Departments

Special Report

Women in Japan Physical Society*

The Paris Conference Preparation Committee Survey Analysis Group

This special report describes the current status of women in Japan Physical Society, as presented by the Survey Analysis Group through analyses of the responses from JPS members on the Questionnaire reprinted as an appendix. It consists of the preface by the Survey Analysis Group Chairperson and three separate analysis reports by the Group, followed by the Questionnaire in its original form.

1. PREFACE

The Physical Society of Japan (JPS) conducted an all-member survey in September 2001, to collect information in an effort to improve the research environment of its members. This was prompted by a request made by the IUPAP (International Union of Pure and Applied Physics) in September 2000. JPS and the Japan Society of Applied Physics (JSAP) were asked to establish a working group, "Women in Physics, " and to send the representatives from this group to the International Conference scheduled for March 2002 in Paris. The JPS established the Paris Conference Preparation Committee, chaired by Dr. Kazuo Kitahara, in order to study the current situation of its female members.

After evaluation and discussion, the Paris Preparation Committee decided that the scope of the survey should include all of the members. The results could then be used to improve the research environment for all members and vitalize their research, regardless of gender.

The Survey Analysis Group, established by the Paris Preparation Committee, first analyzed the survey results with a focus on the female researchers, in order to prepare for the Paris Conference. The Analysis Group started to compile the survey results at the end of November, and completed the analysis just before the Paris Conference, after a number of meetings. The survey was a joint project between the JPS and JSAP, but each asked different questions, reflecting each society's situation.

I reported the results of the survey by these two societies at the Paris conference. Since Japan was the only country that made such a report based on a survey, the presentation drew international interest, and we have received many inquiries regarding the survey results. In response, we have decided to publish an English version of the survey results.

by Masako Bando, Survey Analysis Group Chairperson,
November 2002

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2. RESEARCH ENVIRONMENT FOR FEMALE PHYSICISTS

2.1. Introduction

In the year 2001, The Physical Society of Japan (JPS) conducted a survey regarding the research environment for its members in order to understand the current status of its members' work and family environments as well as their achievements. The direct motivation for this survey was the conference Women in Physics (Paris International Conference) held in March 2002. Per IUPAP'[†]s request, JPS formed the Paris Conference Preparation Committee (chairperson: Kazuo Kitahara) and the Japan Society of Applied Physics (JSAP) formed the Joint Committee of Male and Female Physicists (chairperson: Kashiko Kodate). Both committees conducted member surveys as a joint project in order to understand the current situation of the female physicists. The two committees communicated closely to develop the survey, while the survey also reflected their own perspectives [1]. The JPS decided to survey all its members, seizing this opportunity to obtain valuable information that may contribute to the improvement of the research environment for all members, not limited to female physicists. Some of the current issues in the researchers' environment include the postdoctoral fellowships and mergers of the universities [2]. JPS distributed the survey from September 8, 2001 through November 15, 2001, as inserts in Butsuri (JPS monthly periodical written in Japanese) and on the web. The survey included four categories of questions: research environment, family environment, research achievements, and opinions and views [3]. This report (I) focuses on the research environment for female physicists, but we plan to report subsequently on other topics, such as family and career, research achievements, and awareness. The JPS also received various requests and valuable comments concerning the organization as well as educational policies by the government. We will report on these later.

2.2. Basic Data

Table 1 shows the number of the JPS members and the rate of response. The overall response rate was 13%. Although only 4% of the total number of JPS members is female, their response rate was as high as 8%, or one out of every four female members responded, reflecting their strong interest in this survey.

Figure 1 shows the age distribution of the respondents by 5-year increments. The number of respondents is the highest among the age group of early 30's, and gradually declines thereafter. This is consistent with the age distribution pattern of the members. Fig. 1 also shows the percentage of female respondents: the age distribution pattern differs from the overall age distribution of the members, but it is consistent with the age distribution of the female members. These distribution patterns are different from those of the JSAP, where the percentage of female membership changes significantly over the age of 40 [1]. As described below, these differences reflect the historical changes in the government's science policies and the social situations surrounding female physicists.

2.3. Type of Institutions and Ranks of the Respondents

The institutions that the respondents belong to are classified into three types: universities, corporations, and research institutions. Approximately 60% of the JPS members belong to universities, in contrast to the JSAP, of which 60% of the members belong to corporations. Due to the space limitation, this report will focus on the universities, where the majority of our members belong.

	Total	Female members	Percentage of female members
# of members responding	2,619	214	8%
# of members	19,590	868	4%
Response rate	13%	25%	

Table 1: Number of JPS Members and Response Rate.

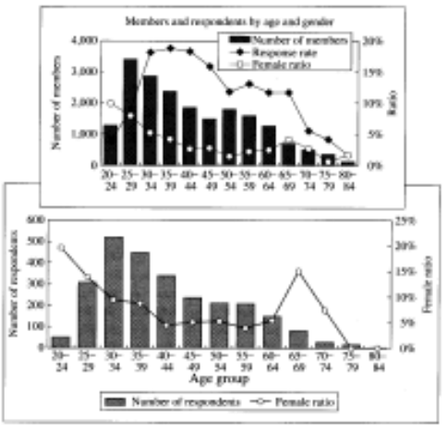

Fig. 1: Members and respondents by age and gender.

Out of all the respondents who work in academia, 58% (both men and women) work for universities with graduate schools, and men and women belong to the same types of institutions. However, there is a distinctive gender difference in the academic ranks. Forty percent of the female respondents are graduate students or postdoctoral fellows without full-time jobs, compared to 17% of male respondents: the remaining 83% of the male respondents have full-time jobs. Fig. 2 shows the gender ratios for each academic rank, and the graph shows an "impossible to pursue" pattern[ε] . In Europe and the US, this phenomenon is called a "leaky pipeline," which means that the women continue to "leak" from the pipeline of the academic ladder, as the rank becomes higher. Fig. 2 also shows the number of university students who major in science and applied engineering. The female ratio of these doctorate students is 7%. Considering that the response rate of female graduate students was 14%, the female response rate was double the overall response rate, as described in section 2 above.

