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Impact of Age on Brand Awareness Sets:

A Turning Point in Consumers' Early 60s

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Abstract

The awareness set is the set of brands that a consumer knows in a category, and it represents a critical determinant of the composition of the consideration set. Yet no previous research analyzes how consumer age affects the brand awareness set, despite the tendency of the increasingly important segment of older consumers to consider fewer brands and prefer longer established brands. Brands have a special status between common nouns and proper names. However conflicting research describes the impact of age on knowledge of common nouns versus proper names, both of which might affect brand knowledge. This empirical study shows that the direct effect of age on awareness sets is complex, non-monotonic, marked by a turning point in consumers' early 60s, and indicative of contrasting patterns for long-established versus recent brands. For long-established brands, age has a direct positive impact up to the turning point but no significant direct impact afterward. For recent brands, there is no direct impact of age before the turning point but a strongly negative direct impact afterward. Further, in addition to direct effects of age, several mediators (lower cognitive ability, lower education, higher category usage, greater liking of long-established brands) indirectly and further expand its total negative effect.

Keywords: brand awareness set; brand recall; brand recognition; consumer age; cognitive decline

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1. Introduction

In their pioneering work, Nedungadi (1990) and Shocker et al. (1991) established the awareness set—the set of brands that a consumer knows in a category—as a critical determinant of the composition of the consideration set in various choice situations. For example, memory-based choice when searching the Internet requires spontaneous brand recall (Edelman 2010; Lynch and Srull 1982), and in supermarket choices, “awareness is a necessary condition for purchase” (Draganska and Klapper 2010, p. 653). Differences in awareness sets thus influence consideration and choice sets, including those of older consumers, who tend to exhibit greater loyalty and smaller choice sets (Lambert-Pandraud and Laurent 2010; Uncles and Lee 2006). Yet no existing research investigates the impact of consumer age on consumer brand awareness sets. In attempting to address this gap, the current research regards brands as a specific type of nouns, with a unique status somewhere in between common nouns and proper names (Gontijo et al. 2002). In previous research, age exhibits contrasting impact patterns on people’s knowledge of common nouns versus proper names. Therefore, we consider which patterns apply most accurately for brands. As we find, the patterns differ across subsets of brands in a category, and we can delineate the direct impact of age from its indirect effects, through several important mediators.

2. Conceptual framework and hypotheses

2.1 Impact of age on the size of awareness sets

Age has a negative linear impact on most aspects of cognitive ability, yet it exerts a positive influence on knowledge of common nouns (Park et al. 2002), such that “vocabulary knowledge is one of the few cognitive skills that remain intact over adulthood” (Bowles, Grimm, and McArdle, 2005, p. 234). However, extensive analyses of the impact of age on vocabulary knowledge also reveal complex, non-monotonic patterns. Bowles and Salthouse (2008) consider the evolution of performance on four vocabulary tests with a very large

sample ($n = 3,512$, from 18 to 98 years of age). The best representation, across all four of their tests, is a spline regression model, in which scores on vocabulary tests increase linearly until a peak (i.e., “knot”) at age 58 years, after which they decrease linearly. Salthouse (2014) uses a similar procedure to assess this evolution on four vocabulary tests, again using a large sample ($n = 4,774$, from 18 to 89 years of age). He concurs that the evolution should be represented by a spline regression—a linear increase up to a peak age, followed by a linear decrease—but puts the peak at a slightly later age of 64–66 years. Bowles, Grimm, and McArdle (2005, figure 4) observe a plateau over a few years, in the late 50s and early 60s, between the end of the increasing period and the start of the decreasing period. Accordingly, we anticipate similar age-related patterns for brand awareness sets.

