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**Do older consumers purchase differently? The effect of age on
brand awareness, consideration, and purchase**

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Abstract

The spending power of older consumers is rapidly rising as global populations continue to age. Yet, little is known about how ageing and its underlying mechanisms impact consumer behaviour. Without knowing whether the purchase patterns of older consumers differ from younger consumers, marketers may be unwisely neglecting or ineffectively targeting older consumers. Thus, across four studies, this thesis investigates whether, how, and why brand awareness, consideration, and purchase differ between older and younger consumers.

This research finds that older and younger consumers display similar patterns of double jeopardy and brand duplication in their awareness and consideration of competing brands. Despite these similarities, an inverse-U shape is found for brand recognition and brand recall with the number of brands recognised and recalled increasing across age before slowing down and then declining. A similar inverse-U shape is found for brand consideration in subscription markets. For brand consideration and purchase sets in repertoire markets, a linear decline is initially found across age. However, when controlling for purchase rates to reflect changes in category purchasing, older consumers are aware of and consider more brands than younger consumers.

Older consumers also show small increases in purchase loyalty across age groups for supermarket store choice and toothpaste, but not for fruit juice and pharmaceutical prescribing. These results provide the first conclusive evidence of age-related loyalty in some low-involvement categories, as loyalty measures used in prior studies are confounded by category purchase rates. While no loyalty differences were found across age groups for prescribing behaviour, longitudinal analysis reveals that physicians, regardless of age, become less reliant on their core armamentarium as they age and accumulate experience.

Taken together, the research indicates that age-related loyalty patterns do sometimes occur, but cannot be explained by differences in awareness and consideration or the mechanisms that would affect these metrics (e.g. cognitive decline and biological ageing). Rather, the most likely explanation is that age-related effects are primarily driven by household lifecycle and accumulated experience. The findings provide strong implications on how to transition older consumers through the brand purchase funnel and outlines a blueprint for future studies of loyalty across age.

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Chapter 1: General Introduction

1.1 Background

Comprehensive knowledge of consumer behaviour is required for effective marketing strategy and the long-term success of businesses. In recent decades the proportion of older consumers has rapidly increased due to ageing populations caused by longer life expectancies, ageing baby-boomers, and declining birth rates (United Nations, 2015). With the world's population aged 60 years and over projected to rapidly rise to 1.4 billion by 2030 and 2.1 billion by 2050 (United Nations, 2015), older adults are becoming an increasingly valuable consumer segment. In the United States, the greatest annual spending (\$548 billion) of any generational cohort is by baby-boomers who were born between 1943-1963 (Epsilon, 2019). To ensure businesses do not ignore a valuable and growing consumer group, it is imperative that marketers understand the purchase behaviour of older consumers and use this understanding to effectively target the elderly.

In past decades, marketing investment was heavily geared towards younger consumers, partly due to negative stereotyping of older consumers. Marketing practitioners and advertisers often held the belief that older consumers had lower spending power, were strongly loyal to well-established brands, and were in physical and psychological decline (Moschis, 2003; Thompson & Thompson, 2009; Tynan & Drayton, 1985; Yoon & Cole, 2008). These negative stereotypes were often seen in advertisements, with older adults portrayed in less favourable ways than younger consumers (Carrigan & Szmigin, 1998; Peterson, 1992).

More recently, there is increasing evidence that these negative stereotypes are beginning to fade as marketers and advertisers become increasingly aware of the financial importance of older consumers (Moschis, 2003; Yoon & Cole, 2008). Subsequently, marketers and advertisers have begun to portray older consumers more often and more favourably in advertisements (Loos & Ivan, 2018; Prieler et al., 2015). Despite improvements in the quantity and favourability of older consumers being portrayed in advertisements, media content analysis in Europe, North America and Asia demonstrates that older people, especially the 'older-old' age group, are still largely under-represented in advertisements (Loos & Ivan, 2018; Prieler et al., 2017; Prieler et al., 2015; Ylänne, 2015). In particular,

research in the United States reports that only 15% of media images depict adults aged 50 years and above (AARP, 2019).

