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Original Article

Sleeping in Safe Places: An Experimental Investigation of Human Sleeping Place Preferences from an Evolutionary Perspective

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Abstract: Although humans spend a third of their life asleep, their choice of sleeping places has so far been little investigated both theoretically and empirically. We address this issue from the perspective of evolutionary psychology. Our basic assumption is that humans have an evolved preference for safe sleeping places, that is, those that promise protection against potential aggressors and nighttime predation. Several testable predictions were derived from this assumption concerning the preferred location of the bed in a sleeping room. Specifically, we predicted that people prefer sleeping places that allow them to view the entrances to the sleeping room (doors and windows) from a distance while remaining concealed from the entrances themselves. To test these hypotheses, 138 participants were asked to arrange a bed and other pieces of furniture on floor plans that were experimentally manipulated with respect to the direction in which the door opened and the presence of a window. In agreement with predictions, participants predominantly positioned the bed in a way that (a) allowed them to see the door, (b) was as distant as possible from the door, and (c) was on the side of the room toward which the door opened. In addition, the positioning of the bed was influenced as predicted by the presence of a window.

Keywords: Sleep, sleeping place, sleeping site, bedroom, theory of evolution, housing, predation risk

Introduction

On average, humans spend a third of their lives asleep. Newborns sleep about 16 hours, grown-ups 7-8 hours, and elderly people approximately 6 hours (Zimbardo and Gerrig, 2004). Thus, the bedroom is one of the rooms in which humans spend most of their time, and the bed is probably the piece of furniture they use most.

Although numerous sleep-related phenomena have been empirically investigated, such as sleep disorders (e.g., sleep apnea, Aloia, Arnedt, Davis, Riggs, and Byrd, 2004), sleeping phases (Gulyani, Majumdar, and Mallick, 2000) and sleep-related social practices such as bed-sharing (Ball, 2002), surprisingly few studies have addressed people's preferences for the furnishing and layout of bedrooms and beds. Parsons (1972, 1981) summarized early research on the topic providing several recommendations concerning the size, lighting, airing and furnishing of bedrooms and the size, height and bedding of beds (but not their positioning). One study addressed the more specific question of how to position the bed in relation to the door, using a structured interview technique (Famos, 1989, cited in Schulze and Richter, 2004; see also: Richter, 2004). Flade (1987) emphasized humans' general need for secure habitats on a theoretical basis without, however, formulating concrete predictions concerning furnishing.

The small number of experimental psychological studies on the topic of beds and bedrooms is not theory-based and has focused on questions such as color preferences and the comfort of different mattresses (Bader and Engdal, 2000; Christl and Richter, 2004; Slatter and Whitfield, 1977). Apart from a few further studies of a similar kind, there are no psychological experiments concerned with the topic of bedrooms and beds. Moreover, although traditional research in architectural psychology is often based on Gestalt psychology (cf. Schramm and Richter, 2004) or field theory (cf. Ehmig and Richter, 2004), these theories have not been applied to the prediction of human sleeping site preferences.

In sum, whereas many other sleep-related phenomena have been extensively investigated, bedrooms and beds have inspired only very little experimental and theory-based psychological research, despite their essential meaning. Indeed, as far as we know, the topic addressed in this article—the preferred position of the bed in a sleeping room—has never been experimentally investigated before. This is surprising, since the question of where the bed (i.e., the sleeping place) is located in relation to the entrance to the bedroom (i.e., the sleeping site) seems to be of fundamental importance for the understanding of human sleeping behavior. Furthermore, it is only through the systematic study of sleeping site and place preferences that we can hope to arrive at scientifically founded practical recommendations concerning the architectural design of rooms and the positioning of beds within these rooms (e.g., in hotels).