However, proper names constitute the linguistic category that normal adults have the most difficulty retrieving as they age (Maylor 1997; Rendell, Castel, and Craik 2005). Several studies have analyzed the impact of age on knowledge of proper names acquired in natural settings over respondents’ lifetimes. For example, Evrard (2002) asks respondent to list, in a minute, as many “famous people” as possible. The monotonic decline with age moves from an average of 16.1 names offered by participants aged 18–34 years to 6.3 names for those 70 years or older. In a comparison of the ability of young ($M = 19.05$ years) and older ($M = 72.23$ years) adults to name photographs of famous persons, after being primed with either a word homophone of the person’s name (e.g., cherry pit for Brad Pitt) or another unrelated word (e.g., cane), Burke et al. (2004) find that in the unprimed condition, older adults perform worse than young adults (33% vs. 42% correct answers) and experience the “tip of the tongue” phenomenon more frequently, such that they indicate knowing the famous person but cannot recall the name (21% vs. 12%). However, in the homophone-primed condition, the differences between old and young adults decrease markedly (43% vs. 47% correct answers, 16% vs. 10% tip of the tongue). Rendell, Castel, and Craik (2005, experiment 2) use 36

photographs of public figures and ask respondents to name them. They find that the average number of photographs correctly named declines with age, with a significant difference between the old-old and two other age groups. Thus, without cues, the memory of proper names appears to decrease monotonically with age, and the tip of the tongue phenomenon becomes more frequent.

The contrasting patterns for common nouns (increase of vocabulary until a peak in the early 60s and then a decrease) and proper names (monotonic decrease of recall and recognition with age) suggest the need for an empirical analysis of the pattern that applies to brands. We thus consider a central contrast, as follows:

H_{1a}: In a given product category, age has a positive linear impact on the awareness set of an adult consumer until a peak, reached in the consumer's late 50s or early 60s.

H_{1b}: In a given product category, age has a negative linear impact on the awareness set of an older consumer, starting in the consumer's 60s.

We also delineate the direct impact of age from its indirect impact, as occurs through five potential mediators. Cognitive abilities relate positively to knowledge of words and names, including antonym identification (Bowles and Salthouse 2008; Salthouse 2014). Thus, cognitive decline with age may reduce the size of the brand awareness set. Education also is an important segmentation variable (Yoon and Cole 2008). For historical and sociological reasons, older people in France, where this study takes place, tend to have less education, and persons with less education should have a smaller vocabulary and smaller brand awareness sets. Furthermore, many consumers develop liking for existing brands early in their adult lives, such that they sense no need to search for new brands later, which should limit the size of their awareness set. Consumers with higher usage rates should be aware of more brands in that category, as should consumers exposed to more advertising related to the category.

2.2 Which brands are better known?

Bowles, Grimm, and McArdle (2005, p. 234) find that "Vocabulary knowledge may not be a unidimensional construct, and the relations between vocabulary knowledge and age may

depend on the aspect of vocabulary knowledge being assessed.” When Worden and Sherman-Brown (1983) present respondents with a list of words to memorize, they determine that respondents in their early 70s better recall “dated” words that were frequent in their childhoods than “contemporary” words that were more prevalent when they were in their 50s. Although these short-term recall tasks differ from the measures we study, we expect older consumers to perform better with brands they have encountered earlier in their lives, partly because these brands have benefited from extended usage opportunities. In a comprehensive review, Ellis, Holmes, and Wright (2010) show that the age of first contact has robust impacts on recognition in multiple domains, including objects, faces, and words (Cuetos, Ellis, and Alvarez 1999; Ellis and Morrison 1998; Holmes and Ellis 2006). They also find, among a sample of older participants ($n = 14$, 50–83 years), that recognition time is faster for early-learned brands from various categories that are now extinct than for more recent, active brands; the fastest recall time occurred for early-encountered, surviving brands. Thus we expect different patterns for long-established versus recent brands.

H_{2a}. In a given product category, the impact of age on awareness sets differs for long-established versus recent brands.

H_{2b}. Older consumers have better awareness of long-established brands than of recent brands.

In addition, proper names are better recalled by older respondents when they are descriptive (e.g., Snow White) rather than non-descriptive (e.g., Charlie Brown) (Fogler and James 2007; Fogler, James, and Crandall 2010; James 2004). We predict a similar effect for brands.

H_{2c}. Older consumers have better awareness of descriptive brands than of non-descriptive brands.

