FACTORS WHICH CAN AFFECT THE PREFERENCES OF THE ELDERLY FOR HAND PRUNERS

by

Ellen J. Pitt

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APPROVED:

Paula D. Relf

Alan R. McDaniel

Rosemary Blieszner

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This study is dedicated to Mary Stabley (deceased, May 1984) and all the seniors who participated in the survey.

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Introduction

Use and development of tools parallel the development of culture (33). Even the simplest tools affect the quality of modern life since hand tools allow the user to accomplish tasks which otherwise may be time consuming or excessively fatiguing.

Many people over the age of 50 own homes and continue to maintain the landscape around their house. Others living in institutions, such as nursing homes, may have an opportunity to participate in outside horticultural activities, which may include landscape development and maintenance. Among the various gardening tasks, the pruning of shrubs can be a fatiguing and time consuming task. If older people are to continue independent gardening activities, derive satisfaction from them and avoid injury, appropriate hand tools must be available to them.

Ergonomics is a "branch of science that aims for optimal matching of task, tools, and environment with human capabilities and limitations" (29). The present study used principles of ergonomics to investigate the design of a hand tool (the pruner), the task (pruning a branch), and the environment (about the home). The investigation attempted to discover to what degree there was a match between various types of pruners in these circumstances with the "capabilities and limitations" of a population of people over 50.

The hand is a part of the body that is vital, or at least very critical, to the successful manipulation of the human environment.

People use their hands to care for themselves, to accomplish assigned tasks at work, and to pursue leisure activities. Any condition that affects people's ability to use their hands will force them to make adjustments in their lifestyle. With normal aging, conditions such as decreased grip strength, increased chance of arthritis and other chronic illnesses, along with an increased chance of sustained injury to the hand, may affect people's ability to use their hands.

The hand tool is an extension of the hand. The design of the tool should be matched both to the prescribed task -- whether it is to brush the teeth, pound a nail, or prune dead wood from a rose bush -- and to the hand that is to use the tool. Using a spade whose handle is too thick to dig a hole is as inappropriate as using a teaspoon to dig up a planter.

As people age, their need for tools changes. Prescribed and chosen tasks change in the transitions from school to work and from career to retirement. Changes in physical capability and size also require a change or modification in tools. Hand tools are no exception. A screw driver designed for the hand of a child differs from one designed for the adult hand, which is larger. Special tools or modifications in tools may allow weaker people to carry on normal self-help activities or to pursue a new avocation such as gardening. Studies focusing on tool improvements that allow weaker or impaired people to participate in activities are needed to expand the knowledge needed to improve the choice and design of tools.

This study had two major goals. The first goal was to investigate an elderly population's preference of hand pruner types and the influence various factors have on their choices. Analyzing the pruner preferences and pruner evaluations made by an elderly population is important because mechanical evaluation and evaluations made by ergonomic experts may not be adequate for preparing recommendations for this population. A study utilizing elderly respondents can be most valuable for giving additional insights about hand tool choices. The factors investigated were divided into characteristics of the humans and of the pruners. The population characteristics include age, sex, hand size, grip strength, and pruning experience. The pruner characteristics include blades, pivot mechanisms, weight, cutting action, and handle size. Relationships between factors and choice were used to make informed recommendations for choosing different types of pruners. The second goal was to develop a framework for scientific investigation that could be used by others interested in research on tools used in horticultural therapy activities, especially hand tools.

Review of Literature

Ergonomics of hand tools:

Using an unsuitable tool for a task, or using a suitable tool improperly, can damage the hand. For example, in carpal tunnel syndrome the person affected experiences pain due to the "compression of the median nerve as it courses through the carpal tunnel" (44) in the wrist. Women have been more likely to exhibit this condition since "work [whether occupation or avocation] requiring light, highly repetitive movements of the wrist and fingers" (10) may be a cause of this affliction, and women often perform such tasks both in and outside of the home. The National Institute for Occupational Safety and Health estimated that 23,000 laborers suffer from carpal tunnel syndrome annually (11). Tenosynovitis, another painful affliction, is caused by the "unaccustomed use" of various muscles in the hand (29). Injuries on the job have often changed the worker's ability to use tools. One report stated that for the year 1979, the second most frequent injuries were those to the thumb and finger. "Arm injuries totalled 210,000, hands 160,000, and fingers 340,000" (11). Furthermore, the threat of pain makes the person avoid using the hand and increases the inability to use tools with comfort.

Durcharme's survey (29) of 14,000 able-bodied women found that many tools were inadequate due to size, bulkiness, weight and difficulty of operation. Studies have found the handicapped population has difficulty "with tasks which require rotation, positioning of small

parts, grasp, and materials handling" (29). A study on hand strength made by the Cerebral Palsy Research Foundation of Kansas' Rehabilitation Engineering Center concluded that "the present tools do not fit 95% of the handicapped population in terms of pinch and grip strength" (29). Therefore, considerations of tool size, weight, and ease of operation are needed in the design or selection of tools for a disabled or impaired population. This is of particular importance to those over 50 who may suffer some impairment due to higher incidences of chronic illnesses and to general deterioration of the body.

Ergonomic experts have made several human factor recommendations for the design and use of hand tools (11,29). The diameter of the tool handle should be no greater than four inches and is best about two inches (five to nine centimeters). The diameter should be smaller if hand use is impaired. The tool design should eliminate pinching and keep the wrist straight. The handle shape should provide maximum contact between the surface of the hand and the handle. At least 270 degrees wrap-around is desirable. The handles should be contoured to reduce slippage. Tools should be light and usable with either hand.

Hand and Grip Characteristics:

Although the shoulders and arms are involved, the hand is the primary body part manipulating hand tools. This is also true with the pruner. Many muscles within the hand and the wrist are flexed and extended during a grasping sequence, including: the flexor pollicis brevis, opponens pollicis and abductor pollicis brevis (7,27). As stated earlier, any damage to the muscles or tissues involved will

affect the use of the hand (6,7,8,12,13,17,29,43,45).

