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DIVERSITY AND SIMILARITY RELATING TO PLANT KNOWLEDGE AMONG BAKA HUNTER-GATHERERS IN SOUTHEAST CAMEROON

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ABSTRACT This paper examines the characteristics of traditional plant knowledge, focusing on inter-individual differences among the Baka hunter-gatherers in the Cameroonian rainforest. An analysis of inter-individual differences demonstrated that Baka adults generally know the common vernacular names of plants, especially those of trees, and have a similar knowledge of plants used for food and material culture. However, they had widely varying degrees of knowledge about medicinal plants. While they can easily share evaluations of the properties of plants used for food and material culture, they cannot share evaluations of the effects of medicinal plants. They have numerous opportunities to share knowledge of plants used for food and material culture in social settings. In contrast, they have fewer opportunities to share medicinal plant knowledge in their social lives because they use medicinal plants mainly within the family. These tendencies may account for the diversity and similarity with regard to plant knowledge among the Baka. An analysis of the acquisition of medicinal plant knowledge showed that the Baka acquired knowledge about medicinal plants from their parents and other family members when they or their children became sick. This suggests that the Baka adults' medicinal plant knowledge reflects their individual and family medical histories.

Key Words: Inter-individual difference; Food; Material culture; Medicine; Traditional knowledge; Vernacular name.

INTRODUCTION

Traditional knowledge of plants and animals has been of interest in ethnobiology and cognitive anthropology for years. Most studies on traditional knowledge have been based on data obtained from a small number of informants possessing rich knowledge in a specific setting. Informants of a particular gender or age and those with different experiences may not be representative of an entire ethnic group. By the middle of the 1970s, this awareness led to studies on the diversity of traditional knowledge, which was previously thought to be relatively homogenous.

Matsui (1975) demonstrated the spread of vernacular names concerning plants and clams among people on Noho Island, Japan, and discussed changes in livelihood and loss of ethnobiological knowledge. Boster (1986) focused on inter-individual differences in the vernacular names of cassava among the Aguaruna in Peru and found that such differences were influenced by gender in terms of labor, kinship, residential groupings, and personal experiences. Shigeta (1988, 1996) identified inter-individual differences in the knowledge of vernacular names within a given

ethnic group and examined a mechanism for creating diversity in landraces. Berlin (1992) found a gender-based pattern in the knowledge of the vernacular names of birds among the Aguaruna. These studies on vernacular names demonstrate a diversity of knowledge with respect to age and gender at the individual level; moreover, they provide insight into the influence of social context on traditional knowledge.

However, research on the diversity of knowledge regarding plant usage within groups is lacking. Knowledge on the various applications of plants is acquired from everyday trial and error and serves as a direct embodiment of the relationship between humans and their environment. Analyzing utilization is as important as studying the cognitions surrounding it.

Studies on the plant knowledge of Pygmy hunter-gatherers have been carried out among the Mbuti and the Efe (Tanno, 1981; Terashima et al., 1988; Terashima & Ichikawa, 2003), the Aka (Motte-Florac, 1980), and the Baka (Betti, 2004; Brisson, 1988; Hattori, 2006; Letouzey, 1976; Sato, 2007). Most of these studies provide a comprehensive description of the ethnobotany of "Pygmy" hunter-gatherers. Ichikawa and Terashima (Ichikawa & Terashima, 1996; Terashima, 2002; Terashima & Ichikawa, 2003) examined differences in plant knowledge among the four groups.

The studies described below allude to inter-individual differences in knowledge. Takeuchi (1994) noted the existence of inter-individual differences in knowledge concerning food avoidance among the Aka. Ichikawa & Terashima (1996) and Terashima (2002) acknowledged the possibility of inter-individual differences in medicinal plant knowledge among Pygmy hunter-gatherers. Sato (2007) demonstrated inter-individual differences in the Baka's capacity for identifying trees and discussed the meaning of inter-individual differences in knowledge. However, no previous study has quantitatively or qualitatively examined Pygmy intra-group diversity in terms of plant-use knowledge.

In this paper, inter-individual and inter-gender differences in plant knowledge among adult males and females in a Baka hunter-gatherer group in southeastern Cameroon are examined, and the factors accounting for diversity and similarity with regard to plant knowledge within the group are discussed. Finally, characteristics of traditional plant knowledge, in particular, those of medical knowledge, will be clarified.

PEOPLE AND STUDY AREA

The study area is located in southeast Cameroon. Vegetation in southeast Cameroon consists of a mixed forest of semi-deciduous and evergreen trees (Letouzey, 1985; Yasuoka, 2009).

The Baka people are one of the so-called "Pygmy" hunter-gatherer populations inhabiting an area covering part of Cameroon, the Republic of Congo, and Gabon (Bahuchet, 1993). The total Baka population is estimated to be around 40,000 (Hewlett, 2000). Approximately 25,000 Baka live in Southeast Cameroon (Joiris, 1998), together with 45,000 farmers of Bantu or of other language groups (Some,

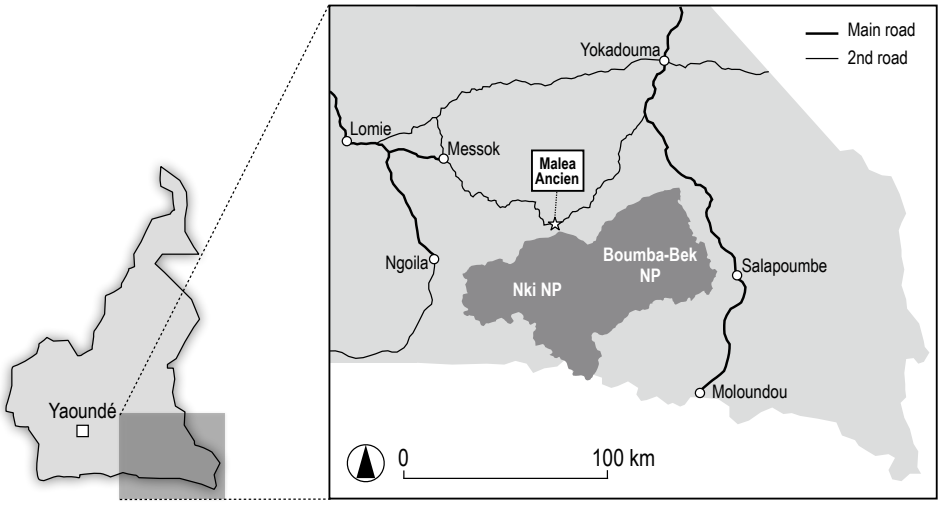

Fig. 1. Study site.