Despite knowledge of the older segment's financial potential, marketers lack sufficient understanding of how to target such a heterogeneous group. This uncertainty primarily stems from a lack of research examining how age influences consumer behaviour. While in recent years some comprehensive studies have informed marketers understanding of behaviour differences between older and younger consumers (e.g. Anesbury et al., 2021; Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005; Phua et al., 2020; Uncles & Lee, 2006), there is still much to discover. Due to the scarcity of research in this area, numerous academics have advocated for further and more sophisticated investigations of how age impacts consumer behaviour (e.g. Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005; Phua et al., 2020).

Further research is needed to investigate whether age-related purchase differences exist across a range of new contexts, as current research is predominately limited to cars, perfume, and some fast-moving consumer goods (FMCGs). These prior studies also reveal conflicting evidence across product categories. Studies in the high-involvement categories of cars and perfume demonstrate that older consumers display greater brand loyalty and a stronger preference for well-established brands than younger consumers (Evanschitzky & Woisetschläger, 2008; Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005). Whereas, research in low-involvement categories such as FMCGs suggest that once differences in category purchase rates are accounted for, brand loyalty patterns do not differ between older and younger consumers (Singh et al., 2012; Uncles & Ehrenberg, 1990a; Uncles & Lee, 2006). Therefore, a broader array of studies in other contexts will aid understanding of the settings where purchase behaviour differs between older and younger consumers.

Most academic studies that investigate age-related purchase differences mainly employ cross-sectional designs (e.g. Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005; Singh et al., 2012; Uncles & Lee, 2006). Although, these studies suggest differences in consideration and purchase behaviours between younger and older consumers, the differences may arise because of cohort effects (Yoon et al., 2009). Additionally, they do not determine how the purchase behaviour of individual consumers change while they age, as multi-year longitudinal data is required for this type of study. The use of longitudinal studies

of age-related behaviour would contribute substantially towards understanding age-related consumer behaviour. However, obtaining longitudinal consumer panel data without significant panel attrition is often difficult. An alternative method is to draw on panels from specialist areas (e.g. pharmaceutical prescribing) to gain insights on how age influences choice.

How age affects the various stages of the brand purchase funnel prior to purchase, such as brand awareness and consideration, is also lacking attention. Only two recent studies have provided a comprehensive examination of how age influences brand awareness (Lambert-Pandraud et al., 2018; Lambert-Pandraud et al., 2017). These studies demonstrate that older consumers recall and recognise fewer brands than younger consumers, although different patterns are witnessed for older and newer brands (Lambert-Pandraud et al., 2017). Lambert-Pandraud et al. (2018) indicates that the relationship between age and brand recognition follows an inverted-U shape, suggesting that in early adulthood the number of brands recognised increases with age, before beginning to slow, and then decline in later adulthood. However both studies by Lambert-Pandraud et al. (2017) and Lambert-Pandraud et al. (2018) are for French radio stations and brand awareness patterns may differ for other contexts, such as FMCGs where purchase choice is more reliant on brand recognition than brand recall. Therefore, further understanding of how age influences brand awareness in other contexts is required.

Results on age-related differences in the number of brands considered also differs across categories. Older consumers are found to have smaller consideration sets than younger consumers for cars (Evanschitzky & Woisetschläger, 2008; Lambert-Pandraud et al., 2005; Lapersonne et al., 1995) and breakfast cereals (Cole & Balasubramanian, 1993), with insignificant relationships witnessed for coffee (Gruca, 1989), toothpaste and laundry detergent brands (Campbell, 1969). Analysis of more product and service categories will give greater knowledge on the circumstances where age-related differences in consideration sets exist.