The hand therapist or surgeon has a series of procedures with which to determine injury to and the status of the hand. The evaluation is based on medical history, skin color, general body condition, range of motion measurements, muscle flexion, sensibility, and pinch strength (6,8,9,18,19,29,40,41). A major criterion used by hand therapists and others interested in the hand condition is grip strength. Grip strength is also very important in the successful use of hand pruners.

Many physical and non-physical factors relate to grip strength. A primary factor is that of sex. It is agreed that females generally score lower than men in testing (1,25,26,29,35,39,41,42,43). The normal percentage differences vary from study to study. Although females exhibit lower mean strengths, the curves follow those of men (39), and a narrowing of the gap has been noted in the later years (25). The narrowing is attributed to the fact that women generally exhibit less absolute strength in their prime years (25).

Aging is also a factor in grip strength (1,13,14,25,26,29,39,40,41, 42) and is taken into consideration in most experiments involving grip strength measurement or normative tables (25,26,29). Different reports state different, but similar, relationships between age and grip strength. Burke, Tuttle and Thompson (14) observed that grip strength increases dramatically until 20 or so, gradually until 30 and declines afterwards (14). Much of the difference in reported scores can be attributed to the use of dissimilar materials and methods. Examples of decline due to aging include a study showing males having a 16.5%

loss at 60 compared to their maximum grip strength and another in which males at 70 displayed only 58% of their hand strength at 30 (25). The decrease in grip strength in the elderly population can be attributed to higher incidences of such chronic diseases as arthritis. Arthritis is very common in the general population with one estimate being 30,000,000 or more people presently affected in this country (3). It has been estimated (4) that everyone over the age of 60 has some degree of osteoarthritis, a common form of arthritis.

Most people display dominance in their hands. Studies show that hand dominance is a factor in grip strength. The dominant hand usually is the stronger (13,29). One study showed that although the grip strength of the dominant hand is usually higher, in 28% of the hands measured, the non-dominant hand was either of equal or higher grip strength (39). It should be noted that the right is normally the dominant hand and most tools are designed for use by the right hand.

Body size is also a factor in grip strength. Schmidt and Toews (39) found that body weight up to 215 lbs., and height up to 75 inches, were correlated with grip strength. Hand, arm, and wrist sizes also contribute to grip strength (12). A larger hand, for example, normally contains more muscle. The grip surface in relation to hand size also will affect the strength exhibited (29).

Occupation, along with other activities that involve the use of the hands, has a small effect on one's grip strength (29). Retirement often changes the schedule and the activities of the people involved. Lack of routine hand exercise can decrease hand strength. Diurnal effects are a

factor in hand strength. One study showed that the best time to measure strength was between 10 a.m. and 12 p.m., since the grip peaked and then plateaued in this period (30).

The normal instrument used in measuring grip strength is a hand grip dynamometer, which translates the grip pressures on the handles into pounds or kilograms. Only in cases where the dynamometer is not available (31) or, more likely, when the hand is extremely disabled, such as with severe arthritis, is a sphygomomanometer used (30). In this case the client or patient squeezes a bulb to register strength.

Many different types of dynamometers have been used (1,5,6,8,12,13, 16,23,25,29,30,32). Early non-adjustable dynamometers have been compared with adjustable dynamometers designed to take hand size into consideration (12). Adjustable dynamometers have been shown to reflect better the strength of those with small or large hands. Though many recommendations have been made, the Jamar dynamometer appears to be the most widely adopted in the United States and is recommended by the California Medical Association, the American Society for Surgery of the Hand, and the American Society of Hand Therapists (5,6,8,26,39).

The procedure for measuring the grip strength differs among studies and dynamometers. A common procedure is to make three measurements with the dynamometer (2,19,28,29,39). Statistically, the measurements have been treated differently with some using only the best reading (2,19,28, 29), while others use an average of all three scores (6,8).

When attempting to discover the best span setting, many therapists use alternate trials on all the span settings and plot the averages (6).

Lack of a curved plot indicates that the patient is not trying (6,19). Hand placement in relation to the body also affects the strength exhibited with a higher grip reading registered when the hand is unsupported rather than supported (42). Most research has used measurements with hand and arm unsupported.

Pruner Characteristics:

Consumer Reports (May 1981) (37) rated several hand pruners and recommended giving care to selection of this tool. The researchers found that the force needed to cut a 5/8 inch [1.6 cm.] wood dowel varied from 29 tO 81 pounds [13.2 to 36.8 kg] depending on the pruner model. The pruners which required greater force might not be usable by those with weakened grip strengths.. Some pruners were also noted to be difficult to use for persons with small hands.

In the report the pruners were divided into the two basic blade types, while other features were noted separately. The generally preferred type had an anvil and blade combination. The cutting motion of this type replicates that of a butcher knife against a chopping board. The advantage is a smooth cutting action through the wood, but there was some bruising of the plant material and the bulkiness prevented close cutting in a branch crotch.

The hook and blade or bypass pruners worked with offset curved blades in a scissors fashion. The curved blade held the twig while the blade cut through the wood. There was a snapping in the cut, which was considered disadvantageous, [possibly due to a jerking of the wrist]. Hand therapists and ergonomic experts believe that the wrist should be

kept still (11,29) and that any jerking of the hand could cause damage to the wrist. The disadvantages of the hook and blade pruner outweigh the advantages of closer cuts and less bruising, according to Consumer Reports.

Several other features were discussed and noted along with the ratings of pruners within blade categories. A non-stick coating on the blades was believed to help with the cutting. Many of the handles had cushioned or non-slip coverings to help with the grip. Some of the pruners had adjustable parts, but these were considered of little benefit since they tended to slip out of alignment and hamper completion of the task. The simpler pruners were often rated as the "best buy" because they did the job as well as more expensive, complicated models. Other studies have shown that keeping the tool simple can reduce frustration and facilitate use and also helps many of the disabled and the weakened elderly (29).

An important feature that was discussed in the Consumer Reports review was the variation within the cutting mechanisms. Most pruners work on a basic lever action which pivots around a bolt or similar axle. One variation is a compound lever system which produces a "cut and draw" or slicing action. This mechanism was found in both blade types and achieved variable success.

