ORNL/TM-2011/81

Awareness, Preference, Utilization, and Messaging Research for the Spallation Neutron Source and High Flux Isotope Reactor

March 2011

ORNL/TM-2011/29073

ORNL Neutron Sciences

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Prepared by
Bryant Research, LLC
March 2011

Prepared for
Lynn Kszos
Manager, Communications, Education, and Outreach
Neutron Sciences Directorate
Oak Ridge National Laboratory

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Executive Summary

Oak Ridge National Laboratory (ORNL) offers the scientific community unique access to two types of world-class neutron sources at a single site—the Spallation Neutron Source (SNS) and the High Flux Isotope Reactor (HFIR). The 85-MW HFIR provides one of the highest steady-state neutron fluxes of any research reactor in the world, and the SNS is one of the world's most intense pulsed neutron beams. Management of these two resources is the responsibility of the Neutron Sciences Directorate (NScD).

NScD commissioned this survey research to develop baseline information regarding awareness of and perceptions about neutron science. Specific areas of investigative interest include the following:

- awareness levels among those in the scientific community about the two neutron sources that ORNL offers
- the level of understanding members of various scientific communities have regarding benefits that neutron scattering techniques offer
- any perceptions that negatively impact utilization of the facilities

NScD leadership identified users of two light sources in North America—the Advanced Photon Source (APS) at Argonne National Laboratory and the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory—as key publics. Given the type of research in which these scientists engage, they would quite likely benefit from including the neutron techniques available at SNS and HFIR among their scientific investigation tools.

The objective of the survey of users of APS, NSLS, SNS, and HFIR was to explore awareness of and perceptions regarding SNS and HFIR among those in selected scientific communities. Perceptions of SNS and FHIR will provide a foundation for strategic communication plan development and for developing key educational messages.

The survey was conducted in two phases. The first phase included qualitative methods of (1) key stakeholder meetings; (2) online interviews with user administrators of APS and NSLS; and (3) one-on-one interviews and traditional and online focus groups with scientists. The latter include SNS, HFIR, and APS users as well as scientists at ORNL, some of whom had not yet used HFIR and/or SNS. These approaches informed development of the second phase, a quantitative online survey. The survey consisted of 16 questions and 7 demographic categorizations, 9 open-ended queries, and 153 pre-coded variables and took an average time of 18 minutes to complete. The survey was sent to 589 SNS/HFIR users, 1,819 NSLS users, and 2,587 APS users. A total of 899 individuals provided responses for this study: 240 from NSLS; 136 from SNS/HFIR; and 523 from APS. The overall response rate was 18%.

Awareness and Utilization

Significant concentrations of APS and NSLS users reported no awareness of HFIR or of SNS. For APS users, 37% were unaware of SNS and 68% were unaware of HFIR. For NSLS users, 48% were unaware of SNS and 71% were unaware of HFIR. Contact with colleagues—including word-of-mouth and conference presentations—was the way that nearly half of those surveyed became aware of SNS. Colleagues played a significant role in generating awareness of HFIR as well, while both APS and NSLS benefited much more from academic channels.

Awareness of neutron source capabilities was particularly low among women and those less experienced in their fields, researchers in areas other than materials science or physics (especially biology), and researchers not working at national labs.

Since scientists cannot incorporate a facility into their plans if they know nothing about the facility, the study strongly indicates a need for an aggressive awareness building effort.

Young scientists tend to make career choices based upon information from academia. APS and NSLS appear to benefit more from information shared in academic channels than do SNS and HFIR—a disparity that SNS and HFIR should aggressively seek to change. Although it is positive that work colleagues provide the initial introduction to the ORNL facilities, the goal should be to establish awareness much earlier in young scientists' careers. The survey results underscore the importance of the National School on Neutron and X-ray Scattering and challenge ORNL to find ways to engage scientists early in their careers.

Choice Criteria

The high flux/intensity of the beam was a driving choice criterion for each of the facilities tested except NSLS. The unique instrument capabilities at SNS prompt users to choose this facility, and access to specific instruments and/or access to capabilities were top choice criteria for those doing work at HFIR as well. None of those surveyed mentioned choosing either of the neutron facilities at ORNL for crystallography or choosing SNS for diffraction. These results suggest an opportunity for NScD to educate scientists about the instrument capabilities at ORNL that support such investigations.

Beliefs about Proposal Submission

The great majority of respondents agreed on the importance of understanding a beam line's capabilities, of knowing sample requirements, and of interacting with a facility's instrument scientists when preparing a proposal. Less experienced scientists—particularly those with little or no neutron source experience, females and those in biological sciences—were more likely to place importance on specific guidance in the proposal submission process. This included seeing examples of successful proposals and getting written feedback rather than just a numeric rating on submitted proposals.

Reasons for Not Using SNS or HFIR

Significant concentrations of those who have not used SNS or HFIR simply do not believe there is a compelling scientific reason to do so. It is important that a number of these scientists indicated they were not familiar with neutron techniques and/or they needed more information about these techniques. Half of those surveyed indicated uncertainty regarding whether neutron techniques could be employed to answer their scientific questions.

Uncertainty about How To Employ Neutron and X-ray Techniques

Significant concentrations of those surveyed (19 to 60%) expressed uncertainty regarding which techniques—neutron, X-ray, or both—they would recommend for studying selected aspects of materials dynamics, structures of materials, imaging, and time-resolved studies. These results further underscore the need for initiatives designed to distribute accurate information to the broader scientific community regarding how X-ray and neutron techniques might be employed.

Educational Approaches

Respondents reported the highest interest in participating in the following:
- Workshops at conferences
- Hands-on learning at the facilities
- Obtaining information from the literature
- Accessing archived lectures available through the facility's Web site

Accessing Publications/Information—Current Behaviors

The survey included specific questions about where, other than the Neutron Sciences Web site, these scientists get information in an effort to facilitate targeted communication through multiple channels.

Society bulletins: Concentrations of society bulletin readership were very fractured, with the vast majority of bulletins mentioned by 5% or less of respondents. Respondents overwhelmingly reported reading society bulletins in hard copy rather than on the Web.

Scientific journals: *Science* and *Nature* were mentioned by significant concentrations of respondents, making them top targets in any communication strategy. Respondents indicated they tended to read scientific journals online. Which journals scientists read is driven by the area of scientific interest.

Search engines: Those surveyed employ search engines to access science-related information. Scientists from different disciplines use the same search engines.

Getting Specific User Facility Information

Those surveyed tended to cite preferences for communication methods that allowed for two-way interaction. These results were noted even when respondents were specifically asked about one-way communication needs, e.g., getting information about a user facility. The vast majority of respondents cited email as their preferred method of two-way communication with the user facility office and with scientists at the user facility. Higher concentrations of those with less neutron source experience expressed a preference for workshops. Younger respondents were more likely to express a preference for instant messaging.

Gap Analysis of the User Facility Experience

Gap analysis was used to gauge the difference between these scientists' expectations (mean importance rating) and their actual user facility experience (mean experience rating).

Mean experience rating – Mean importance rating = Gap Score

The five most important aspects of the user experience were the same for each facility, although these appear in a slightly different order for each facility tested:

- Beam line reliability
- Sample environment needs
- Intuitive software
- 24/7 notification of beam line operation status
- Ease of access into and out of the facility

Gap analysis revealed priority concerns about

- Beam line reliability, particularly at SNS and at NSLS
- Sample environment issues, nonintuitive software, and notification of beam line status at SNS/HFIR
- Access issues at SNS

This report provides baseline data regarding awareness of SNS and HFIR; utilization of the facilities at ORNL; likelihood a scientist will consider using the facilities at ORNL; and specific measures of comprehension regarding the degree to which those in the selected scientific communities understand how neutron and X-ray techniques can be employed. It is highly recommended that NScD set targets for awareness, utilization, consideration of using the facilities, and comprehension before launching the strategic communication initiative, so that the results from this study can be used to gauge the effectiveness of the campaign.

Introduction

Oak Ridge National Laboratory (ORNL) offers the scientific community unique access to two types of world-class neutron sources at a single site—the Spallation Neutron Source (SNS) and the High Flux Isotope Reactor (HFIR). The 85-MW HFIR provides one of the highest steady-state neutron fluxes of any research reactor in the world. The SNS is one of the world's most intense pulsed neutron beams. Management of these two resources is the responsibility of the Neutron Sciences Directorate (NScD).

NScD needed information to guide development of its strategic communication plan, including baseline information regarding awareness of and perceptions about neutron science. Specific areas of investigative interest include the following:

- awareness levels among those in the scientific community about the two neutron sources that ORNL offers
- the level of understanding among members of various scientific communities regarding benefits that neutron scattering techniques offer
- any perceptions that negatively impact utilization of the facilities

NScD leadership has identified users of two light sources in North America—the Advanced Photon Source (APS) at Argonne National Laboratory and the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory—as key publics. Given the types of research in which these scientists engage, they would be likely to benefit from including the neutron techniques available at SNS and HFIR among their scientific investigation tools.

To date, NScD has user satisfaction data but no metrics for gauging how facility users at APS, NSLS, SNS, and HFIR perceive the benefits of using SNS and HFIR. (Likewise, metrics do not exist related to the perceived benefits of using X-ray techniques.) Experts in neutron science think that many of the investigations currently relying exclusively on X-ray techniques might well benefit from incorporating neutron techniques. However, this may not be happening to the extent that NScD believes would benefit world-class science. As user facilities, APS, NSLS, SNS, and HFIR each exist to further world-class science. APS and NSLS collaborated with NScD to gain insights into scientists' perceptions regarding neutron techniques.

Perceptions of SNS/HFIR will provide a foundation for strategic communication plan development and for developing key educational messages. NScD leadership also need to identify communication channels through which they can work to provide educational information. Ultimately, the leaders seek to execute a strategic communication plan that results in scientists appropriately considering neutron techniques for inclusion in their investigations.

Objective

The objective of this study is to explore awareness of and perceptions regarding the neutron sources at ORNL among those in selected scientific communities.

Methodology

Phase 1: Gaining Insights and Access

The research design focused initially on qualitative methods. Goals of the qualitative phase included the following:

- establishing working relationships with those who would be using the research results to make decisions (key stakeholders)
- seeking key stakeholders' points of view regarding the information needed for decision making
- exploring perceptions of those in targeted scientific communities about X-ray and neutron techniques so these could be quantified
- identifying communication channels and educational approaches that needed to be quantified in the survey.

Ultimately, the front-end qualitative work informed development of the online survey.

Additional detail regarding each qualitative method employed follows.

- **Key stakeholder meetings** included meeting with key stakeholders from ORNL as well as members of the strategic marketing and communications team from Mary Beth West Consulting. These meetings were used to
  - establish working relationships
  - inform the research
  - prioritize information needs

- **Online interviews** with User Office administrators at APS and NSLS were employed to
  - discuss potential mutual benefits of the investigation
  - gain qualitative insights
  - inform development of a quantitative survey to be conducted with the broader scientific community

- **One-on-one interviews and traditional and online focus groups** with scientists included users of SNS, HFIR, and APS as well as scientists at ORNL, some of whom had not yet used HFIR or SNS. These approaches informed development of the quantitative survey, the content as well as the language.

Phase 2: Quantifying the Insights

Survey

A copy of the online survey developed from the information in Phase I appears in the appendix to this report, along with a sample email used to introduce the study and a sample reminder email. Respondents received up to three reminders to participate.

The survey was conducted in English since English is recognized as the universal language for science.

Sample Frame

The initial sample design called for a random sample of users from each of the facilities. This plan also included oversampling from the ORNL list of HFIR and SNS users since the SNS/HFIR list was comparatively small. In instances in which the available sample size is limited, oversampling increases the chance that subset sizes will be robust enough for statistical analysis.

Initially all the sample was to come to Bryant Research for a random pull. However, NSLS was unable to release the email sample to an outside vendor. So lists were developed using the following protocol and prepared, in part, by Brian Bindert at NSLS.

- ORNL list—a combination of all HFIR and SNS users that included all who also appeared on the APS or the NSLS list
- NSLS list—all users except those on the ORNL list and every other user shared with APS
- APS list—all users except those on the ORNL list and every other user shared with NSLS

Survey Distribution

Respondents received an initial email from key staff at each facility, introducing the survey:

- Ken Herwig from ORNL to 589 SNS/HFIR users
- Kathy Nasta at NSLS to 1,819 NSLS users
- Susan Strasser at APS to 2,587 APS users

In accordance with internal policies, NSLS distributed all communications to its users. Communications to ORNL and APS users were initially distributed by Bryant Research on behalf of the respective organizations, with later emails coming directly from the user facilities. This change was in response to two issues:

- security concerns voiced by some respondents about getting an embedded email link to the survey from an outside source
- evidence that the spam filters at these national labs were not permitting the survey through the system

The extent to which the change impacted response rates is not known.

Weighting

The sampling frame for this study included a total of 4,995 individuals:

- 1,819 (36.4%) from NSLS
- 589 (11.8%) from ORNL
- 2,587 (51.8%) from APS

A total of 899 individuals provided responses for this study:

- 240 (26.7%) from NSLS
- 136 (15.1%) from ORNL
- 523 (58.2%) from APS

Responses from each of the facilities were assigned a weight so that the weighted totals reflected the sampling frame. For example, 26.7% of the total responses were from NSLS; however, individuals from this facility accounted for 36.4% of the total sampling frame. Therefore, responses from NSLS were given a higher weight to prevent underrepresentation of the responses from this facility.

In this report, weighted totals are used for the combined sample unless otherwise specified. Results for individual facilities were not weighted unless noted otherwise.

Definition of Source Facility and Impact on Gap Analysis

"Source facility" refers to the user list from which the respondent originated. A few respondents reported they had not personally conducted research at their assigned source facilities. For example, a scientist was a member of the investigative team; however, a colleague of this scientist actually did the work at the facility. Therefore, in such cases, a scientist's name appeared on the facility user list when he or she had not actually done work at the source facility.

This survey included question sets designed for Gap analysis. Gap analysis focused on operational issues. Therefore, it was imperative that respondents be queried about facilities with which they actually had experience. Those respondents who reported they had not personally conducted research at their source facilities were queried instead about facilities where they had conducted experiments. A user who had used more than one facility (but not his/her source facility) was queried about the facility he/she reported having used most recently. Nearly all respondents (98.7%) were asked about their respective source facilities. More detail about this selection logic is described in the full text of the online survey, included in the appendix.

Response Rates

The survey achieved an overall response rate of 18%. Facility-specific response rates were

- APS—20.2%
- NSLS—13.2%
- ORNL (including a mix of HFIR and SNS users)—23.1%

Significant Differences

This report compares the demographic characteristics of respondents who answered questions differently and notes significant differences in concentration of those demographic characteristics according to the answer given. This highlights the characteristics of those who were more likely to answer in a certain way. However, it does not mean that all of those with these characteristics answered in the same manner. For example, those unaware of SNS and HFIR were more likely to be female. However, not all females were unaware of those facilities, and there were males who were reportedly unaware as well. It does mean that the percentage of female respondents who were unaware of SNS and HFIR was greater than the percentage of males who were unaware.

The purpose of this type of analysis is to examine the respondent characteristics in a way that highlights targets of opportunity. Using the example just mentioned, if higher concentrations of women or those in particular areas of science are unaware of a particular fact or issue, it suggests seeking education/communication channels that have a higher chance of reaching these types of individuals. For example, if females or chemists are significantly more unaware, the strategic communication plan needs to include ways to boost awareness and understanding of neutron sources among these groups, e.g., reaching out through women's professional societies, professional organizations and publications that target chemists, etc.

Coding

Open-ended responses were assigned numeric codes for analytic purposes. The very technical nature of the written responses coupled with some fairly cryptic replies presented coding challenges. Initial coding—which was reported in the PowerPoint summary delivered in March of 2010—was very broad in nature. Additional coding was conducted after publication of the Power Point summary. This final coding scheme was developed in conjunction with David Korlin of NScD, who provided technical assistance.

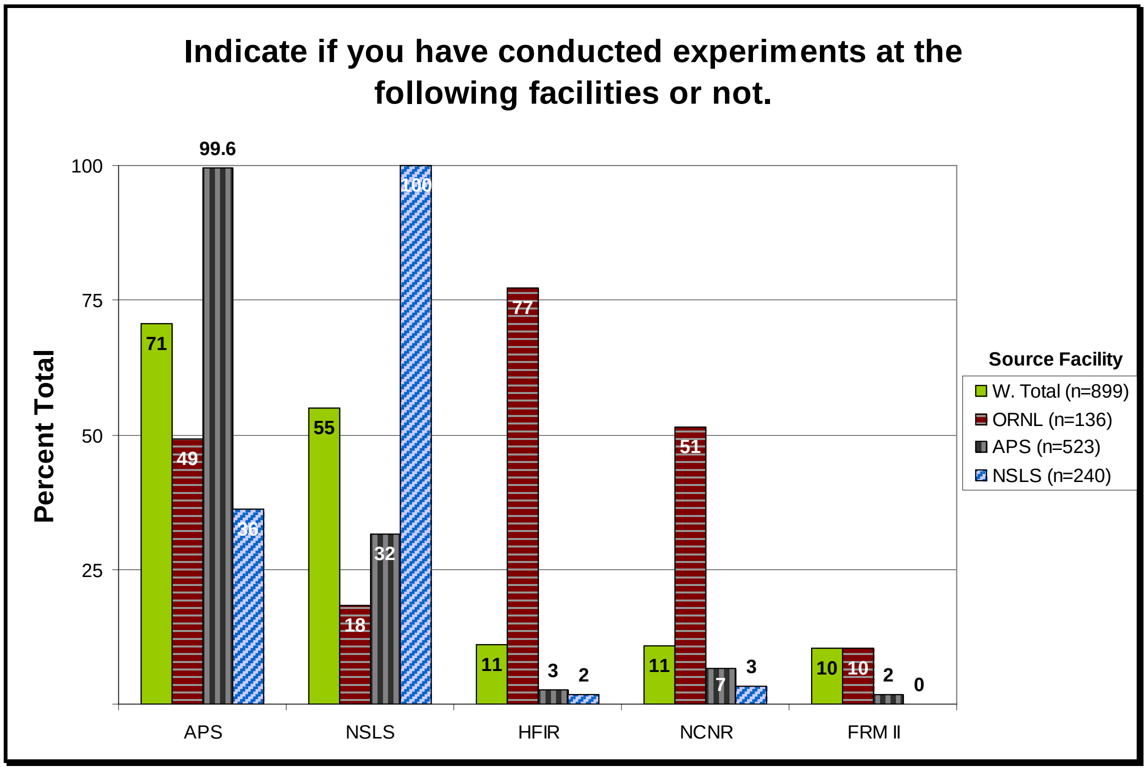
Review of Findings

Awareness and Utilization

Reported Utilization

Exhibits 1 and 2 profile the reported respondent user facility experiences. The majority of those surveyed reported using APS and NSLS. Reported use of a neutron facility was much lower. NOTE: Low use of HFIR and of SNS among APS and NSLS users is exaggerated, as those appearing on the ORNL list as well as the APS and/or NSLS lists were assigned exclusively to the ORNL facility source list during sample preparation.