3. Data

We analyze the impact of age on the awareness set for radio stations in France, taking advantage of a natural quasi-experiment. Prior to 1981, radio was a government monopoly, and the choice of French-speaking stations was limited to the handful owned by the

government and a few “peripheral” stations broadcasting from abroad. After President Mitterrand’s election in 1981, the monopoly was abrogated, allowing dozens of new stations to start broadcasting. This history provides an exogenously determined clustering of stations into two strongly contrasted groups: pre-1981 (introduced between 1931 and 1971) and post-1980 (introduced between 1981 and 2008). All stations are equally accessible today. The list of the top nine stations comprises five pre-1981 stations and four post-1980 stations. We wanted to avoid categories in which older people consume less (which could lead them to a smaller awareness set), and radio listening increases with age. In France in 2006–2007, respondents aged at least 65 years listened to radio for an average of 56.5 hours over a 23-day period compared with 28.5 hours among those aged 20–24 years (Médiamétrie 2014, Panel 2007; $N = 9,866$). Moreover, advertising exposure to radio stations is high and similar for all age ranges; the oldest age range (60 years and older) even benefits from the highest gross rating points (GRPs; details available on request). Radio stations overspend on average by 13% on older consumers, and even recent radio stations overspend by 5%, whereas they underspend toward younger age groups (below 24 or 25–34 years). For each respondent, we include the GRP corresponding with her or his age range as a covariate.

3.1. Sample

We interviewed 169 respondents ($M_{\text{age}} = 56$ years, $SD = 20$, 48% between 18–59 years, 52% from 60–92 years; 57% female), most in a lab, except for 31 respondents older than 70 years whom we interviewed at home, because it was difficult to get them to come to the lab (otherwise, their profile does not differ from that of respondents of similar age whom we interviewed in the lab). They listened to the radio at least 30 minutes a day (mean duration on a weekday = 147 min; 72 min for respondents younger than 30, 180 min for respondents older than 60). All respondents were French residents, had spent most of their lives in France,

and lived in Paris or its suburbs, which features more than 60 FM stations. In addition, 51% completed two years or more of higher education.

3.2. Questionnaire

To assess brand awareness, we use two classical marketing measures: spontaneous awareness and aided awareness (Laurent, Kapferer, and Roussel 1995). Participants were asked to name the radio stations they knew “even if only by name.” The mean number of stations recalled was 9.16 ($SD = 4.26$, $min = 1$, $max = 21$). Immediately afterward, they heard a list of 20 stations and indicated, for each one, whether they knew it or not (again “even if only by name”). The 20 stations in this second question were the market leaders, according to the official French radio panel *Médiamétrie*. They included 7 pre-1981 and 13 post-1980 stations. The stations mentioned by a participant in the first question were not read aloud again in the second question, with the assumption that participants who have spontaneously mentioned them would also indicate they knew them. The mean number of stations recognized (of a maximum 20) was 16.79 ($SD = 3.20$, $min = 5$, $max = 20$). We define a brand as recalled if a participant mentions it in the first question and recognized if a participant either mentions it in the first question or indicates knowing it in the second question. Thus, for a given participant, recalled brands are always a subset of recognized brands.

The questionnaire also included liking ratings for the cited stations; a critical measure of cognitive ability (processing speed, taken from the Wechsler Adult Intelligence Scale; Groth-Marnat 2003; Wechsler 2000); questions about radio listening habits; a spontaneous recall question about car brands ($M = 12.43$, $SD = 6.64$, $min = 2$, $max = 36$); and demographic information. The average time taken to complete the questionnaire was 40 minutes. Afterward, respondents were debriefed, offered a small gift, and dismissed.

We computed delta liking scores for each respondent, reflecting the difference between the average liking of recognized, long-established brands and the average liking of

recognized, recent brands. The respondent's listening time (total over a week) has a skewed distribution, so we use its logarithm. The measure of advertising exposure for radio stations or a subset of stations does not come from respondents' fallible memory but rather from Kantar Media estimates of advertising GRPs for each brand per consumer age range (data available on request).

4. Model

Because previous research on the impact of age on knowledge of common nouns and proper names suggests different patterns, we estimate an augmented spline regression model that can accommodate a great variety of patterns by taking different coefficient values.

