Human-Computer Interaction in Bed

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Abstract. Sleep disorders are increasingly common view and it is a growing problem in modern societies. There are several problems that can cause this type of disturbance, being the demanding obligations of work and study, a current problem, which leads individuals to allocate more time their rest period in at home. Currently, we are seeing the replacement of handwork by mental, automated and computerized work, which translates into an increasing percentage of time spent performing repetitive static character tasks (physical effort), being able to compare yourself to your work done in industry, traditional production lines (Caetano & Vala 2002). It is no less demanding contexts of labor among which are those activities that involve the long hours spent at the computer. This paper presents a study whose objective was to research the human-computer interaction with the time spent by young adults in carrying out activities with computing devices (computer, tablet or mobile phone) in residences' bedrooms of air force military and university students in rest time periods and with ecological validation with observation method to video analysis and using a Software iSEE. A sample of 32956 observations, which corresponds to 1824 sleep-hours of 24 young adults, was classified into two (2) Interaction Categories (IC), body position while participants were awake in bed (2873 observations) and doing activities (3001 observations). The image registration was performed during the period of six months, divided into two periods with each participant, to enable the analysis of different times of the year and not just a single period can mean a higher specific activity. The results show that 38.7 % (N = 1113 observations) of the participants presented the sitting as the most common postural behavior during awake in bed when the participants doing activities. In reference of activities in bed, 49.2 % (N = 1475) used the computer, followed by Using mobile devices, with 16.7 % (N = 501) of observations. When we analyze the group of participants, the students showed 49.2 % of the period of activity in bed, using the computer, and 13.8 % used mobile equipment. In the same reference, the military also used the computer (49 %) as the main activity in bed during the night rest, but they used more mobile devices (19.4 %) than students.

Regarding the postures, students used the sitting (57.1 %) as the main active posture when in bed, however, the military was the only sitting 3rd

indication posture in bed, being the 1st observation of posture in bed, was the supine position with 30.7 %. This data set the type of use of computer devices in bed (studying, playing games, watching movie or playing). Findings of this study allow suggesting what graphical interface designers must seek as new strategies and solutions for posture in bed, exploring other peripheral equipment for using informatics equipment in bed position.

Keywords: Human-Computer interaction · Activities in rest period · Health care professionals' procedures · ISEE

1 Introduction

Circadian rhythms, that is one of several biological rhythms found in humans, are produced jointly by the action of various structures of the nervous system and are influenced by various environmental factors, and also by sleep quality. It would be necessary for the musculoskeletal system the period of rest (Danda et al. 2005).

For the individual get a sense of well-being or physical and mental rest, with recovery of energy, normal period of sleeping or resting is necessary, allowing the individual to perform in good physical and mental condition the next day's tasks (Rente and Pimentel 2004).

Several authors report the sleeping disorders are increasingly common view and there are several problems that can cause this type of disturbance, being the demanding obligations of work and study, a current problem, which leads individuals to allocate more time your rest period in work at home (Wright et al. 2007; Sleep Fundation 2005; Rajaratman and Arendt 2001; Guilleminaut 2005).

There are several problems that can cause this type of disorders, being the demanding obligations of work and study, a current problem, which leads individuals to allocate more time your rest period in work at home. Currently, we are seeing the replacement of handwork by mental, automated and computerized work, which translates into an increasing percentage of time spent performing repetitive static character tasks (physical effort), being able to compare yourself to your work done in industry, traditional production lines (Caetano and Vala 2002).

Some authors have shown that is necessary the analysis of postural behavior in the workplace of computer users (Brewer et al. 2006; Liao and Drury 2000), not just in terms of workplace in the company but ergonomics improvements at work in the rest period.

The behavioral and postural habits can be changed depending with the type of daily activities and they are influenced by various environmental factors, including professional or academic performance. In general, a systemic approach of activity through the analysis of all possibilities of interactions in a real context has been adopted in the ergonomic studies, and these studies has been benefited from long-term monitoring in the home environment to cope with daily variations and habituation effects (Hendrick and Kleiner 2009; Verhaert et al. 2012).

However the observation methodology based on iSEE software (Filgueiras et al. 2012) allows the classification and registration of postural behaviors for long periods of time and it can be applied in this context.

In this context, the main objectives of this study is to evaluate the human-computer interaction in postural behavior during rest period.

This knowledge will allow to: (a) understand the postural behavior in the human-computer interaction during rest period; and (b) elaborate more specific recommendations to the changes in postural behaviors and products' development.

For this paper we will present the results for interaction patterns during the use of a set of specific Interaction Category - IC, according to the methodology and tool to measure postural behavior during sleeping, proposed by Desouzart et al. (2014).