While it is important to uncover age-related differences in brand awareness, consideration, and purchase in various contexts, the next step is to discover why these differences occur. Older consumers may have smaller awareness, consideration, and purchase sets simply because they have smaller household sizes and thus buy from certain product categories less frequently than younger consumers (Uncles & Ehrenberg, 1990; Yang et al.,

2005). However, more complex explanations may include biological ageing (Moschis, 1994), and declines in cognitive performance, such as processing speed, working memory, and long-term memory (Drolet & Yoon, 2020; Park et al., 2002; Salthouse, 2012). Older adults also gain accumulated category experience that allows them to gain “crystallised intelligence” (Salthouse, 2012), which can lead to the formation of purchase habits (Lambert-Pandraud & Laurent, 2020), attachment (Park et al., 2010), and nostalgic preferences (Holbrook & Schindler, 1989; Schindler & Holbrook, 2003). These mechanisms are defined and explained further in section 1.2.5. However, it is clear that age-related consumer behaviour is a complex topic with many potential mechanisms at play. While prior research has considered and tested various mechanisms, more research is required to detangle such an intricate and under-researched area.

A further limitation of current research is the heavy reliance on chronological age as a measure of age (Zniva & Weitzl, 2016). Chronological age is often viewed as an unsophisticated measure of age due to heterogeneity among older consumers (Nelson & Dannefer, 1992). Behaviour often varies as individuals age psychologically, biologically, and socially at different rates and stages throughout their lifetime (Moschis, 2012). This often leads to substantial behaviour differences between adults of a similar age, and is why various academics argue that chronological age is an ineffective determinant of purchase behaviour (Ahmad, 2002; Barak & Schiffman, 1981). This led researchers to consider alternative age measures, such as cognitive, sociological, and biological age (e.g. Evanschitzky & Woisetschläger, 2008), as well as the impact of life circumstances and events (Eastman & Liu, 2012; Mathur et al., 2003, 2008) as a predictor of purchase behaviour. However, these alternative age measures are used infrequently (Zniva & Weitzl, 2016), demonstrating future work should explicitly consider these alternative measures.

The limited attention devoted to investigating the consumer behaviour of older consumers by marketing academics has therefore resulted in multiple unanswered questions on how age influences the consumption behaviour of the elderly. Future research is clearly needed to, i) determine whether awareness, consideration, and purchase behaviour differs across age groups in new contexts, ii) determine how purchase behaviour changes over time as individual consumers age, iii) identify the underlying mechanisms that cause age-related differences in awareness, consideration, and purchase, and iv) determine whether alternative age measures outperform chronological age as a measure of age and determinant of behaviour. These research gaps lead to the specific questions that this thesis examines.

1.2 Definitions of key concepts in the thesis

1.2.1 Consumer buying behaviour and the brand purchase funnel

Consumer behaviour is defined by Solomon et al. (2006) as “the study of processes involved when individuals or groups select, purchase, use or dispose of products, services, ideas or experiences to satisfy needs and desires” (p. 6). Similarly, Schiffman et al. (2014) define consumer behaviour as “the behaviour that consumers display in searching for, purchasing, using, evaluating and disposing of the products and services that they expect will satisfy their needs” (p. 4). Age is one variable among the numerous cultural, social, and personal factors that influence consumer buying behaviour (Kotler & Keller, 2015; Schiffman et al., 2014). Consumer behaviour is thus a wide-ranging field consisting of an extensive process involving selection, purchase, use, evaluation, and disposal, with multiple factors influencing each stage of the process. Specifically, in this thesis, the consumer behaviour focus is limited to the selection and purchase of products and services and to what extent age influences the above stages.

A well-known consumer behaviour model that describes how brands are selected and purchased is Shocker et al.’s (1991) model of brand choice. This model highlights that brand choice follows a funnel of steps from a universal set (all alternative brands available), and through the subsequent awareness, consideration, and purchase (repertoire or choice) sets (Shocker et al., 1991). In marketing there are many variations of this brand choice funnel, and the terms sales funnel and brand purchase funnel are used interchangeable. For consistency, this thesis refers to Shocker et al.’s (1991) series of steps in the purchase process as the brand purchase funnel. The three key steps in the brand purchase funnel, awareness, consideration, and purchase, are now explained further:

