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pure insights

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Editor's Note

Maren Anderson, Western Oregon University

This has been another difficult year in a string of difficult years, yet Western Oregon University students still manage to produce high-quality research. The articles from year's *PURE Insights* are especially diverse in topic. We are showcasing not only poetry, but also identifying bodies, animal/human communication, and caregiver attitudes.

Undergraduate Research is important to students because it not only gives them experience with the nuts and bolts of doing research–library searchers, laboratory set up, analytical skills–but also gives our students the skills to think with clarity and precision.

The more exposure our students have to doing their own research, the more they will understand what "doing your own research" actually means. It does not mean going to your favorite news site and reading the headlines that make you feel vindicated. Nor does it mean reading the comments section of your favorite YouTuber. It absolutely does not mean taking the word of a single authority figure.

Research means looking over many diverse sources that disagree with one another and wrestling with their dichotomies. Research means performing experiments that are ethical, well-designed, and can be replicated. Research means writing up results in a way that the community can understand what you've discovered. People who can do this kind of research have the skills to help all of us make sense of this world.

Research skills are critical thinking skills which are scientific thinking skills. These are skills that are essential to making and keeping our country great. However, whether people will continue to have the opportunities to do research in the future is uncertain because government grants are uncertain. All researchers will be vying for fewer funds, and many have already felt the squeeze. But we need more people who can do the research, not fewer. By not funding research in the United States, we risk losing our best minds who will seek other places to do their studies.

And that won't make us great at all.

Write or call your congressperson and senator and tell them to fight the cuts to government research grants. We all need these young minds (and the more experienced ones, too) to be able to find the answers to the questions that affect our lives. Otherwise, we lose.

Maren Anderson, Editor, *PURE Insights*, June 2025

Golden Gaze

Chloe Elmore , Western Oregon University

Faculty Sponsor: **Jen Bracy**

The design for this cover is a watercolor piece that, through the use of a lavender color scheme and symbolism, is meant to evoke a sense of peace and tranquility, especially in today's current climate. The use of lavender, covering the majority of the work, has a calming effect on viewers, along with the many elements of nature from the deer to the trees and water below it. In the center of the painting is a glowing circle, with which one can correlate to the recent lunar eclipse, demonstrating a time of g rowth. It is a reminder that while changes are happening, we can still find peace and growth in the people and environment with which we choose to surround ourselves.

Keywords: watercolor, deer, peace

A publication of the Program for Undergraduate Research Experiences at Western Oregon University

Informal Caregiving Experiences: Challenges and Opportunities for an Age-Friendly University

CJ Johnson, Western Oregon University
Emily Winters , Western Oregon University

Faculty Sponsor: **Dr. Melissa Cannon**

The growing Age-Friendly University (AFU) global network has been helping its members assess their institutions and identify action items for increasing age-friendliness. This research investigates one of the issues identified through previous assessment of an AFU as a weakness and area of opportunity, which is the lack of resources and information for campus community members who identify as informal or unpaid family caregivers. Data from *N* = 72 campus members (26% faculty, 15% staff, 52% students; 84% female, 16% male) were collected in early 2023 through a campus-wide online survey and analyzed by a team of researchers using quantitative analysis for responses to Likert-type items and thematic analysis for open-ended responses. Issues around physical demands, time demands, financial stress, and social and emotional health while caregiving were assessed. Results indicated that respondents are experiencing different types of stress and need additional support and resources as caregivers, particularly related to respite care, mental health services, financial support, and assistance with physical tasks such as housework and transportation. The findings from this research will be used to develop and share resources around caregiving broadly across the university campus, and to ensure that resources are culturally inclusive, particularly as nearly 25% of the enrollment of undergraduate full-time equivalent students is composed of students from a Hispanic/Latinx background. Findings will also be used to establish community partnerships to harness resources from outside the university, and ultimately to help support the campus community moving forward and to achieve a piece of the university's AFU vision.

Keywords: Informal caregiving; age-friendly university; caregiving resources; survey research

Since 2012, the Age-Friendly University (AFU) global network has been helping its members assess their institutions and identify action items for increasing age-friendliness. The designation of an AFU means that a university is "committed to promoting positive and healthy aging and enhancing the lives of older members of the global community through innovative educational programs, research agendas, curriculum development, online education, health and wellness activities, arts and culture programs and civic engagement opportunities" (AFU, 2023, para. 1). [Blinded for Review] University, a regional public university in [BFR], joined this network in 2019 upon receiving full support from administrators and faculty. University faculty from the Gerontology Department have since been assessing the university in terms of its strengths and areas for improvement for achieving its AFU vision.

One of the findings discovered from the "Age-Friendly University Campus Report" (Silverstein et al., 2021) was that BFRU was lacking resources and information for campus community members who identify as informal or unpaid family caregivers. This finding became the central focus for the research described below, which involved surveying students, staff, and faculty on the prevalence and needs of informal caregivers across campus, with the goal of helping to achieve a piece of the AFU vision for BFRU.

INFORMAL CAREGIVING CONCERNS

Informal caregivers, also known as unpaid caregivers or family caregivers (families of kin or of choice) are considered the backbone of long-term care in the U.S. with an estimated 53 million having provided care to an adult or child with special needs at some time in the past 12 months. This includes an estimated 14.1 million

caregivers of recipients ages 0-17, 6.1 million caregivers of recipients ages 18-49, and 41.8 million caregivers of recipients ages 50 and above. An increasing proportion of caregivers of adults are providing care to multiple people, with 24% caring for two or more recipients (in 2020, up from 18% in 2015) and are increasingly providing care for five years or longer (The National Alliance for Caregiving [NAC] and AARP, 2020, p. 4).