2001). They lead a nomadic lifestyle, similar to other Pygmy hunter-gatherers in Central Africa; however, in the 1950s, they began to move their village sites closer to major roads under the policies of the colonial government (Althabe, 1965). Since then, colonial and post-independence Cameroonian governments have encouraged the Baka to farm. As a result, the Baka now spend more than half of the year in the village and stay in forest camps far from the village for a couple months at a time (Yasuoka, 2006).

In the forests, the Baka engage in hunting animals, gathering wild yams, leaves and fruits, fishing, and performing small-scale agriculture on farms near their villages. Pygmy hunter-gatherers have an interdependent relationship with the Bantu farmers in economic and social domains (Takeuchi, 2001; Terashima, 2001; Hanawa, 2004; Matsuura, 2011). Baka obtain crops, second-hand manufactured goods, and money in exchange for labor and forest products, such as meat and fruit (Hattori, 2014; Oishi, 2012; Rupp, 2003; Sakanashi, 2010).

Like other Pygmy groups, the Baka are famous for their singing and dancing (Bundo, 2001; Tsuru, 1998). Their singing style is polyphonic; that is, music with two or more independent melodic parts are sung together. Like that of other hunter-gatherer groups (Woodburn, 1982), Baka society has been characterized as egalitarian. There is no social inequality between male and female or between elders and juniors, as they share food, clothes, and material goods. Dancing and singing, an egalitarian society, and a strong economic dependence on the forest are all central characteristics of the Baka.

The study area, Malea Ancien village, lies at N 02°49’ and E 14°36’ of Boumba-et-Ngoko Department, East Region, Cameroon (Fig. 1). Malea Anicien is situated 113 km southwest of Yokadouma, which is the department capital. Intensive field

research was conducted over a total of 11 months, from November 2003 to September 2004, and a series of short-term field research studies were carried out up to 2019. During the intensive research period, this village had a total Baka population of 118. There were also 68 Konabembe farmers in Malea Ancien. Modern education and modern medicine are not typical among the Baka there.

METHODS

I. Data Collection

(1) Informants

Using the Baka language, interviews on 90 plant types were conducted with 10 late-adult Baka. Of these informants, five were female (F1–F5) and five were male (M1–M5), with estimated ages ranging from 36 to 45 years. The Baka life stage consists of infancy (*dindo*), childhood (*yande*), adolescence (*wanjo* for boys, *sia* for girl), early adulthood (*mbotaki*), late adulthood (*kobo*), and old age (*ngbekowa*). The Baka are unfamiliar with calendar systems and do not know their exact age. However, neighboring farmers did know their own ages, and the ages of the Baka at the study site were estimated by referencing those of farmers who were born during the same period. By late adulthood, Baka had developed knowledge about the forest and plant diversity.

(2) Plant types

The interviews took place where the plants were growing in the village and in the primary and secondary forests around the village. The village was surrounded by secondary forest; the primary forest was about 1.5 km from the village. The 90 plant types selected for interviews included 51 trees, 36 herbs, and three woody lianas (Table 1). The Baka plant types described here differ from the scientific species and are based on the Baka classification. These consisted of 16 types used for food, including nuts (*Irvingia gabonensis* Aubry-LeComte ex O'Rorke, Baill., Irvingiaceae) and fruit (*Anonidium mannii* (Oliv.) Engl. & Diels, Annonaceae), and 23 types used for material culture and construction, including Maranraceae plants (*Ataenidia conferta* (Benth.) Milne-Redh.), *Megaphrynium macrostachyu* Benth., Milne-Redh.), Palmae plants (*Raphia monbuttorum* Drude, *Laccosperma secundiflorum* (P. Beauv.) Kuntze), and others randomly selected from 359 plant specimens with sufficient information of vernacular names and usages. The study period did not coincide with the plants' fruiting period; therefore, the informants did not share any information about the fruits.

(3) Interview

The plant individuals used for interviews were selected by an older Baka female who was not included among the informants. They were marked with white string, and the same individuals were used for every interview. Each informant was asked about 20–30 plant types per interview to avoid overwhelming them and to help them concentrate on the questions.

First, the informant was asked for the plants' vernacular name, followed by a question about the plant's use and how that knowledge had been acquired. Informants were asked repeatedly about the uses by mentioning ethnobotanical terms to obtain as much data as possible, as they frequently forgot to mention their knowledge of uses. In general, the question, "What do you use this plant for?" was posed, followed by mentioning the plant application category, such as food, material items, medicine, and/or other things. As for items used in their material culture (including construction materials), individuals were questioned by referencing the names of items used for constructing, hunting, collecting, cooking, cleaning, nursing, wearing, and others. Questions about medicine were posed by mentioning parts of plants, such as the root, trunk, bark, sap, fruits, flower, stalk, vine (or liana) and leaf.

Individuals were also asked about how they acquired their knowledge, and exactly when they acquired it. Most informants did not remember the specific circumstances under which they acquired their knowledge about vernacular names, food, or material culture; however, they remembered these details in relation to medicinal plants.

II. Data Analysis

Each person's knowledge was compared numerically and contextually. Each use for a particular plant part was counted as one 'use' in the analyses. The degree of plant knowledge shared between two individuals was calculated and compared in terms of vernacular names and each category of use, i.e., food, material culture, or medicine.