2 Methodology

This paper presents a study whose objective was to research the human-computer interaction with the time spent by young adults in carrying out activities with computing devices (computer, tablet or mobile phone) in residences' bedrooms of air force military and university students in rest time periods and with ecological validation and is based on the observation of the human interaction (with Visual Display Terminals [VDTs] and with observation method to video analysis using the Software iSEE) with postural behaviors in bed during the night period (10 h/night). We used the same group of equipment and the same model of bed, in order to analyze if there are similar patterns of interaction between users.

This study started on the 9th of April 2013 and finished on the 3rd of October 2014 and it has occurred in two distinct periods of image pickup in each group (military and students) with three days per period.

2.1 Study Site and Residence Bedrooms' Properties

Data was collected from 24 young adults aged between 18 and 25 years old (Mean = 20.96 $\pm$ 1.899) of the Portuguese air force military and Portuguese university. Twelve male soldiers, of different categories (1st Corporal, 2nd Corporal or Soldier) and twelve female university students, studying in the healthcare domain, residing in dormitories of the air base and the university were selected. Each participant will be approximately six (6) months with two months of personal contact between the principal investigator and volunteers, and the remaining time implying an impersonal touch through e-mails and mobile phone.

The bedrooms were in dormitories standard of an institution, which is the case of college students and military with 2 beds in each bedroom with the same equipment room conditions (i.e. bed, mattress, air conditioning system, light level and noise).

2.2 The Subjects and Rest Activities

A sample of 32956 observations, which corresponds to 1824 sleep-hours of 24 young adults (12 male and 12 female), aged between 18 and 25 years (mean = 20.96 + 1.899), belonged to the air base nº5 of the Portuguese air force and Portuguese university students. Twelve soldiers worked in the area of: mechanical aviation material,

hospitality services and sustenance, car driver, mechanical, electrical and flight instrument work, weaponry and equipment mechanics, health service. Twelve university students, studying in the healthcare domain in the area of: physiotherapy, occupational therapy, speech therapy, nursing and dietetics.

Participants were informed about the study's objective through a group meeting and an individual approach on the day before each video recording. All video collection was authorized by the participants through a consent form and all procedures are in accordance with the Helsinki Declaration regarding the human study. The ethics committee of the University of Lisbon approved all experimental procedures.

Finally, participants were instructed to perform their tasks as usual and to not change their schedule due to the presence of the cameras.

2.3 Recording Procedure and Features

The participants' interactions with the bedroom equipment were video recorded on a normal rest period day and were assessed using: (a) one infrared digital camera (Wireless AEE Weather-proof - 2, 5 GHz – color); (b) one multiplexer video recorder (ACH MPEG-4 Realtime DVR) and (c) DVD recorder HD (LG recorder). All devices' lights were turned off or hidden and participants were informed about the placement of all cameras.

The digital video cameras turned on automatically from 11:00 p.m. to 9:00 a.m. and during the periods in which the subjects were asleep, awake, out of bed, doing activities, using a pillow, they were filmed using one plan (frontal superior) considering the best visualization of the participant and activity (Fig. 1).

In order to ensure similar interaction times in the bedroom and to not interfere in the evening activity and sleeping period, all volunteers were filmed during three days, ten hours continuously (starting at 11:00 p.m.).
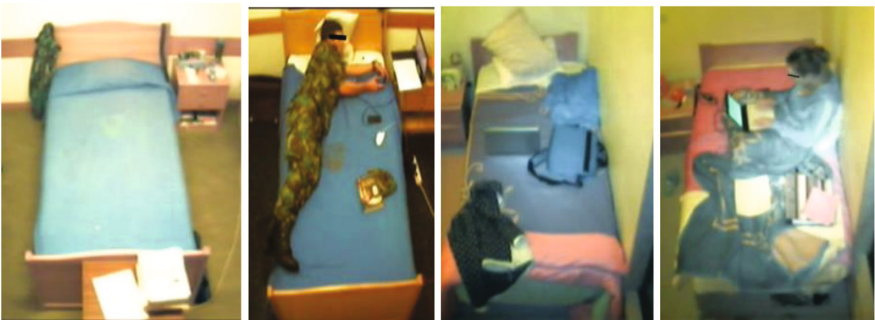
Fig. 1. Images of the first plan (Frontal superior) of the bed observations

The data, collected through video using a methodology proposed by Rebelo et al. (2011), analyzed the postural behavior in real situations in bed and it was done using software developed for this purpose (Fig. 2).