Several factors are contributing to increases in the numbers of informal caregivers. These include the aging of the large Baby Boomer population; limitations of formal support systems of care; efforts to facilitate aging in place with more home-and community-based services; and increases in those who self-identify themselves as caregivers (NAC and AARP, 2020). Previous research demonstrates that while many caregivers report that caregiving provides a sense of purpose or meaning (NAC and AARP, 2020; NORC, 2014), they also increasingly report being in fair or poor health, finding it difficult to take care of their own health, and that caregiving has made their own health worse (NAC and AARP, 2020). Especially during the COVID-19 pandemic, caregivers were disproportionately affected by financial stress, worry about their care recipient's health, lack of access to respite care, social isolation, and missing health care appointments (NAC, 2023; NORC, n.d.).

Currently, 17% of caregivers in the U.S. report being Hispanic or Latino (NAC and AARP, 2020, p. 5). Previous studies have shown that Hispanic/Latinx families rely on informal support networks more than formal support and that social support and caregiving extend broadly across social networks within these communities (Aranda & Miranda, 1997; Commonwealth Fund Commission, 1989; Cruz & Le, 2021). Hispanic/Latinx caregivers may be influenced by cultural values such as familism (i.e., the needs of the familyare greater than the individual) and may not realize they are or identify themselves as caregivers (Cruz & Le, 2021). Previous research indicates that Hispanic/Latinx caregivers experience higher task difficulties, less formal training, and discrimination from healthcare services (AARP, 2012; Cruz & Le, 2021). Over half of Hispanic/Latinx caregivers are the sole caregivers of their loved ones and report having difficulties with healthcare tasks such as medication management and wound care, while over one-third report being isolated and experiencing emotional and physical strain due to caregiving (Cruz & Le, 2021). These issues were identified as of particular importance for this study, as BFRU is expected to achieve "Hispanic-Serving Institution" status in the next year, meaning that 25% of the enrollment of undergraduate full-time equivalent students is composed of students from a Hispanic/Latinx background (U.S. Department of Education, 2023).

The primary objectives for this study are to 1) describe the prevalence and needs of caregivers at BFRU, which joined the AFU network in 2019, and has an increasingly diverse student population; and 2) discuss inclusive opportunities for developing and sharing resources for informal caregivers which will help to improve one area of an AFU institution's age-friendliness.

METHODS

This study used a multi-method design that included analyzing both quantitative and qualitative data collected from a campus-wide survey of students, staff, and faculty at BFRU. Data were collected across two weeks in early 2023 using an online survey administered through Qualtrics. Campus members were notified of the survey with a campus-wide email sent from the university's Provost in order to catch the attention of the target population. They also learned about the survey from students who set up a table in the foyer of the university center on National Caregivers Day.

The survey was designed based on existing scales such as the caregiver burden scale and the caregiver reaction assessment. It included a set of questions asking respondents to describe their caregiving responsibilities, Likert-type items asking about their caregiving burdens and needs, and open-ended questions asking respondents to describe resources they have used and resources they would find helpful as caregivers. The survey was created using Qualtrics software and tested out multiple times before distributing. It could be completed in 10-15 minutes on a phone, tablet, or computer. A gift basket drawing was included as an incentive for participants to complete the survey.

Survey data were analyzed by a team of researchers using quantitative data analysis for responses to Likert-type items and thematic analysis for open-ended responses. For the quantitative data analysis, four categories were

created to encompass the statements in the Likert scale: physical needs, mental needs, social needs, and financial needs. Individual scores were calculated for each participant within each of the four categories by calculating the mean of the scores given in the questions listed above. This calculated a 1-5 numerical score for the categories of each respondent. After calculating the mean scores, the numerical data were then transferred to ordinal data using a computational average. To compute the correlational values of each categorical variable against each other, the team used Spearman's Rho calculated in SPSS. For the qualitative data, the team used thematic analysis and followed the typical six step process: 1) familiarization; 2) coding (which entailed developing a coding frame and applied it systematically to the data (O'Connor & Joffe, 2020); 3) generating themes; 4) reviewing themes; 5) defining and naming themes; and 6) reporting (Braun & Clarke, 2006). The research team worked closely together throughout each step (e.g., reviewed the themes represented in the data, confirming themes and sub-themes, and discarding any that they would ultimately not consider themes). This ensured that throughout each step, a high level of agreement was reached among team members.

RESULTS

Demographics of respondents (N=62) included a majority identifying as female (84%), aged between 26 and 45 years (54.8%), White (85.5%), and students (51.6%), with 11.3% of respondents identifying as Hispanic/Latinx. Table 1 includes more details of sample characteristics. In total, 28 respondents answered "yes" to "Do you currently have an adult(s) over the age of 60 in your life who is dependent on you for certain needs, including care (such as physical, financial, live-in assistance)?" and 56 respondents answered "yes" to "Do you currently have a child/children or adult(s) (under the age of 60) in your life who is dependent on you for certain needs, including care (such as physical, financial, live-in assistance)?"

Of the stressors that respondents indicated having, "physical needs" had the highest agreement (i.e., exceeding what the caregiver believes they can do themselves) over any other stressor (M=1.957, with 64.3% of respondents agreeing or somewhat agreeing). Spearman's Rho data analysis revealed: physical needs significantly correlated with mental needs ($r(70) = .514$, $p = .001$), financial needs ($r(70) = .361$, $p = .01$), and social needs ($r(70) = .477$, $p = .01$); mental needs significantly correlated with financial needs ($r(70) = .717$, $p = .01$) and social needs ($r(70) = .735$, $p = .01$); and financial needs significantly correlated with social needs ($r(70) = .475$, $p = .01$).

Table 1. Sociodemographic characteristics of the participant sample (N=62)*

Characteristic	%
Age	
18-25	17.7
26-35	29.0
36-45	25.8
46-55	17.7
56-65	6.5
65+	3.2
Gender	
Male	16.1
Female	83.9
Race/Ethnicity (selected all that apply)	
White/Caucasian	85.5
Black/African American	0.0
Hispanic/Latino/Latina/Latinx	11.3
Asian/Asian-American	4.8
Native Hawaiian/Pacific Islander	1.6
IndigenousAmerican/American Indian/Alaskan Native	4.8
Other	6.4
University Affiliation	
Student	51.6
Faculty	25.8
Staff	14.5
Other/Student/Staff Combination	8.1
Marital Status	
Single, not married	24.2
Married	58.1
Living with partner	4.8
Separated	3.2
Divorced	8.1
Widowed	1.6

*10 of the 72 surveys were complete except for demographic information

Qualitative analysis revealed the following responsibilities as most discussed among caregivers: transportation (both arranging and providing transportation); activities of daily living (including transferring, grooming/dressing, incontinence/toileting, bathing/showering, feeding assistance); cooking/nutrition; supervision; and home maintenance.