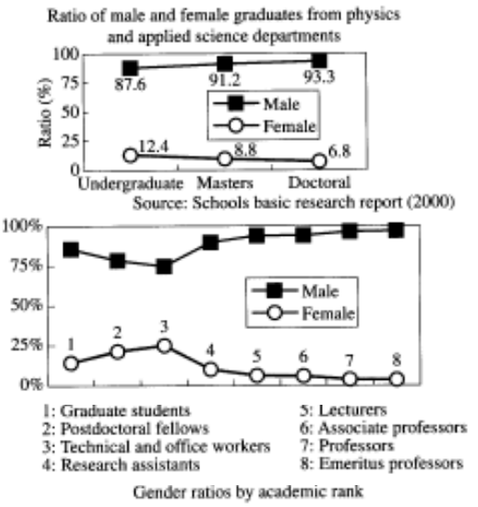

Fig. 2: Distribution of university job positions and physics students.

2.4. Physicists' Careers and Academic Ranking Index

We also examined the average career progression of researchers in academia in terms of their academic ranking at the universities. Fig. 3, the age distribution by academic ranking, shows clearly that the age distribution peaks shift as the academic rank changes from assistant to associate professor and professor. With age 27 as the average starting point (when the students obtain their doctoral degrees), it takes five years to become a research assistant, 10 years to become a lecturer, 15 years to become an associate professor, and 30 years to become a full professor, on average. Based on this, we assigned an academic ranking index of 1, 2, 3, and 6 for these ranks[§].

Figure 4 shows the average academic ranking index by age group. The similarity to the age distribution pattern of the female respondents as shown in Fig. 1 is more evident in this figure. Fig. 4 also shows the job title index in corporations by age group, based on the data provided by the JSAP (see the footnote). The graph pattern is again similar to that of the ratio of female JSAP members. The variance between age groups seems to be a reflection of the change in the social environment.

Next, we will discuss the political and social changes since the 1960's, in an attempt to identify the factors that caused these variances.

2.5. Career Progression and Societal Changes

It is clear in Fig. 4 that the job position index is high for women under the age 50 in corporations, which is a reflection of corporate employment policies. Public outcries against the inequality between men and women increased after the International Year of Women (1975), and the Equal Employment Opportunity Law for Men and Women was enacted in 1985. The effect of this social change can be detected in the age group of students who graduated from college during and after 1975 (right arrow in Fig. 4), and the gender difference in employment was mostly eliminated by 1985 (left arrow in Fig. 4). The gap between the 30's age group and the 40's group in female JSAP respondents can be explained by this change in the employment situation, since approximately 60% of the JSAP members work for corporations [1].

The academic ranking index shows a different age distribution pattern. The academic ranking index for men continues to increase with age, and reaches the saturation point when it

[ε] *The "impossible to pursue" pattern means that the female ratio remains low from the beginning (as students). There are other patterns, such as the "scissors type" where the male and female ratios are the same in the beginning and then the female ratio declines as the rank becomes higher, and the "dangerous crossing type" where the female ratio is higher at the lower ranks and the male ratio exceeds the female ratio as the rank becomes higher. At the Paris conference, in response to the question if there is any pattern where female ratio increases, Prof. Hermann (École Polytechnique) answered that there is only the "leaky pipeline" type. We express our gratitude to Prof. Hermann who provided the information.*

[§] *During a meeting with Dr. Miyoko Watanabe, Chairperson of the JSAP Analyst Group, she introduced us the concept of the "job title index," which quantifies the job positions and titles. We tried to use this index, but it turned out that this index is not suitable for the academic ranking, as there are many postdoctoral fellows and graduate students involved. We named our index "academic ranking index" in order to differentiate from the "job title index," but the concept is similar in that the hierarchy of the positions is quantified. We would like to express our appreciation to Dr. Watanabe for introducing us this excellent analytical method.*

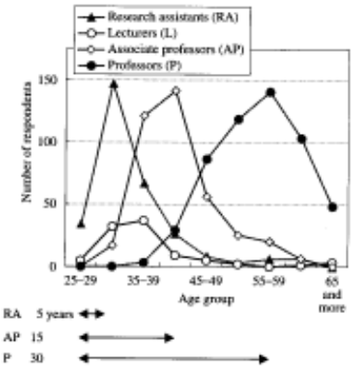

Fig. 3: Age distribution by academic rank (male members only).

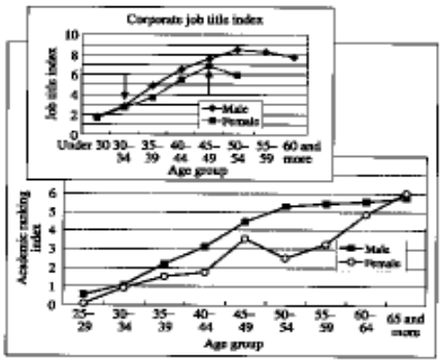

Fig. 4: Age distribution by average academic ranking index (Universities, junior colleges, and technical colleges).

nears the index of 6. On the other hand, the academic ranking index for women dips twice and is always lower than the men's, but it comes very close to the male index at the late 40's and 60's age groups.

Now we look at the changes in the government's educational policies, as they relate to the ratio of women in academia. The number of students in science departments doubled in the 1960's due to the so-called "Science Boom," which entailed an increase in the size of university faculties. In particular, the size of Physics departments increased substantially from 1966 to 1970. This is the reason for the increase of the 60's age group. The student increase after 1970 mainly occurred in the medical schools, and there was no increase in the number of Physics students from 1970 to 1990. Consequently, the female ratio is low for the age groups of early 40's and early 50's. The student increase in the years after 1987 was a result of the temporary faculty increase to accommodate the "second baby boom" generations. The number of students in public and private universities increased nationally during these years, and the employment rate of university faculty increased. The female academic ranking index is directly affected by these two booms. The female ratio of Fig. 1 reflects this. The faculty employment policies directly affect the female ratio. The reason for the variance in the female ratios between age groups was not apparent from Fig. 1, but it became clearer as we separated the respondents based on the institutions they belong to, as the respondents consisted of both academic and corporate members. The female ratios in both corporations and universities are largely dependent on the employment policies and education policies of Japan.

The turning point of the employment policies in Japan had direct effects on the age distribution pattern of the JSAP members and their job position index in corporations, but hardly any impact on universities: the educational policy changes had more effects in academia. The impact of policy changes on the workplace implies that this may be applicable to fundamental issues facing us today, such as postdoctoral issues, which may change the direction of the academic world.