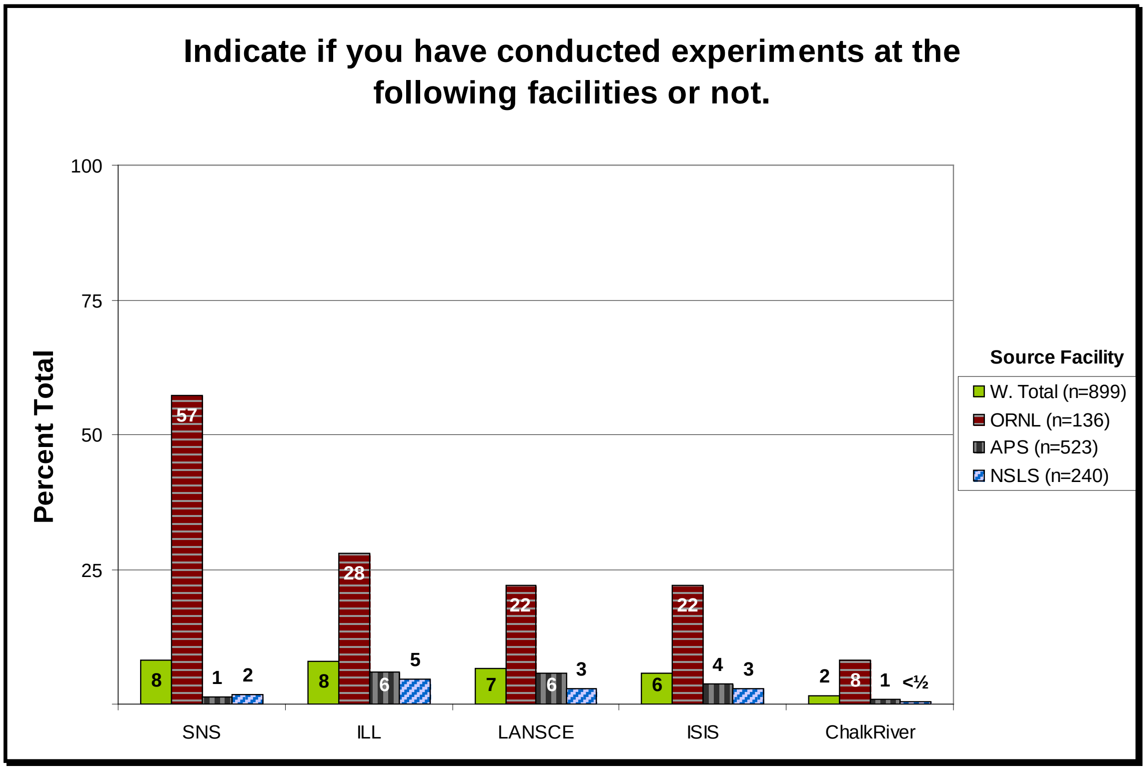
Exhibit 1. Reported work experience at user facilities



These results also show that those with neutron source experience at an ORNL facility were significantly more likely to report experience at other facilities that offer neutron source capabilities. In contrast, APS and NSLS users with no reported experience at one of the ORNL neutron facilities also reported very little experience at other neutron sources. The other facilities included in the survey, each of which features neutron sources, included the following:

- NCNR (NIST Center for Neutron Research, Gaithersburg)
- LANSCE (Los Alamos Neutron Science Center at Los Alamos National Laboratory)
- ILL (Institut Laue-Langevin, Grenoble, France)
- ISIS (at Rutherford Appleton Laboratory, Oxford, UK)
- Chalk River (Canadian Neutron Beam Centre, Ontario, Canada)
- FRM II (Forschungs–Neutronenquelle Heinz Maier-Leibnitz, Munich, Germany)

Exhibit 2. Reported work experience at user facilities, continued



Awareness

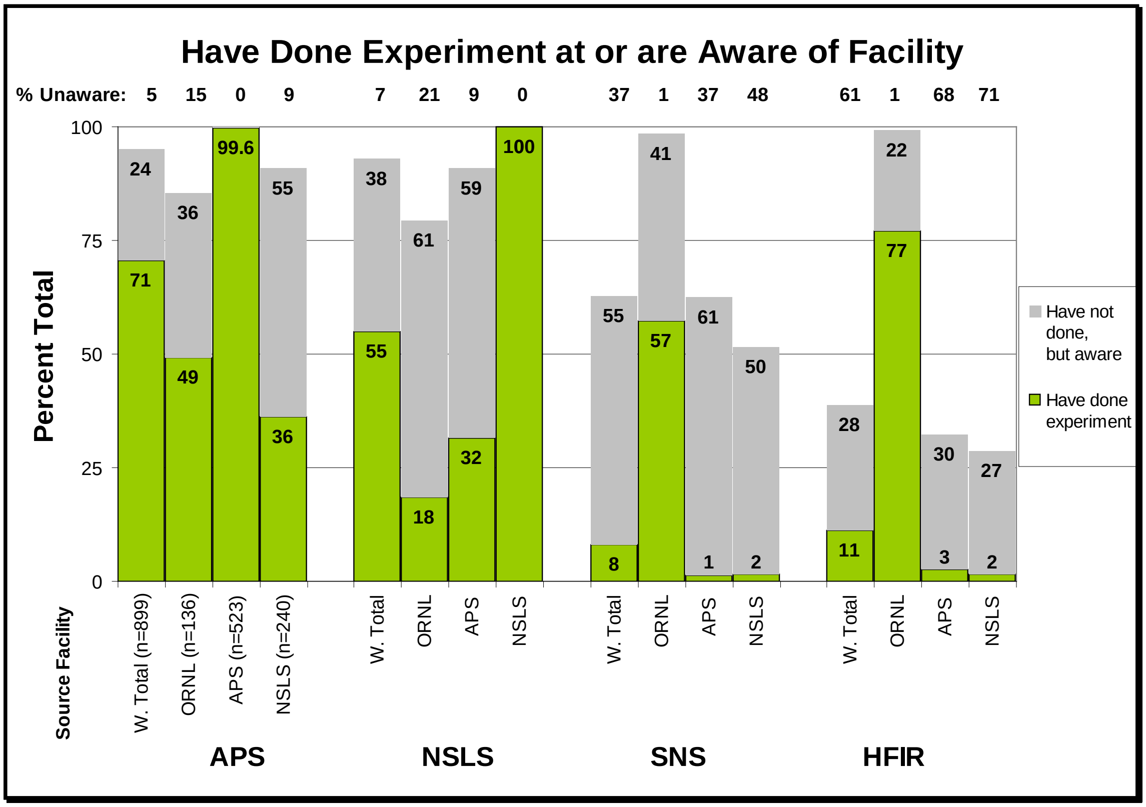
Reported awareness of APS and NSLS was well over 75% among each of the user groups included in the study. (See Exhibit 3.) However, reported awareness of the user facilities at ORNL among APS and NSLS users appeared significantly lower. Over a third of APS users and almost half of NSLS users stated they were unaware of SNS. Awareness of HFIR was even lower, with roughly one in seven from APS and from NSLS indicating no awareness of HFIR.

Conclusion: Reported awareness among NSLS and APS users of the neutron facilities at ORNL was low, with 37% reportedly unaware of SNS and 48% unaware of HFIR. Scientists cannot incorporate a facility's capabilities into their plans of experiment if they do not know about the facility.

Higher concentrations of **those unaware** of HFIR and of SNS more likely included those who were

- female
- not national laboratory scientists
- 20 years or less in their area of science
- in an area of science other than physics or materials science

Exhibit 3. Reported experience and awareness of key user facilities



How Respondents Became Aware of SNS

According to those from each of the targeted user facilities (SNS, HFIR, APS, and NSLS) colleagues at work were the most frequent source of initial introduction to SNS. Then the landscape changes. Conference presentation and mentions in the scientific literature were the next most frequently mentioned sources of awareness of SNS for APS and NSLS users. Those who have used SNS and HFIR were more likely to cite a traditional academic channel, e.g., academic advisors or an introduction through summer school. Also of note is the reported role of Internet browsing in introducing NSLS users to SNS. See Exhibits 4 and 5.

Those whose awareness of SNS came through a colleague at work were more likely to be

- a scientist at a national lab
- older
- a longer time in their field

Those whose first introduction to SNS came from a conference presentation were more likely to be

- age 30+
- a scientist at a national lab at a university/college

Exhibit 4. Reported source of first awareness of SNS

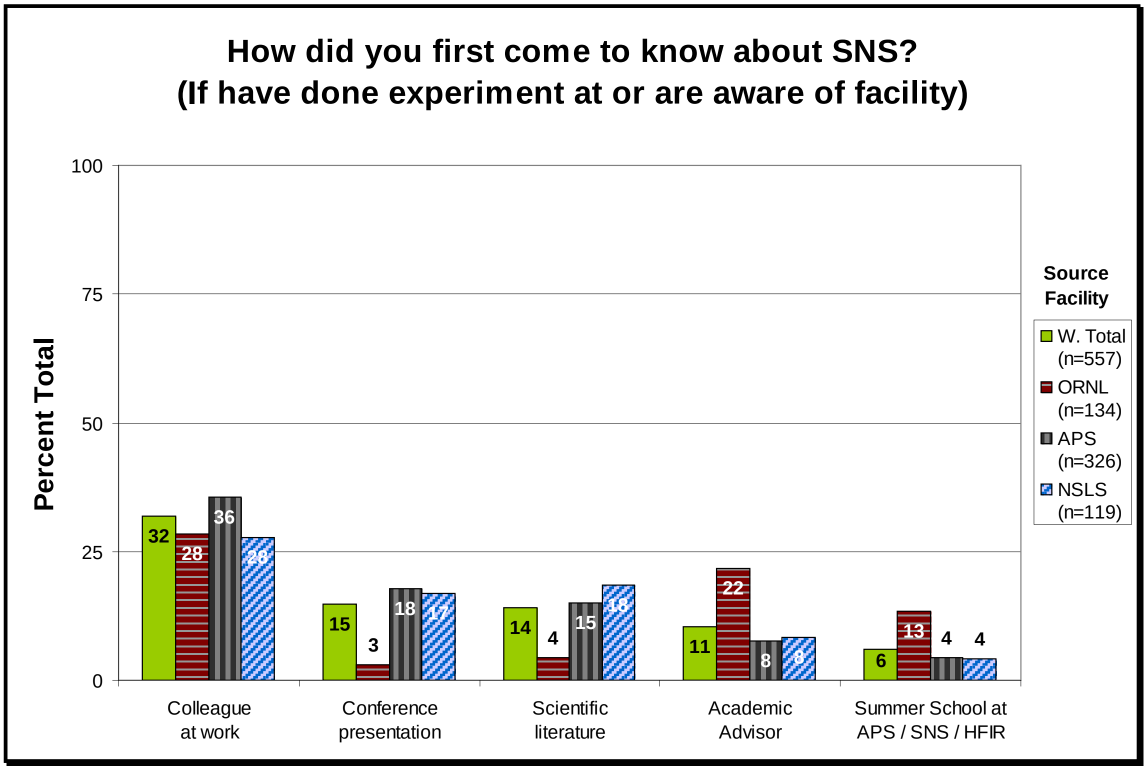
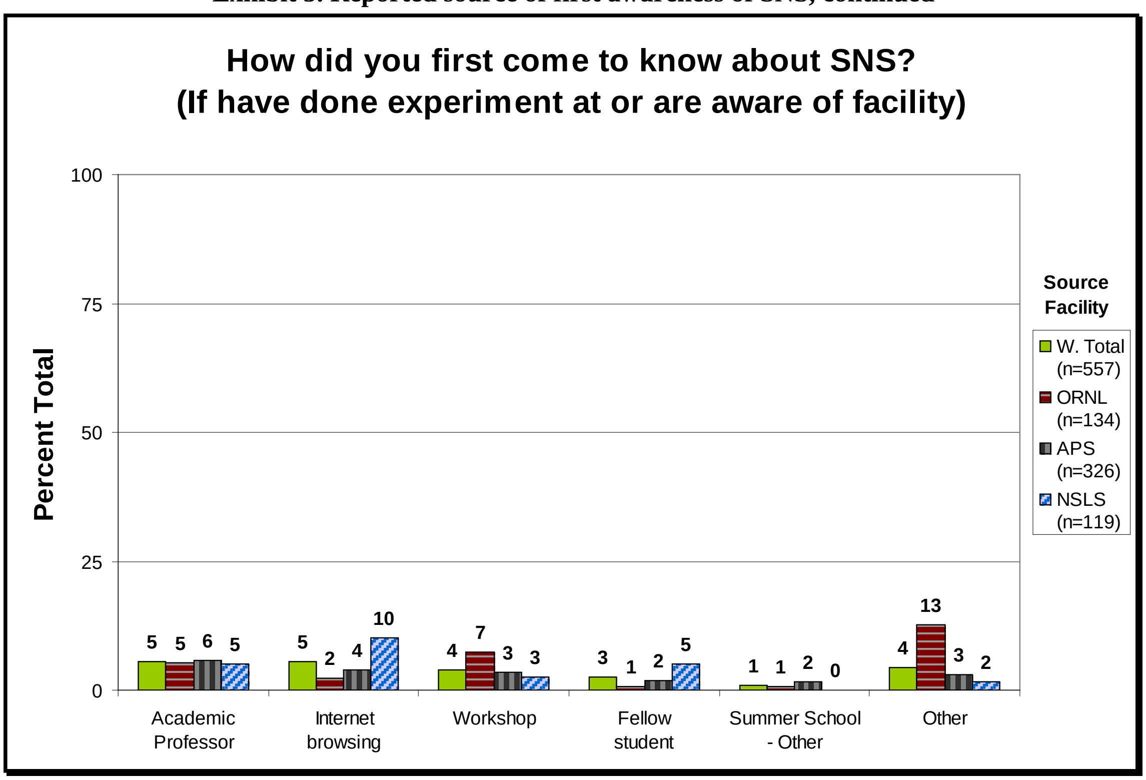


Exhibit 5. Reported source of first awareness of SNS, continued



An academic advisor was more likely to be the source of awareness for the following respondents:

- females
- younger participants
- students
- those in materials science, not biological science

Also noted were higher concentrations of awareness resulting from

- Internet browsing, among postdocs
- summer school, among graduate students
- fellow students, among younger respondents

How Respondents Become Aware of HFIR

Ways in which respondents reportedly came to know about HFIR mirror reported sources of awareness for SNS to some degree. Colleagues at work proved the most frequently mentioned source of initial introduction to HFIR, followed by academic advisors. Again —as with SNS— note the role that academic advisors played in introducing HFIR users to the facility. Similarly, APS and NSLS users tended to cite scientific literature and conference presentations as the way they found out about HFIR. Also note the role of Internet browsing in introducing NSLS users to HFIR. See Exhibits 6 and 7.

Exhibit 6. Reported source of first awareness of HFIR

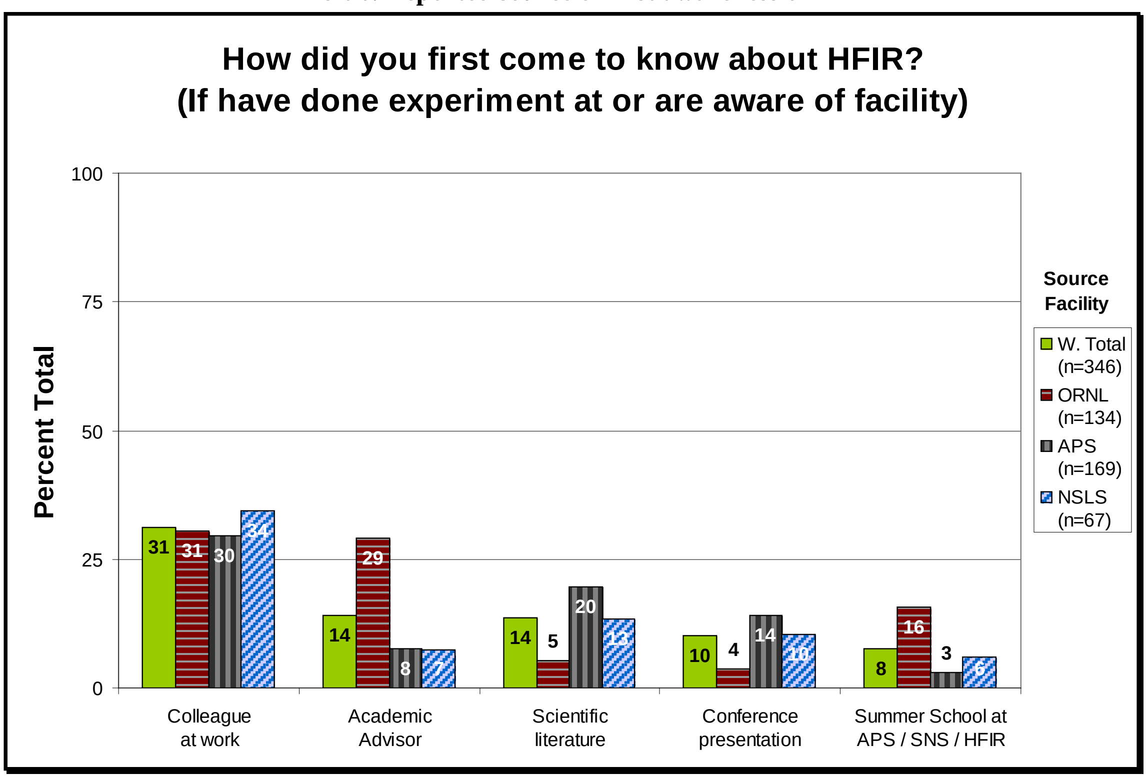
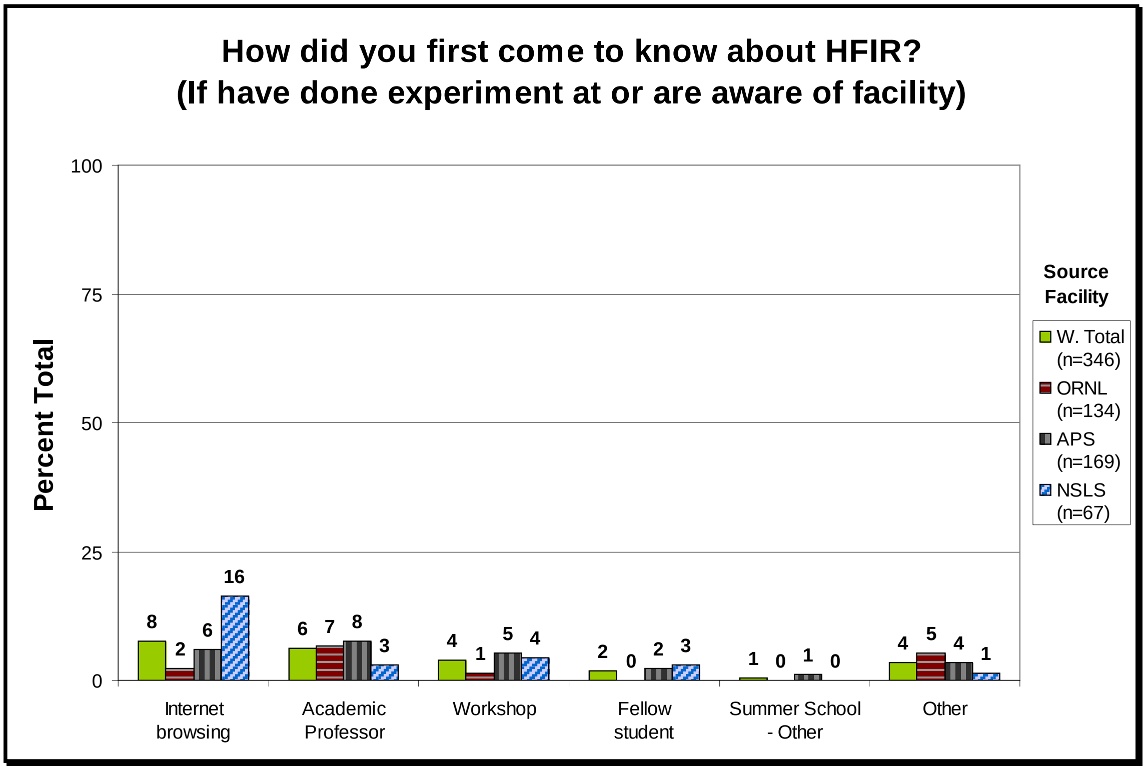


Exhibit 7. Reported source of first awareness of HFIR, continued



If a respondent's introduction to HFIR was from a colleague at work, this person was more likely to

- be a scientist at a national lab
- be older
- hold a Ph.D.
- have 1–3 years light source experience

HFIR awareness benefitted somewhat from

- Internet browsing by postdocs
- summer school mentioned by graduate students

How Respondents Become Aware of APS and NSLS

The pattern of awareness for APS and for NSLS mirrored each other. Academic advisors, followed by work colleagues and professors, accounted for over two-thirds of the introductions in each case. Academic advisors were a particularly important source of awareness for NSLS among its users. And initial introduction through the scientific literature was roughly on par with the concentrations reported for SNS and for HFIR. Internet browsing did not play a particularly significant role in introducing either of these facilities to users. See Exhibits 8–11.

