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User Sailor Participation in the Shipboard Habitability Design Process

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USER/SAILOR PARTICIPATION IN THE SHIPBOARD HABITABILITY DESIGN PROCESS

by

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ABOUT THE AUTHORS

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John Conal Lancaster attended the University of Michigan in a combined degree program of Naval Architecture and Industrial Engineering, receiving the degree of Bachelor of Science in Engineering. Upon graduation he joined NAVSEC and completed the EIT program and since 1971 has been assigned to the Habitability Section (SEC 6131G) of the Ship Arrangements Branch. For the past year and a half Mr. Lancaster has participated as the NAVSEC Habitability representative to the Board of Inspection and Survey, assisting PRESINSURV in the habitability inspection of new construction ships and major combatants. He has also been responsible for developing and implementing a novel approach to habitability improvement of existing fleet ships in which ships force personnel perform the actual installation of equipment using a NAVSEC developed design supplemented by an on-site technical advisor during the installation phase. Significant cost savings have been realized by the use of this ships force self-help program. Mr. Lancaster holds the degree of Master Of Science in Engineering from the University of California at Berkeley in Human Engineering and Environmental Design and is a member of ASE and ASNE.

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ABSTRACT

It is the authors' opinion that shipboard habitability designers differ from shipboard personnel in their perception, interpretation, and evaluation of the shipboard physical environment. This paper compares certain of the environmental dispositions of naval architects with similar dispositions of the ship user. Conclusions drawn from preliminary research conducted by the authors are presented and subsequently used to argue that the U.S. Navy should incorporate some form of user participation in the shipboard habitability design process. This is followed by a brief discussion of shipboard participation methods which have been explored by the authors and their resultant suggestions and recommendations.

INTRODUCTION

In a recent paper,[1] Kenneth Craik, an environmental phychologist, studied "environmental decision-makers" and their "environmental dispositions", which have been defined as an individual's "attitudes, beliefs, values, and sentiments"[2] toward what is often referred to as the everyday physical environment. Craik identified the members of this group as being the "architects, urban designers, transportation planners, landscape architects, natural-resource managers, and conservationists of advanced technological societies".[3] To this group this paper will add naval architects. As environmental decision-makers, these professionals are responsible to an undetermined degree for determining and arbitrating the quality of the man-environment relationships of their "clients", the members of these technological societies, which include the residents of small communities, cities, large metropolitan regions, and, as this paper will demonstrate, the crew members of U.S. Naval ships.

Craik's paper reflected a concern shared by others that the educational, social, and administrative distances which separate these environmental professionals and managers from their client populations cause the former group to formulate policies and make decisions different from those which would be made by the latter group, if given the opportunity. In the 1960's the fields of city planning and social welfare saw this concern manifested in the birth of the concept of citizen participation. Here the expertise of environmental professions, the city planners and the social workers, was supplemented and in many cases superseded by the self-determination and decision-making of their clients, the city residents and welfare recipients.

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[1]Craik, Kenneth H., "The Environmental Dispositions of Environmental Decision-Makers," in Society and its Physical Environment, S. Klausuer (ed.), Annals of the American Academy, 389, pp. 87-94.

[2]McKechnie, George E., "Measuring Environmental Dispositions with the Environmental Response Inventory," paper presented at the 1970 Conference of the Environmental Design Research Association, Pittsburgh, Pa., October 28-30, 1970.

[3]Craik, op. cit., p. 89.

While the existence of such conflicts between professional environmental decision-makers and their clients has been extensively documented, at least in the two fields mentioned above,[4] explanations offered as to why such conflicts exist have been less definitive. One hypothesis which has been advanced by Craik and others is "that environmental decision-makers differ from their clients in their perception, interpretation, and evaluation of the everyday physical environment".[5] This paper pursues this hypothesis by first expanding Craik's list of environmental decision-makers to include naval architects, and then attempting to compare certain of the environmental dispositions of this group with similar dispositions of their client populations. Specifically, this paper examines a group of naval architects employed by the U.S. Navy and a group of enlisted crew members of a U.S. Navy ship to determine and contrast their respective dispositions toward the physical environment provided by the U.S. Naval combatant ship. Tentative conclusions drawn from this preliminary research will be presented and subsequently employed to argue that the U.S. Navy would be well-advised to incorporate some form of user participation in the shipboard habitability design process. This argument will be followed by a brief discussion of shipboard participatory methods which have been explored by the authors and their resultant suggestions and recommendations.

BACKGROUND

Prior to commencing this work, it will be helpful to briefly discuss the role of the naval architect in U.S. Naval shipboard habitability design, and the physical environment of the Naval combatant ship. As one aspect of the larger study of the man-environment relationship, the task of designing the living or habitability spaces of

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[4]The literature on citizen participation is immense. The reader is generally referred to John David Hulchauser, Citizen Participation in Planning: A Comprehensive Bibliography (Toronto: University of Toronto Department of Urban and Regional Planning, Papers and Design, 1974), and Judith V. May, Citizen Participation: A Review of the Literature (Monticello: Council of Planning Librarians, Exchange Bibliography Nos. 210-211, 1971).

[5]Craik, op. cit., p. 89.

U.S. Naval combatant ships presents the naval architect with many unique and challenging problems which are unknown to his land-oriented counterparts. In his efforts to provide an adequate living environment for the sailors who must man the ship, the naval architect faces constraints which exceed the universal limitations of time and money. First and foremost, such spaces must be capable of being contained within the confines of a vessel designed for sustained, high-performance operations within the larger and often hostile environment of the earth's oceans. Second, the Naval ship is essentially a weapons platform and its habitability requirements must be subservient to the hardware and equipment required by the ship's combat mission. Finally, given the compromises necessary in designing a ship to meet the conflicting demands of living environment, sea-going vessel, and weapons platform, the naval architect is further handicapped by his inability to quantify the benefits gained per unit cost of habitability relative to the benefits gained per unit cost of ship's manueverability or fire-power. For example, it is simple to demonstrate that an expenditure of $100,000 will increase the tactical stand-off capability of a ship by a certain number of nautical miles, but virtually impossible to objectively document the benefits gained in either increased morale or more efficient performance of duty gained from better air conditioning.

Operating under these constraints and a tradition of habitability design based on a pragmatic foundation of trial and error experience, naval architects have designed habitability spaces which have appeared to be equal to the task of providing an adequate shipboard living environment. For the "typical" sailor stationed on board the "typical" Naval ship, this has meant a Spartan, utilitarian environment most often comprised of: a bunk hung by chains in a three-high tier in a 20-50+ man berthing compartment, a small personal gear locker, sanitary facilities located in a small, poorly ventilated space conducive to crowding, a metal food serving tray and a seat at a table in the crew's messing space, and occasionally, a lounge or some type of recreation space to be shared among many of his shipmates. While no one, especially the sailors who actually underwent this experience, would argue that living in this environment was pleasant, and there were periodic, cosmetic attempts to improve shipboard living conditions, it was generally acknowledged that shipboard habitability was satisfactory, or at least the best that could be provided under the circumstances.