There were some distinct differences in how caregivers of children described their responsibilities compared to how caregivers of older adults described their responsibilities. Notably, caregivers of children used the word "love" as part of their duties, which was not the case with caregivers of older adults. One individual stated, "As the sole parent of 3 children, I am responsible for [their] complete well-being, from feeding to housing to love to support with all aspects of their lives and emotional development" (F/Latina, 46-55, student, separated). They also were more likely to use "parenting duties" or "mom and dad duties," seemingly as shorthand to describe a common set of duties: "I am a parent, so some of my responsibilities include supervision, love, meeting basic needs" (F/Other, 26-35, graduate student, married); "Parenting, homeschooling, med management, emotional regulation assistance, etc." (F/Other, 36-45, student, single). Bathing/showering (or ensuring that care recipients did so) was also mentioned more frequently among this set of caregivers.

As for caregivers of older adults, responsibilities were more likely to include assistance with finances and technology (as one person shared, "internet, Wi-Fi and Bluetooth connection, captions on the TV, the smart-thermostat and smoke detectors, etc."), as well as overseeing care or advocating for care. One individual said, "My mother is disabled but has not been approved for disability through the state. She is one more fall away from being incapable of walking…I wish that she qualified for some program to help her live in an assisted living situation, but that doesn't seem to be the case, so we are making it work" (F/W, 36-45, student, married). Another shared that she was, "Overseeing her care at ALF [assisted living facility), being an advocate. Taking her to all medical appointments & interacting with physicians. Paying all her bills. Purchasing whatever supplies…support person when she is hospitalized" (F/W, 46-55, faculty, married).

Most respondents indicated that they did not know of any caregiving resources available at the university. Of those that they did know about, the most known (in order of frequency) included: Child Development Center; Food Pantry; clothing donation center; Student Health and Counseling; Center for Equity and Gender Justice; FMLA (Family and Medical Leave Act); the university's Basic Needs Coordinator; and the Gerontology program.

Respondents shared a wide variety of resources that they felt would be helpful to them. The most frequently mentioned included childcare, respite care, in-home care, and older adult care. Many of them emphasized care that is affordable, no-cost, or needing financial assistance with providing care. One individual said, "I would love to know if there was a program that would allow my disabled mother to live more independently, or a place where she could live (without income) where she could have assistance if needed" (F/W, 36-45, student, married). Another shared, "With two young children, no family nearby, and both parents in graduate school, we have few options for affordable childcare" (M/W, 46-55, student, married). Different types of supports mentioned in cluded advocacy, support groups, mental health care, trainings, mentorship, and resource guides. For example, one respondent said "Someone to explain Medicare benefits and Social Security benefits and how to best use them. Also, how I should file taxes as a caregiver" (F/W, 26-35, faculty, married). Another shared, "A mentorship program for parent students. Someone who reaches out to me with resources, makes sure I am on track, and gives space for me to share my experience. Someone to advocate if I need accommodations due to caring for my family" (F/W, 26-35, student, married). Specific instrumental activities of daily living that were mentioned included assistance with housekeeping/cleaning and help with transportation.

DISCUSSION AND IMPLICATIONS

Results indicated that respondents are experiencing different types of stressors and need additional support and resources as caregivers, particularly related to care management, respite care, mental health services, financial support, and assistance with physical tasks such as housework and transportation. Importantly, Spearman's Rho revealed that different stressors compiled on top of each other, with stress/needs in one category correlating with stress/needs in all other categories.

There were interesting contrasts of reported responsibilities for individuals who cared for older adults compared to those who cared for children. These may reflect some of the cultural values related to familism, which involves a sense of collectivism and family attachment, often translated as obligation to provide care. Past research has indicated that African Americans and Hispanic/Latinx individuals are more likely to be guided by familism values in their caregiving role compared to Whites (Coon et al.,2004; Depp et al., 2005; Falzarano et al., 2022;McCallum et al., 2007). This could help illuminate why caregivers of children in this study reported their roles differently (i.e., duties understood as "what you do" as parents, out of love and obligation) from caregivers of older adults. This is an area that would benefit from further exploration.

There is also a need to analyze the results more regarding caregiving burden, needs, and use of resources. While the preliminary analyses indicated high levels of physical, mental/emotional, and financial stress, it would be helpful to better understand how these are connected to specific roles and responsibilities and to investigate how resources are being used among those indicating high levels of stress.

The response rate among Hispanic/Latinx members of the BFRU community was lower than anticipated. It would have beneficial to translate the survey into Spanish and ensure that it was culturally relevant. Existing caregiving resources need to be culturally inclusive, as BFRU has a diverse community including nearly 25% of the enrollment of undergraduate full-time students from a Hispanic/Latinx background. The findings from this research will be useful to develop and share additional caregiving resources in multiple languages across the university campus; these should include, at minimum, more guide/informational materials about resources that currently exist at the university and in the broader community such as respite care, support groups, and financial assistance. BFRU can work to establish more community partnerships to harness resources from outside the university and connect community members with them. Ultimately, this work will to help support the campus community moving forward and to achieve a piece of the university's AFU vision.

LIMITATIONS

A limitation of this study is that while 144 participants started taking the survey, only 72 of them completed it; of those, ten surveys were complete except for demographic information (see Table 1). This may have been due to the length or design of the survey; however, it is also common for caregivers to struggle with identifying themselves as such or see their tasks as "caregiving," so they may not have tried taking it or dropped out. Another limitation is that due to the lack of time and resources, the survey was not translated into Spanish language. Had this been done, it is possible that more participants who identify as Hispanic/Latinx would have completed the survey.