Exhibit 8. Reported source of first awareness of APS

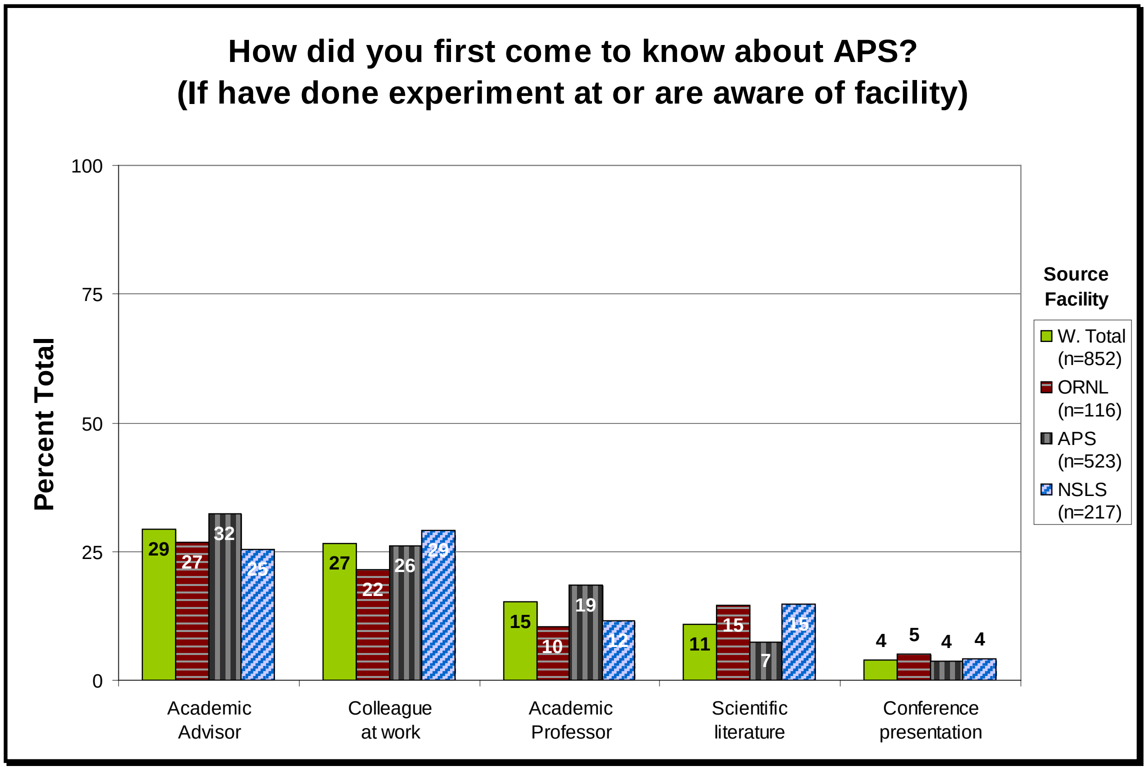


Exhibit 9. Reported source of first awareness of APS, continued

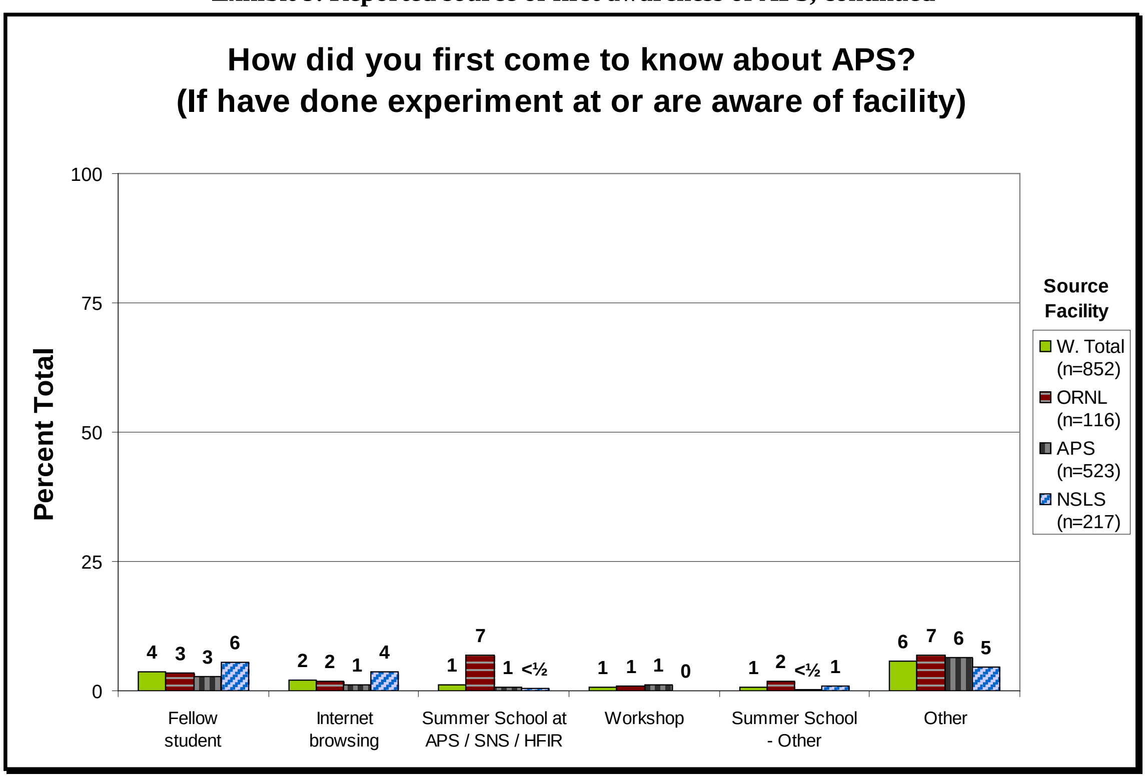


Exhibit 10. Reported source of first awareness of NSLS

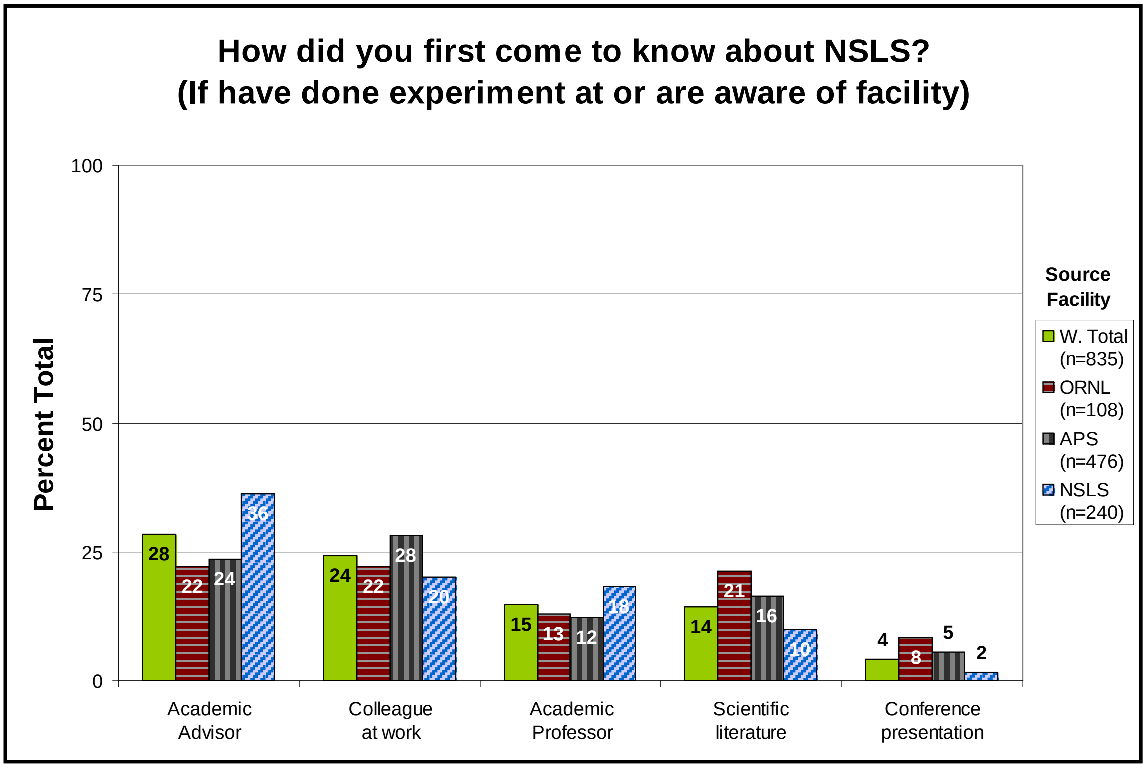
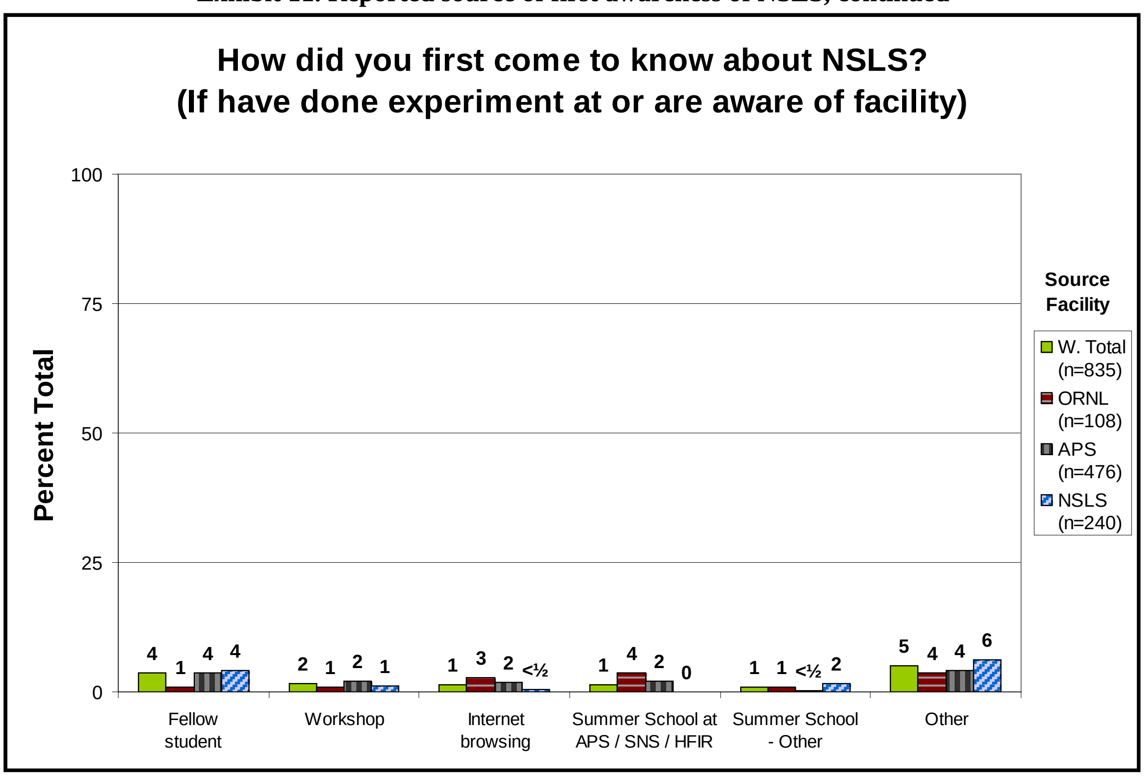


Exhibit 11. Reported source of first awareness of NSLS, continued



There were significant differences among demographic groups in the initial source of awareness of APS. If the source of awareness was

- an academic advisor, the respondent was more likely
  - female
  - s student
- a colleague at work, the respondent was more likely
  - a scientist in private industry
  - someone with 11+ years light source experience
  - not a student
- an academic professor, the respondent was more likely
  - a student
- the scientific literature, the respondent was more likely
  - male
  - A scientist at a university/college or at a national lab

The survey also showed significant demographic differences in the initial source of awareness of NSLS. If the source of awareness was

- an academic advisor, the respondent was more likely
  - someone with no neutron source experience
  - in earth science
  - a student
- a colleague, then the respondent was most likely a scientist at a national laboratory.

Conclusions

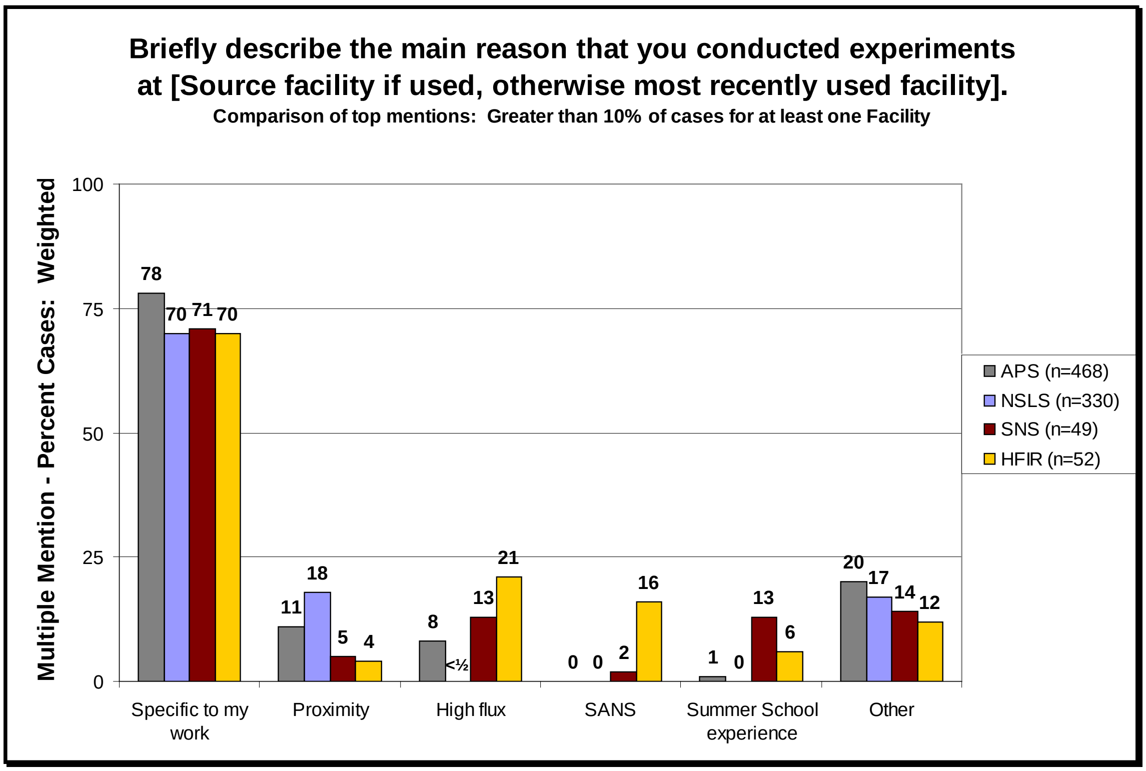
Arguably, information from academic channels forms the foundation upon which young scientists build their career choices. APS and NSLS appear to derive much greater benefit from information shared in academic channels than do SNS and HFIR. This disparity is one that SNS and HFIR should aggressively seek to change. While it is certainly positive that work colleagues provide the initial introduction to the neutron source facilities at ORNL, the goal should be to establish awareness much earlier in the scientist's career. This way, SNS and HFIR increase the opportunity for scientists to consider the neutron sources available at the ORNL facilities when designing experiments. This ultimately increases the opportunities for neutron techniques to contribute to world-class science.

Choice Rationale

Those surveyed were asked to describe the "main reason that they conducted experiments" at a specific facility. Respondents who had performed experiments at their source facilities were prompted to discuss these facilities by default. Those respondents who reported they had not personally conducted research at their source facilities were queried instead about facilities where they had conducted experiments. Respondents who had used more than one facility (but not the source facility) were queried about the facility they reported having used most recently. Nearly all respondents (98.7%) were asked about their respective source facilities. More detail about this selection logic is described in the full text of the Online Survey, located in the appendix.

Initial coding of these open-ended responses yielded a large concentration of responses categorized as “specific to my work.” See Exhibit 12. In an effort to uncover additional insights about what particular aspects of their work drove respondents’ facility choices, Bryant Research worked with David Korlin, an intern designated by NScD to provide technical assistance in recoding responses. Exhibits 13, 14, 15, 16 and 17 reflect this additional coding review. In Exhibit 12 all of the data are weighted. In Exhibits 13 through 17, responses shown for the entire, combined sample are weighted. However, responses shown for the individual facilities are unweighted so that each facility can see its results without the slight shifts in concentrations that weighting yields. (NOTE: Weighted sample sizes for HFIR and for SNS hover at the minimum subset size of n=50. Unweighted data show the actual sample sizes.)

Exhibit 12. Initial coding: Choice rationale for performing work at user facility



The most frequently mentioned rationale for using a facility was the intensity or flux of the beam. This was a fairly strong choice driver for each of the facilities tested except NSLS. At NSLS, proximity and perceptions about instrument capabilities surfaced as top choice criteria. Some in the stakeholder group had hypothesized that proximity might be a significant driver of user facility choice. And though roughly one in six NSLS users and one in ten APS users noted this as a choice criterion, they also cited many other reasons specific to the scientific investigation at hand.

In addition to the intensity of the beam, respondents cited a number of specific techniques and instrument capabilities and mentioned specific types of investigations as their main choice criteria.

Exhibit 13. After recoding: Comparison of choice rationales by user facility

Briefly describe the main reason that you conducted experiments at [Insert Facility Name]. (Percent of Cases)					
Description	**Weighted Total (n=898)**	**APS Unwtd. (n=527)**	**NSLS Unwtd. (n=242)**	**SNS Unwtd. (n=62)**	**HFIR Unwtd. (n=67)**
High flux/intensity	13.8%	20.1%	2.5%	19.4%	23.9%
Proximity	12.6%	10.8%	17.8%	4.8%	4.5%
Crystallography, including structure of proteins/macromolecules	10.2%	13.1%	8.7%	–	3.0%
Technique—Diffraction, including powder diffraction	9.9%	11.6%	9.1%	–	9.0%
Instrument capability / Instrument ideally suited to my technique	9.9%	8.7%	12.4%	8.1%	6.0%
Unique/unmatched instruments	7.8%	7.6%	7.4%	17.7%	3.0%
Sample environment capabilities / Good experimental setup	7.2%	8.7%	5.8%	1.6%	7.5%
Scientific staff/staff expertise	6.1%	5.5%	7.9%	4.8%	3.0%
Collaborators	6.1%	4.9%	7.9%	6.5%	4.5%
Technique—Other X-ray techniques	6.1%	5.5%	8.7%	–	–
Spectroscopy, including XAFS/EXAFS/XANES	5.5%	4.6%	8.3%	1.6%	–
CAT, partnership, contract	5.3%	8.3%	1.7%	1.6%	4.5%
Time / beam line available	5.1%	3.0%	8.7%	–	6.0%
Specific to my work	4.3%	2.3%	7.0%	6.5%	3.0%
Specified light source energy (hard or soft X-ray, UV, IR)	4.3%	5.9%	3.3%	–	–
Instruments—specific light source instrument mentioned	3.8%	4.9%	3.3%	–	–
General praise for/happiness with facility	3.6%	4.4%	3.7%	–	–
Openness of access	3.6%	2.7%	5.8%	–	3.0%
SAXS	3.5%	4.9%	2.5%	–	–
Ability to control beam size, angle, energy	3.4%	5.7%	1.2%	–	–
I am a staff member at this facility	3.3%	3.4%	3.3%	3.2%	3.0%
Grad/postdoc work	3.2%	1.9%	5.8%	1.6%	–
Familiar with instruments	2.7%	1.3%	4.5%	4.8%	3.0%
Better resolution / high resolution	2.7%	3.4%	1.7%	3.2%	1.5%
Structures of materials: Other than proteins	2.6%	2.1%	2.9%	3.2%	4.5%
Technique—Crystallography (SAD, other, or unspecified)	2.5%	4.0%	1.2%	–	–
Colleague	1.9%	1.7%	2.5%	–	1.5%
Summer school experience	1.7%	0.9%	0.4%	**12.9%**	**6.0%**
Biological science (excludes medical applications)	1.6%	1.1%	2.1%	–	4.5%
Newness of instrument	1.5%	2.3%	–	6.5%	–
Advisor/professor	1.5%	1.5%	1.7%	1.6%	1.5%
Polymer science	1.4%	1.5%	0.8%	4.8%	1.5%
Nanoparticles/nanotechnology/nanostructures	1.4%	1.1%	1.7%	–	3.0%
Specific mention of SNS instrument—ARCS, CNCS, Sequoia, SNAP, BASIS, Magnetism Reflectometer	1.1%	–	–	**21.0%**	–
Proteins—Not explicitly crystallography	1.1%	1.5%	–	–	4.5%

Briefly describe the main reason that you conducted experiments at [Insert Facility Name]. (Percent of Cases)					
Description	**Weighted Total (n=898)**	**APS Unwtd. (n=527)**	**NSLS Unwtd. (n=242)**	**SNS Unwtd. (n=62)**	**HFIR Unwtd. (n=67)**
SANS	1.0%	–	–	1.6%	**16.4%**
Can use small/low concentration sample	0.8%	0.8%	0.8%	–	1.5%
Convenience	0.8%	–	1.7%	1.6%	1.5%
Imaging (includes biological and engineering materials)	0.8%	1.3%	–	1.6%	–
Environmental science	0.8%	0.6%	1.2%	–	–
Funding / expense	0.7%	0.9%	0.4%	1.6%	–
Shorter amount of time / quick	0.6%	0.6%	0.4%	1.6%	1.5%
Specific mention of HFIR instrument —Triple Axis Spectrometer, Bio-SANS, Residual Stress Mapping	0.6%	–	–	–	**10.4%**
Time resolved: Pump/probe or real-time studies	0.6%	1.1%	–	–	–
Catalysis	0.6%	0.2%	1.2%	–	–
Workshop	0.5%	0.8%	0.4%	–	–
Good signal to noise ratio, etc.	0.5%	0.4%	0.4%	1.6%	1.5%
Materials dynamics: All	0.4%	–	0.4%	3.2%	1.5%
Physics	0.4%	0.4%	–	3.2%	–
Other useful capabilities nearby	0.3%	0.4%	0.4%	–	–
Optics	0.3%	–	0.8%	–	–
Technique—Quasielastic scattering	0.3%	–	–	**4.8%**	–
Radiography	0.3%	0.2%	0.4%	–	–
Earth science	0.2%	0.4%	–	–	–
Superconducting	0.2%	–	–	3.2%	–
Technique—Inelastic scattering	0.2%	–	–	1.6%	1.5%
Pulsed neutron source	0.2%	–	–	3.2%	–
Chemistry	0.2%	–	–	–	3.0%
Engineering	0.2%	–	–	–	3.0%
Medical applications	0.1%	0.2%	–	–	–
Time of flight	0.1%	–	–	1.6%	–
Continuous neutron source	0.1%	–	–	–	1.5%
Materials science	0.1%	–	–	–	1.5%
OTHER	6.5%	6.3%	6.6%	3.2%	10.4%

Exhibit 14. After recoding: Rationales for choosing APS

Briefly describe the main reason that you conducted experiments at APS. (Percent of Cases)	**APS Unwtd. (n=527)**
High flux/intensity	20.1%
Crystallography, including structure of proteins/macromolecules	13.1%
Technique—Diffraction, including powder diffraction	11.6%
Proximity	10.8%
Instrument capability / Instrument ideally suited to my technique	8.7%
Sample environment capabilities / Good experimental setup	8.7%
CAT, partnership, contract	8.3%
Unique/unmatched instruments	7.6%
Specified light source energy (hard or soft X-ray, UV, IR)	5.9%
Ability to control beam size, angle, energy	5.7%
Scientific staff/staff expertise	5.5%
Technique—Other X-Ray techniques	5.5%
Collaborators	4.9%
Instruments—specific light source instrument mentioned	4.9%
SAXS	4.9%
Spectroscopy, including XAFS/EXAFS/XANES	4.6%
General praise for/happiness with facility	4.4%
Technique—Crystallography (SAD, other, or unspecified)	4.0%
I am a staff member at this facility	3.4%
Better resolution / high resolution	3.4%
Time / beam line available	3.0%
Openness of access	2.7%
Specific to my work	2.3%
Newness of instrument	2.3%
Structures of materials: Other than proteins	2.1%
Grad/postdoc work	1.9%
Colleague	1.7%
Advisor/professor	1.5%
Polymer science	1.5%
Proteins—Not explicitly crystallography	1.5%
Familiar with instruments	1.3%
Imaging (includes biological and engineering materials)	1.3%
Biological science (excludes medical applications)	1.1%
Nanoparticles/nanotechnology/nanostructures	1.1%
Time resolved: pump/probe or real-time studies	1.1%
Summer school experience	0.9%
Funding / expense	0.9%
Can use small/low concentration sample	0.8%
Workshop	0.8%
Environmental science	0.6%
Shorter amount of time / quick	0.6%
Good signal to noise ratio, etc.	0.4%
Physics	0.4%
Other useful capabilities nearby	0.4%
Earth science	0.4%
Catalysis	0.2%
Radiography	0.2%
Medical applications	0.2%
OTHER	6.3%