The advent of the all-volunteer Armed Service, combined with the generally rising standard of living available in civilian life and an increased sensitivity to the man-environment relationship, has stimulated a renewed interest in shipboard habitability among the entire Naval community and especially among naval architects.[6] This increased attention has resulted in several notable efforts where habitability designs have departed from traditional concepts to experiment with significant innovations in shipboard living conditions. On certain new construction ships, mass berthing compartments have been replaced with six-man cubicles containing bunks with privacy curtains and individual air conditioning units. Crew recreation and lounge spaces have also been provided on newer ships and serious efforts are being made to upgrade and improve the arrangements and furnishings of all crew spaces.

This climate of innovation and willingness to venture in new directions in habitability design raises several important questions. Funds for shipboard habitability improvements are limited, necessitating the assignment of priorities. But what are the habitability priorities and preferences of sailors stationed on board U.S. Navy ships? Given a choice between better air conditioning or more privacy in their berthing spaces, which would they choose? Do some habitability improvements have more appeal than others? Perhaps most importantly, do some habitability design innovations have unintended, but nontheless harmful, consequences which make them undesirable? While providing a separate locker and dressing area removed from the berthing space may reduce the noise level in this compartment, it may also entail a loss in the security of personal property which is far more objectionable than the noise.

Presently the priorities and choices described above, as reflected in habitability design improvements and innovations, are being made by naval architects in their capacity as environmental decision-makers employed by the U.S. Navy. Considering that these individuals seldom, if ever, live on board ship for extended periods of time, are several administrative levels removed from their client population, and differ from these clients or sailors in a variety of socio-economic indices, their competence and ability to make shipboard habitability decisions reflective of the needs and desires of their clients may legitimately be questioned. In this respect a crucial question is to what degree do these environmental decision-makers share the "perceptions, interpretations, and evaluations" of the shipboard environment, as it is comprehended by their client population of sailors. It can be hypothesized that any degree of shared comprehension less than a perfect fit will result in some priorities being set and choices being made by the decision-makers which will vary from those which would be made by the client population of sailors.

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[6]See, generally, Castle, Joseph E., et al, "The Naval Architect's Role in Achieving Shipboard Livability," Eighth Annual Technical Symposium, Association of Senior Engineers, March, 1971; Weiler, Daniel J., et al, "The Need for an Open Systems Approach to Naval Ship Habitability Design," Society of Naval Architects and Marine Engineers, 1972; and Saklem, A. A., et al, "The Shipboard Environment - Past, Present, and Future," Naval Engineers Journal, June 1971.

METHOD AND RESULTS

To answer this question concerning shared comprehension of the shipboard environment, first a questionnaire was devised to measure an individual's dispositions toward the environment presented by the U.S. Naval combatant ship. Next, this questionnaire was administered to a group of sailors and a group of naval architects. The responses of these two groups were then compared to determine the degree to which the groups demonstrated a similar or shared perception and understanding of the shipboard environment. The derivation of this questionnaire, its underlying assumptions and rationale, the mechanics of its administration, and its results are discussed below.

As ultimately derived, the Shipboard Environmental Disposition Questionnaire (SEDQ) was similar in format and conceptual foundation to the Environmental Response Inventory (ERI) developed by George McKechnie.[7] In the SEDQ respondents were requested to respond to 105 items related to a total of 15 factors judged to be the most descriptive of the combatant ship as a living environment. These 15 factors, as listed and defined in Table 1, were rationally derived from a prior study conducted by the Naval Ship Engineering Center, Hyattsville, Maryland,[8] a table of "Environmental Needs and Values" developed by Donald Appleyard,[9] and the personal experiences of the authors, a Naval veteran and a naval architect, both with extensive sea-going experience.

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[7]McKechnie, George E., Environmental Response Inventory, 1971.

[8]NAVSEC Shipboard Habitability Inventory, prepared by Human Factors Technology Division, Naval Electronics Laboratory Center, San Diego, California, 1972.

[9]Appleyard, Donald, "Environmental Planning and Social Science: Strategies for Environmental Decision-Making," Working Paper No. 217, Institute of Urban and Regional Development, University of California, Berkeley, September, 1973.

TABLE 1 -- SHIPBOARD ENVIRONMENTAL FACTORS

Factor	Definition
ACCESS	ability to move freely and with minimum difficulty between decks and compartments, and with an acceptable travel time between starting point and destination.
AESTHETICS	degree to which a physical environment is visually pleasing and appeals to an individual's sense of beauty.
ATMOSPHERIC CONDITIONS	quality of the ambient atmosphere as determined by ventilation or air circulation, humidity, and temperature.
CHOICE/ENVIRONMENTAL MASTERY	ability of an individual to modify, alter, select, or otherwise determine his physical surroundings.
CLEANLINESS	freedom from the presence of dirt, trash, and debris.
DENSITY	an individual's feeling of the degree of occupation of a space, as determined by his perception of its size and the number of people using it.
EQUITY	the availability of the same level of environmental quality to all members of a population.
GROUP MEMBERSHIP/SOCIAL INTERACTION	ability of an environment to support an individual's self-identification as belonging to a primary group, and to encourage his relationships with the members of this group.
INDIVIDUALITY/TERRITORIALITY	ability of an environment to support an individual's feeling of uniqueness and self-importance as obtained through his exercise of control over personal space having distinct physical and social boundaries.
LIGHTING	quality of illumination as determined by its intensity, color, and uniform distribution.
NOISE/VIBRATION	freedom from the presence of unpleasant and disruptive sounds and tremors.
ODOR	freedom from the presence of unpleasant and disruptive smells.
PRIVACY	ability of an individual to achieve physical isolation from social relationships.
SAFETY	protection from hazards and conditions likely to cause personal injury or death.
SECURITY	protection from anxiety concerning threats to personal effects and property.

For each of the shipboard environmental factors listed in Table 1, 14 items were developed comparing this factor against all the other factors. Each item was presented in the form of a declarative statement to which an individual was asked to respond on a scale ranging from strongly agree to strongly disagree and including a neutral or don't know response. Care was exercised in the preparation of these items to make the comparison implicit rather than explicit in the hope of obtaining a freer, more genuine response. For example, a choice between the factors of individuality-territoriality and aesthetics is presented as "Each man in a berthing compartment should be able to decorate and paint his locker in any way he wants". Here the implied choice is between individual freedom as opposed to the unharmonious overall appearance of the berthing compartment which could result from the exercise of this freedom. It is also important to note that the phraseology and vocabulary used in these items is that employed by naval personnel and civilian terminology was purposely excluded. This deliberate bias in favor of the sailor-respondents was felt to be necessary for purposes of both realism and to avoid confusion.