Brand awareness is a consumer’s ability to identify a brand in enough detail to make a purchase (Percy & Rossiter, 1992; Rossiter & Percy, 1987). Each consumer, therefore, has a *brand awareness set* that consists of all the brands in a category known to that consumer. Brand awareness is an important determinant of brand consideration and choice (Nedungadi & Hutchinson, 1985; Shocker et al., 1991). In other words, before a brand is considered for purchase, consumers must first be aware of the brand. However, brand awareness differs between two types, namely aided brand recognition and unaided brand recall (Percy & Rossiter, 1992; Rossiter & Percy, 1987). Brand recognition refers to consumers’ ability to confirm they have seen or heard of the brand when given the brand as a cue (Keller, 1993),

and is often measured by presenting consumers with the brand name or logo and asking them to confirm whether they have previously seen or heard of the brand. Whereas, brand recall requires stronger brand awareness as only a category prompt is provided. Brand recall also provides a measure of top-of-mind brand awareness by recording the first brand that is named. However, not all situations require brand recall for a brand to be considered and purchased. Brand recognition is often sufficient for brand choice decisions made at the point of purchase (e.g. FMCGs), whereas brand recall is required for decisions made prior to the point of purchase (Percy & Rossiter, 1992; Rossiter, 2014). Both aided brand recognition and unaided brand recall are measured in this thesis due to the utility of each measure.

The *consideration set* (also known as the evoked set or choice set) is a subset of brands from the awareness set that a consumer seriously considers for purchase (Gruca, 1989; Howard & Sheth, 1969). Therefore, for a brand to enter the consideration set, a consumer must first be aware of the brand and then consider it for purchase (Howard & Sheth, 1969). Only brands that enter a consumer's consideration set can be subsequently purchased. While Shocker et al. (1991) distinguish between the consideration and choice set by defining the choice set as the final consideration set formed immediately prior to purchase, this thesis views the terms consideration, evoked and choice sets as interchangeable and uses the term consideration set to refer to the number of brands considered at any point prior to purchase.

The consideration set can also be measured in many different contexts. Most commonly, the product category is used as the context for measuring a consideration set (Romaniuk & Sharp, 2004, 2016). For example, a question such as, "which of the following car brands would you consider for purchase today?" essentially uses the context of cars to measure brand consideration. Although, often overlooked, the consideration set can also be formed based on internal and external cues (Romaniuk & Sharp, 2004, 2016). These cues can differ between buyers and also differ across time for the same buyer (Romaniuk & Sharp, 2004), demonstrating the highly variable nature of consideration sets. For example, an individual looking for 'a safe and reliable family car' will likely form a different consideration set within the car category compared to a consumer looking for 'a car that can tow a boat'. These internal and external cues that prompt consideration may differ between older and younger consumers. For this thesis, the product category is used as the cue for measuring consideration sets as it provides a measure independent of biases that may come from using a particular internal or external cue.

Lastly, the final brand choice is made from the consideration set. Due to the hierarchical structure of the brand purchase funnel, consumers must be aware of the brand and actively consider it before they can purchase it. In most markets nowadays, few consumers are solely loyal, instead they buy from a repertoire of brands over time (Banelis et al., 2013; Dawes, 2008; Sharp et al., 2002). Therefore, a subset of the consideration set is the *repertoire (or purchase) set* – the various brands that a consumer purchases over a specified time period (Banelis et al., 2013; Dawes, 2008). Repertoire size is a useful brand loyalty measure as it indicates the number of brands a consumer switches between over a specific time-period. Therefore, this thesis uses the terms repertoire set and purchase set interchangeably, as well as using repertoire size to assess brand loyalty across age groups.

1.2.2 Brand performance measures and the NBD-Dirichlet model

As discussed, in most markets, consumers display divided loyalty as they typically purchase multiple competing brands over a specified time-period. To examine buyer behaviour in these markets, brand performance measures (BPMs), such as market share, brand penetration, brand purchase frequency, share of category, and sole loyalty rate, are commonly obtained from panel data (Ehrenberg et al., 2004; Goodhardt et al., 1984). Each measure and the calculation used in this thesis is discussed below:

- *Market share* is the proportion of a category sales generated by one brand over a specified time-period. It is calculated by dividing the total purchases of the brand by the total purchases of the category.
- *Brand penetration* is the proportion of the total category or market of buyers who purchase the brand at least once over a specified period. It is calculated by dividing the number of buyers who buy the brand at least once by the total number of customers in the relevant category or market.
- *Brand purchase frequency (or average purchase frequency)* is the average number of brand purchases made by the buyers of a brand over a specified time-period. Brand purchase frequency is commonly reported as a brand loyalty measure as it indicates repeat purchase behaviour. It is calculated by dividing the total brand purchases by the number of buyers purchasing the brand at least once.
- *Share of Category Requirements (SCR)* is the proportion of category purchases that are for the specific brand in question by its brand buyers over a specified time-period.