4.1. Direct effect of age: Augmented spline regression

We use x_{\ddagger} (we explain its estimation subsequently) to denote the age at which the possible positive, linear effect of age on the awareness set of younger adults stops. Then x_below_n is the difference between respondent n 's current age x_n and x_{\ddagger} , as long as this number is negative; the variable equals 0 if not. For example, if x_{\ddagger} equals 60 and respondent n is aged 45, x_below_n takes a value of -15 . If respondent n instead is aged 70, x_below_n takes a value of 0. Symmetrically, x_{\dagger} is the age at which the linear, negative effect of age on the awareness set begins among older adults, and x_above_n is the difference between respondent n 's current age x_n and x_{\dagger} if this number is positive and 0 if not. For example, if x_{\dagger} equals 65 and respondent n is aged 75 years, x_above_n equals 10, but if respondent n is aged 45, x_above_n equals 0. This formulation can cover cases of a one-year peak during which $x_{\ddagger} = x_{\dagger}$, as well as cases of a plateau, such that if $x_{\ddagger} < x_{\dagger}$, the plateau would extend from x_{\ddagger} to x_{\dagger} .

Formally, the regression equation is:

$$V_n = \beta_0 + \beta_1 * x_below_n + \beta_2 * x_above_n + W_{nk} \theta_k + \beta_3 * female + \varepsilon_n, \quad (1)$$

where

V_n is the value of the dependent variable V (specific measure of awareness set) for respondent n ,

β_0 is the value of V at the peak age,
 β_1 is the change in the value of V for each year of age below x_{\ddagger} ,
 β_2 is the change in the value of V for each year of age above x_{\ddagger} ,
 W_{nk} is a vector of the values of the different mediators k for respondent n ,
 θ_k is a vector of coefficients indicating the impact of each mediator on V ,
 female is a binary indicator of gender,
 β_3 is the effect of gender on V , and
 ε_n is a random element.

This model provides direct tests of the hypotheses. If β_1 is significantly positive, it confirms a direct positive effect of age on V_n until age x_{\ddagger} . If β_2 is significantly negative, it confirms a direct negative effect of age on V_n beyond age x_{\ddagger} . If β_1 equals β_2 , the impact of age remains the same throughout adulthood. If β_1 is not significant, age has no impact before x_{\ddagger} . If β_2 is not significant, age has no impact after x_{\ddagger} .

This formulation thus leaves the specific values of x_{\ddagger} and x_{\ddagger} open. We use a grid search approach to estimate Model 1 for all possible values of x_{\ddagger} and x_{\ddagger} between ages 55 and 70 years (because previous research identifies peaks at ages between 58 and 66), with the obvious constraint that $x_{\ddagger} \leq x_{\ddagger}$. We retain the maximum likelihood estimates, that is, the values of x_{\ddagger} and x_{\ddagger} for which the sum of squared residuals is minimal.

4.2. Assessing the indirect effect of age through multiple mediators

We simultaneously test the direct effect of age and its indirect effect through each of the five potential mediators in W_n (cognitive ability, education, usage rate, differential liking of older brands, advertising exposure). In this case, we hypothesize that the direct effect of age may be nonlinear, with a possible change around age 60, but the indirect effects should be linear. That is, age should have a linear effect on the mediators (e.g., cognitive ability declines linearly with age; Park et al. 2002), and the mediators have linear impacts on the awareness set. We therefore rely on a special formulation of the Process Model 4 suggested by Hayes (2013, p. 437). Process does not allow for more than one independent (X) variable, but Equation 1 includes two independent age variables, x_{below} and x_{above} . In the case of k independent variables, Hayes (2013) suggests identifying one of them as X and the $(k - 1)$

others as covariates. Because the mediators depend on consumer age, we replace, for Process Model 4, the formulation in Equation 1 with a structurally equivalent formulation in which X is consumer age and x_{above_n} serves as a covariate. The rest of the equation remains the same. The predicted values, overall fit, and coefficients of the mediators then are identical in both formulations. The estimated coefficient of x_{above_n} in Process Model 4 is equal to the difference between β_2 and β_1 in Equation 1. Process Model 4 also estimates an indirect effect of age through each mediator and tests whether each effect is significant. In addition, it computes the sum of these indirect effects.