The fundamental aspect of this analysis using the software ISEE was: (a) evaluate the behaviors of interaction in a real environment and for long periods of time; (b) Allow sorting at the same event an impossible number of observable in other techniques; (c) Observe activities, actions, means of interaction (equipment) and postural behavior in the same event; (d) create hierarchies allow for observable (create hierarchies allowing the observation); (e) to question the events in greater depth and detail and be able to sort all visible behaviors and test their viability during analysis by category OTHERS; among others. Following the analysis of the results of the previous phases and the observation of the collected videos, the categories were defined.

Two (2) categories of behaviors were defined, that represent the night activity in this residences' bedrooms and one another non-specific category (Fig. 2).
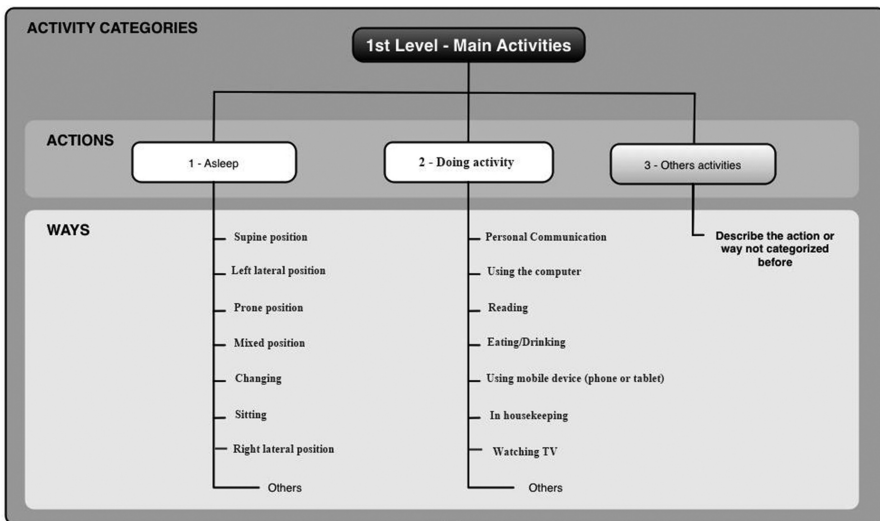

Fig. 2. Level 1 - two categories of behaviors

As mentioned, the analysis was done using software developed for this purpose. It allows classifying the IC (through video analysis) in levels (Filgueiras et al. 2012; Desouzart et al. 2014).
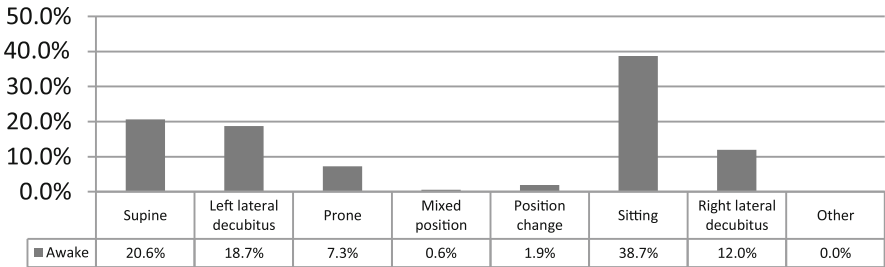
3   Results

A sample of 32956 observations, which corresponds to 1824 sleep-hours of 24 young adults, was classified into two (2) Interaction Categories (IC) (Graphic 1), body position while participants were awake in bed (2873 observations) and doing activities (3001 observations).
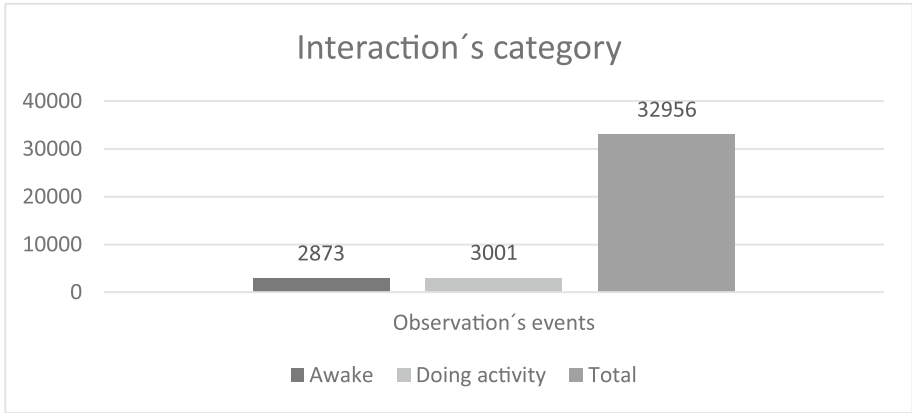
Graphic 1. Results for Interactions Categories groups