In marked contrast to the scarce empirical research on human sleeping site and place preferences as well as its atheoretical nature, the corresponding preferences of mammalians in general (Allison and Cicchetti, 1976), as well as nonhuman primates and monkeys, have been investigated extensively from the perspective of the theory of evolution (for a theoretical transfer of research on apes' nesting behavior to human housing see: James, 2009). For example, Di Bitetti, Vidal, Baldovino, and Benesovsky (2000) studied how capuchin monkeys choose their sleeping places and found clear indications that this choice is mainly motivated by the concern of finding safety from aggressors (rather than, for example, safety from parasites). A whole body of literature on the choice of sleeping places in baboons (e.g., Hamilton, 1982) likewise shows that one of the most important criteria for the choice of a sleeping site is that it is inaccessible to aggressors (for gibbons see: Reichard, 1998; for langurs and macaques see: Ramakrishnan and Coss, 2001a, 2001b; for tamarins see: Day and Elwood, 1999). Anderson (1998, 2000) concludes that not only is the choice of sleeping sites in primates strongly influenced by the level of safety from aggressors that it provides (cf. Isbell, 1994), but also that the primates'

behavior at their sleeping places is directed at minimizing the risk of being attacked. In fact, research indicates that for monkeys sleeping site selections ensuring safety by reducing predation risk might be even more important than foraging (Smith, Knogge, Huck, Löttker, Buchanan-Smith, and Heyman, 2007). Taken together, research of nonhuman primates and other mammalians documents that evolutionary considerations (more specifically: predation risk) are remarkably well able to explain the choice of sleeping locations: mammals prefer sleeping places that maximize their chances of survival during sleep and thereby increase their inclusive fitness.

During recent years, the theory of evolution has become increasingly accepted in psychology as providing plausible and parsimonious explanations of certain phenomena, such as sex differences in mate preferences (e.g., Buss, 2004). However, in the field of architectural psychology, the theory of evolution seems to have been applied only rarely (e.g., it has been used to explain distorted perceptions of architecture; Rump, 2004) and has not inspired much empirical research. We aim at connecting architectural psychology more closely to evolutionary psychology, by studying human sleeping preferences—specifically the location of the sleeping place (bed) within the sleeping site (bedroom) in relation to possible entrances—from an evolutionary perspective.

In keeping with the general evolutionary approach and the primate studies reviewed above, the focus is on the fitness costs and benefits of different sleeping site preferences. The general hypothesis tested is that humans tend to position their bed within a sleeping room in a way that maximizes safety from possible aggressors. Even though sleeping rooms and doors were not part of our environment of evolutionary adaptedness, it seems reasonable to assume that we perceive them in a similar way as our ancestors might have perceived, for instance, caves and their entrances (cf. Brain, 1981, p. 271). Further substantiating the legitimacy of an evolutionary approach to current living environments, it seems justified to assume that modifications of our environment (such as doors) are actually based on our evolutionary needs: "The world has been selectively changed to suit the needs of people. […] In seeking to tailor the world to human needs and desires, people have altered what the world has to offer" (Michaels and Carello, 1981, p. 54f).

Based on the results of primate and anthropological research (Groves and Sabater Pi, 1985; Sabater Pi, Veà, and Serrallonga, 1997; Sept, 1992; Worthman and Melby, 2002), we assume that during the evolutionary development of humans, attacks during sleep came from nonhuman predators, that is, hunters belonging to other species (Hankerson and Caine, 2004; Peetz, Norconk, and Kinzey, 1992) as well as from conspecific aggressors (cf. Hamilton, 1982). Even though in modern urban surroundings attacks by predators no longer pose a significant threat (but see for rural areas: Packer, Ikanda, Kissui, and Kushnir, 2005; Peterhans and Gnoske, 2001; Treves and Naughton-Treves, 1999) attacks by human aggressors do remain an issue. Indeed, empirical research suggests that aggression-caused attacks of humans on other humans occur preferably at night (Cohn and Rotton, 1997), that is, the time predominantly used for sleeping. In line with this, the most frequently reported content of children and adolescent nighttime fears is fear of intruders (Gordon, King, Gullone, Muris, and Ollendick, 2007; Muris, Merckelbach, Ollendick, King, and Bogie, 2001).

Safety from predators can be maximized by choosing a sleeping place that (a) allows one to detect a potential aggressor as early as possible (cf. Nasar, Julian, Buchman, Humphreys, and Mrohaly, 1983), (b) allows one to remain hidden from the aggressor as

long as possible, and (c) allows for maximum reaction time in the case of an attack (at this point, we want to note that not only this choice of sleeping places but also characteristics of sleep itself are assumed to be influenced by predation pressure, see: Lesku, Roth, Amlaner, and Lima, 2006; Lima, Rattenborg, Lesku, and Amlaner, 2005).