The other cutting variation is the ratchet mechanism. This is based on a notched lever in which each squeeze brings the mechanism up a notch, breaking the cutting job into segments with require less force to complete the task. This mechanism has good potential for those not

able to exert the amount of force required by other pruners. One of the disadvantages found was that this mechanism required a number of contractions for each full cut. Though not stated in the pruner review, it should be noted that a possible increase in joint aggravation for those with diseases such as arthritis or carpal tunnel syndrome may be attributed to the repetitive action required by the ratchet pruner. Presently there is only one manufacturer of the ratchet pruner and only one anvil and blade model is available.

The Consumer Reports review, while supplying reliable product research, cannot be directly applied to the elderly's preference of pruners. There is little documentation concerning rating pruners, cutting-force measurements, or the exact criteria used to make recommendations. Data were not presented on the cutting force needed for each individual model, only the ranges were given. The use of pruners on kiln dried hardwood dowels may not parallel their use on green wood in the garden. There was no information on who and how many individuals participated in the rating of the models.

Preference:

Preference can be defined as an action or the object of such an action. The Oxford English Dictionary defines the verb "prefer" as "to put forward ... in status rank," and the noun "preference" as "the action of preferring," or "that which one prefers"(15). In this study, the investigator, using statistical analysis, determined whether or not preferences existed within selected groups. Once this was determined, the investigator proceeded to ascertain the identities of the

preferences.

When a product is being prepared for marketing, several tests are conducted including mechanical tests, evaluations made by product specialists and testing within the market. Product preference studies using a specified population help the researcher accumulate data on the likes and dislikes of their market (21,24). Often in testing, perceived product attributes previously unidentified by investigators have been found (21,24). Ergonomic experts also allow the potential and actual tool users to voice their opinions for many of the same reasons. Horticultural therapists should recognize that a study of tool preferences of an elderly population not only provides data for recommendations for tool selection but also allows the sample group and indirectly their peers to have some control over their environment. Job satisfaction studies have shown that when people are allowed to have some control over the tools used and tasks to be performed the person is happier and performs better (36).

Materials and Methods

Purpose:

The main purpose of this study was to investigate the relationship of the factors -- age, sex, strength, hand size and domicile -- to an elderly population's preference of hand pruners. Tool acceptance is important because it encourages the continuation of beneficial activity among the elderly. Included in this investigation was an examination of the reasons for the choices made and the relationship between the demographic and anthropometric factors and these reasons. These finding can be used to make recommendations for selection of a hand pruner by elderly individuals. An additional purpose was to evaluate the research design for application to other tool investigations.

Design:

A field study was conducted to avoid bringing the elderly subjects to an unfamiliar site. Having the subjects in a familiar surrounding helps to put them at ease and makes them more receptive to the research tasks.

While a field study offered advantages to the subjects, there were limitations or restrictions at the sites. All materials and equipment had to be easily transportable because the sites could not provide storage facilities. Testing locations within the sites varied occasionally. The time for each subject's participation had to be managed carefully. Each testing site had other daily activities in which the prospective subjects participated. They could participate

more effectively in the testing if their time was not taxed excessively.

Standardization of the research procedure was also important, since more than one site was used, each with a slightly different population. All subjects were tested individually and received the exact same information and instruction from an established script conducted by the same investigator.

Materials and Equipment:

The Jamar dynamometer manufactured by Asimow Engineering, a hydraulic hand grip dynamometer with adjustable grip span positions, was used for measuring grip strength. On loan from the manufacturer, the instrument was calibrated at the factory. This dynamometer was chosen for its availability, its popularity for use in screening (5,6,8,19,26, 29,39), and the normative data available.

The pruners selected for the study were limited to the principal available types. The number of pruners was limited to four to simplify requirements on the subjects. The particular pruners were chosen to reflect the available options as follows: hook and blade with simple lever, anvil and blade with simple lever, hook and blade with compound lever, and anvil and blade with ratchet mechanism. Other features that were considered included: handle color, handle treatments, weight, non-stick blade coverings, and safety latches. Descriptions of the pruners, taken from manufacturers' descriptions, are summarized in Table 1. The two simple levered models differ by little other than blade type and length. All the pruners had non-stick coatings on the blade. Three of the pruners had plastic handles, but the compound lever pruner had a

Table 1 - Characteristics of Pruners

Pruner Model	General Description	Dia.[a] (cm.)*	Weight (gm.)*	Blade Coating	Safety Mechanism	Handle Material
Saboten 750-0015	Professional Pruner (20.3 cm.)* Bypass (simple lever, hook & blade)	1.9	241	Teflon	rocker latch	"contour" (plastic)
Saboten 750-0010	Professional Pruner (19.1 cm.)* Anvil (simple lever, anvil & blade)	1.9	241	Teflon	rocker latch	"contour" (plastic)
Brookstone H-2889	Heavy Duty Hand Pruner (compound lever, hook & blade)	1.6-1.9		Teflon	rocker latch	vinyl coated (metal)
Florian #RP-701	Florian "Ratchet-Cut" Hand Pruner (ratchet, anvil & blade)	1.9	99	Teflon	wire safety catch	"fiber-glass with nylon"

* English units converted to metric units

[a] maximum suggested diameter of branch to be cut

note: Both Saboten models have wrist straps.

note: Florian model is designed to work equally well with right and left hands.
Also, pruner comes with carrying pouch that is designed to fit on a belt.

All descriptions with the exception of those within parentheses are taken from packaging, catalog descriptions and the manufacturer's oral descriptions.

plastic-coated metal handle. The simple lever models were a bright orange. The other two models were shades of yellow. The safety latches are very similar with the exception of the ratchet's wire catch. Information not reported by the manufacturers, such as widths, wrap around diameter, and pruner weight, were measured by the investigator and are summarized in Table 2. The same four pruners were used only in the study and were kept locked and in their carrying pouches when not in use.