Exhibit 15. After recoding: Rationales for choosing NSLS

Briefly describe the main reason that you conducted experiments at NSLS. (Percent of Cases)	**NSLS Unwtd. (n=242)**
Proximity	17.8%
Instrument capability / Instrument ideally suited to my technique	12.4%
Technique—Diffraction, including powder diffraction	9.1%
Crystallography, including structure of proteins/macromolecules	8.7%
Technique—Other X-ray techniques	8.7%
Time / beam line available	8.7%
Spectroscopy, including XAFS/EXAFS/XANES	8.3%
Scientific staff/staff expertise	7.9%
Collaborators	7.9%
Unique/unmatched instruments	7.4%
Specific to my work	7.0%
Sample environment capabilities / good experimental setup	5.8%
Openness of access	5.8%
Grad/postdoc work	5.8%
Familiar with instruments	4.5%
General praise for/happiness with facility	3.7%
Specified light source energy (hard or soft X-ray, UV, IR)	3.3%
Instruments—specific light source instrument mentioned	3.3%
I am a staff member at this facility	3.3%
Structures of materials: Other than proteins	2.9%
High flux/intensity	2.5%
SAXS	2.5%
Colleague	2.5%
biological science (excludes medical applications)	2.1%
cat, partnership, contract	1.7%
Better resolution / high resolution	1.7%
Advisor/professor	1.7%
Nanoparticles/nanotechnology/nanostructures	1.7%
Convenience	1.7%
Ability to control beam size, angle, energy	1.2%
Technique—Crystallography (SAD, other, or unspecified)	1.2%
Environmental science	1.2%
Catalysis	1.2%
Polymer science	0.8%
Can use small/low concentration sample	0.8%
Optics	0.8%
Summer school experience	0.4%
Funding / expense	0.4%
Shorter amount of time / quick	0.4%
Workshop	0.4%
Good signal to noise ratio, etc.	0.4%
Materials dynamics: All	0.4%
Other useful capabilities nearby	0.4%
Radiography	0.4%
OTHER	6.6%

Exhibit 16. After recoding: Rationales for choosing SNS

Briefly describe the main reason that you conducted experiments at SNS. (Percent of Cases)	**SNS Unwtd. (n=62)**
Specific mention of SNS instrument —ARCS, CNCS, Sequoia, SNAP, BASIS, Magnetism Reflectometer	21.0%
High flux/intensity	19.4%
Unique/unmatched instruments	17.7%
Summer school experience	12.9%
Instrument capability / instrument ideally suited to my technique	8.1%
Collaborators	6.5%
Specific to my work	6.5%
Newness of instrument	6.5%
Proximity	4.8%
Scientific staff/staff expertise	4.8%
Familiar with instruments	4.8%
Polymer science	4.8%
Technique—Quasielastic scattering	4.8%
I am a staff member at this facility	3.2%
Better resolution / high resolution	3.2%
Structures of materials: Other than proteins	3.2%
Materials dynamics: All	3.2%
Physics	3.2%
Superconducting	3.2%
Pulsed neutron source	3.2%
Sample environment capabilities / good experimental setup	1.6%
Spectroscopy, including XAFS/EXAFS/XANES	1.6%
CAT, partnership, contract	1.6%
Grad/postdoc work	1.6%
Advisor/professor	1.6%
SANS	1.6%
Convenience	1.6%
Imaging (includes biological and engineering materials)	1.6%
Funding / expense	1.6%
Shorter amount of time / quick	1.6%
Good signal to noise ratio, etc.	1.6%
Technique—Inelastic scattering	1.6%
Time of flight	1.6%
OTHER	3.2%

Exhibit 17. After recoding: Rationales for choosing HFIR

Briefly describe the main reason that you conducted experiments at HFIR. (Percent of Cases)	HFIR Unwtd. (n=67)
High flux/intensity	23.9%
SANS	16.4%
Specific mention of HFIR instrument —Triple Axis Spectrometer, Bio-SANS, Residual Stress Mapping	10.4%
Technique—Diffraction, including powder diffraction	9.0%
Sample environment capabilities / good experimental setup	7.5%
Instrument capability / instrument ideally suited to my technique	6.0%
Time / beam line available	6.0%
Summer school experience	6.0%
Proximity	4.5%
Collaborators	4.5%
CAT, partnership, contract	4.5%
Structures of materials: Other than proteins	4.5%
Biological science (excludes medical applications)	4.5%
Proteins—Not explicitly crystallography	4.5%
Crystallography, including structure of proteins/macromolecules	3.0%
Unique/unmatched instruments	3.0%
Scientific staff/staff expertise	3.0%
Specific to my work	3.0%
Openness of access	3.0%
I am a staff member at this facility	3.0%
Familiar with instruments	3.0%
Nanoparticles/nanotechnology/nanostructures	3.0%
Chemistry	3.0%
Engineering	3.0%
Better resolution / high resolution	1.5%
Colleague	1.5%
Advisor/professor	1.5%
Polymer science	1.5%
Can use small/low concentration sample	1.5%
Convenience	1.5%
Shorter amount of time / quick	1.5%
Good signal to noise ratio, etc.	1.5%
Materials dynamics: All	1.5%
Technique—Inelastic scattering	1.5%
Continuous neutron source	1.5%
Materials science	1.5%
OTHER	10.4%

- Those involved with crystallography were significantly more likely to choose an X-ray facility over one of the neutron source facilities at ORNL. In fact, no respondents specifically cited using SNS for crystallography or for techniques associated with crystallography.
- Roughly one in ten respondents cited diffraction capabilities, including powder diffraction, as a main reason for choosing NSLS, APS, or HFIR. None of the SNS users specifically cited this technique as their main reason for working at SNS.

A significant concentration of SNS users (18%) characterized the instrument capabilities at SNS as unique. In fact, SNS users were much more likely to cite unique instrument capabilities as a choice criterion than were users of the other facilities—by a factor of 2 (for NSLS and APS) to 6 (for HFIR). Fully one fifth of those choosing SNS mentioned a specific instrument at the facility.

The National School on Neutron and X-ray Scattering positively impacted 13% of SNS users and 6% of HFIR users. Summer school was not a main reason for choosing to do work at APS or NSLS, according to those surveyed.

Conclusions: The unique instrument capabilities at SNS prompt users to choose the facility. None of those surveyed chose either of the neutron facilities at ORNL for crystallography, nor did they choose SNS for diffraction. These results present an educational opportunity for NScD to inform scientists regarding the extent to which the instrument capabilities at ORNL support these types of investigations. The National School on Neutron Scattering has positively contributed to scientists selecting one of the facilities on the Oak Ridge Reservation, a finding that supports the need for and value of education regarding beam line capabilities.

Reasons Respondents Have Not Used SNS or HFIR

In addition to prompting for choice criteria, the survey asked those who reported they were aware of—but had not used—SNS or HFIR to briefly describe the main reason that they had not yet conducted research at ORNL. (The survey included a programming algorithm that triggered the survey to alternate between asking about HFIR and SNS if a respondent was aware of both HFIR and of SNS, but had not conducted research at either facility. If the respondent reported awareness of SNS *or* HFIR and had not used this facility, the survey prompted for the facility the respondent was aware of and had not used.) More detail about the selection logic for this question is included in the complete text of the Online Survey, located in the appendix.

Exhibit 18 shows results from the initial coding. (NOTE: the data in Exhibit 18 are weighted.) The exhibit shows that a large concentration of respondents indicated they had no need to use HFIR or SNS, while at the same time, a notable concentration indicated they might use one of these facilities in the future. This was particularly true for SNS. Additional reasons mentioned for not using SNS included the following:

- a need for more information
- reported sample issues
- beam line availability

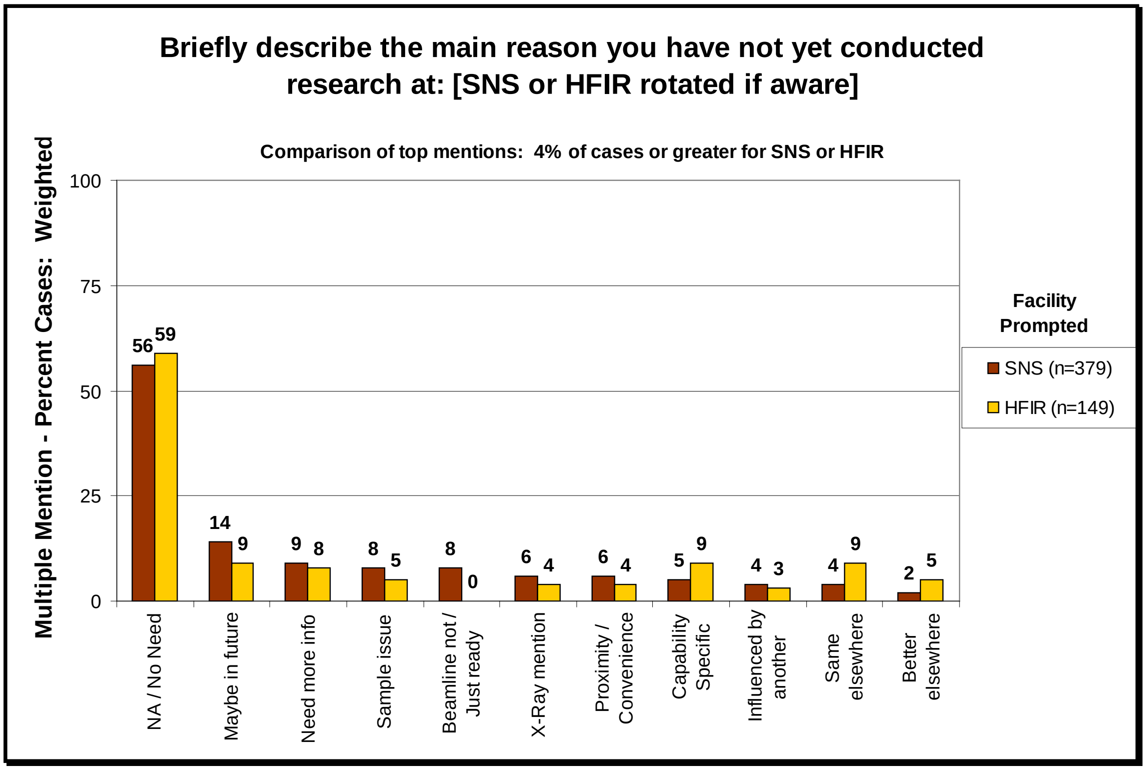
Reasons for not using HFIR were more frequently related to perceptions of capability, i.e., perceptions that another facility offered the same or better capabilities and/or citing a capability-specific need. Some also mentioned a need for more information.

Proximity did surface as a reason for not using a facility at ORNL, but it was mentioned by only a small minority of the respondents.

Those who replied they had **no need** to use SNS more likely

- were APS or NSLS users
- had no neutron source experience
- were in biological science

Exhibit 18. Initial coding: Reasons have not yet performed experiments at SNS, HFIR



Respondents who said they might use SNS in the future were more likely

- not NSLS users
- to be in materials science

Those reporting they had no need to use HFIR were slightly more likely to be older or to have 11+ years light source experience.

Again, Bryant Research worked with David Korlin of NScD to dig into the technical content in the responses. Exhibit 18A shows responses for the individual facilities, which have been un-weighted to remove the slight shifts in concentrations that weighting yields.

Exhibit 18A. After recoding: Reasons have not yet performed experiments at SNS, HFIR

Briefly describe the main reason you have not yet conducted research at SNS. Include specific suggestions that would increase your interest in using this facility. (Percent Cases)	**SNS (n=381)**	**Compare to: HFIR (n=149)**
Maybe in future	15.5%	9.4%
No need for neutrons / neutrons unsuitable for work	13.9%	9.4%
No relevance/application to my field of science/research/work	12.3%	15.4%
Low familiarity/involvement with neutron techniques	10.5%	4.7%
Beam line unavailable	9.7%	–
No need / no project (unspecific)	9.7%	12.8%
Lack of / need more info	8.9%	9.4%
Sample issue	8.7%	5.4%
Same/better elsewhere	5.8%	15.4%
Proximity/convenience	5.5%	4.7%

Briefly describe the main reason you have not yet conducted research at SNS. Include specific suggestions that would increase your interest in using this facility. (Percent Cases)	SNS (n=381)	Compare to: HFIR (n=149)
X-rays suitable / more suitable than neutrons	5.5%	2.7%
No need for instruments or facility	5.0%	10.1%
Instruments not suited to my work/lacks instrument I need	4.7%	8.7%
Influenced by another	4.7%	5.4%
Funding issue	2.1%	1.3%
SANS mention	2.1%	3.4%
N/A	1.3%	4.0%
No reason	1.3%	–
Used HFIR	1.0%	0.7%
Scheduled/waiting	1.0%	–
Proposal rejected	1.0%	1.3%
Access hard	0.5%	2.7%
OTHER	10.8%	6.0%

Recoding underscored the following:

- By and large, those reporting that they have not used HFIR or SNS perceived no need for the instruments and/or for the neutron techniques available at ORNL.
- A notable concentration of respondents indicated they might use one of ORNL's facilities in the future, particularly SNS.
- A sizeable concentration of respondents reported they have not used HFIR because the same or better facilities are available elsewhere.

Recoding did tease out a concentration of scientists who indicated that they had little familiarity with neutron techniques. Additionally, a number of respondents specifically reported they lacked information.

These scientists who had not used SNS or HFIR were asked to note any suggestions that they had. A qualitative review of specific suggestions noted in the written comments underscores the need for education, particularly regarding

- capabilities of today's neutron techniques; how they have advanced
- specific instrument parameters
- applications for and workshops tailored to specific fields, such as biology or industry
- outreach, including contact with beam line scientists, workshops for professionals
- education about the proposal process

Conclusions: The neutron facilities at ORNL are in the consideration set of those who have not used HFIR (10%) or SNS (16%). These numbers should be used as baseline metrics for measuring the effectiveness of the communication plan.

A significant concentration of those who have not used SNS or HFIR simply do not believe there is a compelling scientific reason to do so. It is important that a number of these scientists indicated they were not familiar with neutron techniques and/or they needed more information. These results underscore the need for additional educational outreach and communication regarding how neutron techniques can be employed.

Beliefs about Proposal Submission

During the qualitative phase of the research, key stakeholders as well as scientists in the focus groups mentioned several aspects of the proposal process that they thought might benefit from change. So the survey asked respondents to quantify their level of agreement with these qualitative findings, using a 10-point scale on which 10 meant "agree completely" and 1 meant "disagree completely." This question also allowed respondents to indicate if they were uncertain about any of the aspects tested. Exhibit 19 shows a rank ordering of these aspects from highest to lowest levels of agreement. The far right-hand column highlights the demographic characteristics of those who were more likely to rate an item an "8" or higher.

Exhibit 19. Beliefs about proposal submission, ranked by mean

Indicate how much you agree or disagree with each of the following statements: When submitting a proposal it is important to… (1=Disagree Completely, 10=Agree Completely)	Weighted Total (n=899)			
	MEAN	% NOT SURE	% N/A	More likely rated 8+ if:
…know the capability of the beam line	9.2	2.2	1.0	Ph.D.
…know how much sample will be needed	8.3	2.8	1.3	ORNL user, no neutron source experience
…talk with an instrument scientist at the facility	8.2	3.2	1.4	ORNL user, neutron source experience; in materials science
…get written feedback on any prior proposal	7.8	3.6	2.4	No significant differences noted
...submit a proposal that features high-impact science	7.5	3.5	1.8	Age 30+, Ph.D.
...see examples of successful proposals	7.4	2.7	1.7	Female, younger, student, in biological science rather than physics, less experience
...get specific guidance on how to write the proposal	7.2	3.1	1.8	Female, postdoc, in biological science rather than physics, less neutron source experience
...know the oversubscription rate of that beam line	6.8	7.7	1.9	Less neutron source experience
...have prior contact with the user office at that facility	6.5	5.2	2.2	In materials science rather than physics, less neutron source experience
...collaborate with someone who has already done a similar type of investigation	6.3	3.7	1.9	No significant differences noted
...already know how to use the beam line	5.8	2.7	1.6	No significant differences noted
...collaborate with a prior user of that beam line .	5.8	4.8	2.2	Female, no neutron source experience

Those surveyed overwhelmingly agreed that the most important aspect of submitting a proposal is "knowing the capability of the beam line." They also placed a great deal of importance on

- knowing how much sample would be needed (particularly ORNL users)
- talking with the facility's beam line scientist (particularly ORNL users)
- getting written feedback on prior proposals.

Information from the focus groups and one-on-one discussions offered insight into the reasons for placing importance on particular aspects of the proposal submission process. During the focus groups, discussions surfaced about how important it is to talk with the beam line scientist in order to understand the beam line's capability. Participants described beam line scientists as having specific knowledge about how the beam line might be used in an investigation. Also, several in the focus groups commented on the rather cryptic feedback received when one submits a proposal to a user facility. In some cases, it is just a number with little or no written explanation of the rating. This left the unsuccessful applicants with little to no information about what they could do to improve their chances of securing beam time. Quantitative results corroborate the relative importance of giving more detailed feedback so that a scientist knows the reason a proposal was not accepted.

The survey also highlights the relative importance of seeing examples of successful proposals and of getting guidance on proposal submission. Females, those with less experience, and those in biological sciences more frequently expressed a desire for help with proposal preparation.

Additionally, those with little or no neutron source experience were more likely to want the following:

- to know how much sample will be needed
- to know the oversubscription rate of the beam
- to have prior contact with the user office
- to collaborate with a prior user of that beam line

Conclusions: The vast majority of respondents agreed on the importance of understanding a beam line's capabilities, of knowing sample requirements, and of interacting with a facility's instrument scientists when preparing a proposal. Less experienced scientists— particularly those with little or no neutron source experience, females, and those in biological sciences—placed importance on actions that would guide them in the proposal submission process. The user facilities at ORNL should consider measures that will increase the opportunities that scientists have to interact with the facility when preparing a proposal.

Users' Recommendations Regarding Specific Scientific Investigations

One of the questions that surfaced during the qualitative investigation phase was the extent to which those in the sample group considered neutron techniques when planning their scientific investigations. Quantifying the degree to which scientists from different disciplines might or might not recommend employing neutron and/or X-ray techniques highlighted potential knowledge gaps and/or misinformation in this regard. Bryant Research worked directly with SNS scientist Greg Smith, Ph.D., to develop the question set shown in Exhibit 20.

This series of questions generated very large concentrations of "not sure" responses. Uncertainty regarding recommended techniques ranged from a low of 19% to a high of 60%, with concentrations of uncertainty at 30% or greater on 9 of the 13 items tested, and at 50% or greater on 5 of the 13 items tested. Generally speaking, those in the following groups were more likely to express uncertainty:

- those other than a scientist at a national laboratory
- those with little or no neutron source experience

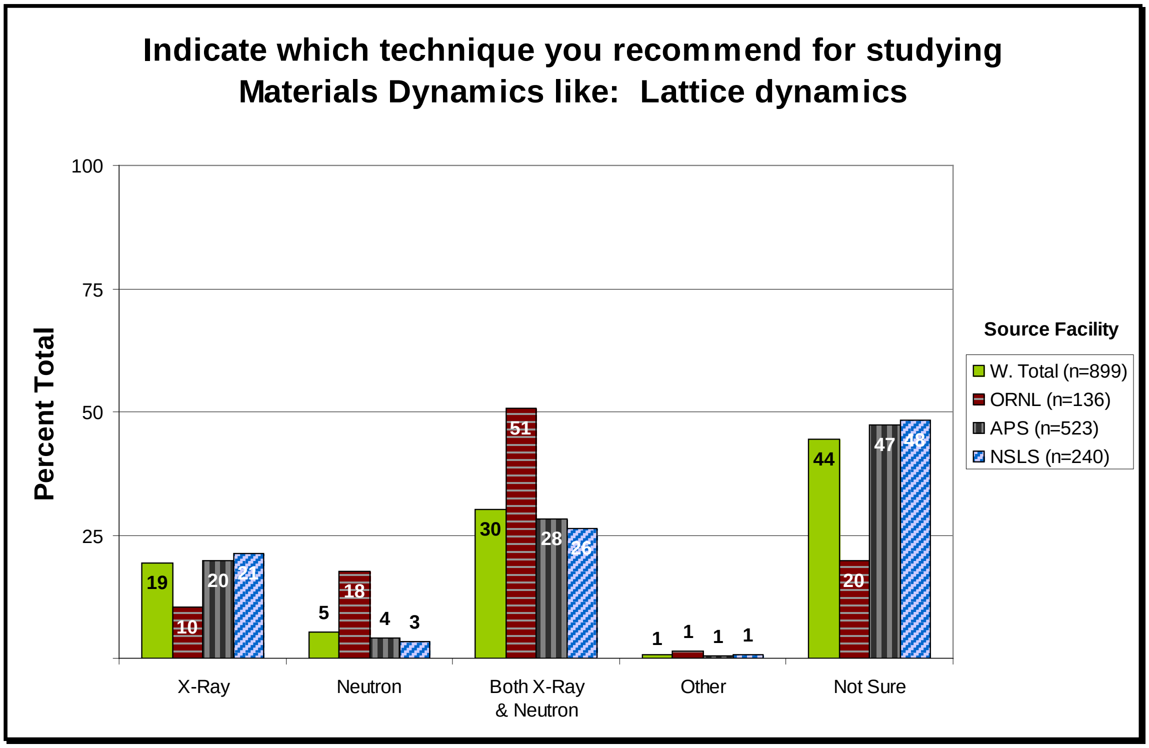
Exhibit 20. Recommendations regarding specific scientific investigations

Indicate which technique you recommend for studying each of the following:	Percent Weighted Total				
Materials dynamics like…	**X-Ray**	**Neutron**	**Both X-Ray and Neutron**	**Other (Specify)**	**Not Sure**
Lattice dynamics	19	5	30	1	44
Magnetic excitations	6	17	17	1	60
Soft matter dynamics	10	8	24	< 0.5	56
Structures of materials like…	**X-Ray**	**Neutron**	**Both X-Ray and Neutron**	**Other (Specify)**	**Not Sure**
Proteins (crystallography)	53	2	27	< 0.5	19
Noncrystalline biological materials	24	7	27	4	38
Thin films	33	2	23	1	40
Magnetic materials	9	13	25	1	53
Engineering materials	18	2	33	1	46
Soft condensed matter	12	5	27	< 0.5	55
Imaging of…	**X-Ray**	**Neutron**	**Both X-Ray and Neutron**	**Other (Specify)**	**Not Sure**
Biological materials	38	3	29	3	27
Engineering materials	23	3	30	2	42
Time-resolved studies…	**X-Ray**	**Neutron**	**Both X-Ray and Neutron**	**Other (Specify)**	**Not Sure**
Pump/probe	30	2	11	1	56
Real-time studies	39	3	17	2	39

- those from the APS or NSLS user list
- those in biological science
- females

Exhibits 21 through 33 detail respondents' technique preferences by user facility. In each case where the subset size was sufficient, statistically significant concentrations follow.