The evolved preference of humans concerning sleeping sites may be regarded as forming the core of a set of evolved psychological processes. We assume that these processes solved a specific problem of survival: sleep is a biological necessity for humans. While asleep, sensory (especially visual) input is reduced and the person is in a state of diminished consciousness. For these reasons, a sleeping person is easy to attack, a fact of which aggressors certainly have tried to take advantage of during evolution. Evolved psychological processes that motivate humans to find a safe sleeping site will foster survival and will for this reason be selected for.

Similar to the concept of the evolved psychological mechanism (Buss, 2004) we propose that the information that these processes use to determine the adaptationally best location of the sleeping place is limited to information relevant for protecting against possible attacks by aggressors. Other information, such as for example air humidity, is not considered relevant in this context. This does not mean, of course, that the ultimate decision for a sleeping place cannot be influenced by nonevolutionary considerations, or environmental aspects (e.g., temperature, cf. Videan, 2006), as well.

Furthermore, we think that these evolved psychological processes (perhaps by triggering affective states) result in behavioral output. For example, the feeling of discomfort caused by an adaptationally inappropriate sleeping place (e.g., with the head positioned in direction and close to the entrance) may lead to feelings of discomfort causing the individual to change or modify the sleep setting (e.g., by moving the bed farther away from the door and placing the body with the feet in direction to the entrance) thus helping the individual to optimize its sleeping place in order to reduce potential risks e.g., of being killed by an intruder. From a Gibsonian perspective of affordances (cf. Michaels and Carello, 1981, p. 41f), the bed and the entrance might be perceived by the individual through their affordances (i.e., their meaning). Therefore, while the bed is perceived as a place to sleep, the entrance is perceived as an access possibility for potential aggressors. We assume that evolved psychological processes enable the individual to meaningfully relate these interpretations of the environment with each other thus enabling optimizing modifications of the environment when necessary.

In sum, we postulate a set of evolved psychological processes underlying the choice of sleeping places in humans, which is accessible to empirical research. In this article, we focused on but a few, but central predictions that can be derived from this set of processes. Specifically, using prearranged floor plans, we empirically tested five hypotheses concerning the positioning of the bed in a sleeping room. Hypotheses 1a and 1b concern the *direction* in which the bed is placed in relation to the door and window; hypotheses 2a and 2b concern the *distance* at which the bed is placed from the door and the window; and hypothesis 3 concerns the location of the bed in the room in relation to the door.

Hypothesis 1a. If possible, people prefer to place their beds in a room in a way that allows them to see the door from a resting position without having to move their heads much, rather than to have the door in their back. Reason: a room surrounded by walls is primarily entered through the door. To detect an aggressor as soon as possible, it is therefore best to place the bed in a way that allows one to have a view of the door.

Hypothesis 1b. If the bedroom has a window, and if it is not possible to position oneself in a way that allows one to see the door and the window at the same time, the preference for the location of the bed (hypothesis 1a) is reduced. Reason: if a window is present, it poses another possibility of entering the sleeping place that needs to be taken into account; hence two behavioral tendencies that cannot be enacted simultaneously (to the same degree) are present. However, as the door still remains the main entrance, most people are expected to stick with the preference for keeping the door in view, although (depending on interindividual differences in how the threat posed by the door and window are assessed) some may regard keeping the window in view as more important.

Hypothesis 2a. Other factors constant, people prefer sleeping places farther away from the entrance to the room. Reason: greater distance allows more time to react to the entry of an aggressor; therefore, other factors constant, sleeping places that are farther away from the entrance are safer and should thus be preferred.

Hypothesis 2b. If the sleeping room also has a window in the wall opposite the door, the distance preference is modified as follows: the bed is placed closer to the door than if the room has no window. Reason: this placement simultaneously maximizes distance to both potential entry points of an aggressor.

Hypothesis 3. Other factors constant, people prefer to sleep on that side of the room to which the door opens. Reason: should an aggressor enter the room, it is of advantage to be on the side of the room to which the door opens, as this allows one to remain unseen longer, but to quickly see the door being opened.

Materials and Methods

Participants

Participating were 138 volunteers (50% female) aged from 14 to 73 years, $M = 29.6$, $SD = 12.1$. A total of 61% of the participants were students, 20% were employees, and 19% had other jobs. More than 80% of participants had a general qualification for university entrance, at least.

Materials and Design.