5. Results

5.1. The number of brands and the early 60s turning point

Table 1 contains the coefficients estimated with Equation 1, such that V_n first reflects the total number of recalled stations (1a), and then the total number of recognized stations (1b). The global fit is very satisfactory (adj. $R^2 = .301$ for recalled stations, $.437$ for recognized stations). The coefficients for x_{below_n} and x_{above_n} reveal a marked difference in the direct impact of age on the awareness set before and after the peak. For spontaneous awareness, $\beta_1 = .022$ (NS) and $\beta_2 = -.098$ ($p < .05$), with a peak at age 61; for aided awareness $\beta_1 = .044$ (NS) and $\beta_2 = -.253$ ($p < .0001$), with a plateau from 59 to 65 years. As predicted, we find a significant, negative, direct impact of age on the awareness set after the peak, for both spontaneous and aided awareness (H_{1b}). Thus we challenge Bowles, Grimm, and McArdle's (2005) assertion that vocabulary remains intact over adulthood. Contrary to H_{1a} , in adult years before the peak, the direct impact of age is not significant, though it is positive, for either spontaneous or aided awareness. Therefore, we find evidence of a "turning point" age, rather than a peak age, in terms of the size of the awareness set. The turning point for spontaneous awareness occurs at age 61; the plateau for aided awareness appears between 59

and 65 years (midpoint at 62). This finding is consistent with previous results related to general vocabulary (peaks at 58 to 66 years).

The five mediators (Equation 1) all depend significantly on age, such that $t = -13.86$ ($p < .001$) for processing speed, $t = -8.08$ ($p < .001$) for education, $t = 3.90$ ($p < .001$) for delta liking, $t = 3.20$ ($p < .01$) for logarithm of listening time, and $t = 20.91$ ($p < .001$) for average GRPs for the age range of the respondent. Age has no significant impact on the gender indicator. In Table 2 we compare (before and after the peak) the direct effect of age (β s estimated by Equation 1) and the sum with its indirect effects, estimated by Process Model 4.

The mediators that support significant indirect effects of age are not identical for spontaneous awareness (negative effect through cognitive ability and education, positive effect through listening time, Table 2a) and aided awareness (positive effect through listening time, negative effect through delta liking, Table 2b). The signs, when significant, are consistent with our expectations though. Advertising exposure (GRPs) has no mediating effect, perhaps because it is not measured at the individual level (which would be impossible) but rather is estimated by an official French panel as an average for each age range.

The sum of the *indirect* effects (from Process Model 4) is negative for both spontaneous and aided awareness; the negative indirect effects of cognitive ability due to older ages, the lower education levels of older respondents, and their better liking of long-established brands surpass the positive indirect effects of longer listening time by older consumers.

5.2. Identifying contrasted subsets in the awareness set

We also test for differences between long-established and recent brands and between descriptively and non-descriptively named brands. We apply a two-step exploratory procedure (Bowles, Grimm, and McArdle 2005) to analyze the latent structure underlying the recall of different words (available on demand). This factor analysis of the matrix of

tetrachoric correlations among indicators of station recall identifies a first factor that is highly correlated ($r = .811$) with the launch date of the station, as well as a second factor that correlates, though to a lesser degree ($r = .548$), with the descriptive or non-descriptive character of the station name (e.g., Nostalgie vs. MFM).

Awareness of long-established versus recent stations. We estimate both equations (Equation 1 and Process Model 4) separately for the four dependent variables that result from the combination of two measures of each consumer's awareness set (spontaneous vs. aided awareness) and two types of brands considered (pre-1981 vs. post-1980). To allow comparisons with our previous results, we use the x_{\ddagger}^{\ddagger} (end of increase) and x_{\ddagger}^{\uparrow} (start of decrease) values obtained previously (spontaneous awareness, $x_{\ddagger}^{\ddagger} = x_{\ddagger}^{\uparrow} = 61$; aided awareness, $x_{\ddagger}^{\ddagger} = 59$ and $x_{\ddagger}^{\uparrow} = 65$). The explanatory variables remain the same, except that for advertising exposure, we use the GRPs for relevant subsets of stations (pre-1981 or post-1980). The results (Table 1) confirm a strong contrast in the patterns observed for long-established versus recent brands (H2a). For long-established brands, age has a direct, positive impact before the turning point (significantly positive for aided awareness, Table 1b; borderline significance for spontaneous awareness, Table 1a) but not after that point. For recent brands, the pattern is radically different, with no direct impact of age before the turning point and a strongly negative, direct impact afterward. The sum of the indirect effects is always negative (Table 2).