We would like to acknowledge the Yukawa Institute of Theoretical Physics, which supported our analysis in cooperation with the research group, as well as the International Christian University, which provided us with the workplace. Professor Kazuko Kitahara gave us valuable comments on this report. We also learned much from the JSAP, especially Dr. Miyoko Watanabe, who worked on this joint project with us. Above all, this project would have been impossible without the cooperation of the members, who spent their valuable time in responding our survey. It is our sincere hope that this valuable data will be used to improve the research environment for the members and to vitalize the organization.

3. FAMILY

3.1. Introduction

Following the previous report published in the May journal [5], in this report we will further analyze the member survey results [6], focusing on the family situation and awareness.

The purpose of these questions was to help our members plan their family and career life-cycles and to find a way to improve the research environment for the members, by analyzing the relationship between family and career from various perspectives, including gender, workplace, academic rank (job position), achievements, and social support systems. Various phases of family life, such as marriage, parenting, and caring for elderly parents, have serious impact on the members' career and family life-cycles, especially in that the parenting phase overlaps the period when the members start building up their career and the caring for parents phase overlaps the period when they are in more responsible positions such as managing the workplace or directing research programs. This report roughly summarizes how the conditions have been changing over time for members who have to manage both family life and science career, especially considering gender differences. We hope this issue merits further analysis

with detail in the future†.

3.2. Marriage and Parenting

The marriage experience rate for men continues to increase with age, until it reaches almost 100%. For women, however, the marriage rate exceeds 90% by the early 40's, but then the rate does not increase any more, and remains in the range of 80%±10% thereafter. The high marriage rate of the female respondents younger than 50 years old indicates that it has become quite common for female JPS members to have both family and career. This change is also reflected in the fact that spouses of over 50% of the male respondents younger than 50 (over 40% of total) have full-time or part-time jobs. Almost 70% of the female respondents' spouses are either university faculty or researchers. To have a social foundation to support the family and career is becoming an important issue for both men and women.

Now we will turn our attention to the relationship between parenting and pursuing a science career. Fig. 5 (a) shows the gender ratio of members with children, and Fig. 5 (b) shows the average number of children by gender and age group. The vertical axis is the ratio of the respondents with children for that age group to all the respondents, including single members. The ratio of the members with children increases with age, and the average number of children peaks at two for male members, whereas both the ratio of members with children and the average number of children remain low for female members over 40 years old. Categorized by the academic ranking, the average numbers of children of female members with full-time jobs at universities are: 1.1 children for professors, 0.8 for associate professors and lecturers, and 0.6 for assistants and technicians. The average age of members increases as the academic rank becomes higher, and so does and their average number of children. No particular difference due to parenting responsibilities is seen among the academic ranks within female members with full-time jobs. The same can be said for their achievements, and there seems to be no apparent effect of parenting [7]. According to the JSAP's report that analyzed the results sorted by the type of research institution [8], men and women of age 44 and younger working for corporations have the same average number of children, hence no gender difference there. However, at universities, female members between their late 30's to early 50's have half the average number of children compared to their male counterparts. Furthermore, female postdoctoral and research fellows under fixed-term contracts have an extremely low average number of children. Based on the survey results by both societies, it seems that it is difficult for female postdoctoral and research fellows under fixed-term contracts to have children, but once they obtain full-time jobs, having children does not hinder their long-term advancement or achievements.

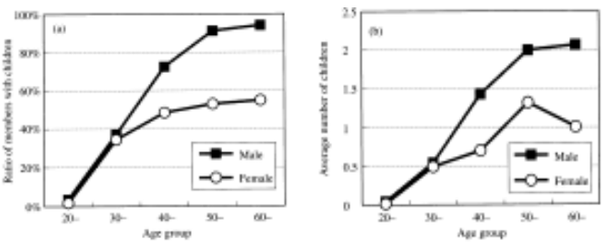

Fig. 5: (a) Members with children by age group and (b) average number of children by age group.

Out of the 528 respondents (out of which 61 were female) who have parenting experience, only 13 (out of which 10 were female) respondents have used the childcare leaves of absence. According to the survey by the JSAP, more than half of the corporate members between 35 and 44 years old have used childcare leaves, indicating that the Childcare Leave Law, enacted in 1992, is in fact functioning in the corporate world. In contrast, the percentage of the JPS members who have used the childcare leaves is very low. It could be a reflection of social and psychological pressures, such as the lack of substitutes and anxiety about possible delays on the research projects, despite the existence of the childcare leave system. Compared to elementary and intermediate school classes, it may be more difficult to find temporary replacements to teach a highly specialized college-level course. It is imperative to establish practical systems that support the childcare leave system, including establishing common pools of substitutes with budgets allocated, and standardizing specialized education programs to secure flexibility. At the same time, an alternative system to supplement the childcare leave should be created, considering the unique characteristics of the teaching and researching professions, such as a partial job support system. It is critical to eliminate the anxiety about the effect of raising children during the career development phase, for the sake of the young researchers and postdoctoral fellows in particular.

Figure 6 shows the grade level of the children of the male members by age group. This distribution pattern is almost parallel to the life stages of the members with children. The grade level of the member's children increases almost proportionally with the age of the members, implying the same pattern of life stages for most of the male members. On the other hand, the pattern was similar with the younger generation of female members (aging from late 20's to early 40's), but the average age of the children does not reach the peak with the female members' higher age, indicating considerable variance in individual life-cycle patterns among female members.

†*The task force established in order to analyze this survey focusing on the female physicists was dissolved at the end of March upon completion of the project. The JPS plans to establish a new analysis group to conduct surveys from various perspectives as an on-going project.*

As for the childcare facilities, an overwhelming percentage of members of every generation uses public childcare centers for their infants and toddlers. The public childcare centers started to increase nationally in the mid 1960's, playing an important role in the scientists' world. It is hoped that more childcare facilities be built within the communities and research institutions. The percentage of members who ask their parents and friends to take care of their children increases with the older generation, and the percentage of the members who use housekeepers (including baby sitters) is also increasing lately. It would be necessary to consider a way to reduce this economic burden as part of the childcare support policies.