Exhibit 21. Recommended techniques for materials dynamics: Lattice dynamics



Those responding **not sure** were more likely

- APS or NSLS users
- to have no neutron source experience
- in biological science
- female
- not a scientist at a national laboratory or an ORNL user

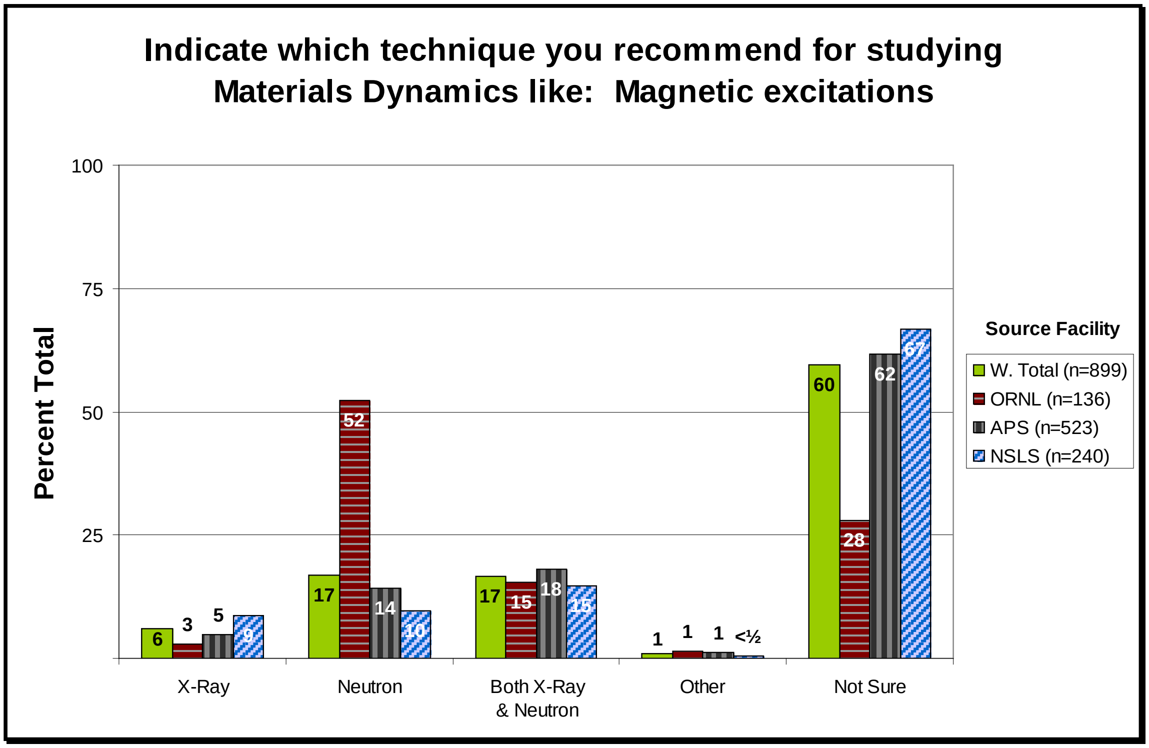
Respondents recommending **X-ray** techniques were more likely

- APS or NSLS users
- to have no neutron source experience

Those recommending **both X-ray and neutron** techniques were more likely

- ORNL users
- to have at least some neutron source experience
- female
- a scientist at a national lab
- not in biological science

Exhibit 22. Recommended techniques for materials dynamics: Magnetic excitations



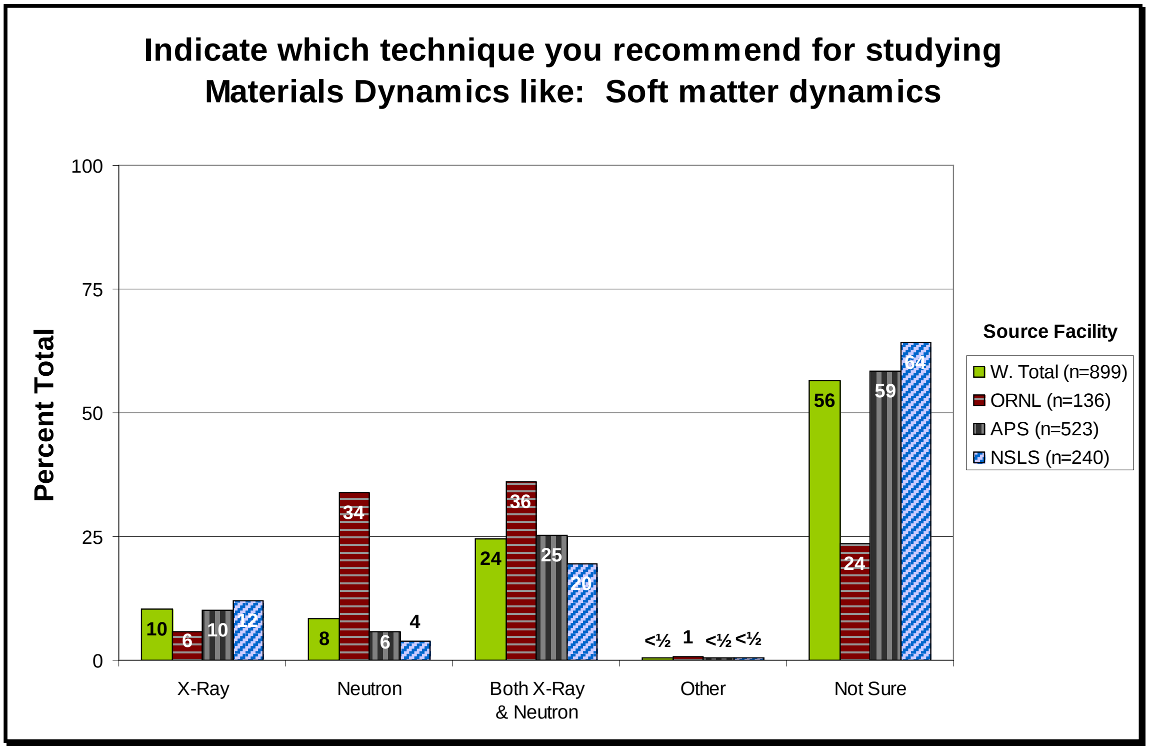
Those responding **not sure** were more likely
- in earth science, chemistry or biological science
- not a scientist at a national lab
- female
- younger

Respondents recommending **X-ray** techniques were more likely
- APS or NSLS users
- in earth science, chemistry or biological science

Respondents recommending **neutron** techniques were more likely
- ORNL users
- male
- a scientist at a national lab
- in physics or materials science

Those recommending **both X-ray and neutron** techniques were more likely
- in physics or materials science
- scientists at a national lab
- male
- to have more neutron source experience
- to have more education

Exhibit 23. Recommended techniques for materials dynamics: Soft matter dynamics

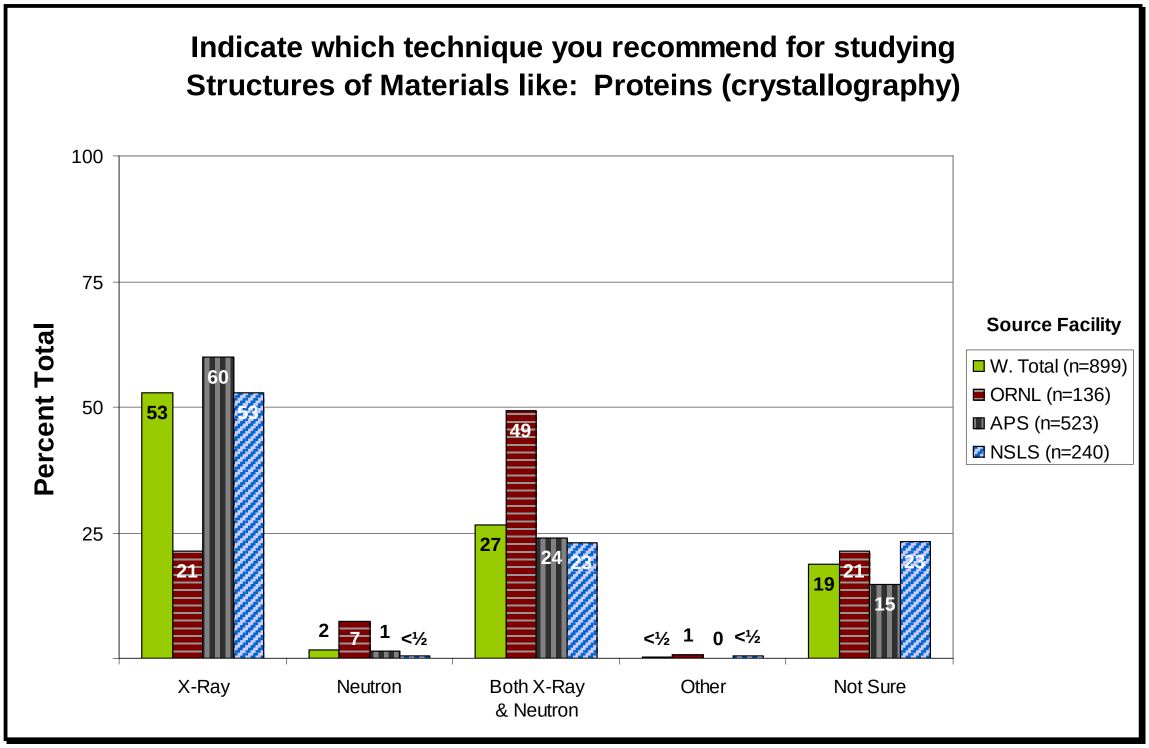


Those responding **not sure** were more likely
- not a scientist at a national laboratory
- to have no neutron source experience
- in biological science
- to have less education

No significant differences noted among those recommending **X-ray** techniques.
Respondents recommending **neutron** techniques were more likely to
- have neutron source experience
- be in physics or materials science

Those recommending **both X-ray and neutron** techniques were more likely
- a scientist at a national lab
- in physics or materials science

Exhibit 24. Recommended techniques for structures of materials: Proteins (crystallography)



Those responding **not sure** were more likely

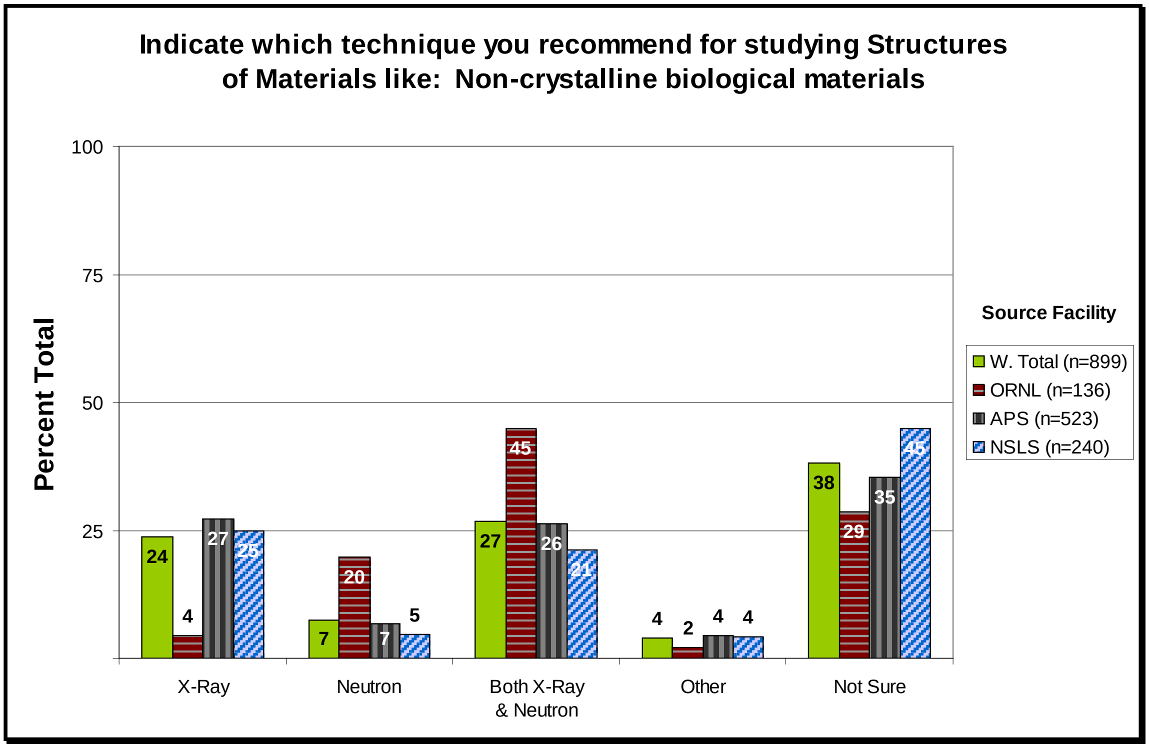
- APS than NSLS users
- under 30 years of age
- to have three or fewer years of light source experience
- not in biological science

Respondents recommending **X-ray** were more likely

- in biological science
- APS or NSLS users
- to have no neutron source experience
- to have at least 1 year of light source experience

Those recommending **both X-ray and neutron** techniques were more likely ORNL users.

Exhibit 25. Recommended techniques for structures of materials: Noncrystalline biological materials



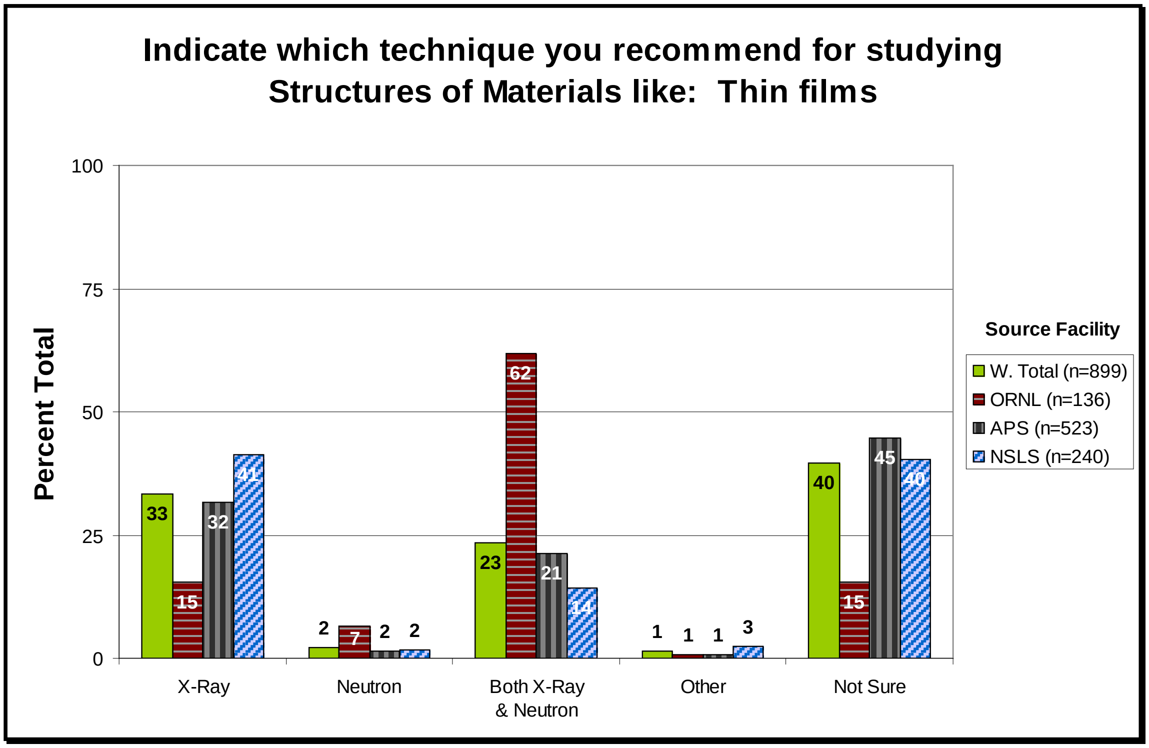
Those responding **not sure** were more likely
- a student or in private industry
- to have no neutron source experience
- to have 3 years or less of light source experience

Those recommending **X-ray** techniques were more likely
- APS or NSLS users
- a university/college scientist than a postdoc
- to hold a Ph.D.
- to have 3 years or less light source experience

Those recommending **neutron** techniques were more likely
- ORNL users
- To have neutron source experience

Those recommending **both x-ray and neutron** techniques were more likely
- ORNL users
- a scientist at a national lab
- in physics than biological science

Exhibit 26. Recommended techniques for structures of materials: Thin films



Those responding **not sure** were more likely

- to have no neutron source experience
- APS or NSLS users
- female
- not a scientist at national lab
- in biological science

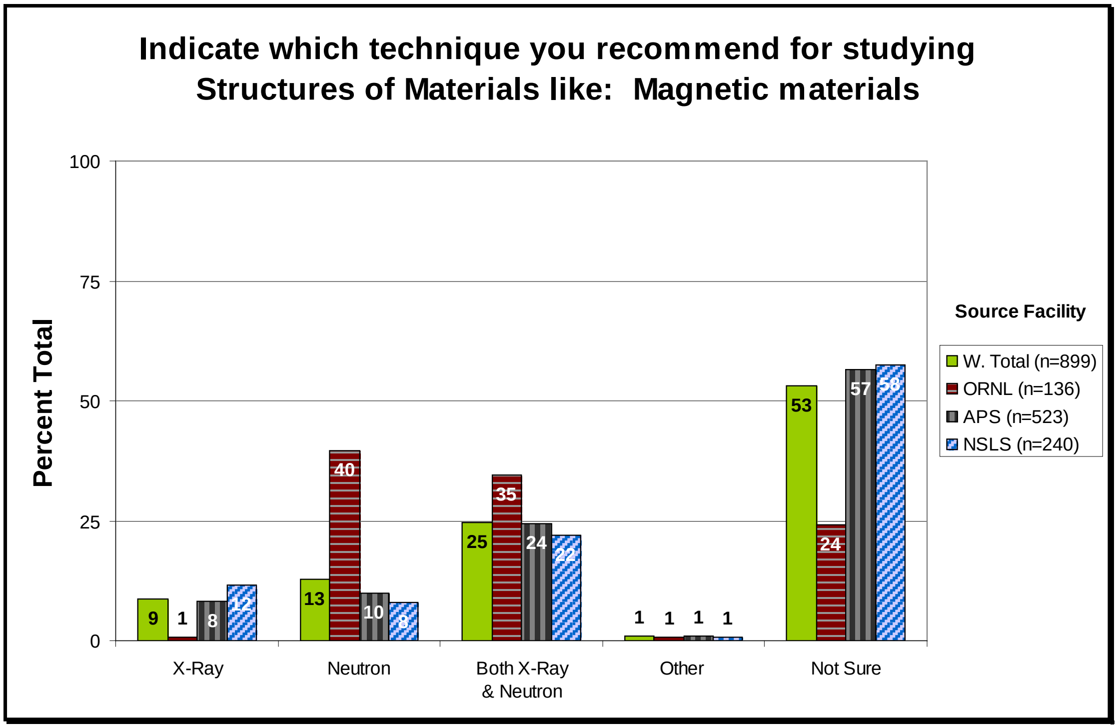
Those recommending **X-ray** techniques were more likely

- APS or NSLS users
- in materials science
- not in biological science
- to have no neutron source experience

Those recommending **both x-ray and neutron** techniques were more likely

- those with neutron source experience
- ORNL users
- male
- a scientist at a national lab
- in physics

Exhibit 27. Recommended techniques for structures of materials: Magnetic materials



Those responding **not sure** were more likely

- to have no neutron source experience
- not a scientist at a national lab
- in earth science, biological science, or chemistry rather than materials science or physics
- younger
- female
- APS or NSLS users
- to have less education