Figure 1 illustrates the contrast between long-established and recent stations. We plot, for each age between 18 and 92 years, the predicted numbers of total radio stations recalled (1a), long-established radio stations recalled (1b), and recent stations recalled (1c). The pattern for the total number of radio stations is the sum of the two very different patterns. We find only limited variation in the number of long-established radio stations recalled, with a significant increase before 61 years and no significant variation afterward. In contrast, there is a strong variation in the number of recent stations recalled, with a significant decline before

61 and an even stronger decline afterward. The global decrease in the size of the awareness set in later years thus is due to recent brands.

Descriptive versus non-descriptive brand names. Next, we investigated whether the impact of age on the awareness set differs for stations with descriptive names (e.g., Nostalgie) versus non-descriptive names (e.g., MFM). Contrary to our expectations (H2c), the estimated coefficients are similar for both groups.

6. Discussion

6.1. Contributions

In consumers' early 60s, there is a *turning point* in the direct impact of age on the awareness of both long-established and recent brands. But the patterns differ. For long-established brands, age has a direct positive impact up to the turning point but no significant direct impact afterward. For recent brands, we find a radically opposite pattern, with no direct impact of age before the turning point and a strongly negative direct impact afterward. Thus we observe *persistence* among older consumers: Their awareness of long-established brands does not decline with age, in contrast with the significant decline in their awareness of recent brands. In support of H_{2b}, older consumers have better awareness of long-established brands than of recent brands. But what mechanisms explain this persistence? Brands learned in younger years may have remained persistently in memory, due to young adults' memory being more effective at encoding newly encountered brands in a durable manner. Brands encountered at an earlier age also may benefit from a longer period during which consumers can become aware of, use, and encode them. Maylor (1998) shows that people are better at naming famous faces with both short- and long-term repetition. However, other studies suggest that cumulative frequency contributes less than the age of acquisition to explain the faster recognition of early acquired stimuli (Ghyselinck, Lewis, and Brysbaert 2004; Menenti and Burani 2007). As Ellis, Holmes, and Wright (2010, p. 44) conclude, "age of acquisition effects cannot be explained in terms of differences in cumulative or lifetime frequency of

exposure.” Memory systems also might be influential, such that those of younger consumers may be less cluttered and less prone to interference by prior knowledge. Younger respondents thus might exhibit higher levels of awareness for recent radio stations, despite their substantial number. Alternatively, older consumers may be reluctant to incur the costs and risks associated with brand switching, so they remain brand loyal and feel no need to search for new brands. However, this explanation seems unlikely for radio stations, which impose very low search or switching costs.

In turn, age has indirect effects on the brand awareness set through four mediators (cognitive ability, education, usage rate, differential liking of long-established brands over recent brands). The sum of these indirect effects is always negative. The indirect effects through mediators that tend to decrease the size of the awareness set with age (cognitive ability, education, and liking of long-established brands) surpass the indirect effect through the sole mediator that tends to increase the set with age (longer radio listening time). Thus the overall effect of age is always more negative than its direct effect. Among the indirect effects, those that move through cognitive ability are most frequently significant. Indirect effects through education, listening time, and delta liking also appear frequently.

6.2. Managerial implications

The important, growing segment of older consumers has a biased vision of the market. At age 20, respondents recall about 2.6 long-established stations versus 9.1 recent ones. At age 60, these values become 3.9 and 5.7; at age 80, they are 3.5 versus 2.7. Thus we have three different visions of the market: recent stations represent a large majority (78%) at age 20, a small majority (60%) at age 60, and a minority (43%) at age 80.