The ruler, used in both the measurements of the pruners and the hands, was clear plastic with a metric rule on one side and could be laid over the hand so that readings could be easily taken. A timer was used to time the rest periods between the grip strength trials. A Mettler PE 1600 Electric Balance was used to determine the weight of the pruners. Stretch resistant string was used in estimating the wrap around measurements for the pruners.

Materials prepared for the study included the scripts and answer sheets for each individual subject, who were identified only by a coded number.

The participants tested the pruners on green wood branches of red oak, Quercus rubra, having a diameter between 1/2" and 5/8". Most came from the same wood lot. A piece of wood with holes drilled in it was constructed so that the person who cut the wood would have a standard to use. Hardwood dowels as used in the Consumer Reports study (37) were considered for use in the experiment, but when they were cut, pieces tended to snap off with considerable force causing a possible safety

Table 2 - Measurements of Weight, Widths, and Wrap Arounds

Pruner	Wt(g.)	Width* (cm.) locked	Width* (cm.) open	Wrap Around* (cm.) locked	Wrap Around* (cm.) open
A. Saboten 75-0015 (simple lever, hook and blade)	247.3	3.4	9.2	11.7	23.0
B. Saboten 75-0010 (simple lever, anvil and blade)	255.0	3.6	9.9	12.1	23.2
C. Brookstone H-2889 (compound lever, hook and blade)	410.3	2.8	9.6	10.5	24.0
D. Florian #RP-701 (ratchet, anvil and blade)	109.7	3.5	9.3	12.3	23.2

* measurement taken 10 cm. from pivot point.

hazard. The kiln dried wood, also, did not have the same feel and appearance as green wood. It was believed the subjects would respond better to cutting more realistic objects. Cutting lengths were marked on the wood in order to assure some uniformity, to decrease the possibility of the smaller pieces flying around the room during cutting (a safety hazard) and to avoid having the subject cut through the more resistant nodal wood.

Pre-Test:

A pre-test was conducted using the script and materials prescribed for the field study. The pretest subjects were asked to comment on the study procedure and wording within the script following the actual testing. The goals of the pre-testing were to test the equipment for use within the design, to obtain reactions to the wording of the script, and to make estimates about the amount of time needed for each session. Four individuals from the University of Maryland participated in the pre-test. Two were female secretaries (ages 50 and 62), one was was a female student (age 24) and one was a male professor (age 58). One of the secretaries had arthritis. Only minor script adjustments were made as a result of the pre-test.

Population and Setting:

The designated population for the study was active people over the age of 50. In this population there would be people who were gardeners or who might need or want to use pruners. The population included people with a wide range of grip strengths since grip strength tends to decrease with age (25,26). Through the years, many older

people may have developed conditions such as arthritis (3,4,47,46) or may have sustained injuries which now affect the use of their hands. Both males and females were tested since there has been a measured difference in both grip strength and hand size (1,6,8,17). There was also an expected sex difference in experience with and knowledge of the pruners. All the participants were volunteers.

Two sites were used for the study, both of which were multi-purpose centers in Prince Georges County, Maryland. The first site, the Cora B. Woods Senior Multi-Purpose Center in Brentwood, served a mixed race group of primarily low to middle income clients. The second, the Langley Park Senior Center, served a primarily white, middle and upper income clientele. The Brentwood Center provided a separate office for all the testing. The traffic through the office was very light, providing little distraction for the subject and the investigator. There was no set area at the Langley Park Center, since there was less space available. What area was used depended on the scheduling for the day. All the testing took place between 10 a.m. and 1 p.m. since it has been found that strength tests may have diurnal effects (30). Care was taken to segregate the subject and the investigator from the other activities at the center.

Twenty-six volunteers were tested at the Brentwood Center and 24 at the Langley Park Center, making a total of 50 subjects. Each site yielded 17 women volunteers with nine male subjects at Brentwood and seven males at Langley Park. The greater proportion of females was not unexpected since there are many more

females attending activities at the centers. The great majority of the women, currently or previously, held traditionally female positions, including housewife, waitress, secretary, sales clerk, and nurse's aide. Few with professional backgrounds were found among persons of either sex. The males were found to have had primarily blue collar jobs before retirement. Over 95% of the participants were currently in retirement.

Testing Procedures:

Each individual participant was tested in a single private session. At the beginning of each session, the volunteer was thanked for his or her participation and given a brief synopsis of why the study was being conducted. The participant was also assured of anonymity throughout the study and report.

The first part of the session centered on the volunteer. The grip strength of the right hand was measured because research indicated grip strength may be a primary factor reflecting the person's ability to use the tool. Only the right hand was measured since the tools, with the exception of the ratchet pruner, were designed for right hand use only. In order to avoid fatiguing the subject, strength was taken in three trials with a timed one-minute break between each trial. In much of the literature, three trials on the dynamometer have been used. There is, however, no agreement concerning whether to use an average the three trials or the best recorded result of the three trials as the final measure of grip strength (6,8,22,28,29). It was decided that three trials would be taken and both methods compared for determining the final measure of grip strength. The span

adjustment was set at the second smallest position (1.4 inches or 6 cm.), the span length recommended by the Clinical Assessment Committee of ASSH (41) for general use. In some previous studies three trials had been made with all the settings (6,19), but this would have taken considerable time and could have excessively fatigued the subject before testing with the pruners. After grip strength was determined, hand length was measured as the distance from the base of the palm to the tip of the longest finger, as pictured in the article by Davies, et al (17). The length of the hand was measured because it was believed to be important in comparing a person's ability to hold a tool in both an open and closed position. In concluding this part of the session, the subject was asked questions about his or her age, occupation, experience with pruners, handedness, and the presence of problems with the hand use. These questions can be found in List 1 in the Appendix.

The second part of the session focused on the pruners. The pruners were introduced and demonstrated in random order. Care was taken by the experimenter not to exhibit preference for any of the pruners. The subject was then instructed to make four cuts with each of the pruners at previously marked intervals (which were placed on the branches at about three inch intervals while avoiding any nodes in the wood). After the subject had finished testing the pruners, the subject was asked to rank the pruners in decending order using the supposition that all the pruners cost the same and that there was a need to buy a pruner. The ranking was recorded. The pruners were again taken randomly and a set of questions was asked about each of the pruners. The questions could

all be answered with a yes or no, and they covered the topics of cutting action, cutting quality, the subject's ability to use the pruner, ease of grip, weight, and the perceived ability of the subject to accomplish work with the pruner. These questions are presented in List 2 in the Appendix.

