How Many People Know? Representing the Distribution of Knowledge

Stanka A. Fiteeva (fiteeva@queensu.ca)
Department of Psychology, Queen’s University
Kingston, ON K7L 3N6, Canada

Abstract
The representation of the distribution of knowledge guides information gathering, help seeking, and communication. The research aimed to explore adults’ and 4-year-olds’ representation of the distribution of common (conceptual and procedural) knowledge and expert knowledge associated with five occupations in their community. In addition, we examined estimates of occupation-related everyday (non-expert) knowledge. Both groups estimated that common knowledge is more widely held than expert knowledge, with everyday knowledge in between. For adults, but not children, the distribution of expert knowledge was correlated with estimates of the proportion of people in each occupation.

Keywords: knowledge distribution; expertise; children; development.

Introduction
People act competently and adaptively in their physical and social surroundings. Yet, their understanding of the physical and social worlds is staggeringly shallow. The solution to this paradox likely rests in the social embedding of human knowledge. That is, they can make an inference from what a person knows to what other things the person is likely to know (Keil et al., 2008).

With respect to the spread of knowledge, previous research on children’s understanding of expertise provides evidence exclusively for the existence of understanding of non-overlaps in knowledge. For instance, Lutz and Keil (2002) presented 3- to 5-year-old children with a list of items representing the expertise of doctors and car mechanics. Children were asked questions like “Who would know more about how to fix a broken arm?” While children identified above chance the relevant expert, this suggests sensitivity to non-overlaps in knowledge and not that everyone knows a given item. The data do not speak to the question of whether children recognize that expert knowledge is relatively narrowly distributed in the population.

Similar issues arise with other studies that have addressed children’s understanding of differences in knowledge. For instance, a number of studies address children’s understanding of the difference between child and adult knowledge (Aquin, Stoess, & Taylor, 2012; Fiteeva, 2010; Fiteeva, Ho, & Hanayama, 2016; Taylor, Cartwright, & Bowden, 1991; VanderBorgh & Jaswal, 2009). Nevertheless, these studies only reveal that children identify non-overlaps of knowledge between social groups. They don’t address children’s representation of the size of social groups and therefore fail to capture children’s representation of the spread of different kinds of knowledge. Perhaps the only study that allows us to establish this is in reference to the common and everyday knowledge. This would be consistent with children seeing adults as omniscient (Piaget, 1959), or at least people capable of exceptional performance in more than one domain. Alternatively, we expected that even 4-year-olds may have a conception of areas of expertise in the community.

Even though past research has documented that by age four children understand that the knowledge of adult experts is not known by children and laypersons, we nevertheless associate expert knowledge with large portions of the population and do not recognize that expert knowledge is more narrowly distributed than common and everyday knowledge. This would be consistent with children seeing adults as omniscient (Piaget, 1959), or at least people capable of exceptional performance in more than one domain. Alternatively, we expected that even 4-year-olds may have a conception of areas of expertise in the community.

To sum up the goal of this study was to examine young children’s understanding of the distribution of expert, everyday, and conventional knowledge. In particular, we had three questions: 1) Do children associate expert knowledge with a smaller proportion of the population than common knowledge? 2) Do they associate it with a smaller proportion of the population than everyday knowledge? 3) Is the perceived distribution of expert knowledge related to the perception of expertise of experts in the community?

Method
Participants
Thirty-six 4-year-old children and 18 adults participated in the study. The children lived in the mid-size urban community of Kingston, Ontario and the adults were students at Queen’s University in the same city. Six children were excluded due to not completing the study (2), self-professed silly attitude (1) and clear pattern in responding (i.e., going up / down the scale, 3). Thus the final sample included 30 children (average age 54 months, range 48-60, 19 girls, 11 boys).

Materials
We asked participants to indicate their perception of the distribution of expert knowledge, everyday knowledge in the same domains, and common knowledge. The expert knowledge pertained to five occupations: farmers, builders, pilots, car mechanics, and doctors. These occupations include the ones frequently appearing in the literature and vary in frequency in the community (more builders, car mechanics and doctors relative to farmers and pilots). An example of an expert knowledge question is “How many grown-ups know how to fix a broken arm?” The corresponding everyday knowledge question was “How many grown-ups know how to lock their front door?”

The five common knowledge items referred to conventional knowledge, e.g., “How many grown-ups know how to use a fork?” and “How do people know how to walk?”

The five common knowledge items referred to conventional knowledge, e.g., “How many grown-ups know how to use a fork?” and “How many grown-ups know how to lock their front door?”