Similarities in plant knowledge were calculated for every pair of individuals: 45 pairs including 10 female–female pairs, 10 male–male pairs, and 25 female–male pairs. The Jaccard Index, i.e., the number of objects in common divided by the total number of objects, was used as an index for similarity. The averages and standard deviations of the indices for each category of use were calculated. F-tests and T-tests were employed to examine differences in the amount of knowledge and similarity with respect to gender. A p-value < 0.05 was considered statistically significant.

The informants sometimes misidentified the plant types or answered usages that only the neighboring farmers applied. The knowledge about "misidentified" plants and farmers' usage was not relevant to the analysis of this paper. The names of trees were more likely to be standardized among the Baka. Concerning trees, a name was categorized as "correct" when 7 of 10 informants gave the same name. The names that deviated were then categorized as "misidentified". Herbs were not distinguished as being "correct" or "misidentified", because the names of different herbs were less likely to be standardized. Informants sometimes answered that neighboring farmers used a certain plant for food, material, or medicine. This knowledge was listed only when they answered that they also used it in the same way.

Knowledge about material culture was classified under the following applications: subsistence activities, cooking utensils, construction materials, carrying devices,

Table 1. Plants used for interviews.

Family	Scientific name	Life form	Vernacular (Baka) name
Acanthaceae	*Justicia laxa* T. Anderson	Herb	*noko-wono* [1], *wono* [1][a]
Acanthaceae	*Thomandersia laurifolia* (T. Anderson ex Benth.) Baill.	Tree	*ngoka*
Amaranthaceae	*Amaranthus spinosus* L.	Herb	No name
Anacardiaceae	*Pseudospondias microcarpa* (A. Rich.) Engl.	Tree	*ewungu* [7]
Annonaceae	*Anonidium mannii* (Oliv.) Engl. & Diels	Tree	*mbe*
Annonaceae	*Hexalobus crispiflorus* A. Rich.	Tree	*hota*
Annonaceae	*Polyalthia suaveolens* Engl. & Diels	Tree	*botunga*
Apocynaceae	*Funtumia elastica* (P. Preuss) Stapf	Tree	*ndama*
Apocynaceae	*Tabernaemontana crassa* Benth.	Tree	*fando*
Araceae	*Cercestis congensis* Engl.	Herb	*jepame*
Balsaminaceae	*Impatiens irvingii* Hook. f.	Herb	*jobele* [3]
Burseraceae	*Santiria trimera* (Oliv.) Aubrév.	Tree	*libaba*
Cecropiaceae	*Musanga cecropioides* R. Br.	Tree	*kombo*
Cecropiaceae	*Myrianthus arboreus* P. Beauv.	Tree	*ngata*
Combretaceae	*Pteleopsis hylodendron* Mildbr.	Tree	*mobito*
Combretaceae	*Terminalia superba* Engl. & Diels	Tree	*ngolu*
Commelinaceae	*Aneilema beniniense* (P. Beauv.) Kunth	Herb	*mboko* [4]
Commelinaceae	*Palisota schweinfurthii* C. B. Clarke.	Herb	*njaya*
Compositae	*Ageratum conyzoides* L.	Herb	*lamoe* [5]
Compositae	*Bidens pilosa* L.	Herb	No name
Compositae	*Chromolaena odorata* (L.) R. M. King & H. Rob.	Herb	*yekele*[b]
Compositae	*Erigeron floribundus* (H. B. & K) Sch. Bip.	Herb	*mbute* [2]
Compositae	*Synedrella nodiflora* Gaertn.	Herb	*bunja* [2]
Convolvulaceae	*Ipomea quamoclit* L.	Liana	*ma na mbili* [2]
Costaceae	*Costus afer* Ker-Gawl.	Herb	*gangelange*
Cyperaceae	*Cyperus alternifolius* L.	Herb	*kiyeye* [4]
Ebenaceae	*Diospyros abyssinica* (Hiern.) F. White.	Tree	*djama* [8]
Euphorbiaceae	*Keayodendron bridelioides* (Mildbr. ex Hutch. & Dalziel) Léandri	Tree	*mbondo* [8]
Euphorbiaceae	*Macaranga hurifolia* Beille.	Tree	*musasa*
Euphorbiaceae	*Manniophyton fulvum* Müll. Arg.	Liana	*kusa*
Euphorbiaceae	*Uapaca staudtii* Pax	Tree	*sengi*
Gramineae	*Eleusine indica* (L.) Gaertn.	Herb	*mepapa* [6]
Gramineae	*Leptaspis cochleata* Thwaites	Herb	*dimbelimbe*
Gramineae	*Paspalum paniculatum* L.	Herb	*mepapa* [5]
Gramineae	*Sorghum arundinaceum* (Desv.) Stapf.	Herb	*sosongo* [6]
Gramineae	*Streptogyna crinita* P. Beauv.	Herb	*yokokome* [1][c]
Huaceae	*Afrostyrax lepidophyllus* Mildbr.	Tree	*gimba*
Irvingiaceae	*Irvingia excelsa* Mildbr.	Tree	*gangendi*
Irvingiaceae	*I. gabonensis* (Aubry-Lecomte ex O'Rorke) Baill.	Tree	*pekie*
Irvingiaceae	*I. grandifolia* (Engl.) Engl.	Tree	*solia*
Irvingiaceae	*Klainedoxa gabonensis* Pierre ex Engl.	Tree	*bokoko*
Lecythidaceae	*Petersianthus macrocarpus* (P. Beauv.) Liben.	Tree	*boso*
Leg. Caesalpinioideae	*Pachyelasma tessmannii* (Harms) Harms	Tree	*mbo*
Leg. Caesalpinioideae	*Scorodophloeus zenkeri* Harms	Tree	*minyenge*
Leg. Caesalpinioideae	*Tessmannia africana* Harms	Tree	*paka bombolo* [8]
Leg. Mimosoideae	*Pentaclethra macrophylla* Benth	Tree	*mbalaka*
Leg. Mimosoideae	*Tetrapleura tetraptera* (Schumach. & Thonn.) Taub.	Tree	*djaga*
Leg. Papilionoideae	*Pterocarpus soyauxii* Taub.	Tree	*ngele*