CONCLUSION

With the increasing numbers of informal caregivers in the U.S., communities need to be responsive by providing supports and resources to help with the various physical, mental, financial needs of caregivers. Universities can serve as examples for how this can be done, helping serve their goal to become more age-friendly. As populations become more diverse, it is critical to support those such as Hispanic/Latinx families who rely on informal support networks more than formal support and may have unique challenges. Supports and resources need to be available in multiple languages and culturally inclusive. Our results illuminate some of the specific responsibilities and needs of informal caregivers who are part of the university community, and how informal caregivers, even those part of the larger community, can be better supported.

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I Remember Great Aunt Patti

Emily Killebrew, Western Oregon University
Faculty Sponsor: **Dr. Henry Hughes**

I Remember Great Aunt Patti

We'd visit her once every few years

in a trailer park on a small island way up north in Washington.

Me, Sister, and Aunt Patti's big mix-breed, Molder,

would play fetch in her barren backyard,

amidst a decrepit shed and tall trees.

Mom and Dad would converse with her

about comedic work anecdotes or politics,

her heart would burn with laughter,

her voice bouncing off the woodwork.

Sometimes, us kids would join 'em when

she divulged in strange and wild stories.

Supposedly she had plans to move closer to us,

but it never happened

because of family dramas

we never knew she had.

A publication of the Program for Undergraduate Research Experiences at Western Oregon University

Forensic Anthropology: Sex Estimation and Intersex Remains

Kairo Mojsiewicz -Shahin, Western Oregon University

Faculty Sponsor: **Dr. Jerielle Cartales**

Intersexuality has been defined as an “umbrella term used to describe a wide range of innate bodily variations in sex characteristics” (Monro et al., 2021). In life, these characteristics are often limited to soft tissue sex organs; in forensic anthropology, the focus is on an individual's bone structure. This is because the bones of males and females have distinct differences attributed to the biological mechanisms for which they are tailored, such as childbirth or walking, and on account of the effects different hormones have on bone growth and development. It is understood that an estimate of "female" would eliminate all "male" individuals from a pool of potential matches, thereby streamlining the identification process of a descendant. These methods can be as simple as visual analysis or as complex as metric analysis and population statistics (Christensen et al., 2014; Moore, 2013). However, intersex people may not have distinct traits from either sex, or they may have a mix of male and female traits. They can therefore present an interesting challenge to sex estimation. Recent anthropological studies have examined the topic of intersex remains, revealing blind spots in many of the standard methods and our own understanding of sex.

Keywords: anthropology, forensics, intersex

Intersexuality has been defined as an “umbrella term used to describe a wide range of innate bodily variations in sex characteristics” (Monro et al., 2021). In life, these characteristics are often limited to soft tissue sex organs; in forensic anthropology, the focus is on an individual's bone structure. This is because the bones of males and females have distinct differences attributed to the biological mechanisms for which they are tailored, such as childbirth or walking, and on account of the effects different hormones have on bone growth and development. It is understood that an estimate of "female" would eliminate all "male" individuals from a pool of potential matches, thereby streamlining the identification process of a descendant. These methods can be as simple as visual analysis or as complex as metric analysis and population statistics (Christensen et al., 2014; Moore, 2013). However, intersex people may not have distinct traits from either sex, or they may have a mix of male and female traits. They can therefore present an interesting challenge to sex estimation. Recent anthropological studies have examined the topic of intersex remains, revealing blind spots in many of the standard methods and our own understanding of sex.

SEX ESTIMATION

When assessing skeletal sex, forensic anthropologists rely on the presence and appearance of specific markers. While there are many methods used to estimate the sex from skeletal remains, the methods themselves take either a morphological or anthropometric approach, as described by Bašić et al. (2013) in a study to determine if humerus measurements could be used for sex estimation in skeletons from the Eastern Adriatic Coast.

Morphological examination relies on visual assessment of certain features of the bones; anthropologists observe what features they do or do not have and which sex these features most align with (Christensen et al., 2014; Krishan et al., 2016). This approach is most common when observing the pelvis or skull. Due to their different functions and how different hormones affect bone growth and development between sexes, these bones have sexually dimorphic features that are relatively easy to assess without formal measurements (Christensen et al., 2014). Of all the bones that can be assessed this way, the pelvis is the best. It has the most obvious sexual dimorphism between male and female bodies because they were designed with different purposes in mind (Spradley, 2016). Female pelves need to be able to sustain childbirth and, as such, tend to be larger and wider with a rounder pelvic inlet (Libtexts, 2023). Male pelves are

designed for optimal locomotion, especially in humans' unique bipedal situation; they tend to have higher iliac crests as well as longer and narrower sacrums (Christensen et al., 2014). The skull can also be used for morphological examination, typically reliant upon the fact that male skulls are overall larger than female skulls, especially when considering the mastoid process, the supraorbital ridge, and the jaw (Christensen et al., 2014). One of the major pitfalls of morphological examination is that it is quite subjective, relying on a person's individual criteria for words like dull, angled, prominent, etc. This, however, has been shown to have a minimal effect on the accuracy of these observational methods. Based on intraobserver tests using the skull and pelvis, less than a 10% discrepancy was noted with morphological methods that utilized common sex markers on the bones (Rogers & Saunders, 1994; Williams & Rogers, 2006).