The SEDQ of the present study and the ERI developed by McKechnie, cited above, share a similar conceptual foundation. Both are based on the rationale "that people relate to the everyday physical environment in stable characteristic ways, just as they relate to themselves and to others according to enduring patterns".[10] The development of the SEDQ and its intended use is further predicated on the belief that an individual sailor is consistently disposed toward the various factors which in sum form the shipboard environment. In other words, the sailor has an internalized, moderately stable priority list which ranks these factors from most to least important to him. Consequently, when presented with a series of paired comparisons of these factors, the sailor will choose between them in a consistent manner which will in turn permit the ordering of these factors to accurately reflect his internalized ranking.

The device developed by this study to accomplish this ordering process and record an individual's priority ranking is the pairwise comparison matrix show in Table 2. The numbers located in the various cells of the matrix reference the number of the Item in the SEDQ, a copy of which is found in the Appendix, which presents a particular choice between factors. Using a method which will be discussed later, a pairwise comparison matrix developed for each respondent to the SEDQ enabled the construction of a priority ranking of his dispositions towards the 15 shipboard habitability factors.

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[10]McKechnie, George E., as in note 2 at p. 1.

TABLE 2 - Pairwise Comparison Matrix of Shipboard Environmental Factors

(Note: An item's location with respect to the diagonal indicates the factor chosen by a positive (agreement) response to the item)

ITEM NUMBERS IN MATRIX ARE KEYED TO SEDQ

agree with ←

disagree with ↑

	ACS.	AES.	A.C.	C./E.M.	CLN.	DEN.	EQU.	G.M./S.I.	I./T.	LIT.	N./V.	ODR.	PRI.	SAF.	SEC.
ACCESS				89		88		62		33		79	45	98	
AESTHETICS	60		44					26			78		4		2
ATMOSPHERIC CONDITIONS	94			97	12	58	86			23				32	29
CHOICE/ENVIRONMENTAL MASTERY		36			48	67			93		24	90		72	
CLEANINESS	54	14				50	17	20	31			84			
DENSITY		64									57	82	100	37	
EQUITY	49	74		105		21			40			96			
GROUP MEMBERSHIP/SOCIAL INTERACTION			91	83		52	69		56		35	73	66		39
INDIVIDUALITY/TERRITORIALITY	53	1	27			7				41		34		28	
LIGHTING		18		59	77	5	92	28				13			80
NOISE/VIBRATION	103		70		25		19		99	30		51	68	85	95
ODOR		104	42												6
PRIVACY			38	87	46		102		71	3		55		16	
SAFETY		63			75		65	11	9			101			15
SECURITY	76			61	81	47	10		43				8		

A further and key assumption of this study is that not only will an individual respond in a consistent manner to the choices presented in the SEDQ, but also that groups of individuals, i.e., sailors and naval architects, will respond in a manner demonstrating group consistency and thus enabling comparison between these two groups. With this assumption as a given, during the period May 20-24, 1974, the SEDQ was administered to enlisted crew members of the USS HAMNER (DD 718) and naval architects employed by the Naval Ship Engineering Center (NAVSEC), Hyattsville, Maryland. The HAMNER, a World War II vintage destroyer home-ported at Treasure Island, San Francisco, California, is presently serving as a Reserve training ship and carries a regular complement of approximately 200 men. During an at-sea period following a restricted shipyard availability, regular crew members of the HAMNER were individually approached and requested to answer the SEDQ. In this manner, 53 completed SEDQ's were obtained.

Due to time constraints and to maintain the voluntary nature of its administration, individual sailors were not selected to receive the SEDQ. Additionally, in the interest of obtaining the maximum return, respondents were not requested to supply personal data. These facts prevent determining in any formal sense if the HAMNER respondents to the SEDQ are a representative sample, but the administrator of the questionnaire attempted to distribute it evenly among the various rates (pay grades) and ratings (occupation groups) present on board the HAMNER, which in turn would reflect the varying ages, time in service, time on board ship, etc., found on this ship.

Concurrent with its administration on board the HAMNER, the SEDQ was administered to naval architects employed by the Ship Arrangements Branch, NAVSEC, Hyattsville, Maryland. The authors did not administer the SEDQ, but requested that it be given to senior personnel responsible for determining priorities and policies in habitability design. Naval architects selected to receive the SEDQ were informed that it was being given to a group of destroyermen and they were requested to respond to the SEDQ as they thought the sailors would respond.

Again due to time constraints and in the interest of receiving the maximum return, respondents were not requested to complete a personal data sheet. This circumstance, and the fact that the SEDQ was not directly administered by the authors, makes it difficult to determine the degree to which the SEDQ was answered by habitability decision-makers, but 12 SEDQ's were completed by naval architects at NAVSEC and were evaluated by this study.

On June 6 and 7, 1974, the SEDQ was administered for comparison and general interest purposes to a group of undergraduate students at the University of California, Berkeley. (No attempt was made to select these students according to any criteria other than the convenience of the administrators and they are in no sense a control group.) Prior to administration, these individuals were given an orientation brief on shipboard living conditions and relevant Naval terminology. The respondents were then directed to answer the SEDQ as best they could, and since the questionnaire was administered in a classroom situation, the administrators were available to answer additional questions concerning the SEDQ. A total of 17 SEDQ's were completed by the students. Since all previous respondents had been male, these questionnaires were divided into two groups by sex. Once all SEDQ's to be analyzed in this study were collected, the assembled data was divided into four groups -- sailors, naval architects, female students, and male students. Using a PDP-8 computer program developed by Dr. E. R. F. W. Crossman of the Department of Industrial Engineering at U. C. Berkeley, a ranking of all 15 shipboard environmental factors was constructed for each of the four groups. The four resulting factor rankings are presented in Table 3.

By inspection, the rankings assigned these factors by the sailors and naval architects are almost identical, but this correspondence declines when the ranking of the sailors is compared with those of the female and male students. This visual analysis is confirmed by the rank correlation coefficients for these comparisons, which are also presented in Table 3 and are .843, .429, and .636 for sailors-naval architects, sailors-female students, and sailors-male students, respectively.

ANALYSIS OF METHODS AND RESULTS

Several comments concerning the methodology employed by this study have been made previously, and will be amplified and supplemented in this section. As noted, the SEDQ owes its format and aspects of its conceptual framework to the ERI developed by McKechnie. Of course, the two methods differ in that the former is designed to measure dispositions toward a physical environment which is "everyday" to only a small group of individuals. The methods express a more fundamental difference, however, in their means of derivation. The ERI was empirically developed through the factor analysis of a pool of items thought to relate to disposition toward the physical environment, while the SEDQ was rationally derived from a priori assumptions made by the authors.[11]

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[11]For an excellent and concise discussion of the strategies evolved for the construction of the scales of psychological inventories, see McKechnie as in note 2, pp. 2-4.