After the last question set was administered, the subject was again thanked for his or her participation and asked not to disclose what happened in order to avoid possible bias. The time involved was from 20 to 30 minutes depending on the subject and how many times instructions were given.

Results and Discussion

Analyses Used:

This survey of preferences for pruner types was designed for use with the Friedman ranking test. The pruners were assigned numerical ranks by the subjects, 1 for the highest rankings to 4 for the lowest rankings. The numbers assigned to a pruner were summed, such that the lowest resulting sums reflected the most favored pruners. A chi square was calculated with values exceeding 7.81 (p less than .050 at 3 degrees of freedom) indicating a significant expression of preference in the group analysed. The Friedman ranking test was repeated for each independent variable or subclass within the total.

Other statistical methods included the t-test and linear regression used to confirm perceived trends as exhibited by the results of the Friedman ranking tests. Percentages were used to describe the population and to summarize the responses to the question set on pruners.

Site Comparisons:

Two survey sites were used to obtain an acceptable number of participants. The sites were chosen for similar populations of active seniors. Before the site data were combined for other analyses, potential response differences due to variations in subject groups were evaluated. The expected nonsignificant chi square values obtained from the Friedman ranking tests at each site indicated no uniqueness at either site (Table 3). T-tests of age, hand length, and

Table 3. Ranking of Pruner Types by Respondent Characteristics and Site.

Independent Variables	n	Pruner Types[a] A	B	C	D	Chi Square
Total	50	124	104	135	137	8.23*
Site						
Brentwood	26	62	55	71	72	4.48
Langley Park	24	62	49	64	65	4.15
Sex						
Females	34	74	73	96	97	9.35*
Males	16	50	31	39	40	6.82
Hand length						
17 or less (cm)	27	58	55	80	77	10.96*
17.1 or more (cm)	23	66	49	55	60	4.10
Grip Strength (avg.)						
26 or less (kg)	25	53	58	73	76	5.59
26.1 or more (kg)	25	71	46	62	71	10.01*
27.6 or less (kg)	16	34	36	38	42	4.50
27.7 to 31.2 (kg)	16	36	35	46	43	3.25
31.3 or more (kg)	18	54	33	41	52	9.67
Grip Strength (best)						
28 or less (kg)	26	57	61	75	67	4.25
29 or more (kg)	24	67	43	60	70	10.95*
Abode						
House	32	81	71	85	83	2.18
Apartment/room	18	43	33	50	54	8.47*
Age						
65 or younger	27	70	56	77	67	5.09
66 or older	23	54	48	58	70	6.75
Hand Use Problems						
No	35	90	70	98	92	7.59
Yes	15	34	34	37	45	3.24
Pruner Experience						
Have used	29	75	60	75	80	4.66
Have not used	21	49	44	60	57	4.60

[a]A = hook and blade with simple lever * significant at .05 level
B = anvil and blade with simple lever
C = hook and blade with compound lever
D = anvil and blade with ratchet mechanism

grip strength also indicated no site difference. Based on these results, it was concluded the two groups represented a uniform, population and the data could be combined.

Anthropometric and Demographic Relationships:

One important function of the Friedman ranking test is to indicate a group preference based on more than random rankings within the group. The significant chi square of the total group rankings indicated such a preference among the four pruners. Subclasses that also displayed a preference were females, those with hands shorter than the median length, those who registered high grip strengths, and those who lived in apartments or rooms.

Although females comprised 68% of the total sample, their expression of a preference was believed due to some attribute related to gender rather than sample size compared to males. T-tests were used to compare the factors of hand length, grip strength (best and the average scores of three trials), and age between the male and female subjects. These results (Table 4) confirmed the expected relationships in the smaller female hand length and grip strength with no difference present in male and female age.

Hand length for the total sample ranged from 15.0 cm. to 19.5 cm. with a mean of 17.3 cm. and a median and mode of 17.0 cm. The females dominated the lower half of the hand length range with a 19.0 cm. maximum, 16.9 cm. mean, and 16.5 cm. median and mode. The male hand lengths had a minimum of 16.0 cm. and mean, median and mode of 18.2 cm.

Table 4. Age, Hand Length, and Grip Strength of Sample Members.

Factor	Means			"t"[a]
	Females	Males	Total	
Age (complete yrs)	66.6	66.8	66.7	0.089
Hand Length (cm)	16.9	18.2	17.3	4.098**
Grip Strength (kg)[b]	24.1	37.8	28.5	5.480**
Grip Strength (kg)[c]	25.6	40.0	30.2	5.514**

[a] T-test of female vs. male values
[b] mean of three test scores
[c] highest of three test scores
** denotes significant at .01 level

The female and male hand lengths of the subjects in this study were smaller than in the study of Davies, et.al. (17) using female factory workers with a hand length mean of 17.5 cm. and Bowers (12) using males, ages 14 to 29 taking a physical education class, with a hand length mean of 19.2 cm. These differences result from the subjects being drawn from different population segments based on age and/or activity. Nevertheless, the females in this and the Davies studies had smaller hand length means than the males in this or the Bowers studies. This links females to another group showing a significant preference, people with hand lengths 17.2 cm. or shorter. Hand length could be expected to influence female-versus-male preferences for tools dependent upon to how the tool fits the hand.

As previously reported (25,26,29,41), the female group exhibited lower scores in grip strength. Of the the total sample range of 14 kg. to 54 kg., the females had a 44-kg. maximum and the males a 21-kg minimum. The total sample had a mean of 28.5 kg., a median of 26 kg., and a mode of 21 kg. The female grip strength mean was 24.1 kg., while the median was 23 kg. and the mode was 21 kg. The males had a grip strength mean of 37.8 kg., a median of 37 kg., and modes of 38 kg. and 40 kg. (two at each).