3.3. Caring for Parents

The percentage of members with parent-care experience increases in the late 40's age group, and more than half of the members in their late 50's answered "yes" to the question. The average care period is 3 years. The number of female members who have parent-care experience increases suddenly from the late 40's, which reveals that many female members must care for parents right after rearing their children. As for the type of care, over 50% of the female members answered that they take care of their own parents themselves, and over 30% take care of their spouses' parents. Male members very often depend on the "care-taker in the family," but still, over 30% of the male members take care of their own parents themselves. It is expected that both male and female members will need to spend more energy, time, and economic resources for caring elderly family members as they reach age 50. The results of this survey provide valuable information for the members' final stage of their lives, and more detailed analysis should be conducted.

3.4. Time Spent on Management and Family—Ideal and the Actual

How does the number of hours spent by the members outside research and study change in relation to the stage of their life cycles? We surveyed the ideal and actual number of hours spent on (1) management of the workplace or projects and (2) housekeeping and childcare. As shown in Fig. 7 (a), both men and women of all age groups want to keep the ratio of administration-related work hours to their research time to less than 40%, but the reality is far from the ideal. Members over age 50 are spending about the same amount of time on management and administrative work as on their research. With age comes more administration-related work, negatively affecting the time for research.

As for the time spent on housekeeping and childcare, the average ideal ratio of time to research time is 35% for male members and 52% for female members, as shown in Fig. 7 (b). The responses reflect the members' plans for coordinating families and careers. In particular, female respondents in

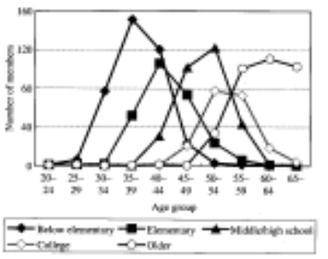

Fig. 6: Grade level of children (male members only).

their 30's with young children want a ratio of more than 60% for housekeeping and childcare versus research time, which suggests that their involvement in their family lives is especially important at that stage of their lives. In reality, the average ratio of time actually spent on housekeeping and childcare to research time is 23% for male members, indicating that they have been unable to enjoy family life as much as they want. The ideal and actual ratios seem to match for female respondents in their 30's. However, the actual number of hours spent on housekeeping and childcare exceeds the ideal for female members in their 50's, implying that the housekeeping and childcare is becoming a burden for them. There is very little fluctuation for male respondents among age groups, but the ratios of both actual and ideal hours spent on housekeeping and childcare declines with their age. Male respondents in their 50's spend less than 20% of the hours they spend on research with their families, while they spend much more time on administrative work. According to Fig. 6, this age group has children of middle school to college age, the critical age when the children mature through adolescence into adulthood. According to the survey by the JSAP, mothers with children of approximately 18 years old expressed their wishes that the fathers spend more time with their families. It is important to understand the gap between spouses' expectations and reality.

When we compare the time spent on administrative work versus housekeeping and childcare by female respondents according to academic rank, the ratio of time spent on administrative work to research time increases to 60% for full professors, while the ratio of time spent on housekeeping and childcare declines to 25%. On the other hand, the ratios of

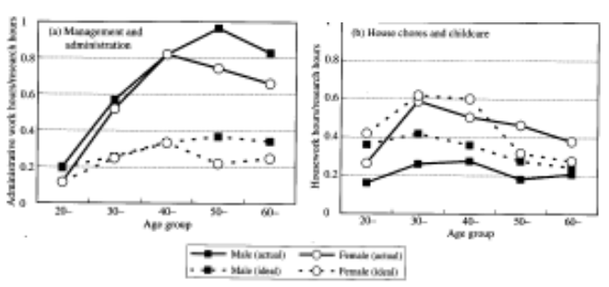

Fig. 7: Ideal and actual ratios of time spent on (a) managemental and administrative work to research time and (b) house chores and childcare to research time.

time spent on administrative work and housekeeping/childcare to research time are both 50% for associate professors and lecturers, indicating that they have to juggle between family and career.

3.5. Future Tasks—Understanding Life Stages

Despite the private nature of these questions, which ask about their marriages and caring for children and parents, over 2,500 members responded (13% of all members or 97% of all the respondents), showing their deep interest in the issue of family and career. Both men and women cherish the desire to be connected with their family, and to have a meaningful relationship with their family, including caring for children and parents. As mentioned in the beginning, the purpose of the detailed questions about family issues was to clarify the issues that the JPS should address, in order to improve the research environment for the members. Through our rough analysis, the relation between the career stage as scientists and life stage as family members has come to the surface, although it is still somewhat obscure. It would be necessary to spend more time analyzing this valuable data.

As for the environment surrounding female physicists, our analysis suggests that neither marriage nor children are negative factors affecting their research projects or advancement in the long run, especially once they obtain full-time jobs. In other words, once female physicists gain self-awareness as scientists and if the conditions to continue their work are met, women can pursue careers as scientists and have families. However, since the scope of this survey was only JPS members, the respondents are basically all "survivors" who were able to continue their careers. We could not reach the women who gave up their careers, who were outside the scope of this survey.

At the end, we would like to emphasize that we paid utmost attention to protect the individual members' privacy by using pre-processed answers in order to maintain anonymity. For highly personal questions, we ensured that the population size should not be less than 10 people for statistics data sorted by gender or age groups.

4. RESEARCH ACTIVITIES OF FEMALE PHYSICISTS

4.1. Achievements and Recognition as Physicists

This is our third report on the JPS member survey, following the report in the August journal. We will focus on research environment for the members in this report. One of the characteristics of this survey was the in-depth questioning about the achievements of the members. These questions were not easy to answer in short time, but we received responses from 2,619 members. The collected data provides us with a valuable information source when looking into various issues, such as research environments, nurturing young researchers, and postdoctoral fellowships. This report mainly focuses on the female-related issues. We hope to suggest ways to improve the research environment for members, while introducing the comments and opinions expressed by members in the comment column of the survey.

4.2. Nurturing the Researchers

There is hardly any gender difference in the education level of the respondents, since college education became available to women half a century ago. The peaks of the age distribution are at 22 years for bachelor's degrees and 24 years for master's degrees for both men and women, although women finish their doctoral courses or degrees slightly later. However, male students overwhelmingly outnumber female undergraduates and graduate students in Physics. In order to find the reasons for this, we should understand the current employment situation in this field. Very few Physics[‡] graduate students have work experience[∫] . Over 80% of the male and female graduate students have student loans, and quite a few female members listed "avoiding debt" as the reason to refuse student loans[¶] .