Anthropometric examination involves metric evaluation of the bones, measuring the dimensions to account for size and shape differences between male and female bones. The complexity of these evaluations can vary as this method is most commonly used with bones that cannot be effectively evaluated morphologically, such as the postcranial bones (Christensen et al., 2014). The postcranial bones, such as the ribs and humeri, are usually assessed using measurements entered into a "discriminant function formula that yields a score indicating male or female" (Spradley, 2016). What that essentially means is the data collected from measurements is put into an equation which assigns the individual to a certain group, such as male or female (Moore, 2013). Anthropometric analyses have been successfully applied to a number of bones including the tarsals, clavicles, and long bones of the limbs (Albanese, 2013; Harris & Case, 2011). Furthermore, Spradley and Jantz (2011) suggest that this is a more accurate estimate of sex than morphological assessment of the skull. Concurrently, there is little room for interobserver error as this method is based on objective analysis regarding the dimensions of the bones. However, because anthropometric examination is based on quantitative assessment, the data tends to be population specific; different ancestral groups have different degrees of sexual dimorphism.

Some bones which can be used for sex estimation, such as the skull and pelvis, are assessed on a scale of 1 to 5. 1 and 2 mean the feature is more typically female and 4 and 5 mean the feature is more typically male (Bearman, 2016; Christensen et al., 2014). However, in every spectrum there is a middle, and bones which average out in this middle area between male and female are typically labeled "indeterminate". Many anthropologists will see this and end the analysis there, but this is a disservice both to the individual and the field. The existence of this sliding scale approach to analyzing the pelvis and skull acknowledges the spectrum within which an individual can fall. However, professionals often do not question the variability and overlap in this "indeterminate category" (Weitzel et al., 2022).

INTERSEXUALITY

Everyone is born with a set of chromosomes which dictate their sex; XX indicates female and XY indicates male, usually. However, not everyone fits neatly into these boxes. While intersex individuals may have a more unique chromosomal pairing such as XXY or XO, some have XX or XY chromosomes and their intersexuality is expressed through hormone levels (Kralick, 2018). These hormone levels can cause intersex traits to manifest even in individuals with more "typical" chromosomal pairings. For example, someone may have XX chromosomes but have an intersex condition like polycystic ovarian syndrome (PCOS) that may cause them to produce significantly more testosterone than the average female (Sheehan, 2004). While there is no clear number on how many intersex people there are relative to population demographics, data from the 2020-2021 Behavioral Risk Factor Surveillance System estimated the figure at 700,000 in the US; others believe it to be much higher (Bearman, 2016). Intersexuality can present itself in many ways; it is therefore important to understand that a biological profile of a decedent based on their skeletal remains may not accurately reflect intersexuality. It is equally important to note that being intersex is not the same as being transgender, which is when someone's gender identity does not align with their assigned sex at birth.

Manifestations of intersexuality are typically viewed in people's reproductive organs; sometimes people will have more than one or not have the reproductive systems that is conducive to their perceived sex (Kaneshiro et al., 2023). Because of this, hormone levels for intersex people can vary and cause different traits associated with either sex

to emerge to varying degrees. Unfortunately, studies on how intersexuality can affect the bones are largely non-existent. However there are plenty of studies that show how different hormones affect bone development, especially in elderly people who tend to have lower levels of testosterone and estrogen than when they were young. Using these studies, we can understand how these hormones affect the bones and apply that knowledge to predict how they may affect intersex people.

HORMONES

There are four (4) main sex hormones, sometimes called sex steroids: estrogen, progesterone, testosterone, and dihydrotestosterone (DHT) (Mirabito, 2023). Each of these has an effect on how the body will develop, especially during puberty when the body is reaching sexual maturity. Many people tend to view estrogen and progesterone as female sex hormones, and testosterone and DHT as male sex hormones. This is a gross oversimplification of the complexities that exist within the human body. Both males and females will have all four hormones as they all play crucial roles in different parts of bodily development and organ function. The main difference between the two sexes in regards to these hormones is the amount the body will naturally produce (Hammes & Levin, 2019).

Estrogen plays an important part in the growth of male and female bones, as it is required for the growth plates to close. Estrogen promotes the activity of osteoblasts, which make new bone, and estrogen deficiency has been observed to cause osteoclasts, the cells which reabsorb bone, to increase production (Väänänen et al., 1996). During menopause, estrogen levels drop.

Because of the role estrogen plays in bone production and maintenance, menopausal women are at a higher risk of osteoporosis, a condition related to cortical bone loss and a lower bone mineral density that can often result in brittle bones and a higher risk of injury (Geng, 2023). In males, estrogen also plays a role in bone maintenance by regulating reabsorption of the bone by osteoclasts (Khosla et al., 2001). Mutations in the male estrogen receptors has also been associated with an increased risk of osteoporosis and, in one particular case, incomplete fusion of the epiphyseal plates (Smith et al., 1994).

Androgens, like testosterone and DHT, sometimes bind to estrogen receptors; the estrogen receptor is essentially regulating and directing the androgens functions (Fuentes et al., 2019). A study by Mohammed et al. (2016) showed that androgen increases the production of preosteoblasts, which are the cells that eventually turn into mature osteoblasts. In that same study, testosterone was shown to increase the width of the growth plate in growing rats, which can cause the mature bones to be longer and wider. DHT has been observed stimulating osteoblast production and limiting bone resorption, which causes the bones to become more dense (Thu et al., 2017). Androgen deficiency can also affect the bones, causing decreased bone mineral density that can lead to more fragile bones. One study, performed on 12 men who had undergone judicial castration, showed that their rate of bone turnover had increased and their bone mineral density had fallen significantly, with most of the loss happening in the first 5 years (Anderson et al., 1997). This is significant, as it means that not only does testosterone build up bone mineral density, but it maintains it; if testosterone levels suddenly drop, so will the bone mineral density of the individual. Other studies on men with hypogonadism correlate with these findings, even showing that synthetic testosterone can help reverse some of these effects (Behre, 1997).

HOW INTERSEXUALITY IS TIED TO THE DISCIPLINE OF FORENSIC ANTHROPOLOGY

The idea that our bodies fit neatly into one of two categories is not only outdated, but incorrect. In many people that express intersex traits, their hormone levels may not be typical of what is expected in that of males or females. The reproductive organs that create these hormones may be mixed and matched in intersex bodies or have conditions which affect their performance (Payne, 2018). Because of this, forensic anthropology and its current binary approach to sex estimation is failing the intersex population. It is very possible that their bones may not neatly fit into our binary assessment of male or female, resulting in the bones being labeled “indeterminate” or even mislabeled. Without a sex estimation, identification of a decedent is more difficult. Considering that gender-nonconforming individuals are nearly four times as likely to be victims of violent crime (Williams Institute, 2021), this is an egregious oversight.