The results of category "Awake" show that 38.7 % (N = 1113 observations) of the participants presented the sitting as the most common postural behavior during awake in bed (Graphic 2).
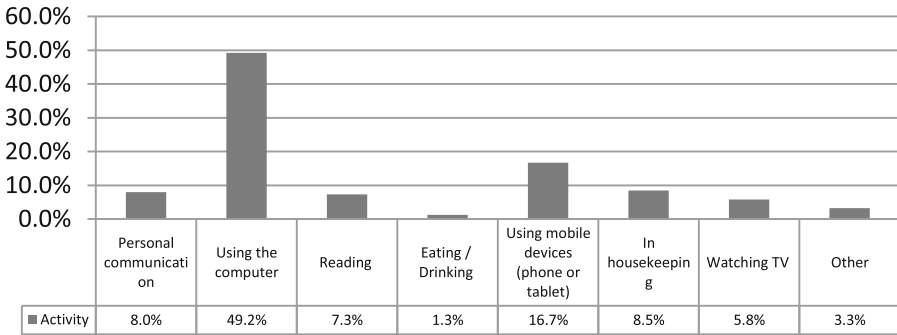

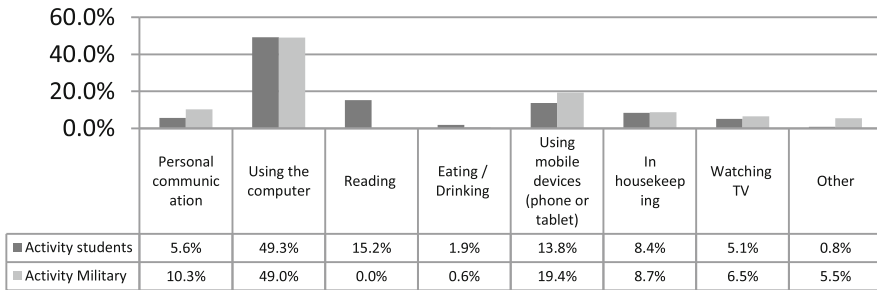|	Supine	Left lateral decubitus	Prone	Mixed position	Position change	Sitting	Right lateral decubitus	Other
Awake	20.6%	18.7%	7.3%	0.6%	1.9%	38.7%	12.0%	0.0%

Graphic 2. Results for Awake category

When the participant stood in the "Activity" category during the video capture, the most common activity was Using a computer, with 49,2 % (N = 1475) of observation, which corresponds to approximately 30 min of computer use per participant per night, followed by Using mobile devices, with 16.7 % (N = 501) of observations (Graphic 3).

When we analyze the group of participants, the students (N = 1422) showed 49.3 % (N = 708) of the period of activity in bed, using the computer, and 13.8 % (N = 198) used mobile equipment. In the same reference, the military (N = 1564) also used the computer (49 %, N = 767) as the main activity in bed during the night rest, but used more mobile devices (19.4 %, N = 303) than students (Graphic 4).

Regarding the postures while participants were awake in bed (Graphic 5), students (N = 1422) used the sitting (57.1 %, N = 812) as the main active posture when in bed,
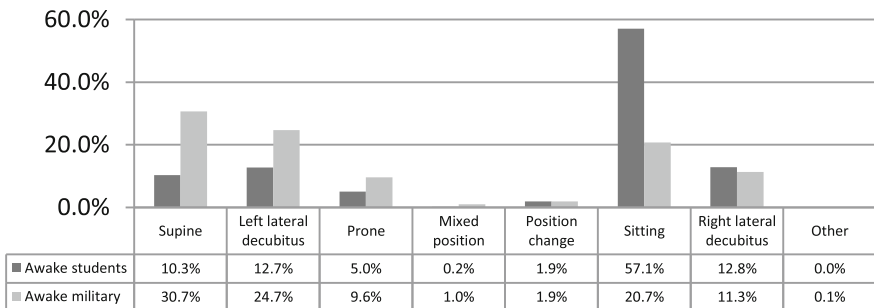
	Personal communication	Using the computer	Reading	Eating / Drinking	Using mobile devices (phone or tablet)	In housekeeping	Watching TV	Other
Activity	8.0%	49.2%	7.3%	1.3%	16.7%	8.5%	5.8%	3.3%