4.3. Qualifications for Employment

Employment opportunity deeply affects researchers' career development. On average, it took the longest for both male and female members in their late 40's to 50's to find a full-time job after getting a doctoral degree (See Fig. 8 (a)). This pattern is most obvious for female members. The two peaks for female members in Fig. 8 (a) correspond to the two dips in Fig. 4, "Academic Ranking Index Chart." The same pattern is evident for the number of employment applications they submitted and the reason for changing majors. For example, the percentage of members who changed their major is approximately 60% for both men and women. However, in the same age groups, more people changed their majors for a reason other than "change of interest," that is, they changed majors to find jobs Fig. 8 (b). Regardless of gender, younger generations are increasingly changing their majors to find jobs, sug-

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[‡] *According to the study by Lehman following Challot Buhler's study regarding age and science productivity, the most productive age depends on the field of study. Productivity peaked at 30-34 years old for physics, 34-38 for mathematics, 35-39 for medicine, 43-47 for astronomy, and 38-42 for literature. The scarcity of the work experience among Physics majors may relate to the fact that scientifically, they are most productive in their young age.*

[∫] *The scarcity of the work experience among Physics majors may also be because of the nature of the subject, its research styles, and academic phases.*

[¶] *The actual number of the respondents who cited this reason was small, since only 20% of the respondents did not have student loans.*

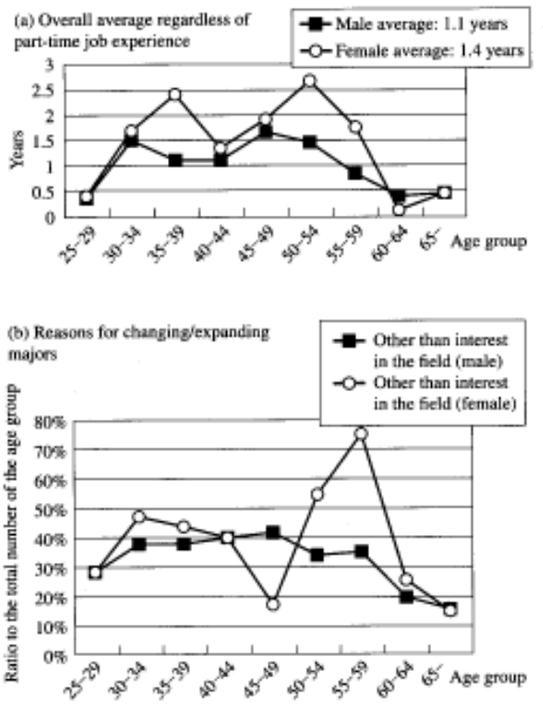

Fig. 8: (a) Number of years as part-time lecturers, OD (over-doctoral), PD (postdoctoral) by age group and (b) ratio of respondents who changed their majors due to job reasons.

gesting the seriousness of the postdoctoral employment problems. It seems that the current postdoctoral generation is facing the same employment situation as female physicists in the 50's age group were facing when they were postdoctoral fellows.

The open recruiting system represents the principles of fairness, transparency, and openness. According to the survey, approximately 70% of the female and 50% of the male members in their late 20's found their jobs through open recruiting systems. In contrast, only 30% of both male and female members found their jobs through open recruiting systems in their 50's. It seems that the open recruiting is becoming more available for the younger generations[✦].

4.4. Achievements

There are various types of achievements in science[☆]. Table 2 shows the average ages when members first accomplish the benchmarks of a science career (listed in the survey), in ascending order. In academia, verbal presentations at domestic conferences or workshops are very often the first benchmarks of a career, whereas development of technology is often the first benchmark in industry. Then, as the career progresses, the members begin to present theses in peer-reviewed journals, file patents, give presentations at international conferences, and publish articles in popular magazines and books. For members over 40, opportunities to serve as board members for academic societies or as managers in the workplace increase. In this report, we will introduce only some of the typical achievements of scientists affiliated with universities due to the space limitation.

Achievements	Male (Age)	Female (Age)
Presentation at domestic conference	24	25
Publishing a thesis	26	26
Developing technology	28	26
Lecturing at international conference	30	30
Patent application	32	31
Publishing an article in a general/popular magazine	32	31
Publishing a book	37	35
Leading a domestic workshop	39	39
Serving on a committee for an international conference	41	40
Serving on the board of a domestic academic societies	41	42
Chairing an international conference	41	42
Managing a workplace	42	45

Table 2: Average age of first major achievements (in ascending order).

Considering the statistical margin of error, we will discuss the age groups by increments of 10 years in the following section.

Figure 9 (a) shows the accumulated number of papers published by the members. According to this figure, the number of papers published by female members starts to fall behind that of male members in the late 40's to 50's age groups. The number of lectures given at the domestic workshops shows the same trend, albeit less conspicuously. The number of presentations and lectures at international conferences are about the same for men and women for short-trips, but there is a distinctive gender difference in the number of long-term overseas experiences. (See Fig. 9 (b)) On the other hand, female members published more books on average. (See Fig. 10 (a)) Another distinctive achievement is to serve on the board of a domestic academic society. (See Fig. 10 (b)) Since members generally start serving on boards after age 40, as described in Table 1, we focused on the data of members who are 45 years

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✦ *The percentage of female members who found their jobs through open recruiting systems are 70% for the late 20's age group and 10% for the age group of 65 and over, compared to 50% and 30% for male members in the same age groups. Although we cannot elaborate due to the space limitation, the ratio of members who found their jobs through open recruiting systems is slightly smaller for female members over 40 years old, albeit with some exceptions.*

☆ *If we do a factor analysis of the correlation of research activities, we can create an index to quantify the achievements. This is one of the tasks that need to be done in the future to analyze the research environment for members in more detail.*

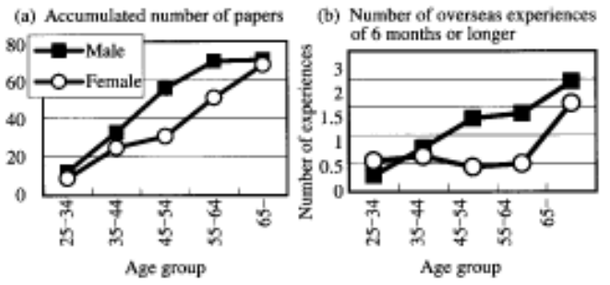

Fig. 9: (a)Accumulated average number of papers published by age group and (b) age distribution in the number of overseas experiences.

or older. The gender difference is obvious in these age groups. This is also the case for chairing international conferences and closely reflects the academic ranking index shown in Fig. 4 and Fig. 8, indicating general positions of the members. We also looked for an effect of having children for female members, to see if the gender difference in the number of papers and lectures that are seen in the middle age group is related to parenting, but we did not find any significant difference in the statistics.