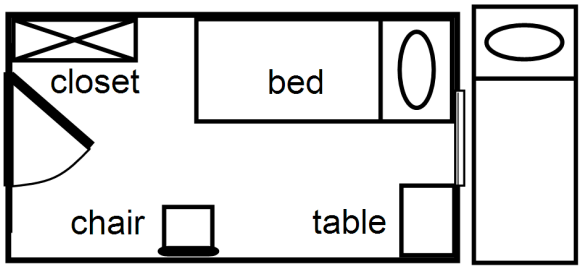
Depending on condition, participants were presented with one of four different floor plans showing a bedroom (Figure 1). The floor plans differed with respect to (a) the presence versus absence of a window in the wall opposite the door, and (b) the direction in which the door opened (to the right versus to the left). These two variables were combined into a 2 (window present vs. absent) × 2 (door opens to the left vs. to the right) factorial design. Male and female participants were separately assigned at random to the four experimental conditions (34-36 participants per condition). Participants were tested individually. At the beginning, a floor plan was placed horizontally on a board. The floor plan was 12 cm x 22 cm in size and showed a non-furnished room. On an instruction sheet, the participant was asked to furnish the bedroom in the way he or she liked it best, keeping in mind that a separate bathroom (not shown on the plan) was available in the apartment.

Figure 1. Example of a floor plan showing an unfurnished bedroom with a window; door opens to the right.



Next to the floor plan, four true-to-scale moveable and widely used pictorial symbols of pieces of furniture were positioned in random order on the board. They included a bed (12.7 x 5.0 cm), a closet (6.2 cm x 2.2 cm), a table (2.8 cm x 3.6 cm), and a chair (2.2 cm x 2.4 cm). The meanings of these pictorial symbols were explained on the instruction sheet. Although our interest was on the positioning of the bed, we added other pieces of furniture to enhance the ecological validity of the participants' task (furnishing a room), and to direct their attention away from the bed. The bed was deliberately made longer (12.7 cm) than the width of the floor plan (12.0 cm), so that it could only be positioned at the longitudinal side of the bedroom or diagonally, but not at the narrower side of the room. This was done to simplify the interpretation of the participants' responses by restricting the possible locations of the bed. For similar reasons, the window (when present) was placed in the wall opposite the door. This position of the window made it impossible to watch the window and the door at the same time from a resting position (Figure 2), thus allowing us to separate the direction and strength of the influences of the door and the window on the positioning of the bed.

Figure 2. Example of a floor plan showing a furnished bedroom with a window; door opens to the left. Another bed is shown outside the bedroom next to its smaller side to illustrate graphically that the bed was too large to be placed on this side of the wall.



After the participants had arranged the furniture, they provided some demographic information. Furnishing the room and completing the questionnaire took about 15 minutes. After each session, the furniture arrangement of the participant was copied by the experimenter onto a sheet of paper for further analysis.

Dependent variables.

Dependent variables included the following: (a) the direction of the bed (i.e., head side towards the door vs. towards the wall opposite the door) chosen by the participant; (b) the distance between the wall opposite the door and the bed (measured in cm); and (c) the

side of the room where the bed was positioned (i.e., the side to which the door opened versus the opposite side).

Results

Preliminary data analyses did not reveal any reliable differences for sex or educational level on the dependent variables.

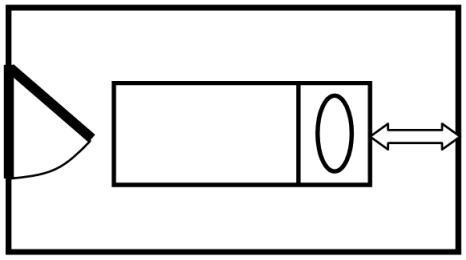
Hypothesis 1a. In each of the four experimental conditions, the majority of the participants (76-94%) positioned the bed in such a way that it offered a view of the door from the resting position. Across conditions, 83% preferred this bed position. This is significantly more than would be expected in the absence of a preference for bed position (i.e., 50%), binomial test, $p < .001$, effect size for dichotomous data $g = .33$. According to Cohen (1988), this is a large effect. Hence, supporting hypothesis 1a, the preferred bed position was strongly influenced by the presence of the door.