SCR is regularly reported as a loyalty measure as it indicates the proportion of a buyer's category purchases accounted for by the brand. It is calculated by dividing the buyer's brand purchases by the total category purchases of that brand buyer.

- *Sole loyalty* is the proportion of a brand's buyers who only buy that brand over a specified time-period. It is calculated by dividing the number of a brand's buyers who purchase the brand only once by the total number of buyers who buy the brand.

Research shows that BPMs follow well-established purchase patterns, such as double jeopardy and duplication of purchase law. Many of these BPMs and purchase patterns can be predicted by the NBD-Dirichlet (Dirichlet) model (Ehrenberg, 1988; Ehrenberg et al., 2004; Goodhardt et al., 1984; Uncles et al., 1995). The Dirichlet is a stochastic model of purchase incidence and brand choice that describes how frequently bought consumer goods are purchased in stationary and unsegmented markets (Goodhardt et al., 1984). These 'theoretical' BPMs and purchase patterns can be predicted by the Dirichlet model by using the 'observed' category penetration, category purchase frequency, as well as the brand penetration and brand purchase frequency of one or more brands as inputs into the model (Goodhardt et al., 1984; Sharp et al., 2002; Wright et al., 2002).

While the Dirichlet inputs are commonly obtained from panel data, research has demonstrated that these inputs can also be estimated through the application of the Juster scale in survey research (Wright et al., 2002). The Juster scale, originally developed by the US Bureau of the Census (Juster, 1966), is a forward looking and prompted purchase probability scale used to predict actual purchase rates. Since its introduction the Juster scale has undergone multiple applications, tests, and refinements (e.g. Day et al., 1991; Gabor & Granger, 1972; Wright et al., 2002). The wording of the Juster scale can vary based on the purchase behaviour and the category measured, however the general wording is, "Now, taking everything into account, what are the chances that you, personally, will <buy/shop> at <brand j> in the next <period>?" (Wright et al., 2002, p. 84). Answers are provided on an 11-point scale ranging from 0 indicating "no chance, almost no chance (1 in 100)" to 10 indicating "certain, practically certain (99 in 100)" (Day et al., 1991).

The ability to use Juster based Dirichlet inputs is especially important in categories and countries where panel data is not available or expensive to obtain (Uncles & Lee, 2006; Wright et al., 2002). Furthermore, using a survey to collect Juster-based Dirichlet inputs also allows for the collection of other measures for the same respondents that are not typically

available in shopper panel data. For example, this method is appropriate for comparing BPMs across age as measures of cognitive, social, or biological age of each respondent can be collected in a survey and compared against the same respondents purchase behaviour. Due to the utility of using Juster-based Dirichlet inputs, two key studies have applied this method when studying loyalty across age groups (Singh et al., 2012; Uncles & Lee, 2006). This thesis replicates the methodology used by Uncles and Lee (2006) and Singh et al. (2012).

1.2.3 Double jeopardy and duplication of purchase law

Double jeopardy and duplication of purchase are two well-known empirical generalisations that describe patterns of buyer behaviour. Both patterns are empirical generalisations as they are observed across a wide range of product and service categories, countries, and time periods (Uncles & Wright, 2004). Empirical generalisations often require ongoing replication and extension to determine the conditions that the patterns hold and do not hold (Ehrenberg, 1995; Uncles et al., 1995; Wright & Kearns, 1998). Examining double jeopardy and duplication of purchase patterns across age groups provides an important extension of these empirical generalisation and will provide new knowledge on whether commonly observed consumer behaviour patterns differ across age. Double jeopardy and duplication of purchase are explained below.