Figure 8 indicates that a large percentage of the female generation that went through the difficult employment situation changed their majors for reasons other than their interest. We

Fig. 10: (a) Number of published books by age group (b) Number of board-member experiences by age group.

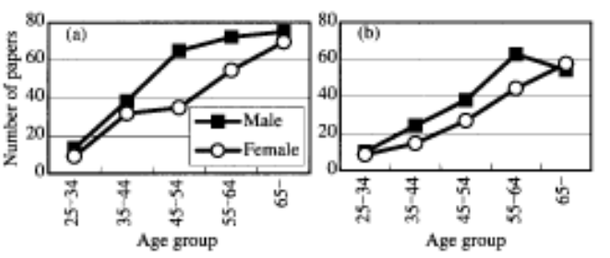

Fig. 11: Accumulated number of papers published by age group. (a) Respondents who did not change majors or who changed majors due to their interest. (b) Respondents who changed majors for reasons other than their interest.

compared the number of papers published to the reasons for changing majors. We found that both male and female members who changed their majors due to the reasons other than their interest have published fewer papers. (See Fig. 11) This was an interesting finding, although more detailed analysis is necessary.

The accumulated number of published papers is not appropriate to correlate directly with a particular time period, and it is better to use more microscopic approach. For example, a research activity index can be defined as: the average number of papers per year = accumulated number of papers/(age – 23), where the research starting age is assumed to be 23. Using this approach, we find that there is a tendency for female scientists to regain their research activity index at the older age. This may be called a "recovery phase." (See Bando's report at the Paris Conference.) This is still just an assumption, but other researchers are finding the similar trends. We should analyze microscopic activity indexes for each stage of the research career, in order to find a way to improve the research environment.

4.5. Scientists' Awareness and Direction of Improvement

How do the members view the current research environment and their achievements? To the question "How much qualification is needed and how much effort must women make to obtain the same position as men," men responded "same degree" regardless of their ages, but younger-generation women responded "1.5 times more," and women in their 50's responded "2.2 times more." In general, women think they need much more effort (average 1.7 times) than men to obtain the same position, and there is a substantial gap in the awareness of this gender bias between men and women. This question was asking about the current situation, but approximately 20 respondents commented (in the comment column) that they were not sure if the question was asking about the current situation or how it should be.

As for opinions about affirmative action, most of the members support the public recruiting system regardless of their gender (male: 88% and female: 90%). However, a slightly higher percentage of male members in the older generation responded "neutral" or "negative" to the public recruiting system question. It is essential to clarify the reasons for these oppositions or hesitations, to address any problems with the public recruiting systems, and to create a more effective public recruiting system. The approval rate of the quota system for female faculty was 40% among male respondents and 70% among female respondents. According to the proposal by "Kokudaikyo" (Japan Association of National Universities), the overall ratio of female faculty in national universities should be raised to 20% as a final goal, equal to the ratio of female graduate students, and each university should establish a quan-

titative goal, based on the gender mix of each department. The target female faculty ratio for physics would be 7% based on the current gender mix of the student body, but there were opinions in the comment column that the goal should be set at 20% for Physics as well. The same trend was observed regarding the quota system for policy-making committees.

4.6. Comments from the Survey

Out of 2,619 respondents (2,397 male, 214 female and 8 unknown), 436 (17%) provided feedback in the comment column. Of these, 377 (16%) were male and 59 (28%) were female. The contents varied in nature, and it provided us a good opportunity to hear from the members directly. We classified the comments into six categories. The following is our summary of the comments.

1. Opinions about the survey (182 respondents)—107 respondents commented on specific questions of the survey. In particular, there were opinions such as "it was unclear whether the question was asking about the current situation or the ideal," and "the viewpoint of this question is too biased toward universities," regarding the question #29.

2. Opinions about the JPS and government policies (111 respondents) :

(1) Issues specific to the JPS included: "nominate more female members to the committee," "request more journal articles from female members," "commit to promote physics education," etc.

(2) Issues related to university employment: Many respondents commented that in principal, university faculty should be publicly recruited, and that the selection process should be fair, open, and transparent. There were also a small number of negative opinions about the public recruiting system. Some respondents also expressed concerns that the fixed-term systems are too biased toward assistant positions.

(3) Issues related to policymaking included: "postdoctoral support (young researchers)," "improved treatment of graduate students," "repayment options for student loans," "research expenses (distribution, more flexibility in the number of available years, qualification)," etc.

3. Issues related to childcare and adult care (27 respondents)—Appreciation of the daycare provided by the society, request to expand the public childcare facilities, pointing out the lack of consideration for caring disabled family members, etc.

4. General opinions and comments (83 respondents)

5. About Question #29 (20 respondents)—Half of these commenting respondents mentioned that more efforts are required from women to obtain the same position as men in reality while there should not be any gender difference in the ideal world.

6. About Question #30 "Quantitative goal of female faculty (teachers and researchers)" (147 respondents)—131 male respondents commented on this question, out of which 20 were in favor of the quantitative goal and 73 were against. Thirty-eight respondents were neutral, or had specific opinions. Sixteen female respondents commented on this question, out of which five approved, eight opposed and three were neutral, or had specific opinions. The reasons for the approval or disapproval vary, but the following are the keywords that appeared most often in their comments:

(1) Gender-related terms: discrimination, differentiation, counter-discrimination, gender, equal, public recruitment

(2) Achievement and ability related terms: ability, competence, achievements, performance, renewed awareness

(3) Living environment related terms: environment, childcare, nursing, household chores

The above is a summary and distribution of the opinions and requests expressed in the survey by the members. Numerous important issues have been raised, which deserves attention and discussion by the JPS. These issues need to be analyzed in more detail so that the JPS can properly address them. We also received an opinion that the analysis results should indicate the statistical margins of error. This is a very valid opinion. Unfortunately, the absolute number of the responses from female members is so small that the statistical error is somewhat large. Therefore, these results represent only qualitative trends. However, when analyzing all the researchers combined, each cell includes about 10 times as many, so that data is more reliable. We expect that a future analysis of the issues facing young researchers and their environment will be reported with the statistical margins of error included.