Hypothesis 1b. In line with hypothesis 1b, fewer participants (79%) selected a bed position with a view of the door if the room had a window than if it had no window (87%). Thus the percentage of persons who directed their view away from the door increased if the room had a window. However, the effect size was small (crosstab data effect size $w = 0.10$; cf. Cohen, 1988), and the difference between conditions did not reach significance, χ^2 (1, $N = 138$) = 1.5, $p = .11$ (one-tailed).

Hypothesis 2a. Within experimental groups 50-83% of the participants (overall: 70%) positioned the bed to the wall opposite the door without leaving space between bed and wall. Hence, a significant majority (binomial test, $p < .001$; $g = .20$) of the participants chose the maximum possible distance between bed and door.

Theoretically, the maximum possible distance between the bed and the wall opposite the door was 9.3 cm on the floor map. However, if the bed was positioned at this distance, it was no longer possible to (fully) open the door since it was blocked by the bed. The *practically* feasible maximum distance between bed and wall was therefore only 4.3 cm on the map (5 cm minus the width of the maximally opened door; see Figure 3; note that choosing the practically rather than the theoretically feasible maximum distance results in a conservative test of the hypothesis at stake). Assuming that the participants had no preference for any of the practically feasible distances between bed and wall from 0.00 cm to 4.30 cm, they should have chosen each distance with equal probability, and the expected distance is then 2.15 cm. A one-sample *t*-test comparing this theoretically expected mean distance between bed and wall in the case of no preference with the observed mean distance of 0.81 cm ($SD = 1.68$) was significant, $t(137) = 9.33$, $p < .001$, $d = 0.79$ (according to Cohen, 1988, $d \geq 0.80$ indicates a large effect), thus further confirming a preference for sleeping places farther away from the entrance to the room.

Figure 3. Example of a floor plan without a window showing the bed positioned with maximum distance (4.3 cm on the plan) from the wall opposite the door.



In sum, the participants (a) preferred a bed position maximally away from the door with a probability significantly beyond chance and (b) chose on average a distance significantly greater than expected on the assumption that all distances were equally preferred.

Hypothesis 2b. Overall, 70% of the respondents did not leave any space between the bed and the wall opposite the door, meaning that they placed the bed at the maximally possible distance to the door. However, if the experimental conditions with and without a window are considered separately, the respective percentages are different: 81% of the participants in the condition without a window, but only 59% in the condition with a window positioned the bed at the maximally possible distance to the door, $\chi^2(1, N = 138) = 8.4$, $p < .005$ (one-tailed), $w = 0.25$ denoting a medium effect (Cohen, 1988). Thus, in both conditions, a majority of the participants positioned the bed maximally away from the door to the opposite wall; however, if a window was present in this wall, a noteworthy proportion of the participants decided to move the bed away from the wall.

On average, participants left a distance of 0.81 cm between bed and wall. A Welch's *t*-test comparing the chosen distance in the condition with a window ($M = 1.2$ cm, $SD = 2.0$) and without a window ($M = 0.4$ cm, $SD = 1.3$) revealed a significant difference, $t(114) = 2.9$, $p < .005$, $d = 0.55$, indicating a medium effect (Cohen, 1988). Hence, the chosen distance between bed and wall was markedly influenced by the presence vs. absence of a window in this wall.

Hypothesis 3. According to hypothesis 3, participants should prefer to sleep on the side of the room to which the door opens. In the test of this hypothesis, we had to exclude two participants because their positioning of the bed (diagonally and in the middle of the room, respectively) did not allow us to unambiguously assign the bed position to one side of the room. Analyses of the remaining data supported hypothesis 3: A total of 74% of the participants positioned the bed on the left side of the room if the door opened to the left, and 64% positioned the bed on the right side of the room if the door opened to the right. The difference between the two conditions was statistically significant, $\chi^2(1, N = 136) = 20.3$, $p < .001$ (one-tailed), $w = 0.39$ indicating a medium effect (Cohen, 1988). Hence, the direction in which the door opens is also important for the positioning of the bed: Participants preferably positioned their bed to the side of the room to which the door opened; presumably because from this location, they can see when the door is opened without being immediately visible to the person entering the room.

Discussion

Although previous psychological studies have investigated diverse aspects of sleep

and sleep-related behavior, only very few of them have specifically looked at the preferred arrangement of the sleeping site (i.e., bedroom) thereby pursuing a non-experimental and atheoretical approach.