As a procedural note, the close relationship between the average grip strength of three trials and the best grip strength of three trials was apparent in the data and confirmed with a 0.994 correlation coeficient. For this reason, only the average grip strength scores are discussed here. Either procedure requires identical data collection

(three trials) plus a calculation (mean or maximum), so neither is simpler. The average of three trials was used based on recommendations made in Rehabilitation of the Hand (19,41). It should be noted that scores were rounded to the nearest kilogram when calculating range, median, and mode.

Compared to Swanson, et.al. (41) the female mean of this study (24.1 kg.) was slightly higher than the female mean charted for ages 50 to 69. The high mean could be atributed to an exceptionally high score of 44 kg. for one woman. The males in this study had a lower mean (37.8 kg.) than the mean in the Swanson table (45.9 kg.). This was to be expected since most of the men were over the age of 60 thus increasing the chance of low scoring due to age factors.

In this study there was a significant preference within a grip strength subclass. However, those subjects expressing the preference were in the higher grip strength group rather than the lower strengths normally associated with females. In the first analysis with the Friedman ranking tests, the grip strength subgroups were divided at the median. A second Friedman ranking test series was conducted using subdivisions based on approximate thirds to evaluate more closely the preference expressed by the stronger subjects. Again the high grip strength group indicated a preference among pruners. However, the ranking by this group differed from the total population rank order by switching places of the two middle pruners. A possible reason for this difference is that the preference of subjects with physical limitations masked the preference of these high grip strength

subjects. The group of people with strong grips can easily exert the force needed to operate any of the pruners. Furthermore, 66% of these people have a hand length longer than 17 cm., which allows them to hold all of the pruners comfortably. Hand length can be used as a possible indicator of tool fit in the hand.

Most (62%) of the participants lived in houses. It was expected that those who lived in houses would respond differently because they would have had a greater opportunity to use pruners, instead only the appartment dwellers and roomers showed a preference. A majority (63%) of the apartment dwellers and roomers were female but were not substantially represented in any other of the subgroups which produced significant results on the Friedman ranking test.

Ages of the total sample ranged from 52 to 83 years with a mean of 66.7 years. The median and mode were both at age 65, and 86% of the sample was in the 60-to-75-year range. Although there were more females in the 50-years-and-above range, the age distribution of females and males was the same.

The Friedman ranking test found no preference in either group divided by the median age. Though the age range within this sample did not produce significant results for the Friedman ranking test, previous research has shown that age does affect grip strength and physical characteristics (4,25,26).

Most (70%) of the participants did not perceive any difficulty with hand use. This indicated that gradual adjustments over time had allowed most of the subjects to continue activity without noticeable hinderance.

Of the 15 subjects who claimed some problem with hand use, mild arthritis as the chief complaint for 11. Other complaints were broken arms, cancer and carpal tunnel syndrome. No significant results in the Friedman ranking tests were found for those who did or did not perceive problems with hand use.

More than half of the subjects (58%) had used a hand pruner before, but no pruner preference was indicated by either group. Previous use of pruners did not affect the ranking process, possibly because all subjects without prior experience with pruners had enough opinions on pruners or similarly functioning tools to not be influenced in the ratings.

No results are presented for the survey question on dominance because all particpants claimed to be right-handed.

Pruner rankings:

The anvil and blade pruner with simple lever action was the highest ranked pruner since it held or shared the preferred spot in all significant rankings. The hook and blade with simple lever was the second most preferred pruner since it was in second place or shared a most preferred ranking in all but one of the significant rankings. The simple hook and blade's close ranking to the simple anvil may be partially due to its appearance and construction similarity to the simple anvil, as they were produced by the same manufacturer. The hook and blade was liked by females, which may account for its good placement. Both simple pruners received many favorable responses in the last question set.

The last two ranked pruners were the compound and the ratchet pruners. Though in all but one significant case there appeared to be no significant difference in the Friedman ranking (i.e. no more than three points difference), the compound lever type might be considered to be rated slightly above the ratchet type. This is due to its better rank than the simple hook and blade among those with stronger grips.

The ordering of the pruners by all participants indicates a clear preference for the simple anvil and blade and the simple hook and blade as the second most popular. The compound lever and the ratchet are least preferred. In the ordering of the females and those with hand lengths 17.2 cm. or shorter, the two simple lever pruners shared the higher ranks while the more complicated models occupied low positions. Those living in apartments or rooms had the same kind of ordering as the total. The only subgroup attributed with a different ordering was in the top third in grip strength. These strong handed people placed the compound pruner above the simple hook and blade.

As mentioned previously, the questions were designed to allow evaluation of the subjects' overall feeling for each of the pruners rather than the simple pruner physical characteristics. Responses to questions about the pruner are presented in Table 5.

The first four questions evaluate feelings about actual pruner performance. Most people felt that all the pruners cut smoothly through the wood. There was little difference in the reactions of males and females. Some encountered problems with the snapping of the the hook and blade pruner. The investigator became concerned with flying pieces

Table 5 - Rating of Pruner Characterististics

Question Number and Topic	Pruner Types[a]							
	A		B		C		D	
	%F	%M	%F	%M	%F	%M	%F	%M
1. smooth cutting action	88	88	97	100	94	94	82	88
2. clean cutting	94	100	97	100	91	100	94	100
3. able to make 4 cuts	97	94	100	100	94	100	94	94
4. ease of cutting	94	94	94	88	70	94	82	88
5. "happy" about using	88	75	85	94	41	88	62	81
6. comfortable with closed handles	100	100	100	100	97	94	97	94
7. comfortable with open handles	97	94	88	100	82	94	94	100
8. weight comfortable	97	88	82	88	38	88	94	81
9. able to accomplish much work	88	88	82	94	44	94	68	81
10. understand how to use pruner	100	100	97	100	94	100	97	100

(a)
A = hook and blade with simple lever
B = anvil and blade with simple lever
C = hook and blade with compound lever
D = anvil and blade with ratchet mechanism

Note: Table entries are percentage of respondents agreeing with statements

produced by these pruners as the wood started to lose moisture and people tended to ignore the line and make too short cuttings. The ratchet was considered to be not smooth at times due either to the repeated squeezes needed for each complete cut or to the roughness encountered when the subject failed to follow directions and attempted to cut with a single squeeze. While all the males agreed that each pruner produced a clean cut, there were some females who disagreed. This is probably due to the problem that some of the females had in using various pruners, especially the compound pruner. Most were able to make all four cuts. Some females were unable to cut with the compound pruner, and others of both sexes were frustrated with the ratchet and eventually gave up trying to use that pruner. Sex disagreement was present in responses about ease of cutting. While the males were relatively comfortable with all the pruners, 30% of the females were uncomfortable cutting with the compound pruner and 18% found the ratchet pruner uncomfortable.