To examine whether the reported spread of expert knowledge corresponded to the community, we asked an occupation-related question in each domain (e.g., “How many grown-ups in Kingston are doctors?”) Participants were also presented with 12 questions about the distribution of various individual characteristics and behaviors, e.g., “How many grown ups in Kingston go to work / have pets?”

Children answered the question on a 5-point scale with a slider. The five points depicted with pie charts 0%, 25%, 50%, 75%, and 100% of the population. Note that this scale in the community, we also asked an occupation-focused question in each domain (e.g., “How many grown-ups in Kingston are doctors?”). Participants were also presented with 12 questions about the distribution of various individual characteristics and behaviors, e.g., “How many grown ups in Kingston go to work / have pets?”

These property questions aimed to further prompt thinking about wider and narrower sets of the population.

Children answered the questions on a 5-point scale with a slider. The five points depicted with pie charts 0%, 25%, 50%, 75%, and 100% of the population. Note that this scale was not designed for recording realistic estimates of prevalence. This would have required a logarithmic scale and we were not aware of evidence of successful use of such a scale with children.

For the adults, the questions were presented on a piece of paper. The instructions and a figure representing a 0-100
knowledge with a significantly smaller proportion of the
Adults included a combination
occupations the data
builder, car mechanic, doctor, farmer, and pilot, and related
affect the current results. Parents also answered
analyzed. These questions were presented later and do not
asked
know. As a
that
, that, t
100 range.
Adults
The experiment began by explaining to children
that they will be asked questions about grown-ups. After
that, the experimenter informed them that they were to
answer the questions by moving the slider to the pie chart
that showed the relevant proportion of grown-ups who know. As a warm-up, children were asked to position the
slider in the all, none, and half positions. Children were also
asked “How many grown ups in Kingston are shorter/\n\text{you?”}} to provide practice answering with the slider.
Children were asked the experimental questions in the
same random order, with the property questions interspersed
among them. Although children were free to position the
slider anywhere on the 0-100 scale, they used the five
points, consistent with the directions they received.
Subsequently, children were asked whether or not their parents knew the items, e.g., “Do mom and dad know how
\text{to fix a broken arm}?” These questions aimed to provide
an assessment of whether children encountered the relevant
information in their homes. The study included several
additional questions the data from which have not yet been
analyzed. These questions were presented later and do not
affect the current results. Parents also answered questions
regarding their child’s familiarity with a large set of
occupations.

Results
Figures 1 and 2 show respectively adults’ and children’s
responses to the questions about adults in the occupations
of builder, car mechanic, doctor, farmer, and pilot, and related
expert and everyday knowledge. In addition, they show the
groups’ estimates of the prevalence of common knowledge.
The research questions identify two key comparisons in
the distribution of expert knowledge and everyday knowledge. In addition, we examined the correspondence between participants’ estimates of the proportion of people in the five occupations and the distribution of expert knowledge related to these occupations in the population. Thus, the analytical approach included a combination of targeted t-tests and analyses of variance and correlation.

Adults
As Figure 1 suggests, on average, adults associated expert knowledge with a significantly smaller proportion of the
population than common knowledge ($M_{expert} = 9.93, M_{common} = 92.16$; $t(17) = 36.36, p < .001$). We conducted an area (3) x question (occupation-focused, expert knowledge, everyday knowledge) repeated measures ANOVA to assess the differences in adults’ assessments of the prevalence of the five occupations, expert knowledge, and everyday knowledge. Both main effects and the interaction effect were significant. The effect
of area ($F(4, 60) = 42.7, p < .01$) reflected that some occupations and related knowledge were perceived as more
common in the community than others. Of key interest, was
the effect of question, $F(2, 34) = 158.2, p < .01$. As Figure
1 suggests, there was a significant difference in the
estimates of the distribution of expert and everyday
knowledge: Children’s estimate of the distribution of common knowledge appears on the right. Error bars represent $\pm$ 1 SE.

We conducted a three-way ANOVA on children’s estimates of the proportion of adults in the five occupations and of the distribution of related expert and everyday knowledge. Adults’ estimate of the distribution of common knowledge appears on the right. Error bars represent $\pm$ 1 SE.