TABLE 3 -- PRIORITY RANKINGS OF SHIPBOARD ENVIRONMENTAL FACTORS

Factor	Group Priority Rankings in Descending Order			
	Sailors	Naval Architects	Female Students	Male Students
Odor	1	1	1	1
Cleanliness	2	5	10	5
Atmospheric Conditions	3	2	2	3
Safety	4	4	13	7
Density	5	3	3	11
Group Membership/ Social Interaction	6	7	4	2
Aesthetics	7	9	14	14
Security	8	13	5	9
Lighting	9	10	11	6
Noise	10	6	6	8
Equity	11	11	12	10
Individuality/ Territoriality	12	12	7	4
Privacy	13	8	8	12
Access	14	15	15	15
Choice/Environmental Mastery	15	14	9	13
Rank Correlation Co-efficient		.843	.429	.636

In this process, first those factors thought to be significant in the shipboard living environment were selected on criteria based heavily on the personal experience of the authors. Second, aspects, qualities, and circumstances of shipboard living thought to accurately express feelings and dispositions toward each factor were selected for use in the SEDQ items, and again the selection process weighed heavily on personal experience and judgment. For example, conditions descriptive of the noise level in berthing compartments were felt to be more pertinent to this factor than conditions relating to noise levels in work spaces or watch stations. Finally, each item of the SEDQ was constructed in a manner intended to equalize the choice it presented between the two environmental factors, as reflected by those aspects or circumstances of shipboard living employed to present the choice. For example, given the generally dirty condition of most shipboard sanitary spaces, an item relating to this space to present a choice between cleanliness and aesthetics or almost any other factor would be unfairly prejudiced toward a favorable response to the former factor. Thus, items presenting such unfair or weighted choices were avoided.

From the above discussion it should be readily apparent that this rational derivation of the SEDQ will have some adverse impact on its validity. As stated by McKechnie, "The success of this approach depends . . . on the ability . . . to make correct a priori inferences about both the various manifestations of underlying psychological dispositions and the subtleties of verbal self-report".[12] Concerning this ability, the authors of this study can certainly claim no special expertise.

Next, it is important to consider that the responses of the 53 sailors are informed to an undetermined degree by their present, specific, shipboard environment. In the overall factor ranking of the HAMNER sailors, access was given the next to the lowest priority ranking. Does this low ranking reflect a genuine lack of concern for access as a factor in shipboard environments, or does it reflect the fact that the HAMNER is a relatively small ship (length - 380', beam - 40') with only minor problems of internal access? Had the SEDQ been administered to sailors stationed on board an aircraft carrier, would access have received a high priority ranking, and if so how much higher? To ascertain the

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[12]McKechnie, George E., as in note 2 at pp. 2-3.

usefulness of the SEDQ, these and related questions must be answered. Then either some method must be devised to extract the influence an individual's current shipboard environment exerts on his dispositions toward a composite or universal shipboard environment, or it may be discovered that dispositions toward the shipboard environment are dependent on the specific ship type, necessitating that separate factor priority rankings be developed for each. This latter alternative is one area where the SEDQ in its present form could be meaningfully used for future research.

An additional comment concerning the methodology of this study is addressed to the selection of the sample populations. As noted above, time and other constraints prevented any formalized or tightly controlled effort to administer the SEDQ to a representative group of sailors. Although such an effort was not made by the present study, not the least of difficulties in such an attempt would be determining what constitutes a representative population of sailors in this instance. In the case of the naval architects, where some attempt was made to reach decision-makers, the different question, ignored by the present study, raised is what criteria objectively define such individuals.

The final comment on methodology is concerned with the statistical analysis employed or not employed by this study. In the latter class, a quantitative expression of both individual and group consistency in responding to the SEDQ was not discovered and in this respect qualitative analysis is not judged to be completely adequate. In the former class, the use of the mean of individual responses to determine group consensus and factor priority rankings is certainly not beyond question, nor can the use of the rank correlation coefficient to compare priority rankings escape challenge. Concerning the derivation of these priority rankings as described above, such rankings may effectively order a group's dispositions, but it does nothing to account for the distances between the factors which are being ordered. Such distances are critical to the present study, but are essentially ignored by its methodology.

CONCLUSIONS

The negative tone of the above discussion is not intended to totally discount the value of the present study, but only to stress its preliminary nature. Despite its methodological weaknesses, the authors believe the present study does demonstrate a degree of validity which supports the following general conclusions.

As expected, naval architects and sailors surveyed by this study do possess a shared comprehension of the physical environment of the U.S. Naval combatant ship, as evidenced by the high rank correlation coefficient of these two groups. Comparison of the responses of the sailors and naval architects with those of the students indicates that persons without first-hand experience of an actual shipboard environment comprehend it in a manner different from those individuals with this experience. Thus, it seems that dispositions toward the environment of the combatant ship are uniquely acquired by its user population of sailors and the comprehension of these "attitudes, beliefs, values, and sentiments"[13] is shared by the professional decision-makers who design this environment, but not by the general civilian population.

Despite the general agreement between sailors and naval architects, close comparison of their dispositions toward the shipboard environment reveals four factor rankings where these two groups diverge significantly. Sailors and naval architects respectively ranked cleanliness 2 and 5, security 8 and 13, noise 10 and 6, and privacy 13 and 8. As noted previously, any degree of shared comprehension less than a perfect fit could result in naval architects determining shipboard habitability design priorities and choices that do not reflect the real desires of sailors. While the consequences flowing from such variances would not necessarily always be harmful, they would represent sub-optimization in terms of cost-effectiveness.

If, for purposes of argument, the environmental factor rankings presented in Table 3 are accepted as correct, funds allocated by naval architects to increase individual privacy on board ship would perhaps be better spent on air conditioning or odor elimination equipment. This illustration raises difficult questions concerning the point beyond which an environmental factor reaches an optimum level and is replaced by "too much of a good thing", but it does serve to demonstrate where variances between the disposition of sailors and naval architects could result in less effective design decisions.

At deeper issue are instances where such variations could result in design decisions adversely impacting on the welfare and well-being of sailors. It is not difficult to hypothesize such a situation and a recent real-life example is provided by the installation on board the USS VIRGINIA (CGN 38) of personal gear lockers located in a dressing space separate from the berthing compartments. The intent of this design decision was to improve shipboard habitability by reducing the noise level in berthing spaces, through the elimination of disturbances associated with opening and closing lockers, dressing and changing clothes. The results of informal surveys, however, indicate that sailors generally find this arrangement undesirable because it removes

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[13] Ibid., p. 1.

their personal effects and belongings from their physical proximity while sleeping. As stated by one crew member informant, "Sailors like to sleep on their wallets". The underlying rationale of this observation is that on board ship removing a man's locker from the immediate vicinity of his bunk makes it more vulnerable to pilfering and theft.

Reference to Table 3 may account for the dissatisfaction with separate dressing spaces. Sailors ranked the factors of security and noise as 8 and 10 respectively, while naval architects placed a far higher value on noise relative to security, ranking them as 6 and 13 respectively. In this instance there is a marked difference between the environmental dispositions of sailors and naval architects, as measured by the SEDQ. Assuming these relative rankings are correct, they could explain, as in the instance of separate dressing spaces, how a decision could be made which reflects the values of the designers but not the sailors.