Questions 6, 7, and 8 dealt with the construction of the pruner in relation to comfort. Most (90 to 100%) of all questioned were comfortable with the pruner handle form while closed or locked, but most (82%, primarily women) had a problem with the spacing of the compound pruner handles while open. That pruner model had the largest wraparound measure (See Table 2). Some subjects voluntarily commented during the questioning that the ratchet would make a good woman's pruner because of its weight, while others questioned its durability due to the light-weight construction. The pruners showed a margin of difference in

subject responses to pruner weight. Many (94%) of the women were happy with the weight of the ratchet model, and 62% were not happy with the weight of the compound model (See Table 2.). The compound pruner was almost four times as heavy as the ratchet model. The two simple lever models weighed almost the same but fared differently in the responses because the weights were perceived differently. A possible explanation is that the balance of the two models is different mainly due to the anvil. This component moves the center of balance closer to the blade end, thus changing the leverage. The fact that the compound pruner fared better in the ranking with those having a stronger grip is probably due to their strength allowing application of the force and leverage needed for proper use of this heavier pruner. Two thirds of the stronger hands also had longer hands, and the compound pruner would fit better in the longer hands. The two simple levered models had a slightly smaller and a lighter weight design, giving a better fit for the more "average" hand.

Questions 5, 9, and 10 were general questions used to gauge the mood and importance of the other questions and to compare them to the rankings given earlier. The word "happy" was used to see what pruners were accepted. Acceptance of the tool is important because acceptance of the activity is more likely to follow. The positioning of question 5 also may reflect the subject´s general feelings about the tool´s performance. A sex difference was displayed in the reaction to question 5. The females indicated a "happiness" with the simple lever pruners while the ratchet and compound types were given much disfavor by 59 and

38% respectively. The investigator believes that the weight and additional examination of this pruner further influenced the unfavorable reaction to the compound pruner. The solid construction may have given the compound pruner a perceived greater value, but this was not reflected in the pleasure of use, except with subjects with strong grip strength. Many were not happy with the technique required to properly use the ratchet. The ability to accomplish "much" work paralleled question five, and the same reasons apply. The placement of question 9 may reflect the subjects' general evaluation of the pruners' construction. As before, the females scored the ratchet and the compound pruner low. Most claimed to understand how to use all the pruners even though several were observed to have some problems with the locking mechanism and much resistance to the multiple compression ratchet technique.

Volunteer Characteristics:

The present sample population consisted entirely of volunteers who understood that they would receive no material benefit from participating. Nevertheless, many cheerfully volunteered and some even recruited others for the study. This eagerness of volunteers to participate is called the "Hawthorn effect," in which the person is more willing to cooperate if given special attention (20,38). Special attention related to this study included participation by the investigator in group and individual activities at both centers. During the actual survey, each participant received individual and constant attention.

While enthusiasm was expressed during recruitment and other activities, a conscientious attempt was made by the investigator to to use little expression in the voice and show no bias towards any of the pruners. A small percentage of the subjects appeared to be supplying more positive evaluations than the investigator's observation of the subject's ability to use the pruner would seem to justify. Of the twelve respondents who answered yes to every question in the last survey set, the investigator noted either difficulty in use or negative comments given by five of the subjects. The overall generally favorable responses to the pruners in the last question set may be partially due to a "halo effect." The halo effect, in its simplest terms, is the phenomenon where people attribute positive traits to people who are attractive to them (34). This halo effect was expanded in a study which showed that even a poorly written essay was evaluated higher if the writer was more attractive (34). In this case the "essay" is the pruner and the attractive person is the investigator displaying warmth in the earlier association. The halo effect cannot be proven but the possible presence should be noted.

Conclusions

From the study results and with additional ergonomic considerations, some recommendations can be made for the selection of pruners for an active senior population.

From the ranking preference by females and their responses to the questions, females appear to be more sensitive to differences in pruners. Therefore, more care should be taken in choosing pruners for women's use.

The Freidman ranking test scores and the subjective questions indicated the simple levered anvil pruner as the pruner of preference. The anvil pruner adequately fulfilled the needs of the task, and it did not display any of the drawbacks of some of the other pruners.

Weight appeared to be a major consideration. Heavy models (greater than 250 gm.) should be avoided when choosing models for those with weaker hands. Leverage also affects the person's perception of weight, so the balance of the pruner in the hand also should be checked. Extra options (such as the added lever gears in the compound lever, adjusting screws, and all metal handles) can contribute unneeded weight if these additions are not essential to accomplish the desired goal. Ergonomic experts recommend keeping the wrist straight and still when performing tasks. A heavy pruner can exert unneeded stress on the wrist which tires the user, decreases effectiveness in accomplishing the task, and risks damage to the hand. The lightness of the ratchet pruner was appreciated by some of the men and women. If the instructor is

patient and willing to teach, this pruner model may still gain favor with the person having weaker hands.

The ratchet did not receive much favor, probably due to a resistance among the respondents to this new mechanism. Some of the respondents commented on its newness, as more than one squeeze is needed for a complete cut. A potential problem with this pruner in use by seniors is that it may be detrimental to some individuals as the repetitive activity may aggravate conditions such as arthritis in the hand.

