Computer Supported Cooperative Work*, pp. 1487–1498 (2013)
15. Brown, B., McGregor, M., Laurier, E.: iPhone in vivo: video analysis of mobile device use. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2013)*, pp. 1031–1040 (2013)
16. Müller, H., Gove, J., Webb, J.: Understanding tablet use: a multi-method exploration. In: *International Conference on Human Computer Interaction with Mobile Devices Services – MobileHCI*, pp. 1–10 (2012)
17. Barkhuus, L., Polichar, V.E.: Empowerment through seamfulness: smart phones in everyday life. *Pers. Ubiquit. Comput.* **15**, 629–639 (2011)
18. Rosales, A., Fernández-Ardèvol, M.: Beyond whatsapp: older people and smartphones. *Accept. to be Publ. Rom. J. Commun. Public Relations (RJCPR)* (2016)
19. INE: Population at 1st January 2014. Municipal Register. <http://www.ine.es/jaxi/menu.do?type=pcaxis&path=%2Ft20%2Fe260&file=inebase&L=1>
20. Sawchuk, K., Crow, B.: Into the grey zone: Seniors, cell phones and milieus that matter. *WI: J. Mob. Media* **5**(1) (2011)
21. Bytheway, B.: Ageism and age categorization. *J. Soc. Issues* **61**, 361–374 (2005)
22. Higgs, P., Gilleard, C.: *Rethinking Old Age*. Palgrave Macmillan, London (2015)

23. Böhmer, M., Hecht, B., Schöning, J., Krüger, A., Bauer, G.: Falling asleep with angry birds, facebook and kindle – a large scale study on mobile application usage. In: Proceedings of the International Conference on Human-Computer Interaction with Mobile Devices and Services, vol. 47 (2011)
24. Carrascal, J.P., Church, K.: An in-situ study of mobile app & mobile search interactions. In: Proceedings of the SIGCHI Conference on Human factors in Computing Systems (CHI 2015), pp. 2739–2748, Seoul (2015)