Double jeopardy (DJ) determines that brands with low market share have fewer buyers who also purchase the brand slightly less frequently than do the buyers of brands with high market share (Ehrenberg et al., 1990; Sharp, 2010). In other words, this means smaller brands are punished twice as they have lower market penetration and slightly lower brand loyalty. This shows that market share and penetration vary greatly between brands, with only minor differences in brand loyalty. DJ was first observed for comic strips and radio presenters (McPhee, 1963), and has since been observed in wide range of consumer behaviour settings (e.g. Ehrenberg et al., 1990; Ehrenberg et al., 2004; Sharp, 2010; Wright et al., 1998). Although, only two studies have compared double jeopardy patterns across age groups (Singh et al., 2012; Uncles & Lee, 2006), demonstrating the need for further replication. The need for further replication is addressed in this thesis by assessing the double jeopardy pattern across purchase data for three repertoire markets. This thesis also provides the first examination of whether the double jeopardy pattern extends to customer mindset metrics (awareness and consideration) and whether the pattern holds across age groups.

Duplication of purchase (DoP) patterns highlight the degree of customer sharing between competing brands. The proportion of customers shared by two brands is predicted by the penetration or market share of those brands, with brands sharing a greater proportion of their customer base with the bigger brands and a smaller proportion of their customer base with the smaller brands (Ehrenberg, 1988; Ehrenberg & Goodhardt, 1970). The pattern also demonstrates that each brand shares a similar proportion of their customer base with any given competitive brand (Ehrenberg, 1988; Ehrenberg & Goodhardt, 1970). This lawlike pattern was first observed for magazine readers (Agostini, 1961, 1962), before being extended to television audiences (Ehrenberg, 1966; Ehrenberg & Goodhardt, 1969; Goodhardt, 1966; Goodhardt & Ehrenberg, 1969; Headen et al., 1979) and a range of consumer behaviour settings (e.g. Colombo et al., 2000; Dawes, 2016; Keng et al., 1998; Uncles et al., 1995). The DoP pattern observed in many consumer behaviour settings further reinforces that few customers are solely loyal, instead buying from a repertoire of brands, with the amount of sharing between brands governed by the brand size. This thesis extends the DoP empirical generalisation by testing whether the pattern exists for customer mindset metrics (awareness and consideration) and whether the pattern holds across age groups.

1.2.4 Polarisation Index

Aside from assessing BPMs and empirical purchase patterns, loyalty can also be measured through the polarisation index (ϕ). Originally developed to measure television program loyalty by Sabavala and Morrison (1977), the polarisation index is used extensively in the wine industry in multiple countries (Casini et al., 2009; Corsi et al., 2011; Jarvis & Goodman, 2005; Jarvis et al., 2007; Krystallis & Chrysochou, 2010). More recently, ϕ has been used as a loyalty measure for dairy products, cigarettes, soft drinks, and healthy foods (Anesbury, Nguyen, et al., 2018; Krystallis, 2013; Krystallis & Chrysochou, 2011; Sjostrom et al., 2014).

Typically, ϕ is used to assess loyalty for a group of brands operating in a category. This is because purchase patterns, uncovered by the Dirichlet model, highlight that consumers are rarely solely loyal to one brand (Ehrenberg, 1988; Goodhardt et al., 1984). Instead, most consumers are polygamous in their loyalty and regularly switch between a repertoire of brands (Banelis et al., 2013; Dawes, 2008; Sharp et al., 2002). However, motivated by evidence that some brands can have excess or lower loyalty than expected (Fader & Schmittlein, 1993; Kahn et al., 1988), Li et al. (2009) showed that ϕ can also be

used to determine the loyalty for individual brands. Other applications of φ include sub-categories and product attributes, such as research investigating loyalty towards wine price tiers (Jarvis & Goodman, 2005), as well as grape varieties and wine regions (Jarvis et al., 2007).