Handle characteristics are important. This study demonstrated that handles which open to a relatively wide wrap-around may cause discomfort for people with smaller hands. Ergonomic experts state that all-plastic handles molded to hand proportions are optimal because they weigh less than metal, the design helps prevent slippage, and the plastic reduces the conduction of heat and cold. Cold handles would be damaging for arthritis sufferers. Human factor engineers recommend that handles should be designed to angle the pruner rather than the wrist during tool use. A bright color given to the handles is recommended so the handles can be easily found in the work area if dropped or laid down.

Most people are right handed, but an attempt should be made to find pruners appropriate for people who are not. The ratchet pruner is designed for use in either hand, but other factors discourage its choice for some in the senior population.

Before choosing a pruner, both the user and advisor should know what task(s) the pruner will be performed. The person giving the

recommendations must instruct the user on proper use of the pruners and any specifics involving a recommended model. The person making the actual choice should compare several pruners using the weight and balance, ease of safety latch use, ability to grab handles in open and closed positions, and, if possible, cutting ability as evaluative criteria.

The survey results support the general recommendations given by ergonomic experts for selection and use of hand tools. This is important because, until more research is published on specific garden tools for this population, there needs to be a reliable pool of concepts to consider for hand tools. People with small hand size and/or weakness in the hands and wrists should choose all hand tools carefully with special attention to the task to be done, the tool's fit in the hand, the weight and balance of the tool, and the actual performance of the tool. Therapists and those recommending tools should be aware of the options available to and limitations inherent in each tool and be prepared to help match tool, task and person.

Another primary goal of the present research was to create a study design which might be adaptable for use in further research involving pruners and other tools used in horticultural therapy activities. Important factors that could be replicated in future research are the solicitation of the prospective users preferences, employment of a single session which enables the individuals to participate in a relatively short amount of time, and the portability the survey materials. Other approaches could be used to enhance research in this

area. Suggestions for possible variations include the following:

1. The same basic survey could be utilized with related populations, such as infirmed elderly in rest homes, cerebral palsy victims, or even a healthly younger population, and the resulting information could be compared to that presented here. This could allow information application to outdoor focused horticultural therapy programs involving institutionally bound clients.

2. Though this study eliminated problems with subject drop-out due to sickness or death, a long-term study should be attempted to measure possible preference change. With this case immediate problems with learning new techniques, such as ratchet cutting, could be overcome, and the pruner itself could be compared on other merits.

3. Like mechanisms in related tools could be compared, so that the mechanism itself can be examined as it functions for related tasks. For example ratchet pruners and loppers could be tested in comparison with simple lever pruners and loppers.

4. Different tasks can be compared, such as trimming branches and flower stem cutting. The same pruners could be compared for both the activities. In this case a general pruner can be chosen to serve a variety of needs. A more natural setting may be used for these activities such a trimming an actual shrub. The natural setting can bypass testing problems of wood dehydration and having the subject equate an unrealistic task of cutting three inch pieces off twigs and a realistic task of trimming an apple tree.

5. The basic portable design can be adapted to other small tools such as the wire cutters used in floral design. The basic design should be limited to those tools with grip strength requirements. For other tools, the investigator would need to define the options within the tool, determine the possible factors affecting the use or choice of the tool, and develop a procedure for simulation of tool use in order to identify the factors affecting preferences.

In summary this study found that physical characteristics of hand length and grip strength affected the preference of elderly persons for tools, and these factors should be considered along with other human factors when choosing a hand pruner.

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APPENDIX

List 1 - Questions from Script: Part I

1. How old are you?
2. Do you live in a house, apartment or elsewhere? If elsewhere, where?
3. Do you know what hand pruners are used for?
4. Have you ever used a pruner before?
5. Are you right handed, left handed or do you use both equally well?
6. Do you have any problems with the use of your right hand? Is so what are they?
7. What is or was your occupation?

List 2 - Questions from Script: Part II

1. Was the pruning action smooth while going through the wood?
2. Did the pruner make a clean cut while going through the wood?
3. Were you able to make all four cuts with the pruner?
4. Were the cuts easy for you to make?
5. Would you feel happy about using this pruner if it were the only one available? Remember the key word is happy.
6. Could you easily get your hands around the handles when they were in the closed position?
7. Was your hand comfortable around the handles when the pruner was in the open position?
8. Did the weight of the pruner feel comfortable?
9. Do you think you could get much work done with this pruner?
10. Did you understand how to use the pruner?

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FACTORS WHICH CAN AFFECT THE PREFERENCES OF THE ELDERLY FOR HAND PRUNERS

by

Ellen J. Pitt

(ABSTRACT)

Preferences for four types of hand pruners were solicited from an active elderly population and these preferences were analysed in relation to anthropometric and demographic characteristics of sample members. Participants at senior multipurpose centers included thirty-four females and sixteen males ranging from fifty-two to eighty-three years of age. The subjects were surveyed individually in a single session in which the investigator asked selected demographic questions, measured their grip strength and hand length and recorded their ranking and evaluation of four pruners.

The independent variables included, age, sex, hand length, grip strength, dwelling, problems with hands, and experiences with hand pruners. Relationships between sex and hand size, and sex and grip strength were assessed with t-testing. The four pruners were chosen to reflect the following combinations: hook and blade with simple lever, anvil and blade with simple lever, hook and blade with compound lever, and anvil and blade with ratchet mechanism. Other characteristics included handle design and weight.

The Friedman ranking test was used to determine the factors which significantly affected pruner preferences. Of the variables measured, sex, hand size, grip strength, and type of residence were associated with pruner preference. Of those groups displaying significant results from the Friedman ranking tests, only the group containing the top third strongest grip strengths showed a rank order with the compound lever pruner higher than the simple lever hook and blade pruner. T-tests showed relationships between sex and hand length, and sex and grip strength.

The simple levered anvil and blade pruner placed highest in all significant rankings while the compound and ratchet were placed low in the rankings. The compound pruner did not appeal to many of the participants because of by its heaviness and the design of its handles while the ratchet pruner was resisted because of the multiple squeezes needed for proper use. Recommendations for choosing pruners and other hand tools were made along with suggestions for further investigations of factors affecting preferences for hand tools.