Malvaceae	*Sida rhombifolia* L.	Tree	*tandanda*
Marantaceae	*Ataenidia conferta* (Benth.) Milne-Redh.	Herb	*boboko*
Marantaceae	*Haumania dunckelmaniana* (J. Braun and K. Schum.) Milne-Redh.	Liana	*kpasele*
Marantaceae	*Megaphrynium macrostachyum*(Benth.) Milne-Redh.	Herb	*ngongo*
Melastomataceae	*Tristemma littorale* Benth.	Herb	*mbaka* [1]
Meliaceae	*Entandrophragma cylindricum* (Sprague) Sprague	Tree	*boyo*
Meliaceae	*Guarea thompsonii* Sprague & Hutch.	Tree	*njombo* [8]
Meliaceae	*Trichilia lanata* A. Chev.	Tree	*mayimbo na banga* [9][d]
Moraceae	*Ficus vogelii* (Miq.) Miq.	Tree	*lingembe* [8]
Moraceae	*Sloetiopsis usambarensis* Engl.	Tree	*dundu*
Myristicaceae	*Pycnanthus angolensis* (Welw.) Warb.	Tree	*malanga*
Nyctaginaceae	*Boerhavia diffusa* L.	Herb	*dusi* [1]
Olacaceae	*Strombosia pustulata* Oliv.	Tree	*bombongo* [9]
Palmae	*Elaeis guineensis* Jacq.	Tree	*mbila*
Palmae	*Eremospatha haullevilleana* De Wild.	Liana	*kpombo*
Palmae	*Laccosperma secundiflorum* (P. Beauv.) Kuntze	Liana	*kao*
Palmae	*Raphia monbuttorum* Drude	Tree	*peke*
Pandaceae	*Microdesmis puberula* Hook. f. ex Planch.	Tree	*fifi*
Pandaceae	*Panda oleosa* Pierre.	Tree	*kana*
Piperaceae	*Piper umbellatum* L.	Herb	*dembelembe*
Rhamnaceae	*Lasiodiscus fasciculiflorus* Engl.	Tree	*esuma makombo*
Rhamnaceae	*L. marmoratus* C. H. Wright	Tree	*esuma yee njembe*
Rubiaceae	*Massularia acuminata* (G. Don) Bullock ex Hoyle	Tree	*mindo*
Rubiaceae	*Mitracarpus villosus* (Sw.) Cham. & Schltdl.ex DC.	Herb	No name
Sapindaceae	*Blighia welwitschii* (Hiern) Radlk.	Tree	*toko* [8]
Sapotaceae	*Gambeya lacourtiana* (De Wild.) Aubr. & Pellegr.	Tree	*bambu*
Solanaceae	*Physalis angulata* L.	Herb	No name
Solanaceae	*Solanum torvum* Sw.	Tree	*abamila*
Sterculiaceae	*Cola lateritia* K. Schum.	Tree	*fofoko*
Sterculiaceae	*Sterculia oblonga* Mast.	Tree	*egboyo* [8]
Tiliaceae	*Triumfetta rhomboidea* Jacq.	Tree	*mbaya* [7]
Ulmaceae	*Celtis mildbraedii* Engl.	Tree	*ngombe*
Ulmaceae	*Trema orientalis* (L.) Blume	Tree	*misyongo*
Urticaceae	*Laportea aestuans* (L.) Chew	Herb	*sasangulu na ngbengbe* [2]
Urticaceae	*Urera cordifolia* Engl.	Herb	*sasangulu*
Verbenaceae	*Clerodendrum splendens* G. Don	Liana	*niesoso* [2]
Verbenaceae	*Stachytarpheta indica* (L.) Vahl	Herb	*tandanda* [1], *fileli* [1]
Verbenaceae	*Vitex thyrsifolia* Baker.	Tree	*fulu* [9]
Vitaceae	*Cissus leonardii* Dewit	Liana	*mongengele* [8]
Zingiberaceae	*Aframomum alboviolaceum* (Ridl.) K. Schum.	Herb	*njii* (*tondo a Baka*)
Zingiberaceae	*A. danielli* (Hook. f.) K. Schum.	Herb	*njii* (*tondo a seko*)[e]
Zingiberaceae	*A. letestuanum* Gagnepain	Herb	*njii* (*tondo a sua*)

[a] Numbers of informants and the plants named, as noted in parentheses. Names without box brackets are plant names that all of the 10 informants shared.

[b] Neighboring farmer (Konabembe) called it *bokasa* and all informants called it *bokasa* as well.

[c] Others include *dimbelimbe a gba* [1], *mepapa* [1]; *kpa a yaka* [1], *mepapa na ngbengbe* [1].

[d] Nine informants called it *mayimbo na ngbengbe* as well.

[e] All of the informants called it *tondo a ebobo* as well.

entertainment, nursery items, accessories and costumes, furniture, cleaning tools, and others. For medicinal plants, the following were used as application categories: digestion, general health, respiratory system, pediatrics, dermatology, sores, headaches, birth, flank, and others. The concept of *ma* in the Baka language refers to medicines that are used not only to treat physical sickness but also for ritual and magical purposes. This study focused on household medicines used by the informants themselves; however, there is another type of medicine that is used by traditional doctors, *nganga*, for hunting and healing rituals. Baka call it *ma* as well. Although *ma* differs from the modern concept of medicine, it is referred to as "medicine" in this study.