This brings us to the thrust of our paper. Just as urban planners have benefited from the counsel of citizen groups and organizations, the authors believe that the expertise of naval architects should be supplemented by direct input and guidance from the "citizens" who live in the environments designed by these decision-makers. Although preliminary, the evidence of the present study is strong enough to support the need for some form of sailor participation in the shipboard habitability design process. Despite the high correlation between the environmental dispositions of sailors and naval architects, evidence indicates that agreement is less than perfect, and where dispositions are at variance, sailor participation in the decision-making process would be of significant value. The remainder of this paper will be devoted to a discussion of how such participation may be effected.

PARTICIPATION TECHNIQUES

This paper has analogized the relationship of the city planner to his client population of city dwellers to that of naval architects to sailors for purposes of illustrating the value of sailor participation in the shipboard habitability design process. While fruitful in this respect, further application of this analogy to elucidate actual techniques or methods of participation is equally promising. The balance of this paper will discuss the methods which the authors have experimented with in their efforts to develop an effective method of obtaining sailor participation in habitability design. As will be seen, these efforts were only preliminary and support no firm conclusions. They do offer the promise that certain methods and techniques of citizen participation, as employed in the city planning process, can be applied to the problem of creating more habitable shipboard living environments.

It is important to note in passing that a discussion of sailor participation in the decision-making process of habitability design must recognize that sailors of the U.S. Navy are subject to a degree of authority not present in the civilian community. This subject raises interesting questions of ultimate accountability concerning the naval architect and his relationships with the enlisted community vis-a-vis the commissioned hierarchy of Naval officers. Pursuit of these questions in turn could lead to fascinating discussions of the role of the naval architect as advocacy planner, as understood within the context of city planning. However, these questions can only be mentioned here. Suffice it to say that based on our experiences discussed below, the authors believe that the subordinate position of the enlisted sailor will not bar his effective participation in habitability design, if his participation is provided for with imagination and sensitivity.

Shipboard Survey of Environmental Dispositions

It is obvious that the SEDQ employed by this study and embodied in the data found in Table 3 could be directly and immediately used to discover the shipboard environmental preferences of sailors and to provide habitability designers with general guidance and a starting point for more in-depth studies. As mentioned previously, future studies should undertake to determine if these preferences are related to the ship types of the respondents, or are they in fact independent of this variable.

Cognitive Mapping

When first attempting to analyze the impact of the physical environment of the Naval ship on its inhabitants, the authors employed a technique whose use was pioneered by Kevin Lynch in The Image of the City.[14] In a manner similar to Lynch's work with the residents of three large, metropolitan cities, sailors were requested to draw sketch maps of their ship, identifying its important physical features, as they proceeded on various imaginary trips throughout its interior. It was intended that the resultant cognitive maps, two of which are present in Figures 1 and 2, would be used to identify the crucial physical features of the shipboard environment. Once identified, it was hoped that analysis of their character and inter-relationships would reveal design principles that could enable Naval architects to create more ordered, imageable, and hence, more habitable shipboard environments.

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[14]Lynch, Kevin, The Image of the City, M.I.T. Press, 1960.