Those recommending **X-ray** techniques were more likely

- APS or NSLS users
- in chemistry than biological sciences

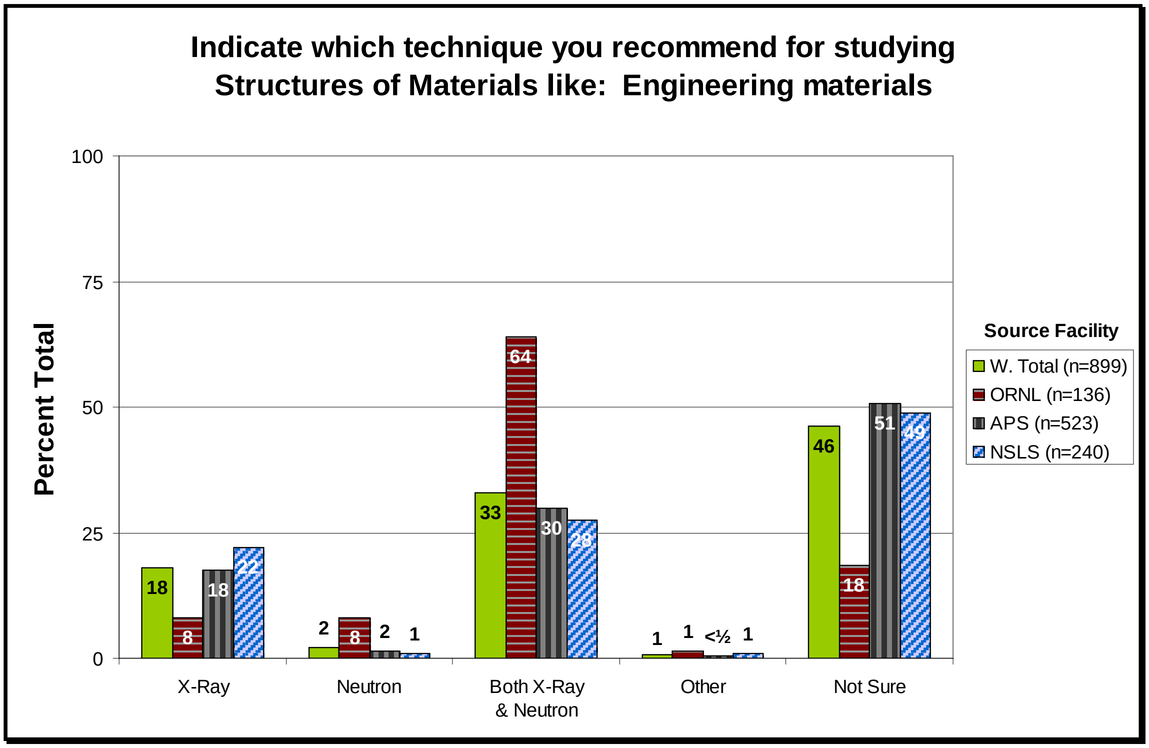
Those recommending **neutron** techniques were more likely

- to have no light source experience
- to have neutron source experience
- ORNL users
- a scientist at a national lab
- in physics, material science, or earth sciences rather than biological sciences

Those recommending **both X-ray and neutron** techniques were more likely

- to have 11+ years experience in their field
- ORNL users
- a scientist at a national lab
- in physics or materials science

Exhibit 28. Recommended techniques for structures of materials: Engineering materials



Those responding **not sure** were more likely

- in biological science
- APS or NSLS users
- female
- younger
- not a scientist at a national lab

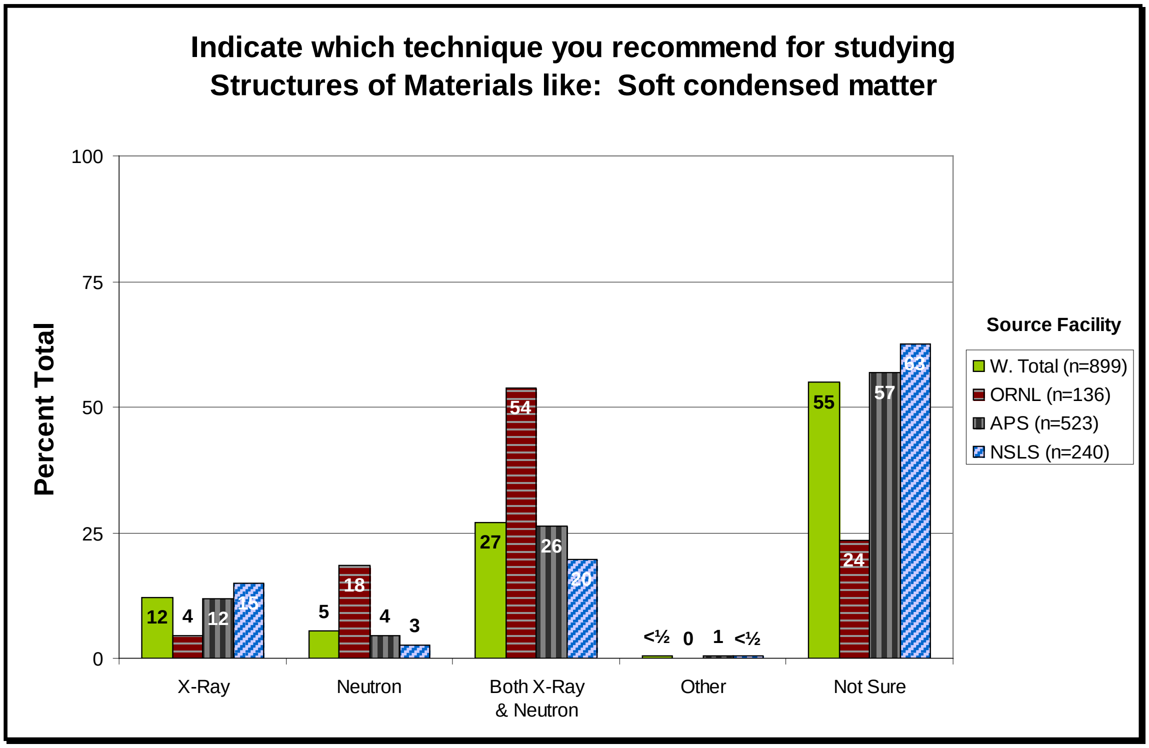
Those recommending **X-ray** techniques were more likely

- APS or NSLS users
- not in biological science
- to have fewer years experience in their field

Those recommending **both X-ray and neutron** techniques were more likely

- to hold a Ph.D.
- to have 11+ years neutron source experience
- to have more years of experience in their field

Exhibit 29. Recommended techniques for structures of materials: Soft condensed matter



Those responding **not sure** were more likely

- APS or NSLS users
- female
- in biological science
- without neutron source experience
- not a scientist at a national lab

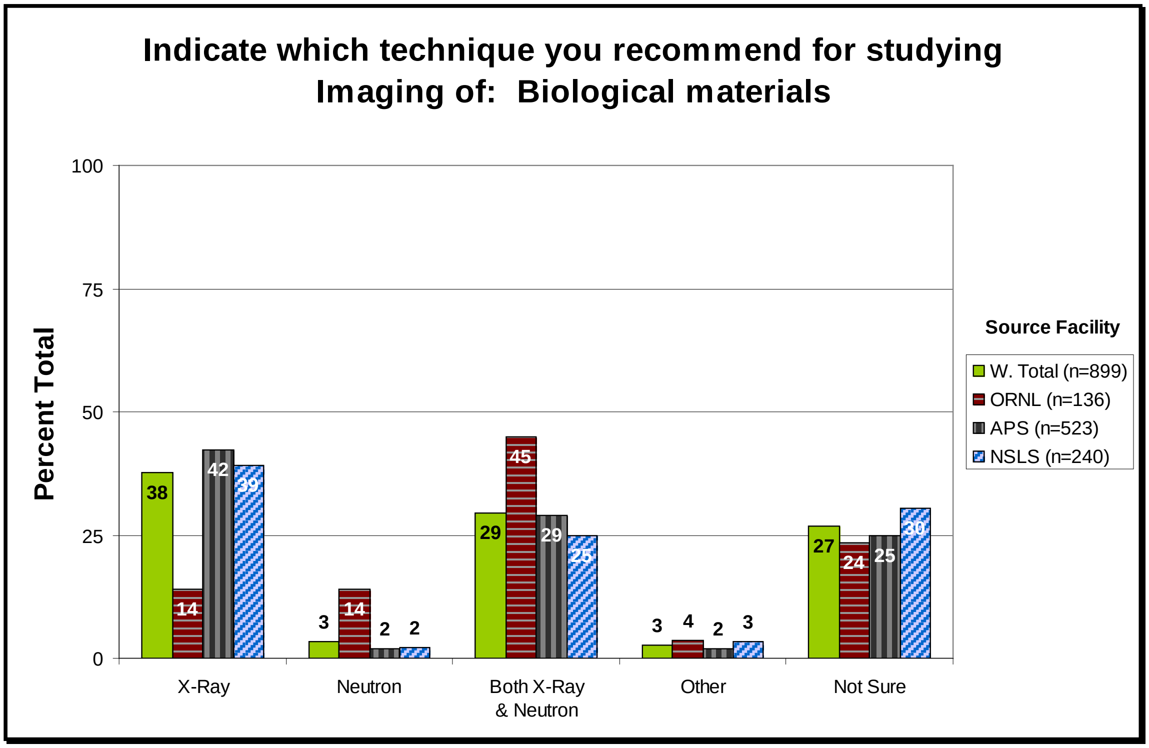
Those recommending **X-ray** techniques were more likely

- NSLS users
- in materials science; not in biological science
- to have 3 or fewer years of neutron source experience

Those recommending **both X-ray and neutron** techniques were more likely

- ORNL users
- a scientist at a national lab
- to have more years of neutron source experience
- to have more years of light source experience

Exhibit 30. Recommended techniques for imaging of materials: Biological materials



Those responding **not sure** were more likely

- not in biological science
- younger
- to have less education
- to have fewer than 5 years experience in their field

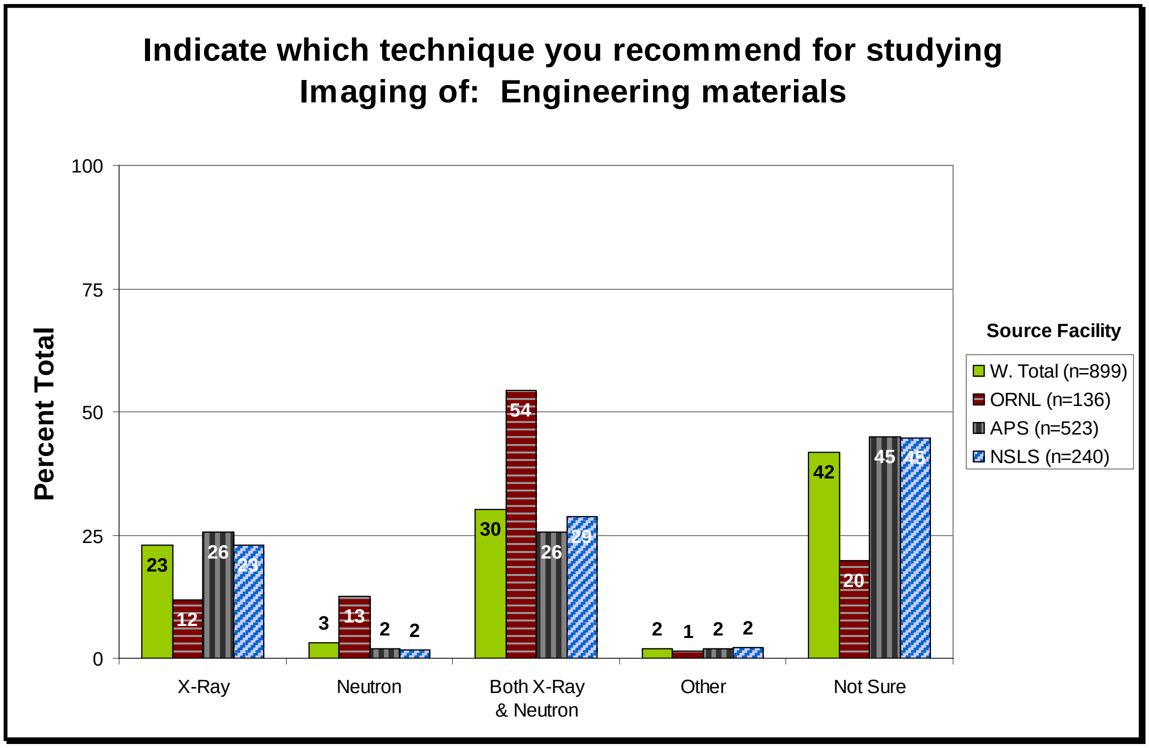
Those recommending **X-ray** techniques were more likely

- APS or NSLS user
- in biological science; not physics or materials science
- to have no neutron source experience
- to have more years of light source experience

Those recommending **both X-ray and neutron** techniques were more likely

- ORNL users
- to have at least 1 year of neutron source experience

Exhibit 31. Recommended techniques for imaging of materials: Engineering materials



Those responding **not sure** were more likely

- in biological science
- not a scientist at a national lab
- female
- younger
- APS or NSLS users
- to have less neutron source or light source experience

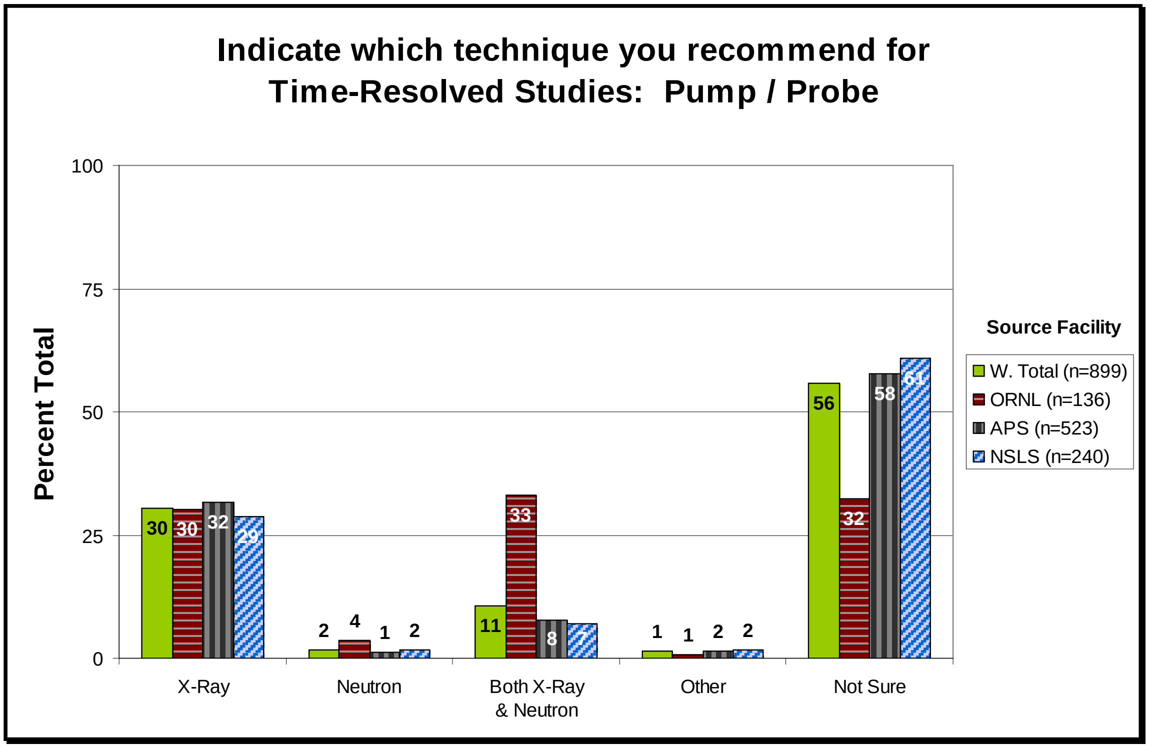
Those recommending **X-ray** techniques were more likely

- APS or NSLS users
- a scientist at a national laboratory, rather than a postdoc or university/college scientist
- to have 4 or more years of light source experience
- to have less than 11 years of neutron source experience

Those recommending **both X-ray and neutron** techniques were more likely

- ORNL users
- in materials science
- to have more years of neutron source experience

Exhibit 32. Recommended techniques for time-resolved studies: Pump/probe



Those responding **not sure** were more likely

- APS or NSLS users
- to have less light source or neutron source experience
- younger
- to have less education
- in biological science

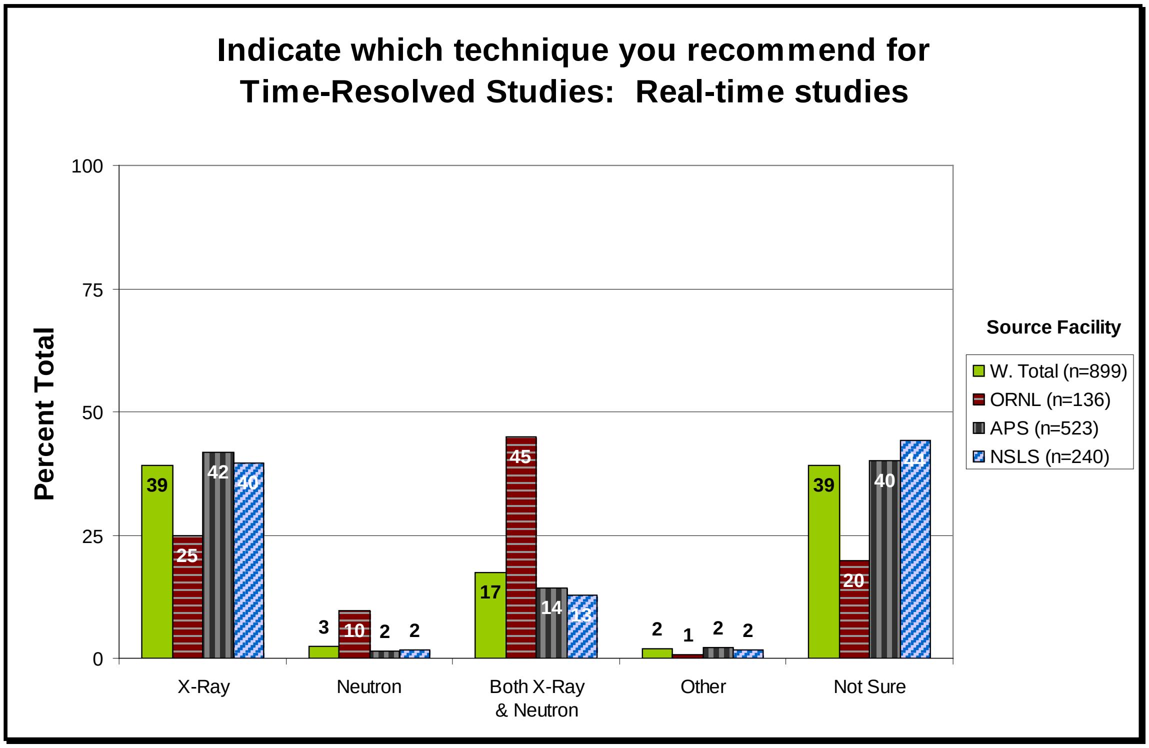
Those recommending **X-ray** techniques were more likely

- male
- older
- a scientist at a national lab
- in physics
- to have more years experience in their field
- to have more light source or neutron source experience
- to have more education

Those recommending **both X-ray and neutron** techniques were more likely

- ORNL users
- in physics or materials science
- to have more neutron source experience

Exhibit 33. Recommended techniques for time-resolved studies: Real-time studies



Those responding **not sure** were more likely

- in biological science
- APS or NSLS users
- female
- younger
- not a scientist at a national lab
- to have less education
- to have less neutron source experience

Those recommending **X-ray** techniques were more likely

- APS or NSLS users
- older
- not a scientist at a national laboratory
- not in biological science
- to have more light source experience

Those recommending **both X-ray and neutron** techniques were more likely

- in physics or materials science
- ORNL users
- to have 11+ years of neutron source experience

Conclusions: Significant concentrations of those surveyed (19 to 60%) expressed uncertainty regarding which techniques—neutron, X-ray, or both—they would recommend for studying selected aspects of materials dynamics, materials structures, imaging, and time-resolved studies. These results underscore the need for initiatives designed to get accurate information to the broader scientific community regarding how X-ray and neutron techniques might be employed.

Impressions about Using Neutron Techniques

In addition to quantifying the extent to which these selected facility users might recommend neutron and/or X-ray techniques for particular types of investigations, this study sought to quantify additional assumptions, opinions, and beliefs about using neutron techniques that surfaced during the qualitative phase of the research. Here, too, the survey documented a great degree of uncertainty among respondents. (See Exhibit 34.)

As Exhibit 34 shows, half of the survey respondents said they were uncertain whether neutron techniques would answer their scientific questions. A majority of those surveyed were uncertain about all but two of the other aspects tested. The uncertainties included the following:

- proposal acceptance rates
- beam reliability
- facility support for interpreting data
- software reliability
- sample environment
- readiness of the facility
- impact of neutron techniques on sample
- the degree of resolution that can be achieved with neutron techniques

The only two items tested for which a majority of respondents did not reply "not sure/don't know" were those asking about unfamiliarity with some aspect:

- unfamiliarity with neutron techniques
- unfamiliarity with interpreting data from neutron techniques

Concentrations of uncertainty were more likely in the following groups:

- APS and NSLS users
- those with less experience, particularly less neutron source and light source experience
- those in biological sciences
- females

Conclusions: These results further highlight the need for education in the scientific community about neutron techniques and how they can be used in scientific investigation. Demographic trends are beginning to emerge in the data that point to targets of educational opportunity, including early-career scientists, females and biological scientists.