4.7. Closing Remarks

We have reported the results of our analysis of the JPS member survey in three reports I, II, and III (in the May, August, and September issues). We discussed the survey results from a perspective common to men and women in Report II, but we focused on the research environment surrounding the female physicists in Reports I and III. The purpose of the survey, conducted from September through November last year, was to understand the current educational and research environment surrounding JPS members from various viewpoints. Further analysis of the results from other angles should help to identify issues that need to be addressed by the JPS. We would like to conclude our report by reporting that a new analysis group will continue to analyze the survey results in such directions.

5. REFERENCES

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[2] See Butsuri **56** (2001) 637 for a detailed background.
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[4] Science Policies in the European Union, A report from the ETAN Expert Working Group on Women and Science (2000).
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[6] Insert questionnaire Butsuri **56** (2001) 718.
[7] Report III on the JPS Member Survey—Research Activities of Female Physicists, Butsuri **57** (2002) 673.
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APPENDIX

The Questionnaire for JPS Members

Please mark an x in □ for your choice.
Please write figures or words within the [ ].

Firstly we will ask you about your present situation.

1. Age: (Sep., 2001) [ ] years old
2. Sex: □ female □ male
3. Nationality: □ Japanese □ Non Japanese Nationality [ ]
4. School Education: Undergraduate degree [ ] years old, Master's degree [ ] years old, Ph.D. [ ] years old
5. Affiliated Academic Societies (Mark all that apply):
   □ The Physical Society of Japan(JPS)
   (Sub-sections: □ Property of matter; theory and experiment
   □ Elementary Particle; theory and experiment
   □ General Physics; history of physics, physics education, and others)
   □ The Japan Society of Applied Physics (JSAP) :
   □ Other Academic Societies: Write their names [ ]
6. Compared with your major at (your) college or graduate school, your present major is
   □ the same □ expanded □ changed
   The reason, expanded or changed:
   □ interested in the field □ for getting a job □ other [ ]
7. Fellowships and grants during your graduate school years:
   □ accepted → names of fellowships and grants (You can mark more than one.)
   □ Gakushin (Japan Society for Promotion of Science)
   □ Nihon-ikueikai (the Japan Scholarship Foundation, including loans)
   □ companies' grants □ foundations' grants □ other [ ]
   □ non □ Not accepted
   □ Not applied → The reasons
   □ not qualified financially □ avoiding debt □ other reasons
8. Do you have a Doctor's degree/a Ph.D.?
   □ No.
   □ Yes. □ Through a graduate school in Japan
   □ By writing a doctor's thesis in Japan
   □ Foreign Ph.D.
   The age, given: [ ] years old
   More than one Ph.D. the 2nd Ph.D. [ ] years old

9. Working experience outside of academia (companies, etc.) before your doctor's degree/Ph.D.

☐ No.
☐ Yes. ☐ full-time job about [ ] years
☐ part-time job about [ ] years
☐ others (incl. no job) about [ ] years

10. Working students

☐ No.
☐ Yes. ☐ presently student → ☐ college student, ☐ master course, ☐ doctor course
☐ received degrees → ☐ bachelor's degree, ☐ master's degree, ☐ doctor's degree

11. Present affiliation:

☐ university (with graduate school) ☐ university (without graduate school) ☐ junior college, professional school
☐ senior and junior high schools ☐ research institute (public or national) ☐ company ☐ national or public office
☐ retired ☐ no job ☐ other

12. Present position

University, college, professional school: ☐ undergraduate student ☐ graduate student ☐ postdoctoral fellow
☐ technician, office worker ☐ research assistant ☐ lecturer
☐ associate professor ☐ professor ☐ professor emeritus

Senior & junior highschools: ☐ teacher ☐ principal, vice-principal ☐ others

Research Institute: ☐ temporary contracted (incl. postdoctoral fellow) ☐ research member ☐ chief ☐ head ☐ director

Company: ☐ general worker ☐ chief ☐ head ☐ director or upper class ☐ non-regular

National or public office: ☐ general worker ☐ chief ☐ head ☐ director ☐ head of bureau

13. Type of research, if you carry out any (Mark all that apply)

☐ experimental method → ☐ outdoor experiments ☐ indoor experiments ☐ others [ ]
☐ surveying → ☐ outdoor ☐ indoor ☐ bibliographical method ☐ others [ ]
☐ theoretical method → ☐ theory ☐ simulation ☐ others [ ]

Secondly, we will ask you about your research work and job situation.

14. About your academic career (approximate numbers):

When did you publish your 1st paper (incl. as a co-author) in a journal, accepted through referees ? [ ] years old.

Total number of papers in journals, accepted through referees:
☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-30 ☐ 31-50 ☐ 51-100 ☐ more than 101

Number of presentations at (domestic) academic societies

When did you deliver your 1st talk at an academic society? [ ] years old.

Total number of presentations given at academic societies :
☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-30 ☐ 31-50 ☐ 51-100 ☐ more than 101

Number of applied research, developed to a new product (so-called R & D)

The age of your 1st success [ ] years old.

Total number of applied research: ☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-30 ☐ 31-50 ☐ 51-100 ☐ more than 101

Number of patents

When was your 1st patent accepted? [ ] years old

Total number of patents :
☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-30 ☐ 31-50 ☐ 51-100 ☐ more than 101

Number of published books (incl. as a co-writer):

When did you publish your first book (incl. as a co-writer)? [ ] years old

Total number of books:
☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-30 ☐ 31-50 ☐ 51-100 ☐ more than 101

Number of other submissions in popular journals, etc.

When was your first submission ? [ ] years old

Total number of articles: ☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-30 ☐ 31-50 ☐ 51-100 ☐ more than 101

15. Int. congresses, sent abroad by your employer

The 1st attendance [ ] years old

Number of attendances at int. congresses ☐ 0 ☐ 1-5 ☐ 6-10 ☐11-30 ☐ More than 31

The 1st participation (incl. poster presentation) [ ] years old

Number of presentations at int. congresses. ☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-30 ☐ More than 31

When did you go abroad for more than 6 months for the 1st time? [ ] years old.