NAVSEC

SAMPLE COGNITIVE MAP I

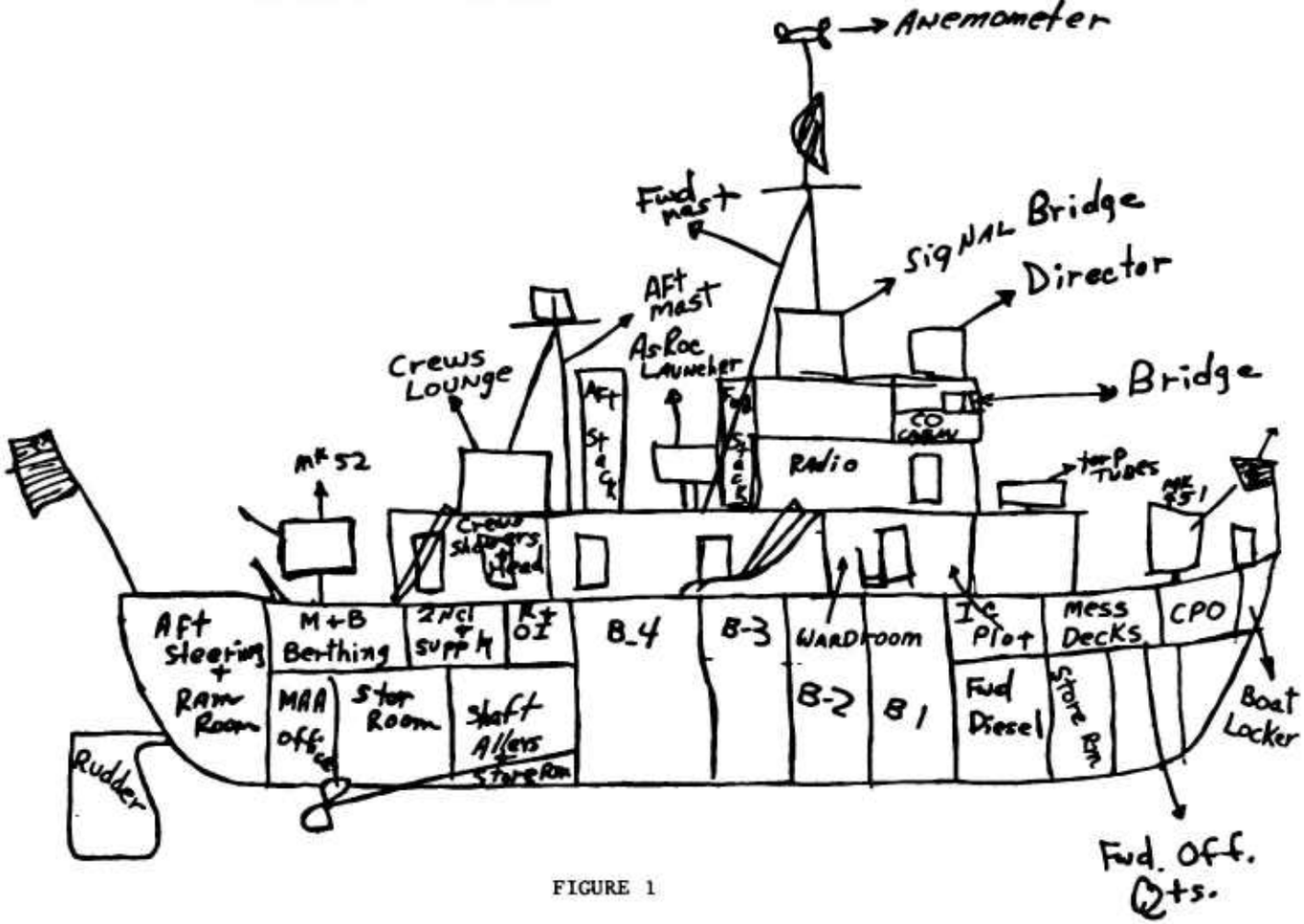

FIGURE 1

SAMPLE COGNITIVE MAP II

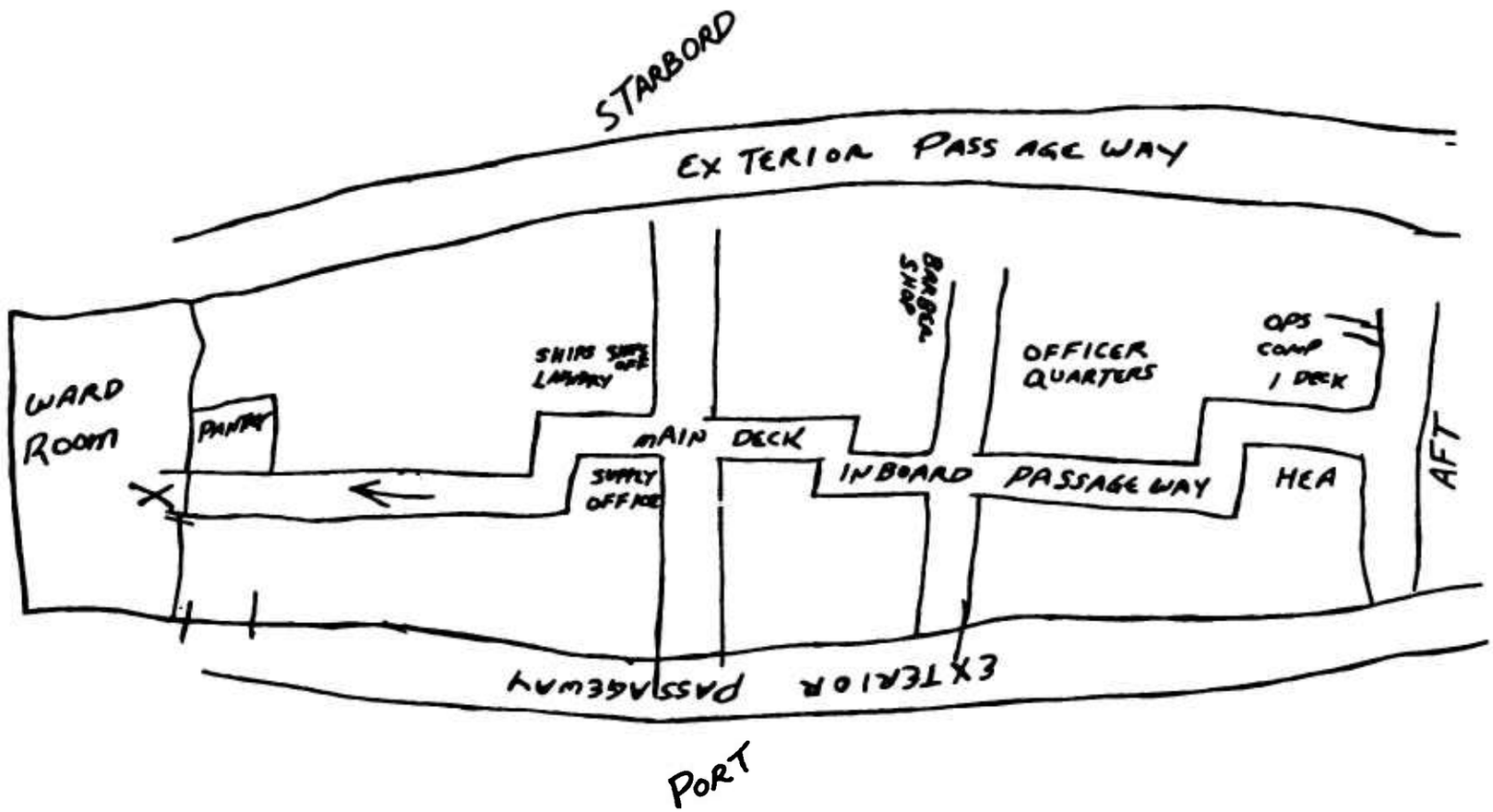

FIGURE 2

Although this study received the enthusiastic attention of its participants, it yielded only limited results. The important, critical physical features of the shipboard environment were readily identified. However, the variety of the limited number of responses precluded their systematic analysis, making it impossible to discover and isolate design principles applicable to the physical environment of ships. Given a much larger sample size and a more tightly structured response framework to enable closer analysis, the authors believe that the cognitive mapping technique holds great potential for soliciting sailor participation in shipboard environmental design.

Opinion Survey

Subsequent to exploring the above indirect method of obtaining sailor participation in the habitability design process, the authors developed and administered a questionnaire which requested sailors to directly comment on various, proposed habitability improvements. A portion of this questionnaire is presented in Figure 3. As expected, this conventional method yielded data immediately applicable to habitability design decisions. However, use of this technique must be accompanied by careful documentation of the sample population characteristics and application of this information to temper survey data.

Interviews

While developing and experimenting with the methods described above, the authors were constantly engaged in one of the most commonplace methods of obtaining user participation, i.e., informal, face-to-face discussions with individuals or small groups of sailors. Some of the most valuable insights into the shipboard living environment, as it is experienced on a day-to-day basis by sailors, were obtained in this manner. While the application of this technique on a Fleet-wide basis would be unrealistic, its value cannot be overstressed and naval architects should avail themselves of every opportunity to elicit this type of sailor participation in the habitability design process.

Given the imminent passage of the Equal Rights Amendment, it seemed appropriate for this study to explore methods of obtaining female sailor participation in the habitability decision-making process. As a first step in examining the impact of the physical design of shipboard habitability spaces on women crew members of combatant ships, four midshipwomen in their first year of study at the California Maritime Academy, Vallejo, California, were interviewed. During the previous summer (1973) these women had completed a ten-week cruise on board the GOLDEN BEAR, the Academy training ship. The experiences of this cruise were the subject

FIGURE 3

SAMPLE OPINION SURVEY

PART ONE

Many proposals are being made to improve the habitability of U. S. Navy ships. Before developing recommendations, we would like to have your views of what is needed.

Which of the following do you think are high priorities, worth considering, low priorities, or should be rejected as unnecessary?

BERTHING	high priority	worth considering	low priority	reject
1. The number of men in a berthing compartment should be reduced.	---	---	---	---
2. Berthing compartments should be divided into cubicles with 4 to 6 men per each cubicle.	---	---	---	---
3. Efforts should be made to increase privacy in a berthing space.	---	---	---	---
4. Three high bunks should be replaced with two high.	---	---	---	---
5. Lockers should be moved from the berthing area to a separate locker/dressing area.	---	---	---	---
6. Stand-up lockers should replace under the berth lockers.	---	---	---	---
7. The present system of assigning men to a berthing compartment by division/ department should be replaced with assigning men by underway watch section.	---	---	---	---
8. The present system of assigning men to a berthing compartment by division/ department should be replaced with assigning men by in port duty section.	---	---	---	---

of a discussion which identified problem areas and proposed several specific design recommendations. Following this discussion, these midshipwomen were taken aboard a U.S. Navy small combatant ship for a tour and an informal discussion of women on board Naval ships with interested members of ship's company. This discussion raised more questions than it answered, but it proved extremely valuable in quickly identifying the fundamental issues surrounding the integration of male and female crew members through shipboard environmental design. If the assignment of women to U.S. Navy combatant ships is to be successfully undertaken, such discussions should be undertaken in the future and they must receive the serious consideration of naval architects.