RESULTS

I. Vernacular Names

Informants knew between 73–82 names (average, 76.8 ± 2.7) of the 90 plant types used for the interview and showed neither individual nor gender-specific differences ($p = 0.67$) in the numbers of vernacular names (Table 2). There were no significant differences in terms of "misidentification" cases between female (1.8 ± 2.5) and male (0.4 ± 0.5) ($p = 0.25$) subjects. Informants shared many vernacular names with one another (0.75 ± 0.09), and there was a small difference with regard to similarity between females (0.71 ± 0.08) and males (0.81 ± 0.06) ($p < 0.01$) (Table 3). Male pairs shared vernacular names more than female pairs.

The numbers of vernacular names shared across various types of life forms reflected one trend in particular: most of the names of trees were shared by all of the informants, whereas most of the names of herbs were shared among only a few individuals (Fig. 2). The informants gave *Synedrella nodiflora* Gaertn (Compositae) six names (*bunja*, *mepapa*, *lamoe*, *dadi*, *tandanda*, and *ampon*) and *Eleusine indica* (L.) Gaertn. (Gramineae) four names (*mepapa*, *duje*, *ampon*, and *bai*). No informants assigned names to four herbs (Table 1).

Table 2. Average numbers of vernacular names and uses as answered by 10 informants.

	Female	Male	All
Identified vernacular name	76.4 ± 2.4	77.2 ± 3.3	76.8 ± 2.7
Misidentified	1.8 ± 2.5	0.4 ± 0.5	1.1 ± 1.9
Number of uses (of applied species) for food	21.4 ± 1.1 (18.4 ± 1.1)	22±1.4 (19±1.4)	21.7 ± 1.3 (18.7 ± 1.3)
Number of uses (of applied species) for material culture	143.2 ± 7.0 (53.8 ± 2.6)	150 ± 4.5 (48.4 ± 2.1)	146.6 ± 6.6 (51.1 ± 3.6)
Number of uses (of applied species) for medicine	61.6 ± 20.3 (53.0 ± 15.9)	59.8 ± 5.4 (52.4 ± 5.9)	60.7 ± 14.1 (53.0 ± 11.3)
Total number of uses	226.2 ± 27.1	231.8 ± 10.9	229.0 ± 19.7

Table 3. Similarity of knowledge between pairs among 10 informants.

	Female/Female pairs	Male/Male pairs	Female/Male pairs	All pairs
Vernacular name	0.71 ± 0.08	0.81 ± 0.06	0.75 ± 0.09	0.75 ± 0.09
Uses for food	0.90 ± 0.04	0.92 ± 0.05	0.90 ± 0.07	0.91 ± 0.06
Uses for material culture	0.88 ± 0.02	0.90 ± 0.03	0.82 ± 0.04	0.85 ± 0.05
Uses for medicine	0.17 ± 0.04	0.14 ± 0.05	0.17 ± 0.04	0.16 ± 0.04
Number of pairs	10	10	25	45

The Jaccard Index, the number of common objects divided by the total number of objects, was used for the similarity index.

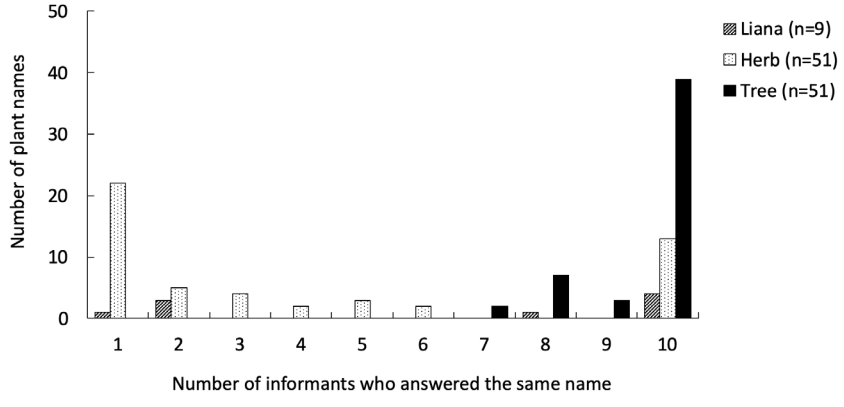

Fig. 2. Distribution of plant names by the number of informants who answered the same name. A total of 111 different names were recorded from 90 plant types by 10 informants.

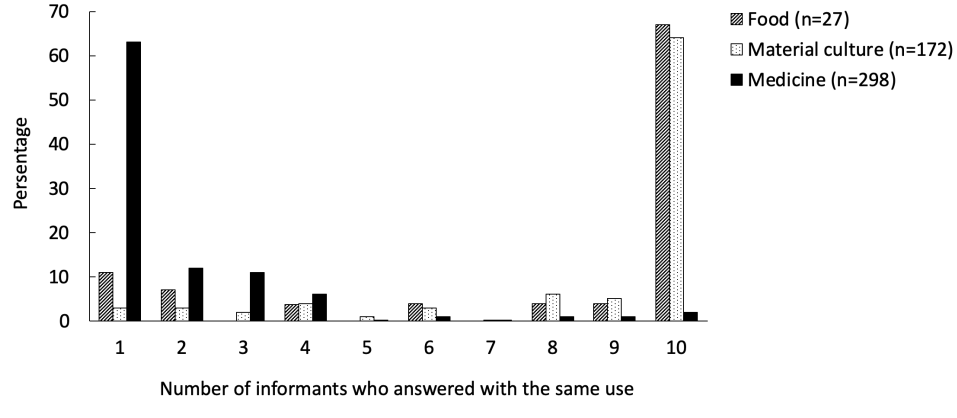

Fig. 3. Distribution (%) of uses for each category by the number of informants who answered with the same use.

II. Knowledge of Food

Informants cited 17–21 plant types (18.7 ± 1.3) as food in 20–24 ways (21.7 ± 1.3); no individual or gender-specific differences ($p = 0.48$) in knowledge were observed (Table 2). They shared most of their knowledge (0.91 ± 0.06), and no individual or gender-based differences in similarity ($p = 0.29$) were found. As shown in Fig. 3, about 75% of food-use knowledge was shared among 8–10 informants, whereas the knowledge shared among a small number of informants was less (Fig. 3).