Total number of experiences of being sent abroad for more than 6 months

☐ 0 ☐ 1-3 ☐ 4-7 ☐ 8-10 ☐ more than 11

16. Research grants from the Japanese Ministry of Science, Culture and Sports and from foundations, etc.

The age when you received the 1st grant [ ] years old.

Total number of grants ☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-20 ☐ more than 21

17. Have you ever supervised young followers and graduate students?

☐ No.

☐ Yes. Officially supervised any master thesis: Total number [ ]

Non-officially supervised any master thesis: Total number [ ]

Officially supervised any doctor thesis: Total number [ ]

Non-officially supervised any doctor thesis: Total number [ ]

18. Have you ever been a postdoctoral fellow, a non-regular researcher, or an unpaid researcher after your Ph. D.?

☐ No.

☐ Yes. How many years did it take to receive tenure position? [ ] years

(If the situation has continued, please write the total number.)

19. How many times did you apply before getting the 1st tenure position?

☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-20 ☐ more than 21

20. How did you obtain your 1st tenure position ?

☐ through public announcements (incl. recruiting examinations)

☐ through limited announcements

☐ by recommendations → By ☐ supervisor ☐ colleague, friend ☐ family and relatives ☐ others

☐ other Please explain. [ ]

21. From your 1st tenure position, how many years did you spend before going to the next higher position?

How often did you apply for them?

From the 1st position to the 2nd higher position, how many years did you spend ? [ ] years

Times of application ☐ 0, ☐ 1-5, ☐ 6-10, ☐ 11-20, ☐ 21-40, ☐ more than 41

From the 2nd to the 3rd higher position, how many years did you spend? [ ] years

Times of application ☐ 0, ☐ 1-5, ☐ 6-10, ☐ 11-20, ☐ 21-40, ☐ more than 41

From the 3rd to the 4th higher position, how many years did you spend? [ ] years

Times of application ☐ 0, ☐ 1-5, ☐ 6-10, ☐ 11-20, ☐ 21-40, ☐ more than 41

22. About your experiences of administrative positions

Positions	The year of 1st experience	Times 0	1-5	6-10	more than 11
Administrative job at working place	[ ] years old	☐	☐	☐	☐
At domestic academic societies	[ ] years old	☐	☐	☐	☐
At Int. academic conferences	[ ] years old	☐	☐	☐	☐
Chairperson at int. academic confs.	[ ] years old	☐	☐	☐	☐
Organizers at domestic research meetings	[ ] years old	☐	☐	☐	☐

We will now ask about your family situation.

23. Have you ever been married or not?

☐ Unmarried

☐ At least once married

About your partner's profession, if possible.

Working style : ☐ Full time ☐ Part-time ☐ No job

Classification : ☐ Univ. teacher, Researcher ☐ Company or Gov. employees

☐ Senior or junior high school teacher ☐ Freelance or private businness ☐ Others [ ]

24. About the number of your children:
☐ None
☐ More than one How many? [ ]
Ages of children ☐ Younger than elementary school age ☐ Elementary ☐ Junior high
☐ Senior high ☐ College ☐ Older than college age

25. If yes, for the above, please write an x for your selected child care facilities, to your 1st and last children (Mark all that apply.)

	The 1st	The last
a. Public child care center	☐	☐
b. Public pupil care center	☐	☐
c. Private child care center	☐	☐
d. Parents help	☐	☐
e. Friend's or neighbor's help	☐	☐
f. Hiring a home maid	☐	☐
g. Partner's help	☐	☐

h. Others, please explain. The 1st [ ] The last [ ]

26. Do you have any experience of bearing a child?
☐ No.
☐ Yes. Utilize the formal right for child bearing → Length of time off [ ] years

27. Do you have any experience of taking care of aged parents or other relatives?
☐ No. ☐ No.
☐ Yes. Your own parents ☐ Yes. Main methods (Mark all that apply.)
☐ by yourself ☐ with a family member ☐ relatives' cooperation ☐ hospitalized
☐ parttime visiting home helper ☐ hiring a home maid
☐ No.
The parents of your partner ☐ Yes. Main methods (Mark all that apply.)
☐ by yourself ☐ with a family member ☐ relatives' cooperation ☐ hospitalized
☐ parttime visiting home helper ☐ hiring a home maid
Total length of years ☐ less than 6 months ☐ 6 months-1 year ☐ 1-2 years ☐ 2-5years ☐ more than 5 years

28. If you count your efforts for teaching and research as 1 unit, write your time-spending rate for the following 3 activities? Please write your idealistic rates for the same activities.
Time for administrative and management activities
actual ☐ 0 ☐ 1/4 ☐ 1/2 ☐ same degree ☐ 3/2 ☐ twice or more
ideal ☐ 0 ☐ 1/4 ☐ 1/2 ☐ same degree ☐ 3/2 ☐ twice or more
House and child care
actual ☐ 0 ☐ 1/4 ☐ 1/2 ☐ same degree ☐ 3/2 ☐ twice or more
ideal ☐ 0 ☐ 1/4 ☐ 1/2 ☐ same degree ☐ 3/2 ☐ twice or more
Volunteer activity, etc.
actual ☐ 0 ☐ 1/4 ☐ 1/2 ☐ same degree ☐ 3/2 ☐ twice or more
ideal ☐ 0 ☐ 1/4 ☐ 1/2 ☐ same degree ☐ 3/2 ☐ twice or more

29. How much qualification is needed and how much effort should women make to obtain the same position as men?
☐ less than 1/2 ☐1/2 ☐ same degree ☐ 3/2 ☐ twice ☐ twice or more

30. The working group, "Kokudaikyo" (the Japan Association of National Universities) published a report on cooperation of women & men in May, 2000.

In the report, establishment of the system for public recruiting of national university teaching staff was proposed, and also it was uggested that female teaching staff must be increased up to 20% in the coming 10 years. Please write your comments on the following:

Introduction of the system for public recruiting: ☐ Positive ☐ Negative ☐ Neutral
To decide the final goal of the percentage for female teaching staff: ☐ Positive ☐ Negative ☐ Neutral
To decide the final goal of percentage for the female members of the governmental policy making committees:
☐ Positive ☐ Negative ☐ Neutral