We found that there was a significant difference in the
estimates of the distribution of expert and everyday
knowledge questions, $t(17) = 108, p = 0.295$. Given the
significant interaction effect between area and question ($F(18, 136) = 47.7, p < .01$), we conducted two follow-up analyses. First, we examined the difference between expert and everyday knowledge items in each area. Although always in the expected direction, this difference was significant in three of the five areas (the exception being farmer and pilot).
Second, as we were interested in the relationship between participants’ perceptions of the proportion of professionals and of the distribution of expert knowledge, we calculated the correlation between these variables (rather than their differences). The correlations ranged from 0.45 to
0.89 ($r = 0.09$) suggesting an overall significant relation between these variables. In sum, adults recognized that expert knowledge is less prevalent than common knowledge. Furthermore, their estimates of the distribution of expert knowledge was tightly linked to their beliefs about the proportion of people in each occupation.

Children
As Figure 2 suggests, 4-year-olds associated the common
knowledge items on average with 79% of the population,
which was significantly larger than their estimate of the
prevalence of expert knowledge $53\%$ ($t(29) = 5, p < .01$).
As for the adults, we conducted an area (3) x question
(professional, expert knowledge, everyday knowledge) repeated measures ANOVA on children’s responses to the questions about the distribution of expert and everyday
knowledge and occupations. The analysis only showed a significant effect of question type, $F(2, 58) = 6.2, p < .01$.
Children’s estimates of the distribution of a significantly
smaller proportion of the population than everyday knowledge ($M_{expert} = 53$; $M_{common} = 67$; $t(29) = 3.61, p < .01$). The difference in children’s estimates of the proportion of professionals in the population and the distribution of expert knowledge was not significant; $t(29) = .73, p = .49$. The correlation between children’s answers to these two questions in the individual areas ranged between .3 and .45 and with the exception of highest (for farmer domain) failed to reach significance.

Interestingly, children’s estimate of the proportion of people in the five occupations was on average of 58%. It was higher than their estimate of the proportion of people with related expert knowledge (53%) but lower than their estimate of the distribution of everyday knowledge (67%).

The next analysis examined 4-year-old’s responses to the questions regarding their parents’ knowledge. Children’s answers were averaged across area. Common knowledge was attributed to parents on average 90%, significantly more often than either expert or everyday knowledge (both
$t(29) < .01$). Everyday knowledge was more likely to be attributed to parents than expert knowledge ($M_{expert} = 35$; $M_{everyday} = 64$, $t(35) = 5.86, p < .01$). The difference between expert and everyday knowledge was significant for all areas except car mechanic.

Discussion
The present findings enrich our understanding of children’s and adults’ representation of the spread of different kinds of knowledge. Adults showed clear differentiation between expert knowledge and related everyday knowledge as well as between expert knowledge and common knowledge. Furthermore, their estimates of the distribution of expert knowledge closely corresponded to their estimates of the frequency of different occupations. Children also indicated that expert knowledge is less widely distributed than everyday knowledge and common knowledge. Past research has revealed that children recognize that different adults know different things (Keil et al., 2008; Lutz & Keil, 2002). The current study extends these findings to demonstrate that both children and adults see differences in the spread of different kinds of knowledge.

It is important to note that children’s responses in the
present study are unlikely to be affected by gender
language that distinguishes knowledge that most people
have from idiosyncratic knowledge of individuals. As
mentioned, children can use generic language to distinguish widely and narrowly known novel facts (Cimpian & Scott, 2012). Generic language did not distinguish the stimuli in the
different conditions in present study. Thus, 4-year-olds
not only judge widely and narrowly held knowledge based
on linguistic cues but have built representations of how
knowledge in their environment varies in its spread.

How do people arrive at these representations, especially with regards to expert knowledge? One possible route to representing the spread of expert knowledge is through considering the frequency of different occupations. Indeed, there was a clear relationship between adults’ estimates of the proportion of people with the target occupations and the proportion of people with occupation-related knowledge.

However, no such relationship was evident in the
children’s data. In fact, children’s estimates of the frequency of different occupations were in-between the spread of expert and everyday knowledge. This finding suggests that children may not arrive at a representation of the distribution of knowledge considering the frequency of experts. It is possible that children’s estimates of the distribution of expert knowledge and people in related occupations derive from different sources. Naturally, the occupation questions focused on social actors while the
expert knowledge questions focused on mental states associated with activities. For young children, tracking activities may be easier (given that their estimates were lower and thus more realistic) than the social agents associated with those activities.

Another route children can take to developing an understanding of whether something is widely or narrowly known is through observations of adults in the family. Indeed, the analyses revealed that children crisply differentiated expert, everyday, and common knowledge when asked whether their parents have that knowledge.

Children appear to believe that the number of people in each of the five occupations targeted by the study is over