Exhibit 34. Impressions about using neutron techniques

Indicate your opinion for each of the following. (Weighted, Percent Total, n=899)	**Total Agrees**	Strongly Agree	Somewhat Agree	**Total Disagrees**	Somewhat Disagree	Strongly Disagree	**Not Sure / Don't Know**	**More Likely to Say Not Sure / Don't' Know if…**
Proposal acceptance for those in my field is low	**9**	3	6	**20**	10	10	**71**	APS or NSLS user; not scientist at national lab; in biological science or chemistry; less neutron source experience
Beam production is unreliable	**7**	1	6	**25**	10	15	**68**	APS or NSLS user; female; not scientist at national lab; in biological science; less experience
Limited facility support with interpreting data	**10**	2	9	**22**	11	12	**67**	APS or NSLS user; female; in biological science; less neutron source experience
The software is not available that supports my investigative needs	**9**	2	7	**25**	12	13	**66**	APS or NSLS user; female; in biological science or chemistry; less experience
The sample environment that I need is not available	**12**	2	10	**25**	11	14	**63**	APS or NSLS user; female; not scientist at national lab; in biological science; less experience
The facility is not ready	**10**	3	7	**27**	11	16	**63**	APS or NSLS user; not scientist at national lab; in biological science; less experience
Results in radioactive production that presents a problem	**11**	2	8	**26**	11	15	**63**	APS or NSLS user; not scientist at national lab; in biological science; less neutron source or light source experience
Radiation damages the sample	**10**	3	8	**33**	9	24	**57**	APS or NSLS user; female; not scientist at national lab; in biological science; less experience
Neutrons do not provide enough resolution	**15**	3	11	**30**	15	15	**56**	APS or NSLS user; female; in biological science; less neutron source or light source experience
Requires large sample size	**36**	17	19	**12**	8	4	**52**	APS or NSLS user; female; younger; not scientist at national lab; in biological science; less experience; Not PhD
Does not answer my scientific questions	**19**	6	13	**31**	11	20	**50**	APS or NSLS user; female; younger; not scientist at national lab; in biological science; less experience; Not PhD
Involves unfamiliar techniques	**30**	12	18	**27**	13	14	**43**	APS or NSLS user; not scientist at national lab; in biological science; less experience
I am unfamiliar with interpreting data from neutron techniques	**37**	21	16	**26**	11	15	**37**	APS or NSLS user; not scientist at national lab; in biological science; less experience

Gap Analysis of the User Facility Experience

Gap analysis offers the ability to both pinpoint and prioritize information for action. In this survey, Gap analysis was used to measure the difference between what users believe to be important about the user facility experience and what they actually experienced. First, survey respondents were asked to rate the importance of selected aspects of the user facility experience using a 10-point scale on which 1 meant very unimportant and 10 meant very important. This score is referred to as the **importance rating**. Second, they were asked to rate their actual experience on each dimension using a 10-point scale on which 1 meant did not meet expectations and 10 meant their expectations had been met. This value is referred to as the **experience rating**. The difference between the level of importance placed on each dimension and what was actually experienced is referred to as the **Gap score**.

Mean experience rating – Mean importance rating = Gap score

Positive Gap scores indicate that the facility user's expectations are being exceeded. A Gap score of zero means that the experience is on par with expectations. A negative score pinpoints any areas of needed improvement. In addition to pinpointing needed actions, Gap analysis assists management in prioritizing any needed changes. Management should focus improvement initiatives first on those items with a higher importance rating.

The survey prompted for the source facility unless the respondent reported not having used that facility. In these few cases, respondents were prompted to respond in the context of the facility that she/he had used most recently. Since the facilities at ORNL provided a combined list of SNS and HFIR users, those on the ORNL list were prompted to the facility on the Oak Ridge Reservation that they had reported using. If they had used both SNS and HFIR, they were randomly assigned to SNS or HFIR. (NOTE: In the course of surveying, because of a combination of laboratory policies and problems with spam filters at the facilities, some of the survey invitations needed to be sent using a survey link that did not include a PIN number. In two cases, this resulted in ORNLs user being prompted for APS, their most recently used facility, instead of HFIR.)

Feedback garnered during the qualitative phase of the investigation was used to develop the dimensions tested. Dimensions tested included the following:

When working at the user facility, it is important to have…
…someone who can help interpret the data
… software that is intuitive to use
…the sample environment you need
…facility staff available 24/7 to answer questions about using the beam line
…lab facilities available to prepare sample
…a beam that operates reliably 24/7 during your experiment
…lab facilities available to characterize sample
…your hotel room on campus
…24/7 notification regarding whether your beam line is on or off
…food services in addition to vending machines available 24/7
…easy access in and out of the facility
…a beam line scientist who is a recognized expert in the field

Analysis was done separately for each facility using unweighted data. The intent is to provide each facility with its own metric. This information is not intended, and should not be used, to make comparisons between facilities. Note that the subset sample sizes for SNS and for HFIR were small: 62 for SNS and 67 for HFIR. The following tables show the results of Gap analyses of each facility, ranked by importance rating mean.

Conclusions: The following were identified as the five most important aspects of the user experience:

- beam line reliability
- sample environment needs
- intuitive software

- 24/7 notification of beam line operation status
- ease of access in and out of the facility

As Exhibits 35A– D show, the five most important aspects were the same for each facility, although they appear in a slightly different order in each case. Each item received a mean importance rating of 8.28 or greater.

Exhibit 35A. SNS Gap analysis

SNS Gap Analysis (Unweighted, n=62)	**Experience Rating Mean 1=Did Not Meet Expectations 10=Met Expectations**	**Importance Rating Mean 1=Very Unimportant 10=Very Important**	Gap**: Experience – Expectation**
...the sample environment you need	7.90	9.35	−1.46
...a beam that operates reliably 24/7 during your experiment	6.20	9.29	−3.09
...software that is intuitive to use	6.05	8.82	−2.77
...easy access in and out of the facility	7.58	8.69	−1.11
...24/7 notification regarding whether your beam line is on or off	6.95	8.52	-1.57
...a beam line scientist who is a recognized expert in the field	8.39	8.16	0.23
...someone who can help interpret the data	8.03	7.84	0.20
...facility staff available 24/7 to answer questions about using the beam line	8.57	7.75	0.82
...lab facilities available to prepare sample	6.90	7.60	−0.70
...lab facilities available to characterize sample	6.46	7.26	−0.79
...food services in addition to vending machines available 24/7	4.73	7.20	−2.47
...your hotel room on campus	3.67	7.02	−3.34

Exhibit 35B. HFIR Gap analysis

HFIR Gap Analysis (Unweighted, n=67)	**Experience Rating Mean 1=Did Not Meet Expectations 10=Met Expectations**	**Importance Rating Mean 1=Very Unimportant 10=Very Important**	Gap**: Experience – Expectation**
...the sample environment you need	8.09	9.45	−1.36
...a beam that operates reliably 24/7 during your experiment	8.55	9.36	−0.82
...24/7 notification regarding whether your beam line is on or off	7.87	8.81	−0.94
...software that is intuitive to use	7.67	8.75	−1.07
...easy access in and out of the facility	8.05	8.51	−0.46
...someone who can help interpret the data	8.20	8.24	−0.04
...lab facilities available to prepare sample	8.32	8.07	0.25
...facility staff available 24/7 to answer questions about using the beam line	8.34	8.01	0.33
...a beam line scientist who is a recognized expert in the field	9.11	8.00	1.11
...lab facilities available to characterize sample	8.00	7.58	0.42
...your hotel room on campus	4.18	7.06	−2.88
...food services in addition to vending machines available 24/7	4.93	6.93	−1.99

Exhibit 35C. NSLS Gap analysis

NSLS Gap Analysis (Unweighted, n=243)	**Experience Rating Mean 1=Did Not Meet Expectations 10=Met Expectations**	**Importance Rating Mean 1=Very Unimportant 10=Very Important**	Gap**:** **Experience – Expectation**
...a beam that operates reliably 24/7 during your experiment	7.86	9.40	−1.54
...24/7 notification regarding whether your beam line is on or off	8.46	8.90	−0.43
...the sample environment you need	8.75	8.80	−0.05
...software that is intuitive to use	7.95	8.69	–0.74
...easy access in and out of the facility	8.75	8.51	0.24
...facility staff available 24/7 to answer questions about using the beam line	8.17	8.14	0.02
...your hotel room on campus	7.78	7.78	0.01
...lab facilities available to prepare sample	8.21	7.76	0.45
...a beam line scientist who is a recognized expert in the field	8.56	7.67	0.89
...food services in addition to vending machines available 24/7	5.25	7.28	–2.03
...someone who can help interpret the data	7.97	7.02	0.95
...lab facilities available to characterize sample	7.51	6.94	0.57

Exhibit 35D. APS Gap analysis

APS Gap Analysis (Unweighted, n=527)	**Experience Rating Mean 1=Did Not Meet Expectations 10=Met Expectations**	**Importance Rating Mean 1=Very Unimportant 10=Very Important**	Gap**:** **Experience – Expectation**
...a beam that operates reliably 24/7 during your experiment	8.68	9.43	–.076
...the sample environment you need	8.88	8.97	–0.09
...software that is intuitive to use	8.07	8.70	–0.63
...24/7 notification regarding whether your beam line is on or off	8.94	8.68	0.26
...easy access in and out of the facility	8.95	8.28	0.66
...facility staff available 24/7 to answer questions about using the beam line	8.64	8.15	0.49
...a beam line scientist who is a recognized expert in the field	8.84	7.98	0.85
...your hotel room on campus	9.29	7.93	1.36
...lab facilities available to prepare sample	8.69	7.84	0.86
...someone who can help interpret the data	8.31	7.41	0.91
...lab facilities available to characterize sample	8.29	7.26	1.03
...food services in addition to vending machines available 24/7	6.77	7.04	–0.27

Gap analysis reveals concerns about

- beam line reliability, particularly at SNS and at NSLS
- sample environment issues, nonintuitive software, and notification of beam line status at SNS/HFIR
- access issues at SNS

Note that SNS and HFIR garnered very negative Gap scores specific to room and board issues. Although not as important as other items, each of these did receive an importance rating of around 7, and they should be not be ignored.

Educational Approaches

The survey explored educational approaches with the intention of providing direction for the strategic communication plan regarding the approaches that this group of scientists would be most likely to use. In addition to some of the traditional educational contexts like lectures and workshops, the survey tested interest in a number of electronic and Web-based educational approaches (see Exhibit 36.) The approaches that three-quarters or more of respondents indicated they would be most likely to use are shaded in dark green. Half or more of those surveyed would be at least somewhat likely to engage with the approaches highlighted in light green. Items highlighted in yellow had somewhat less broad-based appeal; however, it must be noted that those who favored some of the electronic approaches tested were more likely to be in some of the demographic groups on which ORNL may need to concentrate its educational outreach.

Exhibit 36. Educational approaches

If available, indicate how likely you are to participate in the educational approaches listed below. Weighted Total (Percent Total, n=899)	**Total Likely**	Very Likely	Somewhat Likely	**Total Unlikely**	Somewhat Unlikely	Very Unlikely	Not Sure / Don't Know	**More Likely to Say Very Likely or Somewhat Likely if…**
Workshops at conferences	**82**	36	45	**16**	11	5	2	Female
"Hands on" learning at the facility	**81**	49	33	**17**	12	5	2	Student; less neutron source experience
Hard copy, like books, journals	**78**	33	45	**20**	14	6	3	At NSLS than APS
Archive of lectures accessible through the web	**76**	34	42	**21**	13	8	3	Under 50
Topical lectures at the facility	**65**	23	43	**31**	20	11	3	Scientist at national lab; in materials science, Not in biological science
Technique-specific wiki	**58**	21	36	**32**	19	14	10	Under 50; postdoc or student; in biological science; less **experience**
"Hands on" learning in a virtual facility environment	**54**	21	33	**38**	22	16	7	Female; under 30; postdoc or student; in biological science; less **experience**
Discipline-specific wiki	**53**	19	34	**36**	20	16	11	Under 50; postdoc or student; in biological science; less **experience**
Interactive webinar	**37**	9	29	**53**	28	25	10	Female; under 50; postdoc; in chemistry or biological science, Not in physics; less **experience**
Internet-based class for credit	**31**	10	21	**62**	23	40	6	Under 50; postdoc or student; Not in physics; less **experience**
Classroom-based course for credit	**28**	10	18	**65**	24	41	7	Female; under 30; graduate student; less **experience**; Not PhD
Automatic newsfeeds (RSS)	**27**	7	20	**61**	27	34	12	Female; under 50; postdoc or student; in biological science; less **experience**
Podcasts	**27**	6	20	**63**	27	35	11	Under 50; postdoc or student; in biological science; less neutron source experience

Conclusions: Respondents reported the highest interest in participating in the following:

- workshops at conferences
- hands-on learning at the facilities
- information from the literature
- accessing archived lectures available through the facility's Web site

Those with less experience (in their field, with light sources, and with neutron sources) were more likely to express interest in participating in Web-based applications.

- At least half noted they were likely to use both technique- and discipline-specific wikis, as well as participate in "hands-on learning in a virtual facility environment."

Repeatedly, this less experienced demographic showed a higher interest in online educational approaches, e.g., wikis, interactive webinars, Internet-based class for credit, RSS feeds, and podcasts. It also is interesting to note that those in biological science appeared more likely to access information via Web-based applications. These online approaches can and should be incorporated into the facility's Web site in an effort to boost its educational value.

Accessing Publications/Information—Current Behaviors

This survey establishes a baseline of awareness and perceptions regarding APS, HFIR, NSLS, and SNS among its users. This baseline provides a benchmark against which education and other outreach efforts can be measured.

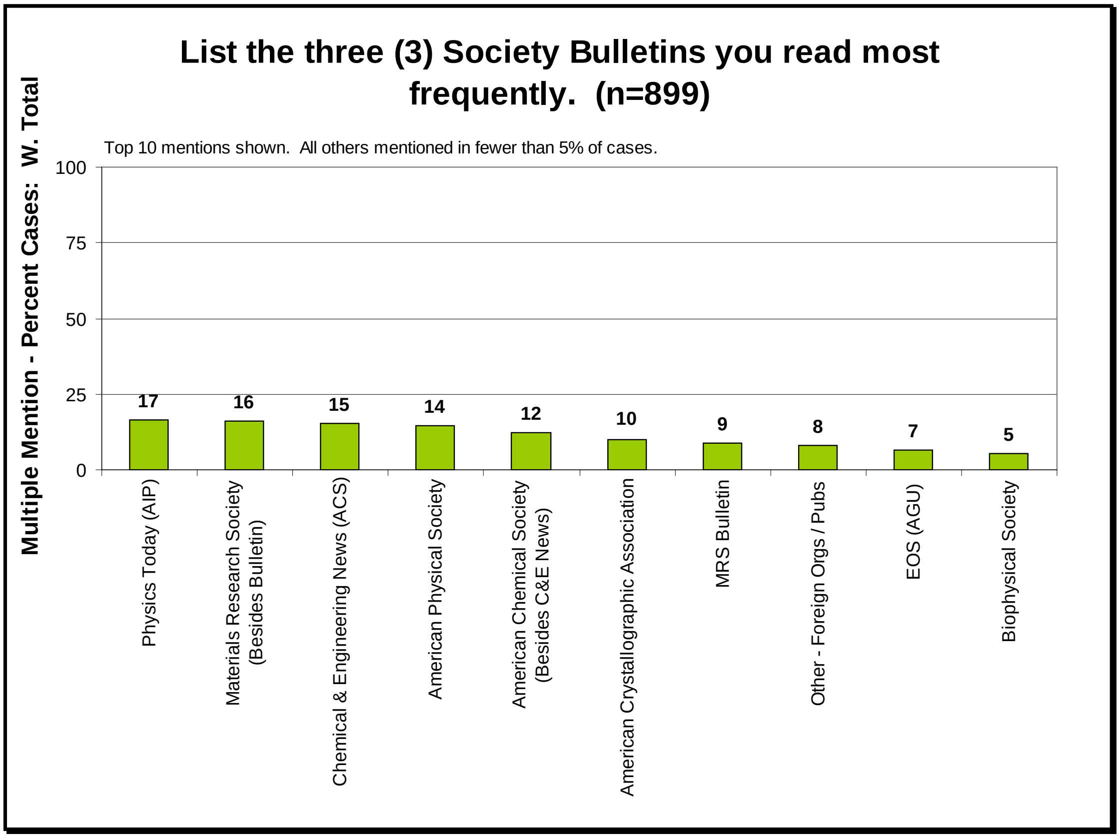
In addition to the sources of initial information cited in this report, the survey included several open-ended queries designed to quantify where these scientists are getting information. This included questions about the most frequently read society bulletins and scientific journals as well as the search engines used most frequently when looking for science-related information.

Because user responses were open-ended, the same source may be mentioned in different ways. For example, the Materials Research Society (MRS) was mentioned 94 times by the society name alone, and 53 mentions specifically cited the MRS Bulletin. Additionally, some organizations issue multiple publications covering different fields of science. Therefore, each publication is listed by both its title and publishing organization. In some cases, the category "other, or by name" indicates a catch-all for mentions of a specific publishing organization that did not fall into a larger publication category.

Society Bulletins

The most frequently mentioned bulletins appear in Exhibit 37. A complete list of bulletins mentioned appears in the appendix to this report.

Exhibit 37. Most frequently read society bulletins

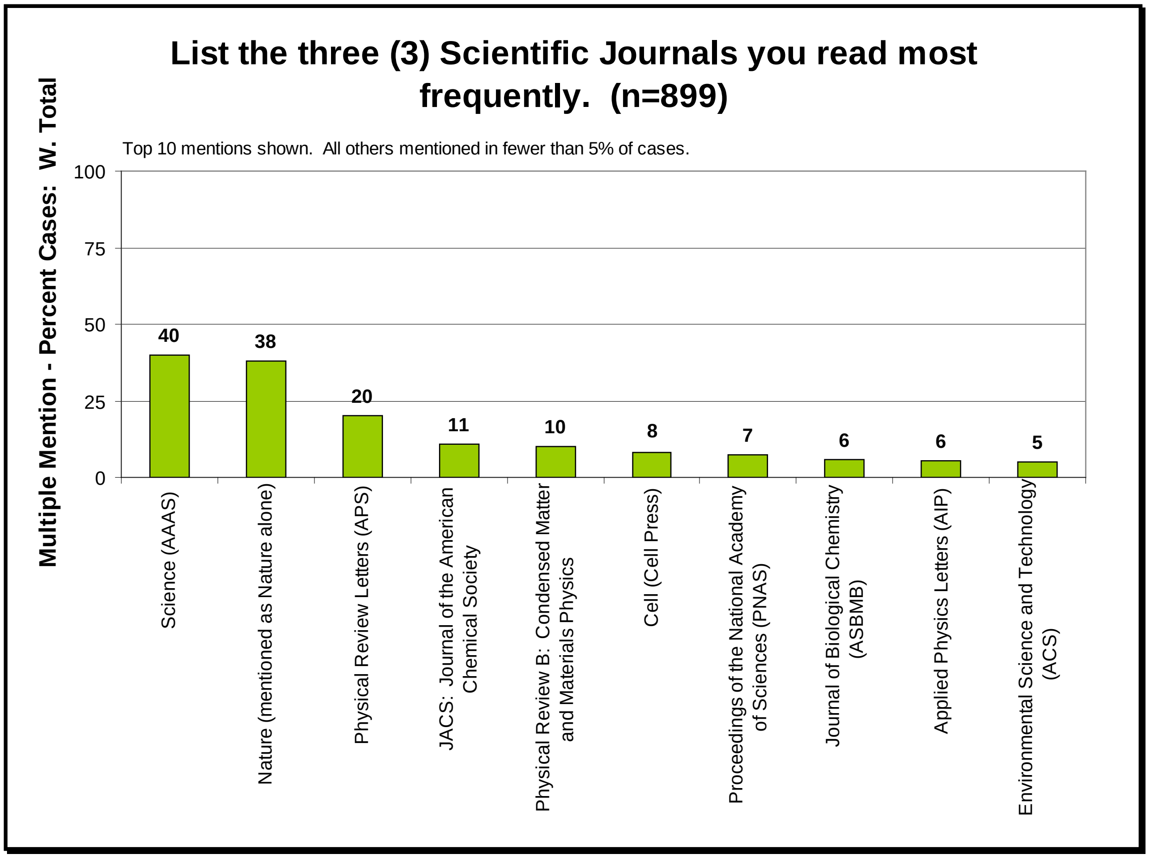


Conclusions: Concentrations of society bulletin readership were very fractured, with the vast majority of bulletins mentioned by 5% or fewer respondents. This is not surprising, as the bulletins are very specific to the different areas of science. It should be noted that respondents overwhelmingly reported reading society bulletins in hard copy rather than on the Web.

Scientific Journals

Reported readership of scientific journals also was fractured, though not quite to the extent noted for society bulletins (see Exhibit 38). A sizeable concentration of respondents mentioned *Science* and *Nature*, and roughly one in five cited the American Physical Society's *Physical Review Letters*. Other publications were mentioned by 11% or fewer respondents. Again, this reflects the diverse scientific focus among those surveyed. It is interesting to note that scientific journals were more likely to be read online. A complete list of science journals mentioned appears in the appendix to this report.