III. Knowledge of Material Culture

Informants answered that they used 45–57 plant types (51.1 ± 3.6) in 132–154 ways (146.6 ± 6.6) for material culture (Table 2). There was not a significant difference in the amount of knowledge between females (143.2 ± 7.0) and males (150.0 ± 4.5) ($p = 0.11$).

They shared most of their knowledge about material culture (0.85 ± 0.05). Pairs of the same gender (female: 0.88 ± 0.02; male: 0.9 ± 0.03) shared a little more knowledge than pairs of different genders (0.82 ± 0.04) ($p < 0.001$).

Material culture was divided into 10 categories (Fig. 4). Males had more knowledge about subsistence tools than females. For example, males shared knowledge about mindo (*Massularia acuminata* (G. Don) Bullock ex Hoyle, Rubiaceae), which is used for making crossbows, and about fifi (*Microdesmis puberula* Hook. f. ex Planch., Pandaceae) and mindo, which are used for making bows for the purpose of shooting birds, in particular. However, it was not typical for knowledge of use about material culture to be shared among only men. As well as use for food, about 75% of the knowledge was shared among 8–10 informants (Fig. 3).

IV. Knowledge of Medicine

Informants answered that they used 30–69 plant types (53.0 ± 11.3) in 33–86 ways (60.7 ± 14.1) for medicinal purposes (Table 2). There was no difference in the average amount of knowledge between females (61.6 ± 20.3) and males (59.8 ± 5.4), although the standard variation among females was much larger than among males. The knowledge of women differed in terms of quantity (e.g., F2 had twice as much knowledge of medicinal plants as F5).

Fig. 5 presents the content of the knowledge of medicinal plants for each informant. Medicine was divided into 10 categories. The knowledge each informant possessed differed considerably in terms of both quantity and category. For example, M1 knew more medicines for dermatology than did M2, but M2 knew more medicines for headaches than did M1. F3 had more knowledge about respiratory treatments than did F2, but F2 had more knowledge about dermatological treatments than did F3.

Informants did not share much of their knowledge regarding medicinal applications (0.16 ± 0.04, Table 3). No individual or gender-based differences (p

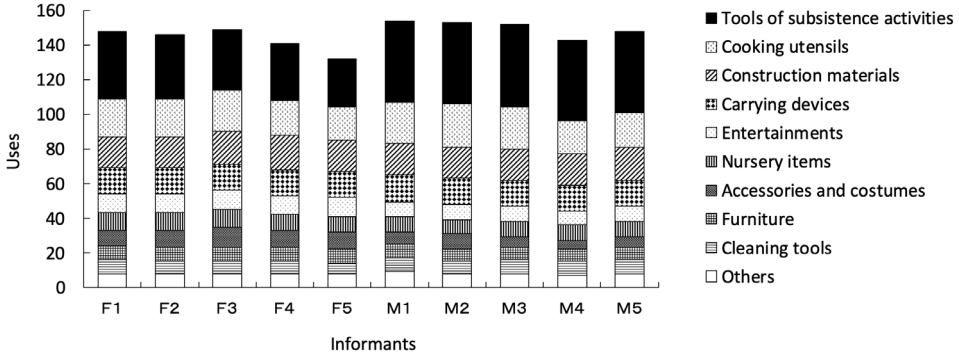

Fig. 4. Content of the knowledge of material culture as revealed by 10 informants. A total of 1,466 answers were recorded.

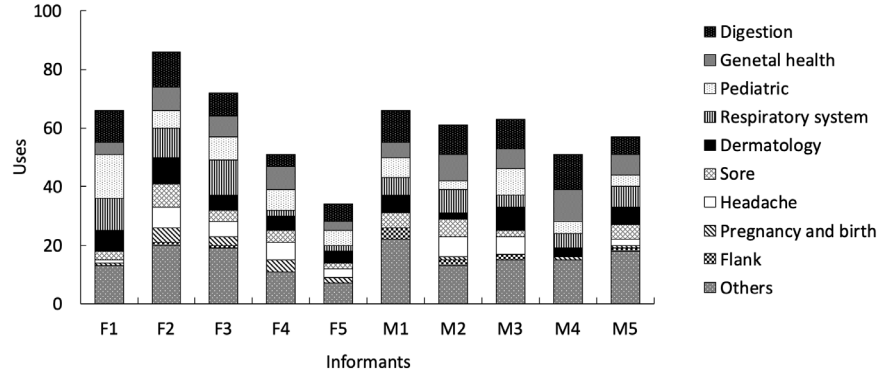

Fig. 5. Content of the knowledge of medicine as revealed by 10 informants. A total of 607 answers were recorded.

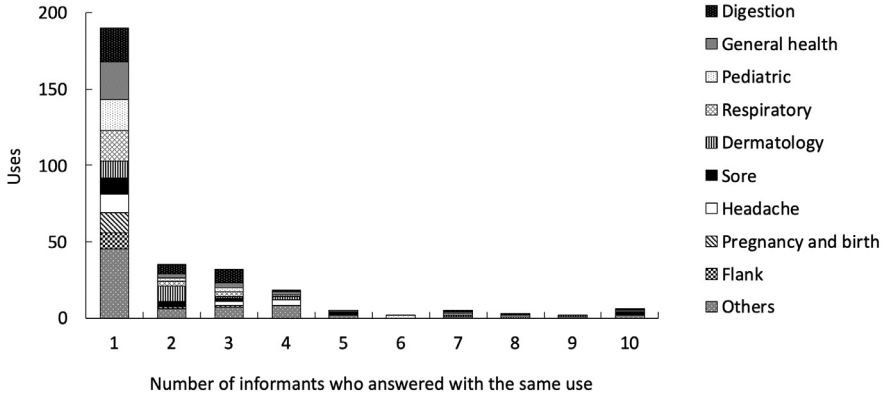

Fig. 6. Distribution and content of uses for medicine by the number of informants who answered with the same use. A total of 298 different uses for medicine were recorded from 90 plant types by 10 informants.