In contrast, the present study used experimental methodology to test predictions derived from an evolutionary-psychological theory of sleeping place preferences concerning the preferred positioning of the bed in the sleeping room. Starting from the consideration that sleeping constitutes a state of increased vulnerability, and the assumption that protection during sleep was a selection factor in human's evolutionary history, we postulated a set of evolved psychological processes whose function is to minimize the risk of fitness costs resulting from attacks during sleep. Our hypotheses concerned two aspects of bed position that are of crucial importance for reducing the fitness costs resulting from possible attacks: the easy visibility of possible room entrances (door and windows) to the person lying in the bed, and the establishment of space between the sleeping place and the possible entrances. We predicted that people should prefer a bed position that (a) allows them to keep the entrance in view, ideally without being immediately visible themselves to a possible attacker (as is the case if the bed is positioned at the wall to which the door opens); and (b) allows them to prepare against an attacker entering the room, which is achieved most easily by keeping a distance to the room entrances. We tested these hypotheses by asking participants to furnish hypothetical bedrooms that were experimentally varied in a way that allowed us to study the effects of different entrance configurations.

In line with predictions, participants predominantly positioned the bed in a way that allowed them to see the door. This preference was found both when the door was the only entrance to the room, and when a window was present at the opposite side of the room. In the latter case, however, there was a tendency (although it failed to reach statistical significance) towards a reduced preference for the "visible door" bed position. This orientation towards the (only) entrance is in line with the assumed selection pressure of our ancestors during roosting: "Pliocene hominids that anticipated a particular direction of attack might have been more successful at evading predation" (Coss and Goldthwaite, 1995, p. 129). In addition to this orientation towards the entrance, also in line with predictions, the majority of the participants positioned their beds on that side of the room to which the door opened. As said, evolutionary theory explains this finding by assuming that this bed position allows the person lying in the bed to quickly perceive the opening of the door while remaining hidden from the intruder. This positioning closely corresponds to the concept of prospect refuge (Appleton, 1975), a place providing the possibility "to look out and not be seen" (Owens, 1988, p. 21). Finally, we found strong evidence for a tendency to maximize the distance between the bed and the entrance. This maximization is primarily assumed to provide the sleeping person with increased time to react on approaching intruders. In sum, fundamental aspects of bed positioning were systematically influenced by the entrance options to the bedroom in a way that was predicted by, and can be parsimoniously and coherently explained by evolutionary-psychological considerations that center on an evolved desire for a safe sleeping place.

Our results are in line with existing findings. For instance, the distance maximization between bed and dominant entrance option corresponds to research indicating that even young children without climbing experience maximize their distance between themselves and a ground predator (e.g., a lion) by preferring higher trees as

antipredator refuge sites (Coss and Moore, 2002). Moreover, our results closely correspond to findings of a controlled primate study on sleeping place preferences (Caine, Potter, and Mayer, 1992) which found that captive tamarins chose as sleeping places boxes that were maximally distant to the door of the room.

In addition to being supportive of the evolutionary approach to sleeping site preferences in humans, our findings are somewhat inconsistent with alternative non-evolutionary approaches. For example, they are difficult to explain purely in terms of considerations of functionality. If the positioning of the bed were fully determined by considerations of functionality, people should not prefer the maximum practically feasible distance between bed and entrance, because this distance has to be walked whenever one moves into or out of the room from the bed (e.g., when going to the restroom at night). Finally, choosing to sleep at the side of the room to which the door opens also is counter to convenience, as it means a longer way to walk to open the door (or, if it is already partly open, to circumvent it) to leave the room.

Still, *some aspects* of our findings are amenable to an ergonomic-functional explanation. For example, some participants may have positioned the head side of the bed to the wall because they imagined a bed without a headrest, and wanted to compensate for its lack by placing the bed to the wall (however, this explanation cannot explain the tendency to keep the window in view by turning the head position to the room). Moreover, positioning of the bed in relation to the door might also be influenced by intentions to avoid a draft coming from this entrance. These alternative explanations can be tested in future studies in which the relevant variables are systematically varied. For example, participants could be explicitly informed that the bed has a headrest versus no headrest or that draft is present versus absent.