In 2022, the FBI reported that 4% of all hate crimes in the U.S. were motivated by the victim's gender identity or expression; this is likely an under-estimate, as not all jurisdictions track hate crimes motivated by gender identity and not all of them report their data to the FBI (Human Rights Campaign Foundation, 2023). Additionally, the category of "indeterminate" is vague, since it is also applied to bones that are broken, fractured, or missing, and not just to possibly intersex individuals (Bearman, 2016). Ultimately, a lack of research and training is affecting forensic anthropology's ability to serve this community. This is a significant shortcoming in our current system, and as society moves forward, it is no longer an issue the field can ignore.

At the same time, intersex people represent a small percentage of the overall population; no statistics identifying the percentage of intersex individuals are accepted as accurate. However, the concerns and questions raised here can also apply to non-intersex individuals, as sex is a spectrum (Flaherty et al., 2023). Hormone levels can vary between people of the same biological sex for many reasons, ranging from traumatic events and anxiety disorders to medications and medical conditions (Moyer et al., 2019; Weber & Reynolds, 2004). Not everyone's bones will fit perfectly into the category of male or female. The more we understand these variations, the better we can be at asserting the sex of bones that may simply be more androgynous. As stated before, many bones are assessed on a scale; the lower numbers being attributed to female traits and higher numbers being attributed to male traits. But the middle of that spectrum hides a significant amount of natural variation. When we understand how our bones can naturally vary from the norm, we can expand our knowledge of sex and make more inclusive, and potentially even more accurate, methods for sex estimation.

To start, we can include intersex individuals in future studies on sex estimation and sexual dimorphism. Additionally, forensic anthropologists can partner with people in fields such as endocrinology to understand how intersexuality can affect the bones' development and appearance. Understanding how different hormone levels affect bone development and how synthetic hormone use affects the bones after puberty, and measuring its long term effects on bones like the pelvis, would be a strong place to start. Forensic anthropologists already know that sex is more of a spectrum than a clear binary, as seen by the very existence of the "indeterminate" label. Expanding this acceptance into action will likely make major strides in the field.

CONCLUSION

Sex estimation is based on identifying sexually dimorphic traits using either visual or metric methods, however, our current systems only separate these bones into male or female. While some bones are labeled as indeterminate, this classification can lump intersex remains with broken or missing bones. This exclusion can make matching the bones to a decedent much more difficult, demonstrating a need for sex estimation to be expanded beyond the binary. Our current classification system is convenient, as it avoids nuance; however, this impedes its ability to be applied to the very nuanced world in which we live.

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A Review of Human Perceptions of Emotions From Animal Vocalizations

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The study of the evolution of emotional communication dates back to Charles Darwin and has a rich history rooted in ethological research. The evolution of emotional communication is a growing field of research that explores how animals express and perceive different emotions. Studies continue to shed light on the complexity and universality of emotional communication in the animal kingdom. This review article examines the literature on human perceptions of emotions from animal vocalizations, addressing the acoustic variables that predict the way vocalizations are interpreted, whether people are generally more accurate with gauging arousal or valence from vocalizations, any patterns with respect to species, and subject variables that influence perceptions. By reviewing and synthesizing the existing literature, this article seeks to provide a comprehensive overview of the current understanding of human perceptions of emotions in other species and highlight avenues for future research in this field.

Keywords: communication, cats, animal vocalization

Emotional communication is a fundamental aspect of social interaction, allowing individuals to convey and perceive emotions, thereby facilitating coordination, bonding, and adaptive responses. The evolution of emotional communication in animals has captiva ted researchers for decades, with early contributions from influential figures such as Charles Darwin (1872). While the study of emotional communication has predominantly focused on human -to-human interactions, there is a growing recognition of the importa nce of understanding emotional communication across species. One method of research in this topic is the testing of heterospecific emotion perception - perception of emotion from another species' signals. In the last decade, there has been increasing resea rch investigating human perception of emotion from other species' vocalizations. Exploring how animals express and perceive emotions provides valuable insights into the evolutionary roots and universality of emotional experiences. Furthermore, studying emo tional communication can help contribute to animal welfare, advance knowledge of evolutionary pressures that shape behaviors, and enhance human-animal interactions.

In order to understand the current direction of the study of emotional communication, it is important to understand the dimensional view of emotion (Mendl et al., 2010), which suggests that any emotional state can be characterized by where they lie on the dimensions of valence (positive or negative classification) and arousal (activation of the sympathetic nervous syste m). For example, the emotion of fear could be described as having high arousal and negative valence whereas the emotion of sadness could be characterized by low arousal and negative valence. The dimensional view of emotion has gained prominence due to its ability to capture the complexity and variability of human emotional experiences. It allows for a more nuanced understanding of emotions by considering them as continuous variables rather than discrete categories. This dimensional way of characterizing emotions is especially helpful when studying how humans perceive animal emotions as each dimension is hypothesized to have consistent acoustic correlations. The current article is a review of the literature on human perception of heterospecific vocalizations, focusing on four questions that have emerged as central within this area of research. First, it explores the acoustic variables that predict the way vocalizations are interpreted and how they contribute to emotional understanding. Second, it investigates whether individuals tend to be more accurate in gauging arousal or valence from

vocalizations. Third, it examines any patterns observed in emotional perception across different species, shedding light on potential species-specific characteristics. Finally, it explores the subject variables that influence perceptions of emotions from vocalizations, such as individual differences and contextual factors. This article aims to offer a comprehensive overview of the present comprehension regarding human perceptions of emotions in other species and identify potential directions for future research by extensively examining and synthesizing the existing literature.