= 0.12) were found. In contrast to knowledge of food and material culture, 63% of the knowledge of medicinal application was possessed by only one informant and 29% of the knowledge was shared among 2–4 informants (Fig. 3).

Only 4% of the knowledge was shared among 8–10 informants. Knowledge related to six applications was shared among all participants (Fig. 6): two for dermatology and one each for general health, digestion, pediatrics (charm and general health for children), and quelling a storm. No particularly common characteristics were evident among these medicines. The informants answered with a total of 607 medical applications, 190 of which were known by only one informant. The 'un-shared' knowledge included applications for digestion, general health, pediatrics, the respiratory system, and others. Any kind of application can potentially be possessed by only one person. Unfortunately, the sample size was too small to conclude that kinship (e.g., marital relationship, siblings, etc.) affected knowledge sharing.

V. Acquisition of Knowledge

Figure 7 shows from whom each informant acquired their knowledge of medicinal plants. Most of an individual's knowledge was acquired from their parents. Female informants obtained much of their knowledge from their mothers, whereas male informants learned more from their fathers. These results confirm the argument of Hewlett & Cavalli-Sforza (1986) that vertical (parent–child) transmission is the most important mechanism for knowledge sharing among hunter-gatherers. However, males obtained more knowledge from other group members than did females. For example, M2 learned about medicinal plants from his parents and brothers, and M3 learned from his parents and brothers-in-law.

I also asked to whom the medicine was applied when the informants obtained knowledge of the medical application (Fig. 8). When their children became sick, females obtained knowledge about medicinal plants more often than did males. In contrast, males obtained knowledge of medicinal plants more often when their parents or other family members became sick.

DISCUSSION

I. Similarity of Knowledge

Many ethnobotanical studies assumed that traditional plant knowledge was uniformly shared among members of a given ethnic group. However, as Ichikawa & Terashima (1996) have argued, based on a study of the knowledge of Pygmy hunter-gatherers in the Democratic Republic of the Congo, traditional knowledge depends both on the material properties of the plants and the cultural factors of a residential group. Thus, here, the similarities and diversity of the Baka's knowledge of plant use was examined from the viewpoint of evaluations of material properties of plants by individuals, and opportunities for sharing knowledge in their daily life.

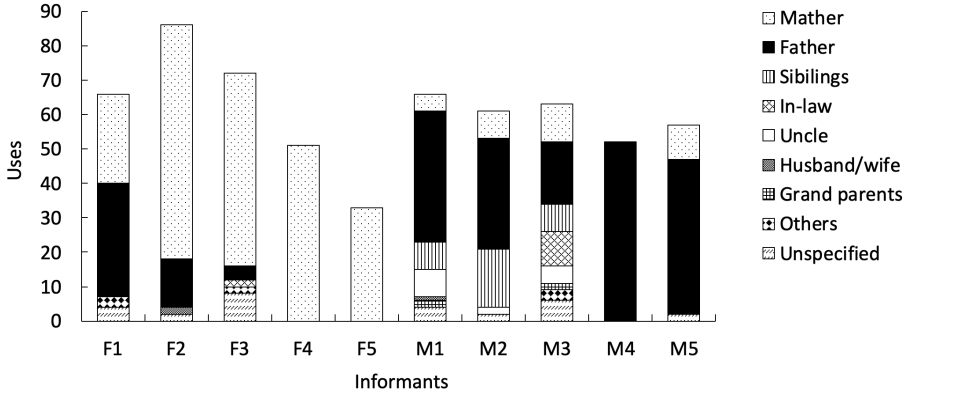

Fig. 7. Person responsible for teaching the informant regarding the use of a particular medicine.

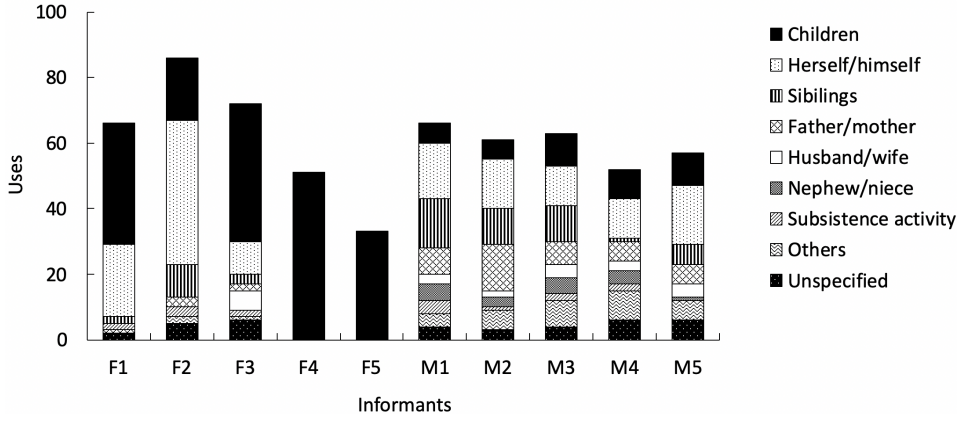

Fig. 8. To whom the medicine was applied when the informant learned of the medicine. Baka sometimes uses ritual medicine for hunting, gathering, and farming.