Managers of recent brands have a difficult task overcoming their handicap among older consumers, who struggle to recall such brands. This problem arises even for recent radio stations in our sample that target older people (e.g., *Nostalgie*, *Rire & Chansons*). One option

might be to build on established brands' cues (prefixes, suffixes, homophony) to introduce and name new brands, as Nestlé did with Nespresso, or else to rely on familiar brand logos. Liking of old brands also has a negative, indirect effect from consumer age to awareness of recent brands, so managers should seek to enhance recent brands' appeal to older consumers.

Increasing older consumers' awareness set also may have public policy implications. Public policies might seek ways to help older consumers avoid becoming prisoners of their own limited view of the market, with little or no awareness of new opportunities that may better fit their needs.

6.3. Methodological implications

Our individual-level analysis extends previous work on the impact of age on vocabulary, which typically compares average vocabulary capabilities across different five-year age ranges. Our individual-level analyses help identify the important role of indirect effects through mediators, both general (cognitive ability, education) and category specific (usage rate, advertising exposure, preference for long-established brands). As our study shows, it is possible to obtain both significant results and good fit (R^2) using individual-level analyses. They also confirm the notion that vocabulary knowledge is not unidimensional, such that its link to age varies with the element of knowledge that is being assessed (Bowles, Grimm, and McArdle 2005). Further research might verify if brands' launch dates are similarly important for other categories, in addition to radio stations.

6.4. Limitations and research avenues

Although our study is cross-sectional, longitudinal tracking of awareness sets among the same consumers over years would be impossible in practice and would bias the memory process. We must focus on variables that can be measured currently, namely, the consumer's awareness set and the values of the mediators. Some potential underlying mechanisms are not measurable; for example, we cannot reliably determine the precise date of a consumer's first

exposure to a brand, because few consumers could remember that date years later (Craik 1999), so we used the brand's launch date instead. We also cannot know what a 70-year-old consumer's awareness set or cognitive ability was when he (she) was 30. Furthermore, it would be very difficult to identify whether a consumer had developed a significant relationship with a brand during formative years.

Further analyses might use alternative measures of the awareness set though, such as production measures (what kind of products does this brand sell?), scenarios (which brand would a respondent with a specific profile choose and in which scenarios?), brands recalled or recognized in a "shopping list" experiment, or reaction times for brand recognition in a category. Further experiments also might measure whether the learning ability of older consumers is impaired with regard to unknown and recent brands.

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Table 1 Impact of consumer age and other variables on awareness sets

x_{\ddagger} (Age at end of increase)	x_{\dagger} (Age at start of decrease)	β_1 impact of age (before x_{\ddagger})	β_2 impact of age (above x_{\dagger})	β impact of processing speed	β impact of education	β impact of logarithm of listening time	β impact of delta liking	β impact of advertising exposure (GRPs)	β impact of gender (female)	Adj. R ² F(9,159)
A. Spontaneous awareness set										
Number of recalled radio stations										
61	61	.022 (t = .52)	-.098* (t = -2.20)	.055* (t = 2.57)	1.09** (t = 2.67)	.748 (t = 1.89)	-.389* (t = -2.01)	.000 (t = -.09)	-1.66** (t = -2.85)	.301 F=9.81****
Long-established stations recalled										
61	61	.038 (t = 1.84)	-.006 (t = -.33)	.018 * (t = 2.12)	.234 (t = 1.43)	.129 (t = .81)	.140 (t = 1.79)	.000 (t = .59)	-.689 (t = -2.94)	.137 F=4.26 ***
Recent stations recalled										
61	61	-.025 (t = -1.04)	-.092** (t = -2.61)	.037* (t = 2.17)	.848** (t = 2.61)	.619 (t = 1.96)	-.533 *** (t = -3.43)	-.000 (t = -.54)	-.974* (t = -2.09)	.422 F=15.94****
B. Aided awareness set										
Number of recognized radio stations										
59	65	.044 (t = 1.60)	-.253**** (t = -7.47)	.012 (t = .84)	.476 (t = 1.76)	.868** (t = 3.32)	-.287* (t = -2.23)	-.000 (-.06)	-.937* (t = -2.43)	.437 F=16.91****
Long-established stations recognized										
59	65	.053**** (t = 4.19)	-.010 (t = -.73)	.015** (t = 2.85)	.107 (t = 1.04)	.247* (t = 2.48)	.007 (t = .15)	-.000 (t = -1.26)	-.592**** (t = -4.04)	.224 F=6.93****
Recent stations recognized										
59	65	-.006 (t = -.38)	-.244*** (t = -8.99)	-.004 (t = -.32)	.372 (t = 1.71)	.621** (t = 2.93)	-.293** (t = -2.81)	.000 (t = .07)	-.344 (t = -1.10)	.522 F=21.33****