SUMMARY

In this paper we have advanced the argument that the shipboard habitability design process should include the participation of those most directly and intimately affected by this process. We believe this argument is supported by our research using the Shipboard Environmental Disposition Questionnaire. Several methods and techniques for obtaining participation have been discussed by us, but not in the depth they deserve. The next, important step is the development of a methodology or methodologies which can be universally employed to effect sailor participation. It is our hope that this paper will encourage those with the requisite resources and authority to undertake this project.

APPENDIX

SHIPBOARD ENVIRONMENTAL DISPOSITION QUESTIONNAIRE

This questionnaire is designed to study attitudes about living conditions onboard U. S. Navy ships. It consists of a series of statements on various aspects of shipboard living. Read each statement and decide how you feel about it (whether you agree or disagree, or whether or not you are neutral or don't know). Use the following five categories to describe your feelings:

1 - strongly agree
2 - agree
3 - neutral or don't know
4 - disagree
5 - strongly disagree

Mark your answers by circling the appropriate number to the right of each statement. Be sure to answer every statement, even if you must guess.

1.	Each man in a berthing compartment should be able to decorate and paint his locker in any way he wants.	1 2 3 4 5
2.	The Navy should make berthing spaces more attractive by moving all personal gear lockers to another, separate compartment.	1 2 3 4 5
3.	If I had my choice between an individual bunk light or bunk curtains, I would choose the bunk curtains.	1 2 3 4 5
4.	I don't need more privacy in the heads, but I would like them to look better.	1 2 3 4 5
5.	I don't mind eating in a crowded mess deck, as long as the lighting is how I like it.	1 2 3 4 5
6.	Personal gear and soiled clothes lockers should be moved to a separate space to eliminate unpleasant odors from the berthing compartment.	1 2 3 4 5
7.	I wouldn't mind living in a crowded berthing space, if I had some say in who lived in it.	1 2 3 4 5
8.	Any improvements to my berthing space should start with providing more secure lockers before money is spent on increasing privacy.	1 2 3 4 5
9.	A berthing space should be brightly lit at all times to prevent accidents, even though some men may find it difficult to sleep.	1 2 3 4 5

1 - strongly agree/2 - agree/3 - neutral/4 - disagree/5 - strongly disagree

10. Men with valuable personal gear, such as cameras, radios, and tape decks, should be given more secure lockers than other men. 1 2 3 4 5

11. In rough seas when the mess deck is unsafe, I won't go there to play cards or meet with my friends. 1 2 3 4 5

12. Ventilation in a berthing space is more important to me than its cleanliness. 1 2 3 4 5

13. In my berthing compartment, I'm more annoyed by bright lights than by unpleasant odors. 1 2 3 4 5

14. I don't care whether or not my berthing space looks nice, just as long as it's kept clean. 1 2 3 4 5

15. Personal gear and soiled clothes lockers should be moved to a separate space to reduce fire hazards in the berthing compartment. 1 2 3 4 5

16. Berthing compartments should be partitioned into small sections for privacy, even though this might make the compartment more difficult to get out of in an emergency. 1 2 3 4 5

17. Compartments used as recreation and lounge spaces should be off-limits to those men who won't keep them clean. 1 2 3 4 5

18. The type of lighting on the mess deck is more important to me than the appearance of the bulkhead and overhead coverings. 1 2 3 4 5

19. If I was offered a berthing space just as good as the officers have, I wouldn't take it if it was noisier than my present berthing compartment. 1 2 3 4 5

20. The mess deck should not be used for card games and bull sessions because this makes it difficult to keep clean. 1 2 3 4 5

21. I don't care how many people are in my berthing space, as long as it's no more crowded than any other space. 1 2 3 4 5

22. My division should be allowed to decorate our berthing space with carpeting, pictures, bunk curtains, etc., even though these might be fire hazards. 1 2 3 4 5

23. Ventilation on the mess deck has more affect on my appetite than the lighting. 1 2 3 4 5

1 - strongly agree/2 - agree/3 - neutral/4 - disagree/5 - strongly disagree

24. If I could pick my bunk, it wouldn't bother me as much if the berthing compartment I'm assigned to is noisy. 1 2 3 4 5

25. Noisy compartments don't bother me as much as ones that are dirty. 1 2 3 4 5

26. I would like to live in the most attractive and best looking berthing space, even if my friends live in another berthing compartment. 1 2 3 4 5

27. Each division should have its own lounge, even if some air conditioning equipment would have to be eliminated to provide space for it. 1 2 3 4 5

28. If I had a choice and the lighting in my berthing compartment annoyed me, I would request to be assigned to another division's berthing space. 1 2 3 4 5

29. Personal gear lockers should be removed from berthing spaces to increase the effectiveness of air conditioning and ventilation. 1 2 3 4 5

30. My sleep is disturbed more by noise than by bright lights. 1 2 3 4 5

31. Men that don't keep their bunks neat and clean should be disciplined. 1 2 3 4 5

32. The quality of the ventilation in my work space is more important to me than how safe a place it is to work. 1 2 3 4 5

33. The Navy should spend more money on making spaces easier to get to, rather than improving the quality of their lighting. 1 2 3 4 5

34. If I had some say about who lived in my berthing space, I wouldn't mind the smell of the compartment as much. 1 2 3 4 5

35. I don't mind the noise on the mess deck at meal times because I enjoy talking with my shipmates. 1 2 3 4 5

36. The appearance of a berthing space is not as important to me as being allowed to pick my own bunk. 1 2 3 4 5

37. I think more about the crowded living conditions onboard ship than I do about the chance of being injured in an accident. 1 2 3 4 5

38. I would like to have bunk curtains, even though they reduce ventilation and air flow. 1 2 3 4 5

1 - strongly agree/2 - agree/3 - neutral/4 - disagree/5 - strongly disagree

39. If there was an unknown thief in my berthing compartment and I had the chance to move out, I would still stay there to be with the other members of my division. 1 2 3 4 5

40. I don't mind being required to wear the uniform of the day when at sea because everyone else has to wear it. 1 2 3 4 5

41. Men should be allowed to read in their bunks, even if it disturbs others near them. 1 2 3 4 5

43. If conditions onboard ship were extremely crowded, I would "hot bunk" before I would share a personal gear locker with another man. 1 2 3 4 5

44. I would rather have my berthing space look nice and present a pleasing appearance than have good ventilation. 1 2 3 4 5

45. If I had a choice, I would use the closest head, even if it gave me the least amount of privacy. 1 2 3 4 5

46. More attention should be devoted in the heads to keeping the doors on the toilets and the curtains on the showers, than to keeping them clean. 1 2 3 4 5

47. The Navy should spend more money on making a secure locker than on reducing the number of people in a berthing compartment. 1 2 3 4 5