The informants had almost the same amount of knowledge about plants used for food and for material culture. Plant characteristics such as taste, quality, and shape are often linked directly to the use of particular plants for food and material culture (Ichikawa & Terashima, 1996; Kimura, 1996). Informants described the material properties of inedible plants using words such as 'bitter' (*soso*). They described edible plants using words such as 'sweet' (*lokoloko*). They referred to the material properties of plants used for material culture using words such as 'hard' (*kpeke*) or 'long and straight' (*gengele*). They also described the material properties of useless plants for material culture using words such as 'soft' (*moko*). They expressed that they had tasted inedible plants and had tried to make their huts and tools from plants that they had not used before; it had not been successful. The informants thus knew the characteristics of each plant, regardless of whether the particular plant was useful. Material properties are perceived directly through

touch, taste, sight, and smell. These physical senses are easily shared with others. It is therefore understandable that knowledge about plants used for food and material culture is shared by many.

Frequent opportunities to share plant knowledge in daily social life also contribute to the similarity of Baka's shared knowledge of food and material culture. Edible plants are often shared before being eaten, among the Baka as well as other groups of Pygmy hunter-gatherers (Kitanishi, 1995). Wild yams and Irvingia nuts are especially important plants when harvest season comes (Kimura, 2003; Yasuoka, 2006). The Baka routinely collect plants used for material culture and construction. The leaves and stalks of Marantaceae species are used for a variety of purposes (Hattori, 2006). During the study period, women were frequently observed making mats and baskets together and men making carrying devices. Tools are shared among the Baka; wooden mortars and pestles and cutting boards are passed around among the women as they cook. These tools are common among the Baka and appear to be central to their social life. The Baka further confirm their knowledge about useful plants for food and material culture through their daily life experiences. They sometimes obtain new knowledge from their peers and integrate it into their daily routines. Informants rarely remembered when or from whom they had learned their knowledge, which is generally acquired in such mundane situations.

II. Diversity of Knowledge

In contrast with the knowledge of food and material culture, the knowledge of medicinal plants was largely different among the informants, which supports the view that knowledge belongs not to a group but to each individual. Differences in knowledge among individuals is likely to be generated through the different medical experiences of each person.

Baka medicine generally involves crude herbal medicines made by pounding leaves and soaking them in water or by boiling the bark. These medicines do not appear to function as rapidly as modern medicines, and their effects are not stable. Plant age, growth stage, soil properties, nutritional value, sunlight conditions, period of collection, and patient condition all influence the effects (Terashima, 2002). Informants often said, "The medicine works on some people but not on others," and identified medicinal plants as "my medicine (*ma a le*)". As for ritual medicines and charms, which accounted for 28% of the reported use, the effects perceived by the users can vary considerably. Such varied effects of the Baka's medical applications are likely to have caused the diversity in their knowledge of medical plants.

In addition, medicinal knowledge was not transmitted in the same way as the knowledge of food and material culture. Baka do not often speak about medicine in daily life. Most informants learned about medicinal plants from their parents and family members when they, their children, or other family members became ill. In other words, their knowledge of medicinal plants reflects their family's medical histories. As for ritual medicines for subsistence activities, they use these medicines when they go to the forest with their family members. Non-family members had few opportunities to prepare and use medicinal plants together. The

Baka occasionally discuss their options for the most effective medicine for long illnesses. F3, one of the informants, told me that when she had visited her relative who suffered from a lengthy illness, other relatives of the patient discussed which medicine would be the most effective and chose one particular medicine to give to the patient; however, such discussions rarely happened during this study. The fact that there are very few opportunities for the Baka to share their medical knowledge in daily life is one of the major factors in generating differences in knowledge of medical plants among individuals.

III. Remaining Questions

Is such great diversity of medical plant knowledge among individuals generally observed in other societies? Apagibeti of north central DRC offers this aphorism, "To each person, his own leaf or medicine (*nto na nto na eboke te ngake*)." (Almquist, 2001) Takako Ankei, who studied the ethnobotany of the Songola in DRC, spoke of an old Songola saying, "People have their own medicine." Thus, it is likely that in other traditional societies, each person has his/her own medical plant knowledge that is different from others.

However, quantitative descriptions about inter-individual differences in this knowledge are not available for other societies than the Baka, as shown in this paper. People in traditional societies try to cure themselves when they first become sick (Fratkin, 1980; Sato, 2009). If they cannot recover from their illness using domestic medicine, most of them will go to a traditional doctor to seek treatment (Kakeya, 1982). In the Baka society, there are also traditional doctors or *nganga*, but they are not prominent as in the Buntu society. At the study site, there was no traditional doctor. Rather, the Baka cared for themselves and their family members in most cases. Active homecare may be a major factor that contributes to diversification of the Baka's medical knowledge.

How important are cultural factors with regard to generating and sharing knowledge? "Cultural choice" may work to generate and then share new knowledge at the residential group level, and it can stimulate a collective identity by allowing a group to distinguish themselves from others. For example, comparisons of plant knowledge among four groups of Pygmy hunter-gatherers living in the same region of the DRC showed that they had different knowledge regarding edible food and material culture (Ichikawa & Terashima, 1996). For the Baka, there are also several examples of cultural choice. Neighboring farmers ate *sengi na fasa* (*Uapaca staudtii* Pax., Euphorbiaceae) fruits, but none of the informants in this study had eaten them before. Most of the informants did not eat *tondo a sua* (*Aframomum letestuanum* Gagnepain, Zingiberaceae), but Baka in other groups preferred it. However, there has been no comprehensive ethnobotanical study on other Baka groups or neighboring farmers in the study area. The diversity of Baka plant knowledge should be examined from this perspective.

Finally, further research is required to understand more fully how Baka plant knowledge is changing. Many studies have focused on the impact of modernization on traditional knowledge (Heckler, 2002; Ross, 2002; Zarger & Stepp, 2004; Zent & López-Zent, 2004). Access to education, wage-earning jobs, and modern medicine

have spread among people in traditional societies, resulting in a loss of their traditional knowledge. However, we must pay attention to changes in the quality of knowledge. Modern education provides standardized knowledge and modern medicine delivers homogeneous effects to most patients. The spread of such education and medicine may have a big impact on the diversity of Baka plant knowledge, which has been generated based on individual experiences.

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