* $p < .05$. ** $p < .01$. *** $p < .001$. **** $p < .0001$.

Notes: Significant coefficients appear in bold.

Table 2 Direct and indirect effect of age on awareness sets

Dependent variable	β s Direct effect of age (before the peak)	β s Direct effect of age (after the peak)	Total indirect effects of age (including non significant)	Mediators with significant (5%) indirect effects
Source of estimate	Equation 1	Equation 1	Process Model 4 ^a	Process Model 4
A. Spontaneous awareness set				
Total number of recalled radio stations	.022	-.098 *	-.070	(-.042) Cognitive ability (-.028) Education (+.013) Listening time
Long-established stations recalled	.038	-.006	-.004	(-.014) Cognitive ability
Recent stations recalled	-.025	-.092 **	-.058 *	(-.029) Cognitive ability (-.022) Education (+.011) Listening time (-.014) Delta liking
B. Aided awareness set				
Total number of recognized radio stations	.044	-.253 ****	-.027	(+.014) Listening time (-.008) Delta liking
Long-established stations recognized	.053 ****	-.010	-.028 *	(-.012) Cognitive ability (+.004) Listening time
Recent stations recognized	-.006	-.244 ***	-.004	(+.010) Listening time (-.008) Delta liking

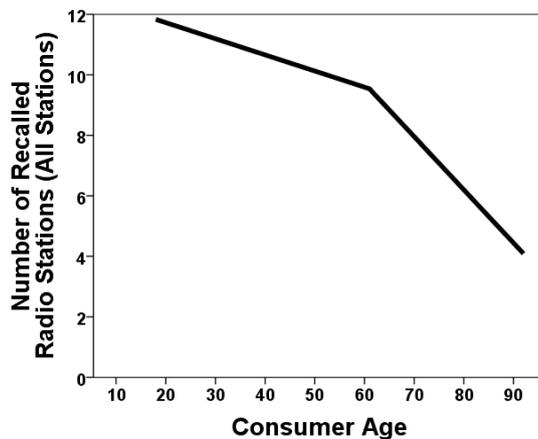
* $p < .05$. ** $p < .01$. *** $p < .001$. **** $p < .0001$.

Notes: Significant coefficients appear in bold.

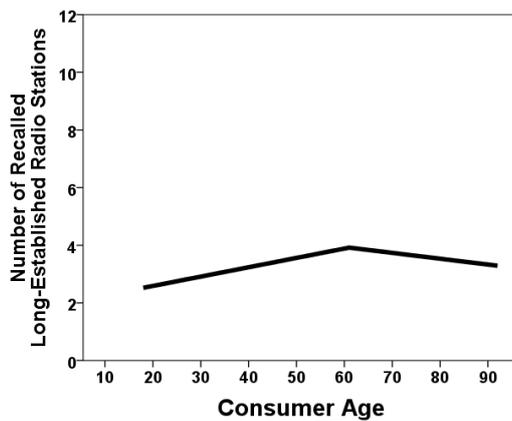
^aWe could use MEDIATE instead of Process, because MEDIATE allows for two or more X variables (Hayes 2013). However, doing so would require us to estimate separate indirect effects of age before and after the peak, which conflicts with previous research that demonstrates that the negative effect of age on cognitive ability is linear (e.g., Park et al. 2002).

Figure 1 Impact of consumer age on awareness sets (turning point at 61 years)

a. Number of Recalled Radio Stations (All Stations)



b. Number of Recalled Long-Established Radio Stations



C. Number of Recalled Recent Radio Stations