ACOUSTIC VARIABLES

When it comes to predicting people's responses to animal vocalizations, there are different acoustic variables that can be important depending on the context and species being studied. Pitch, also known as fundamental frequency (F0), is a key factor that can influence human perception of animal vocalizations. The F0 is the frequency of the lowest frequency component of a sound and determines the perceived pitch of the sound. Many mammals and other species experience a tensing of vocal folds when the sympathetic nervous system is activated, resulting in a higher F0 when more aroused. Different animals can have vocalizations with varying F0, and this can convey different emotions or information. For example, in a study by Pongracz et al. (2005), they found that the F0 and duration of dog barks were important cues for humans in recognizing different types of barks, such as alarm barks and play barks. Similarly, Tallet et al. (2010) found that the F0 contour and duration of piglet vocalizations were important cues for human listeners in identifying the emotional content of the vocalizations.

Duration, or the length of a sound, is another important acoustic variable that can affect human perception of animal vocalizations. The length of a vocalization can convey different meanings, such as the level of urgency or intensity of an animal's communication. In some studies, duration has been found to be a more important predictor of human responses to animal vocalizations than pitch. For example, McComb et al. (2009) found that duration alone was the most important predictor of emotional valence in cat vocalizations. Meanwhile, in a study by Farago et al. (2014), both pitch and duration were important predictors of human recognition of emotional states in dog vocalizations.

In addition to pitch and duration, other temporal parameters, such as rhythm and tempo, can also be important predictors of human responses to animal vocalizations. In a study by Filippi et al. (2017), the rhythmic structure of macaque vocalizations was found to be a key factor in determining their emotional content. However, there is also mixed evidence and variability across studies regarding the importance of these acoustic variables in predicting human responses to animal vocalizations. For example, some studies have found that contextual factors, such as the familiarity of the listener with the species, can influence the relative importance of different acoustic variables. Some studies have even found a difference in F0 during positive valence in vocalizations of different species. For example, Jovanic and Gouzoules (2001) found that rhesus monkeys and gray mouse lemurs produce calls during positive contexts that are characterized by low frequencies, whereas vocalizations made by dogs in positive situations were characterized by high frequencies (Yin & McCowan, 2004). Overall, while pitch, duration, and temporal parameters can all be important predictors of human perception of animal vocalizations, the specific cues that are most influential may depend on a variety of factors, including the context, species, and listener.

AROUSAL VS. VALENCE

The accuracy of perception regarding arousal and valence varies from study to study. Overall, arousal perception accuracy tends to be higher than chance, but valence perception accuracy can vary across species and contexts. Valence is also less studied compared to arousal in the context of emotional vocalizations in part due to the difficulty of finding calls with a positive valence, especially those that have a similar arousal level to calls with a negative valence (Briefer, 2012).

In general, humans tend to rate vocalizations with a higher F0 as having greater arousal. As discussed previously, vocalizer arousal does generally correlate with vocalization F0 in many animal species, therefore this “pitch rule” often leads to accurate judgments of arousal (Filippi et al., 2017). However, using F0 as a sole indicator of arousal can also lead to inaccurate judgements of arousal in cases where the F0 of an animal vocalization is dependent on body size, age, or sex of the animal rather than the animal’s arousal.

More research is needed to determine the accuracy of this "pitch rule" in a wider range of species.

Conclusive and repeated research has been done to support the idea that humans are fairly accurate with rating the arousal of animal vocalizations, although the variation in species is still fairly limited. Research by Filippi et al. (2017) found that humans accurately rated the arousal of vocalizations of nine species including hourglass treefrogs, American alligators, black-capped chickadees, common ravens, domestic pigs, giant pandas, African bush elephants, Barbary macaques, and humans. Another study found that humans accurately categorized pig calls into various categories of contexts based on valence and arousal (Tallet et al., 2010).

Less research has been conducted on the accuracy of the valence of animal vocalizations, however some studies have found significant results. A study by Greenall et al. (2022) found that humans accurately rated the valence of vocalizations by mammalian species including humans, horses, pigs, goats, cattle, and boars. It has also been found that even when participants could not accurately categorize the contexts of certain animal vocalizations, they could still accurately judge the arousal and valence (Kamiloglu et al., 2020). Another study found that participants, regardless of age or previous experience, were able to accurately categorize the valence of horse whinnies (Merkies et al., 2021).

Overall, more research is needed to determine a more precise conclusion on how humans rate the arousal and valence of animal vocalizations, how often these methods lead to accurate judgements, and how the accuracy differs based on species.

VARIATION ACROSS SPECIES

Previous research on human perceptions of animal vocalizations have focused largely on mammals, especially those closely related to humans and those that are commonly kept as pets. Regarding patterns with respect to species, it seems that humans are generally more accurate in perceiving emotional vocalizations in species they are most familiar with, such as dogs, cats, and domesticated animals. There is evidence to suggest that familiarity with a species can enhance perception accuracy. However, it is not consistently found that humans are more accurate with closely related species compared to distantly related species. Much of the current literature is based around human perceptions of vocalizations of commonly domesticated species such as dogs and cats, and more research is needed to establish findings for other species that humans may not have experience with.

It has also been found that familiarity with some specific species can improve accuracy in emotional judgements. For example, McComb et al. (2009) found that individuals that had owned a cat performed significantly better than non-cat owners in judging urgency and pleasantness of cat vocalizations. Another study looked at how humans with different experience levels interpreted pig vocalizations. They found that ethologists studying pigs showed more accurate contextual recognition than students with no pig expertise (Tallet et al., 2010). On the other hand, one study found that experience level with horses did not affect the accuracy of categorizing valence of horse vocalizations. Another study found a facilitating effect of experience where humans with cat experience more accurately classified the context of single cat calls, but not bouts of cat calls (Nicastro & Owren, 2003). Furthermore, Pongracz et al. (2005) found that humans rated the emotional content of dog barks in a similar manner and with similar accuracy regardless of prior experience. It is possible that familiarity with a species may affect perceptions depending on the type of animal or vocalizations or the context of the experience.