A different alternative explanation of our findings that could be attempted is to explain them in terms of culturally transmitted norms. Specifically, it could be argued that the preferred bed position is the traditional and culturally prescribed way of how to position one's bed. However, the mere existence of such cultural norms does not contradict the evolutionary explanation, because these norms could themselves be based on evolutionary preferences. Furthermore, it can be questioned whether such explicit norms—at least norms that are behaviorally relevant, as opposed to mere folk traditions—do indeed exist. If the evolutionary story is correct, there may be no need for such norms, because the evolutionary preferences are strong enough to make people prefer particular bed positions. To our knowledge, there is at present no systematic empirical evidence concerning the existence of such norms. However, this question is highly amenable to future (cross cultural) research (cf. Tooby and Cosmides, 1992).

According to the postulated processes, safe bed positions might elicit feelings of comfort and unsafe bed positions feelings of discomfort. These feelings were not measured in our study. However, this could easily be done in future research by asking participants to imagine safe and unsafe bed positions, and to indicate the experienced degree of comfort versus discomfort. We predict that participants experience discomfort when they imagine an unsafe bed position (i.e., one counter to their evolutionary preferences), and therefore avoid such configurations. Conversely, they should experience comfort if they imagine safe bed positions.

A methodological limitation of the present study is that the participants did not furnish a real room nor spend a real night in it, but did both only in their imagination.

However, participants were apparently able to imagine the room quite well; for example, they spontaneously added flowerpots to the floor map or commented on what they would store in the closet. Furthermore, asking participants to imagine places and situations is a well-established method of architectural psychology (e.g., Slatter and Whitfield, 1977) and of evolutionary psychology (e.g., Buss, Larsen, Westen, and Semmelroth, 1992). Moreover, we believe that the task (furnishing a room) has prima facie ecological validity, which was further increased by the requirement to actually arrange the icons on the floor plan.

Another limitation of the present study is that the pre-specified floor plans used permitted only a restricted set of possibilities to arrange the furniture, specifically the bed. In particular, there was not enough room to position the bed at a right angle to the door or on the same wall as the door. As mentioned, this restriction was deliberately chosen to limit the degrees of freedom available to the participants for positioning the bed to those locations that were particularly diagnostic (in particular, this restriction forced the participants to move the bed either towards or away from the door). Nevertheless, future studies should also use floor plans with higher degrees of freedom.

Another limitation of our research is that our floor plans and the symbolic representations of the furniture were only two-dimensional in nature. Therefore, it was not possible to modify the height of the bed which might be influenced by evolutionary mechanisms, as well (cf. Hunt, 1997, p. 65). Thus, future research should try to replicate our findings by using three-dimensional representations of the room (e.g., by means of virtual environments).

To summarize, the present study seeks to contribute to the literature on sleeping behavior in three ways. First, by examining the effects of the position of the door and the window on bed positioning, we investigated a central aspect of human sleeping environments that, surprisingly, has not been experimentally investigated so far. Second, we presented a theoretical framework for investigating the topic of sleeping place preference that allows concrete predictions that can be experimentally tested. Thereby, evolutionary psychology is put to concrete use in the field of architectural psychology. Third, the present study also contributes to evolutionary psychology, by extending its domain of application to the domain of sleeping behavior in humans. We postulated the existence of evolved psychological processes for sleeping that are of central importance for human survival, comparable to the evolutionary mechanisms for e.g., food selection. Thereby, we hope to have opened up a new field of inquiry to evolutionary psychology that has not been attended to so far.

The present results encourage further investigation of the topic. Three possible lines of future inquiry were already mentioned: the investigation of the universality versus possible cultural specificity of sleeping place preferences; the investigation of possible mediating emotional processes (comfort and discomfort); and the systematic test of possible alternative explanations of (certain aspects of) our findings, such as the hypotheses that sleeping-place preferences are based on functional-ergonomic considerations. Further studies could also address individual differences in bed positioning, as well as the effect of various contextual conditions on bed positioning (e.g., knowledge of where the sleeping room is situated in the house, for example the ground floor versus the second floor) and the interplay with other security-related mechanisms (e.g., increased group cohesion at night, cf. Vessey, 1973). More generally, it would be interesting to extend the present

evolutionary model to other types of rooms and their protective function.

Perhaps characteristic of modern achievement societies, too little attention has been paid to sleeping as a central human need. The present work seeks to contribute to changing this state of affairs, at least on an empirical level.

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