Graphic 3. Results for Activity category

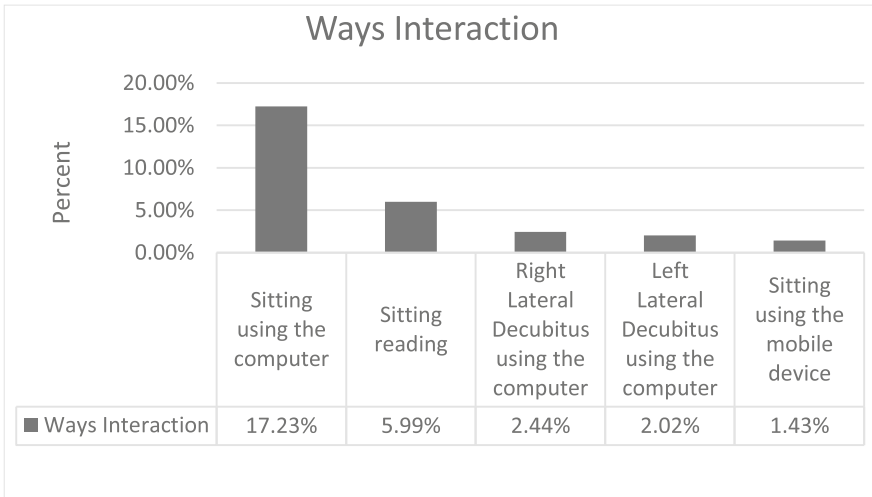|	Personal communication	Using the computer	Reading	Eating / Drinking	Using mobile devices (phone or tablet)	In housekeeping	Watching TV	Other
Activity students	5.6%	49.3%	15.2%	1.9%	13.8%	8.4%	5.1%	0.8%
Activity Military	10.3%	49.0%	0.0%	0.6%	19.4%	8.7%	6.5%	5.5%

Graphic 4. Results for Activity category

however, the military was the only sitting 3rd indication posture in bed (20.4 %, N = 301), being the 1st observation of posture in bed, was the supine position with 30.7 % (N = 446).

	Supine	Left lateral decubitus	Prone	Mixed position	Position change	Sitting	Right lateral decubitus	Other
Awake students	10.3%	12.7%	5.0%	0.2%	1.9%	57.1%	12.8%	0.0%
Awake military	30.7%	24.7%	9.6%	1.0%	1.9%	20.7%	11.3%	0.1%

Graphic 5. Results for Awake category

The interaction between "Posture" and "Awake" category in all participants (N = 2873) presented that the most common interactions category (IC´s) were that the participants had in the sitting position using the computer with 17.23 % (N = 495), followed by sitting posture and reading with 5.99 % (N = 172) and right lateral decubitus in bed using the computer with 2.44 % (N = 70), according Graphic 6.

Ways Interaction

	Sitting using the computer	Sitting reading	Right Lateral Decubitus using the computer	Left Lateral Decubitus using the computer	Sitting using the mobile device
■ Ways Interaction	17.23%	5.99%	2.44%	2.02%	1.43%

Graphic 6. Results for ways interaction

The analysis whether there is any relationship between male sample from air force military and female sample from undergraduate students.

The results showed significant difference ($p = .000$) between the postures used during the period when the participants were awake in bed and between the period when the participants were doing activity in rest period between the two groups of participants (military men and women students) within the same age group (18–25 years old), according Independent samples test (Table 1).

Table 1. Comparison of awake positions category and activity category between military and students

	Group	N	Mean	Std. deviation	Sig. (2-tailed)
Awake Posture in bed	Students	1422	4.93	2.019	.000
	Military	1451	3.26	2.278	.000
Activity	Students	1437	3.19	1.740	.000
	Military	1564	3.49	2.153	.000

4   Conclusion

The demanding obligations of work and study, is a current problem, which leads individuals to allocate more time in their rest period in work at home. Currently, we are seeing the replacement of handwork by mental, automated and computerized work, which translates into an increasing percentage of time spent performing repetitive tasks (Caetano and Vala 2002), principally in using computer to work or simply to play.

In the ICs of Awake in bed, "Using the computer" was the largest activity period and, "Sitting" was the principal postural behaviors in bed during rest period by young adults of the Portuguese air force and Portuguese university.

While held image capture, the video analysis showed that the military used the rest period to carry out leisure activities (e.g. Play games on the computer, watching movies on the computer) while Students use the same time to the extension of academic work, verifying a higher incidence in computer use, followed by the reading on paper.

This data set the type of using computer devices in bed (studying, playing games, watching movie or playing). Finally, this iSEE methodology was considered efficient for the proposed objectives and the findings suggest new challenges for future research. Findings of this study allow suggesting what graphical interface designers must seek as new strategies and solutions for behavior change in posture in bed, exploring other peripheral equipment for posture position in bed; or, at least, to improve the ideal posture of the participants in the bed and if these Ergonomic changes can influence their quality of life.

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