Exhibit 38. Most frequently read scientific journals



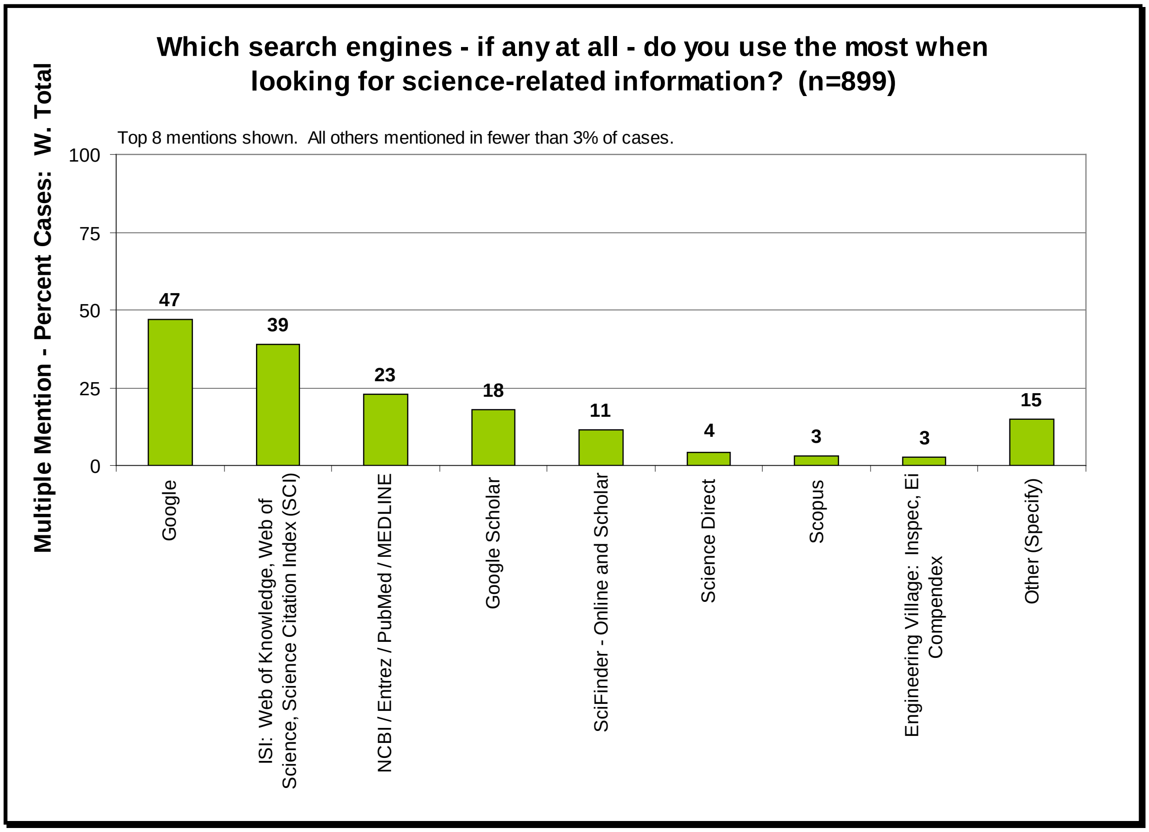
Conclusions: *Science* and *Nature* were mentioned by significant concentrations of respondents. These publications should be top targets in any communication strategy. Respondents indicated they tended to read scientific journals online. So it is a good idea to include Web links in articles submitted for publication in scientific journals to increase the opportunity for readers to go directly to more information.

Publication conclusions: Much like the data on society bulletin reader concentrations, journal readership is driven by the area of scientific interest. The fractured nature of the responses was driven by the number of different scientific disciplines in the sample. Therefore, passive tactics such as Web site–based information should be parsed so that a viewer can quickly go to his or her area of science.

Search Engines

Responses regarding the search engines used to access information were more concentrated. Almost half of those surveyed mentioned Google, followed by a significant concentration of respondents citing ISI Web of Knowledge/Science. Other search engines mentioned by at least 10% of respondents included the National Center for Biotechnology Information's Entrez/PubMed, Google Scholar, and SciFinder. See Exhibit 39.

Exhibit 39. Most frequently used search engines



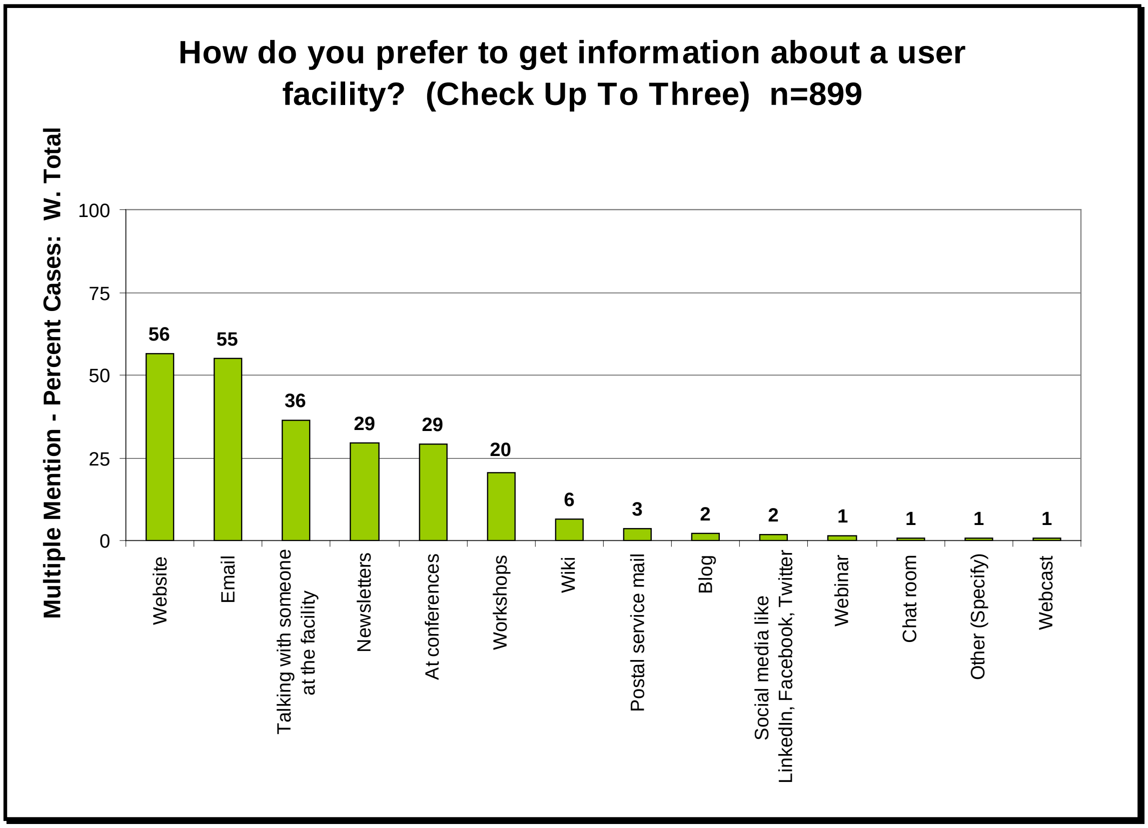
Conclusions: Those surveyed employ search engines to access science-related information. Scientists from different disciplines use the same search engines. These results confirm a working assumption regarding the criticality of leveraging the Internet in the communication strategy and underscore the importance of search engine optimization, particularly with Google, with ISI Web of Knowledge/Science, and with Entrez/PubMed.

Getting User Facility Information

Preferences for Accessing Information

Over half of those surveyed cited a Web site and/or email as their preferred way to access information about a facility. A significant concentration of respondents noted a preference for talking directly with someone at the facility as well. Newsletters, a fairly traditional communication tool for pushing out information, were cited by a significant concentration of respondents, as were conferences and workshops. Note that the latter two options offer the opportunity for two-way communication. These results strongly suggest that those interested in user facility information often choose a method of accessing information that accommodates two-way communication in addition to the one-way options for getting just the facts.

Exhibit 40. Preferences for accessing information



Those citing a preference for email were more likely to exhibit one the following characteristics:
- female
- in biological science
- no neutron source experience

An expressed preference for talking with someone at the facility was more prevalent among those
- age 30+
- in materials science

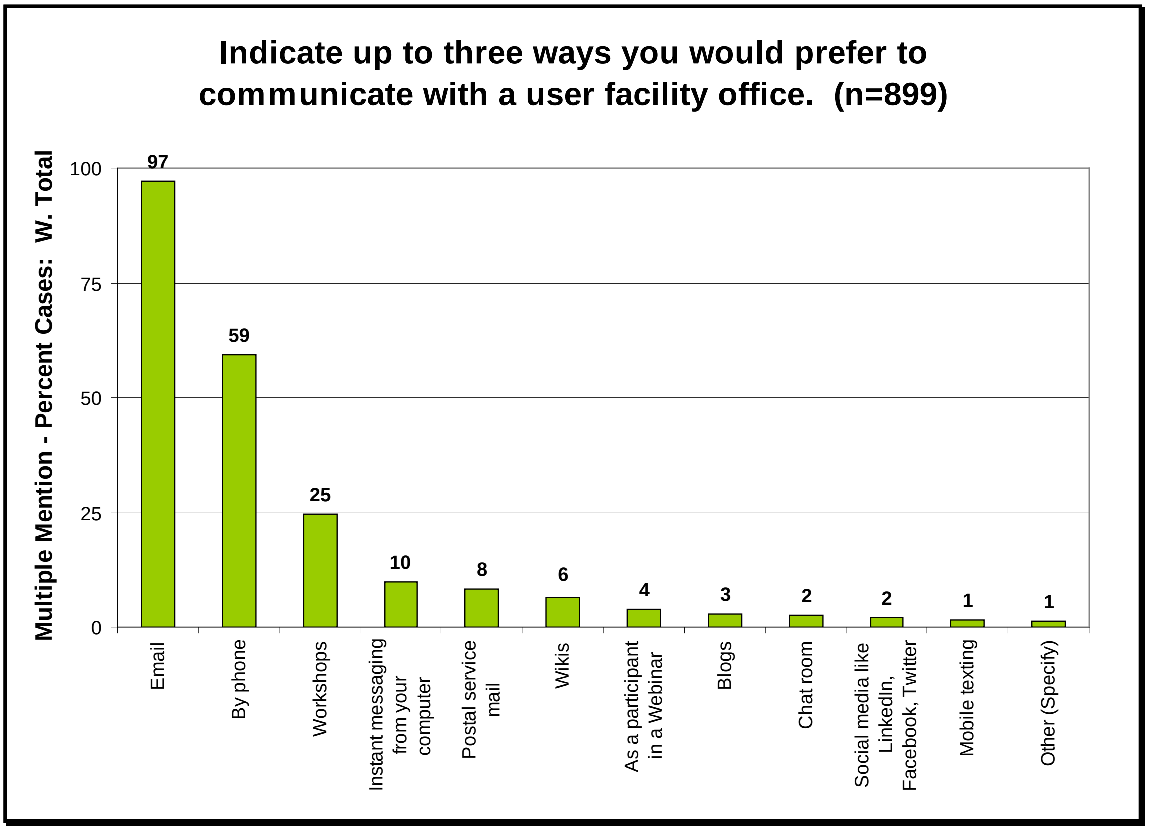
Conferences were more likely the preferred way to get information if a respondent was
- an ORNL user
- in materials or earth science

A preference for workshops was more frequently cited by those in materials science.

Preferences for Communication with User Facility Office

Respondents overwhelmingly cited email as their preferred method for communicating with the facility's user office, followed by phone (Exhibit 41). Roughly one in four respondents also noted a preference for workshops.

Exhibit 41. Preferences for communication with user facility office



Those citing a preference for email were more likely age 50+.

Workshops tended to appeal to those
- with less neutron source experience
- in materials science

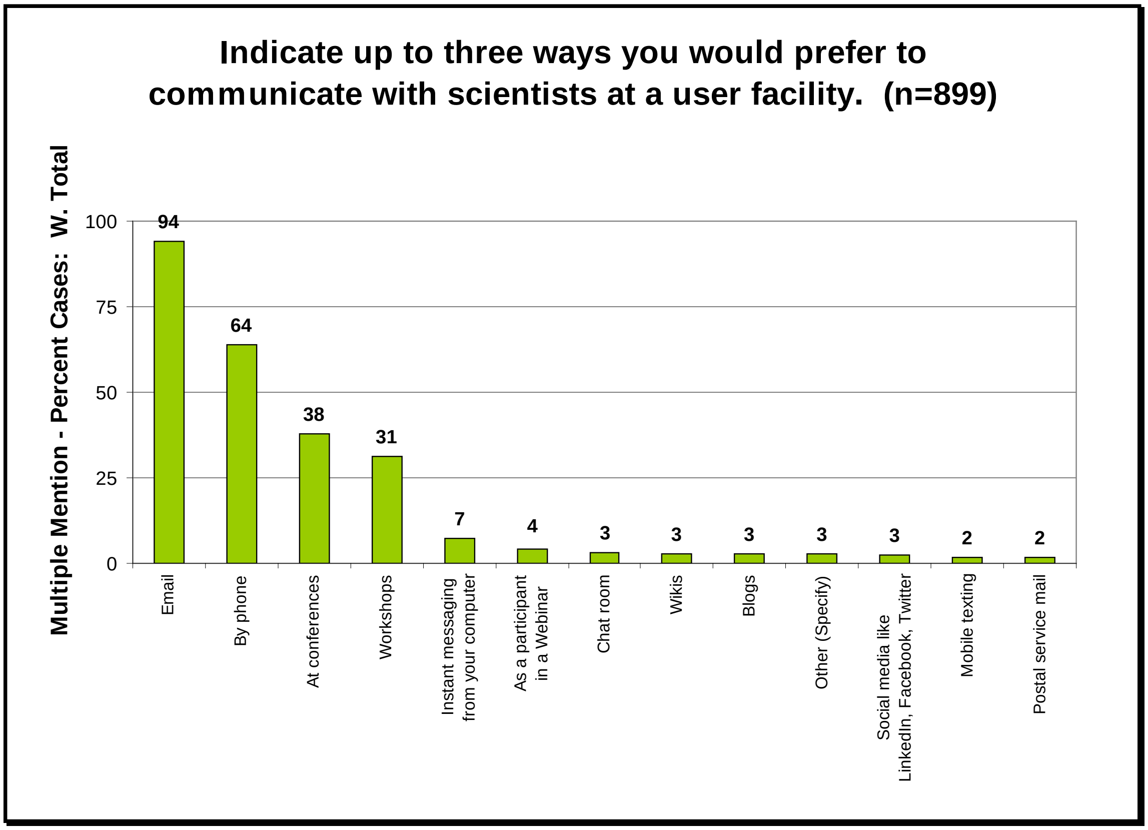
Preference for instant messaging was concentrated with students, while those age 50+ were more likely to prefer Postal Service mail.

wikis appealed more strongly to those in biological science.

Preferences for Communication with Scientists at the User Facility

Again, respondents cited an overwhelming preference for email communication with the scientists, followed by phone contact. A significant concentration also favored interactions at conferences and workshops. See Exhibit 42.

Exhibit 42. Preferences for communication with scientists at the user facility



Statistically significant differences in preferences follow.

Phone contact was more likely to be cited as a preference among those with 1–3 years of neutron source experience.

Conferences are more likely to appeal to respondent in physics, not biological science.

Workshops are more likely to be preferred by those
- with 1–3 years neutron source experience
- in earth sciences, not biological science

Instant messaging is more likely to appeal to those
- <30 years old
- with less education
- with less light source experience

Interest in webinars was higher among scientists in private industry.

Conclusions: Those surveyed tended to cite preferences for communication methods that allow two-way interaction. These results were noted even when respondents were specifically asked about one-way communication needs, e.g., getting information about a user facility. The Web site must be a central focus of the communication strategy, as it is how the majority will seek information. The Web site should include email and phone contact information. Additionally, we recommend exploring interactive opportunities through the Web site, e.g., forums, wikis, promotion of online workshops/webinars.

The vast majority of respondents cited email as their preferred method of two-way communication with the user facility office, as well as with scientists at the user facility. It is notable that higher concentrations of those with less neutron source experience expressed a preference for workshops. This suggests that those with more fundamental information/education needs are more likely to respond favorably to face-to-face, hands-on educational/informational opportunities. Younger respondents were more likely to express a preference for instant messaging.

Conclusions and Recommendations

Awareness and Utilization

Survey results show that significant numbers of APS and NSLS users are unaware of HFIR and SNS. Since scientists must be aware of resources to include them in their research plans, this finding strongly indicates the need for an aggressive awareness-building approach.

Contact with colleagues is a key way survey respondents became aware of SNS and HFIR, whereas they learned about APS and NSLS more through academic channels. Young scientists tend to build their choices on what they learn in their university years, and information shared through academic channels appears to benefit SNS and HFIR less than APS and NSLS. SNS and HFIR should aggressively seek to change that disparity. The goal should be to establish awareness earlier to encourage scientists to consider the neutron sources when designing experiments.

Arguably, information from academia forms the foundation upon which young scientists build their career choices. APS and NSLS appear to derive much greater benefit from information shared in academic channels than SNS and HFIR. This disparity is one that SNS and HFIR should aggressively seek to change. While it is certainly positive that work colleagues provide the initial introduction to the neutron source facilities at ORNL, the goal should be to establish awareness much earlier in a scientist's career. This way SNS and HFIR increase the opportunity for scientists to consider the neutron sources available on the ORNL reservation when designing experiments, and thus increase the opportunities for neutron techniques to contribute to world-class science. These results underscore the importance of the National School on Neutron and X-ray Scattering and challenge ORNL to think of multiple ways to engage scientists early in their careers.

Choice Criteria

The high flux/intensity of the beam was a driving choice criteria for each of the facilities tested except NSLS. The unique instrument capabilities at SNS prompt users to choose this facility, and access to specific instruments and/or capabilities were top choice criteria for those doing work at HFIR, as well. None of the users surveyed mentioned choosing either SNS or HFIR for crystallography or choosing SNS for diffraction. These results present an educational opportunity for NScD to educate scientists about instrument capabilities at ORNL that support these types of investigations.

The National School on Neutron and X-ray Scattering has positively contributed to scientists selecting SNS or HFIR. This further supports the value of education regarding beam line capabilities.

Beliefs about Proposal Submission

Most respondents said it is important to have technical information available about instrument capabilities and sample requirements and to be able to communicate with instrument scientists when preparing a proposal. Less experienced researchers emphasized guidance such as written feedback on proposals and being able to see examples of successful proposals.

To meet those needs, Neutron Sciences should consider instituting procedures to support proposal success, such as posting successful proposals online, providing workshops on proposal submission, identifying proposal mentors for first-time submitters, and other actions that enable scientists to interact with facility staff when preparing a proposal.

Reasons for Not Using SNS or HFIR

Many of those who have not used SNS or HFIR see no compelling scientific reason to do so, and some indicated they needed more information about these techniques. These results underscore the need for educational outreach and communication about the uses of neutron scattering. The survey data can serve as baseline metrics for measuring the impact of communication strategies for increasing understanding of the value of neutron scattering.

Impressions about Using Neutron Techniques

Half of those surveyed were uncertain whether neutron techniques could be employed to answer their scientific questions. Therefore, the strategic communication plan should inform scientists about applications of neutron science in particular fields of study.

The NScD Web site should be the initial focus of the communication strategy, and it should include specific consideration of the following:

- Formats should be used that appeal to those with less experience (in their research fields and with neutron sources) and to those in biological science—particularly discipline- and technique-specific wikis and “hands-on” learning in a virtual environment. Podcasts and online classes for credit might also be useful formats.
- The Web site should feature educational content and reinforce key messages regarding applications of neutron scattering to experiments in different scientific fields. This information needs to be displayed so that Web users from different areas of science can easily find the information pertinent to them.

Uncertainty about Using Neutron and X-ray Techniques

Significant concentrations of those surveyed expressed uncertainty regarding which techniques—neutron, X-ray, or both—were most appropriate for studying selected aspects of materials dynamics, structures of materials, imaging, and time-resolved studies. These results further underscore the need for initiatives designed to distribute accurate information to the broad scientific community regarding how neutron techniques can be employed.

Educational Approaches

Those with less experience (in their fields and/or with neutron sources) showed a higher interest in online educational approaches, e.g., wikis, interactive webinars, Internet-based classes for credit, RSS feeds, and podcasts. Those in the biological sciences appeared more likely to access information via Web-based applications. A mix of these online approaches should be incorporated into the facility’s Web site to boost its educational value.

Accessing Publications Information—Current Behaviors

The survey included specific questions about where these scientists get information in an effort to facilitate targeted communications through multiple channels. The results suggest strategies for targeting information.

Society bulletins: Society bulletin readership is divided among many audiences by specialty. This communication channel presents an opportunity to target information to specific areas of science.

Scientific journals: *Science* and *Nature* should be top targets in the communication strategy, as they were mentioned by a larger number of respondents. Respondents say they tend to read journals online; therefore, it would be helpful to include hot links in articles submitted to scientific journals to encourage online readers to go directly to more information. Since journal readership is driven by area of interest, both active outreach (e.g., workshops, conferences) and tactics such as Web-based information should be parsed by area of science to direct readers to their areas of interest.

Search engines: Survey results indicate it is critical to leverage the Internet in the communication strategy and underscore the importance of search engine optimization, particularly for Google, ISI Web of Knowledge/Science and the National Center for Biotechnology Information's Entrez/PubMed.

Getting Specific User Facility Information

The Web site must be a central focus of the communication strategy, as it is how the majority will seek information. The Web site should include key contacts' email and phone information. Additionally, interactive opportunities through the Web site should be explored, e.g., forums, wikis, promotion of online workshops/webinars, etc., and perhaps an online mentoring program for those new to the proposal submission process.

The survey data suggest those with more fundamental information/education needs are more likely to respond favorably to face-to-face, hands-on educational opportunities.

Gap Analysis of the User Facility Experience

Based on Gap analysis results, it is recommended that the user facilities first concentrate on ensuring a positive user experience in the following areas:

- beam line reliability
- sample environment needs
- intuitive software
- 24/7 notification of beam line operation status
- ease of access in and out of the facility

SNS and HFIR garnered very negative Gap scores on the issue of room and board, which should not be ignored, as it has a high importance rating.

It is highly recommended that NScD set targets for awareness, utilization, consideration of using the facilities, and understanding before launching the strategic communication initiative, so that the results from this study can be used to gauge the effectiveness of the campaign.