48. If the men in my division don't want to keep our berthing space as neat and clean as others, we should be allowed to do so. 1 2 3 4 5

49. I think it's more important that my berthing space be just as good as anyone else's, rather than easy to get to. 1 2 3 4 5

50. If the heads were kept cleaner and more sanitary, I feel a greater number of people could use them. 1 2 3 4 5

51. Spaces that are noisy bother me more than spaces that have an unpleasant smell. 1 2 3 4 5

52. I don't mind the mess deck being crowded at meal times because it gives me a chance to talk with a lot of my shipmates. 1 2 3 4 5

1 - strongly agree/2 - agree/3 - neutral/4 - disagree/5 - strongly disagree

53. The top bunk is the best because no one can sit on it or use it as a foot rest. 1 2 3 4 5

54. I would use the cleanest head if I had a choice, even though I would have to go farther to get to it. 1 2 3 4 5

55. As long as I can get some privacy, I don't care about the unpleasant smell in my berthing compartment. 1 2 3 4 5

56. I don't mind it when one of my friends throws his gear on my bunk. 1 2 3 4 5

57. If I had my choice, I would pick the least crowded berthing space, even if it was the noisiest. 1 2 3 4 5

58. Air conditioning in a berthing space is more important to me than how crowded it is. 1 2 3 4 5

59. The correct level of lighting should be set for each compartment onboard ship and no one should be allowed to change it. 1 2 3 4 5

60. The appearance of the mess deck is more important to me than how easy it is to get to. 1 2 3 4 5

61. I don't care if I can't pick my locker, just as long as the one I'm assigned can't be broken into. 1 2 3 4 5

62. If I had a choice, I would pick the berthing compartment closest to the mess deck, even though it meant living with another division. 1 2 3 4 5

63. Although carpeting would improve the appearance of my berthing space, I wouldn't like to see it installed because it is a potential fire hazard. 1 2 3 4 5

64. I would like to see the Navy spend more money on increasing the size and number of heads onboard ship, rather than trying to improve their appearance. 1 2 3 4 5

65. I would rather eat out of a metal tray because there is less danger of spills and breakage than with the plates and bowls which the officers use. 1 2 3 4 5

66. I don't mind the lack of privacy in my berthing space because we're all members of the same division. 1 2 3 4 5

67. If I could pick my bunk, I wouldn't be so concerned if my berthing compartment was crowded. 1 2 3 4 5

1 - strongly agree/2 - agree/3 - neutral/4 - disagree/5 - strongly disagree

68. Onboard ship, I value peace and quiet more than I value my privacy. 1 2 3 4 5

69. My division should have the best berthing compartment. 1 2 3 4 5

70. I find it is more difficult for me to sleep in a space that is noisy than one which is too hot or too cold. 1 2 3 4 5

71. Members of other divisions should be allowed to use another division's head if it gives them more personal privacy. 1 2 3 4 5

72. The mess deck should be equipped with movable chairs and tables which the crew can arrange as they like, even though they could be hazardous in heavy seas. 1 2 3 4 5

73. The smell of the mess deck doesn't annoy me during meal times because I can talk with my shipmates. 1 2 3 4 5

74. I don't care about how attractive or nice looking my berthing space is, as long as it's the same as other berthing spaces. 1 2 3 4 5

75. I think ships should be designed for accident prevention before they're designed for ease of maintenance and cleaning. 1 2 3 4 5

76. The Navy should provide more secure, theft-proof lockers, even if they couldn't be located in my berthing space. 1 2 3 4 5

77. Good lighting on the mess deck is more important than how clean it is. 1 2 3 4 5

78. I think the Navy should spend more money on making berthing compartments more attractive and nicer looking before they spend money to make them quieter. 1 2 3 4 5

79. If I had a choice, I would use the head closest to my berthing space, even if it smelled the worst. 1 2 3 4 5

80. Berthing compartments should be dimly lit or dark when men are sleeping, although this may encourage stealing. 1 2 3 4 5

81. I would rather sometimes wear dirty clothes at sea, than risk loosing them in the ship's laundry. 1 2 3 4 5

82. I'm more concerned with the crowding in my berthing space than with the smell. 1 2 3 4 5

1 - strongly agree/2 - agree/3 - neutral/4 - disagree/5 - strongly disagree

83. Even if I could pick to live in any berthing compartment on the ship, I would still stay with my division. 1 2 3 4 5

84. I like to work in a compartment that is clean and easy to maintain, even if it does have an unpleasant odor. 1 2 3 4 5

85. The Navy should spend more money on making shipboard spaces quieter, before they spend money on reducing safety hazards. 1 2 3 4 5

86. Some ratings do work which requires them to have better ventilated spaces than other ratings. 1 2 3 4 5

87. I'm bothered more by the lack of privacy than not being able to pick my berthing compartment. 1 2 3 4 5

88. I wouldn't mind living in a crowded berthing space, as long as it was close to the mess deck and my work space. 1 2 3 4 5

89. As long as it's easy to get to, I don't mind being assigned to a berthing space. 1 2 3 4 5

90. If I could have some say in the design of my berthing space, I wouldn't be so bothered by the smell in the compartment. 1 2 3 4 5

91. The Navy should spend money on crew's lounges for each division, rather than on air conditioning equipment. 1 2 3 4 5

92. Some work spaces onboard ship require and should have better lighting than other work spaces. 1 2 3 4 5

93. I would rather have some say in which berthing compartment my division was assigned to, than being able to pick my bunk within the space. 1 2 3 4 5

94. If I had a choice, I would use the head with the best ventilation, even if I had to travel farther to get to it. 1 2 3 4 5

95. The noise of people opening and closing lockers should be eliminated from my berthing space by moving personal gear lockers to a separate compartment. 1 2 3 4 5

1 - strongly agree/2 - agree/3 - neutral/4 - disagree/5 - strongly disagree

96. I don't care if my berthing space has an unpleasant smell, as long as its odor is no worse than that of other berthing spaces. 1 2 3 4 5

97. Once a satisfactory temperature and ventilation level is set for each compartment onboard ship, no one should be allowed to change it. 1 2 3 4 5

98. Compartments onboard ships should have more hatches and ladders to make them more accessible, even though this might create more safety hazards. 1 2 3 4 5

99. Men shouldn't be allowed to play their radios and tape decks in berthing spaces because they make too much noise. 1 2 3 4 5

100. When using the head, having to wait in line annoys me more than the lack of privacy. 1 2 3 4 5

101. The Navy should spend money improving the safety of ships before they spend money on equipment to reduce unpleasant odors. 1 2 3 4 5

102. I don't mind that the officers have better living conditions than I do, as long as I can have some privacy. 1 2 3 4 5

103. If I could pick my berthing space, I would pick the quietest one, even if it was difficult to reach. 1 2 3 4 5

104. I don't mind living in a space which is drab and monotonous as much as I mind living in a space which has an unpleasant odor. 1 2 3 4 5

105. As long as I'm treated the same as everybody else, not being able to choose my berthing compartment or pick my bunk is not that important to me. 1 2 3 4 5