Some species that have been featured in many studies of human perception include domesticated dogs, cats, pigs, and horses. A consistent finding across many studies is that humans appear to have the ability to accurately perceive dog vocalizations (Farago et al., 2017; Nicastro & Owren, 2003). It has also been found that humans can accurately judge the vocalizations of domesticated farm animals such as pigs and horses (Filippi et al., 2017; Greenall et al., 2022; Merkies et al., 2021; Tallet et al., 2010). Such research enhances our understanding of human-animal communication and the potential for cross-species understanding, but the evolutionary considerations that can be drawn are limited as these are species with which humans have had significant domestication or interactions with.

In regards to evolutionary relatedness to humans, there is evidence to suggest that humans use the same acoustic variables to judge vocalizations of animal calls regardless

of how distant the species are from humans, but there are varying results. Filippi et al. (2017) found that in a study of nine species spanning all classes of air-breathing tetrapods, human participants were able to identify higher levels of arousal using similar acoustic variables for all nine species. On the other hand, one study by Greenall et al. (2022) found that humans could not accurately judge the arousal of wild boar, Przewalski's horse, and cattle vocalizations but could accurately judge the arousal of pig, horse, goat, and human vocalizations. More research is needed to explore the ability of humans to accurately perceive arousal and valence from vocalizations of a wider array of species both closely and further related to humans.

PARTICIPANT CHARACTERISTICS

The previous research suggests that subject variables such as species, context, and individual differences can all play a role in the perception of animal vocalizations, but the extent to which they do so consistently across species is not entirely clear. Some studies suggest that there may be some universality in the perception of vocal emotions across species. For example, Belin et al. (2008) found that human listeners could recognize basic emotions in dog vocalizations, and Fritz et al. (2018) found thathumans and dogs show similar neural responses to emotional sounds. Furthermore, Pongracz et al. (2005) found that the vocalizations of different animal species (dogs, cats, humans) were perceived differently by human listeners, suggesting that there may be some variation in how humans interpret vocal cues across species.

However, other studies suggest that individual differences and context can play a significant role in the perception of animal vocalizations. For example, Farago et al. (2014, 2017) found that individual differences in vocalization production and perception were related to social behavior in non-human primates, suggesting a role for a social experience in shaping vocal communication. Briefer (2012) and Kamiloglu et al. (2020) found that context, such as the presence of a conspecific or human, can influence the perception of dog vocalizations.

When considering gender as a subject variable in the perception of animal vocalizations, there is some evidence to suggest that gender can play a role in how individuals perceive and interpret vocal cues. For example, Maruščáková et al. (2015) found that female participants rated piglet vocalizations as more positive than male participants, indicating that gender can influence how individuals perceive and interpret animal vocalizations. Similarly, Filippi (2017) found that female participants were better than male participants at identifying different emotional states in dog vocalizations.

However, other studies have not found consistent gender differences in the perception of animal vocalizations. Scheumann et al. (2017) found that there were no gender differences in the ability of human participants to recognize the emotional content of chimpanzee vocalizations, and Parsons et al. (2019) found no gender differences in the ability of participants to recognize the emotional content of dog vocalizations.

In summary, while there is some evidence for universality in the perception of vocal emotions across species, the overall evidence on subject variables and consistency in the perception of animal vocalizations is mixed, with some studies suggesting that individual differences and context can play a significant role in shaping vocal communication and others suggesting that there may be some variation in how humans interpret vocal cues across species.

CONCLUSION

Based on the reviewed literature, scientific understanding of animal emotional communication and human perception of it appears to be mixed. While there is evidence for some universality in the perception of vocal emotions across species, the overall picture suggests that subject variables, individual differences, and contextual factors play significant roles in shaping the human perception of animal vocalizations. Humans generally demonstrate high accuracy in perceiving emotional vocalizations in species with which they are familiar, such as dogs, cats, and domesticated animals. However, there is a lack of consistent findings regarding the influence of evolutionary relatedness on perception accuracy. Studies have shown that familiarity with specific species can enhance perception accuracy, but the specific impact varies depending on the animal or vocalization type. Alongside this, the amount of research conducted in regards to domesticated species compared to those undomesticated or familiar may play a crucial role in this finding.

Regarding the acoustic variables predicting human responses to animal vocalizations, factors such as pitch, duration, and temporal parameters have been identified as important cues. However, the relative importance of these variables can vary depending on the context, species, and listener. While pitch and duration have been found to be influential in some studies, the importance of other parameters like rhythm and tempo has also been observed. Moreover, contextual factors such as listener familiarity with the species can influence the relative importance of these acoustic variables. Thus, the specific cues that predict human perception may depend on a variety of factors. When it comes to accuracy in perceiving arousal and valence, studies indicate that humans tend to be more accurate in perceiving arousal compared to valence. The "pitch rule," associating higher F0 with greater arousal, generally leads to accurate judgments. However, the accuracy of this rule may be influenced by factors such as body size, a ge, and sex of the vocalizing animal. While more research is needed, current evidence suggests that humans have some degree of accuracy in rating arousal and valence, with varying results across species.

In conclusion, human perception of animal emotional communication is a complex and multifaceted phenomenon. While there are instances of universality in emotional perception across species, subject variables, individual differences, and contextual factors can significantly influence the accuracy of human judgments. Scientific understanding of emotional communication is particularly enhanced in species that humans are familiar with, such as dogs, cats, and domesticated animals. Acoustic variables like pitch, duration, and temporal parameters play important roles in predicting human responses, although their relative importance can vary. The accuracy of perceiving arousal tends to be higher than valence, but further research is needed to establish a clearer understanding of these perceptual processes and their evolutionary implications . Further research in the field of emotional communication evolution holds the promise of unraveling the intricate mechanisms underlying the evolution of emotional expressions, providing invaluable insights into the origins and adaptive functions of emotio ns across species, and deepening our understanding of the fundamental aspects of human and animal behavior.

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