The polarisation index essentially measures loyalty for repeated choices by the same person from two discrete alternatives (Rungie et al., 2005). It is easily calculated from obtaining the S statistic (the category switching parameter) when fitting the Dirichlet model to purchase data. The Dirichlet S statistic is calculated as the weighted mean of the sum of the parameters (α , β) of the Beta binomial distribution (BBD) for each brand. For the purpose of this thesis we do not go into a technical discussion of the Dirichlet model, instead we use the DIRCHLET program by Kearns (2009) to fit the model and obtain the S statistic. The calculation of φ from the S parameter is as follows:

$$\varphi = \frac{1}{1 + S} \quad \text{where } 0 \leq \varphi \leq 1$$

The S statistic is difficult to interpret as it ranges from zero to infinity. The transformation of the S statistic to φ is extremely useful for interpretational purposes as it ranges from zero to one. If φ is zero, there is no loyalty and maximum switching between brands. Whereas, if φ is one, there is maximum loyalty and no brand switching. When φ is close to one the BBD is U-shaped, with consumers either having a high probability of purchase, p , or a high probability of not purchasing the brand, $1-p$. In other words, consumers are either strongly loyal or disloyal in their purchases – there is *polarisation* of loyalty.

A strong motivation for using φ is that it overcomes the limitations of BPMs. When BPM's are used to measure loyalty, the results are confounded by differing category purchase rates and market shares. For example, as category purchase rates increase, the purchase frequencies of certain brands may increase. The increase in category purchase rates will also likely lead to reductions in sole loyalty and SCR as consumers start buying from a wider repertoire of brands. However, φ overcomes these limitations by providing a measure of loyalty independent of category purchase rates and market shares (Corsi et al., 2011; Sabavala & Morrison, 1977). Because category purchase rates are known to differ across age as household sizes decline (Uncles & Ehrenberg, 1990a), φ will provide a more accurate

measure of loyalty across age groups. Accordingly, this thesis uses φ to assess loyalty across age groups due to its ease of calculation from the Dirichlet S statistic and its ability to measure loyalty unaffected by differing category purchase rates and market shares. For each age group, φ is calculated at a category level for each repertoire market investigated, rather than for individual brands. The primary motivation for measuring φ at a category level is that consumers in these repertoire markets are typically polygamous in their loyalty and are seldom loyal to one brand.

1.2.5 Underlying age-related mechanisms

There are multiple mechanisms that may cause brand awareness, consideration, and purchase to differ between older and younger consumers. The following section defines and explains the key mechanisms debated in the literature.

Category purchase rates

A well evidenced purchase pattern is that a positive relationship exists between category purchase rates and repertoire size (Banelis et al., 2013; Trinh, 2014). The more times a consumer purchases from a category during a specific period, the greater the chance they will purchase a wider variety of competing brands, thus increasing their repertoire size. As discussed previously, older consumers typically have smaller household sizes and therefore buy from certain categories less frequently and have smaller repertoire sizes (Uncles & Ehrenberg, 1990a; Yang, Zhou, et al., 2005). This subsequently confounds BPMs commonly used to measure loyalty. To uncover the mechanisms causing ‘real’ differences in loyalty, analysis carried out in this thesis regularly controls for differing purchase rates across age groups, as well as adopting the φ as a loyalty measure.

Accumulated experience and the formation of habits

As consumers age, they are exposed to more advertising, word-of-mouth, and advice from salespeople. Older consumers also have more experience conducting information searches, making purchase decisions, and using products and services than younger consumers. This accumulated experience across an adult’s lifespan leads to greater familiarity and expertise

among older consumers (Alba & Hutchinson, 1987) and allows them to gain “crystallised intelligence” (Salthouse, 2012). This expertise can lead to the formation of habits where consumers repeatedly purchase a brand without a strong psychological connection (Wood & Neal, 2009). Habits are formed at any point in time through the repeated purchasing of a brand, leading to an automatic propensity to repeat the behaviour (Drolet et al., 2017; Lambert-Pandraud & Laurent, 2020).

One of the benefits of accumulated experience and the formation of habits is that it reduces the cognitive load required for decision making as decisions become automatic and intuitive (Alba & Hutchinson, 1987). Habits therefore allow older consumers to compensate for lower cognitive performance. Habits are more likely to be formed for low-involvement goods where repeat purchases are more frequent than for high-involvement goods (Lambert-Pandraud & Laurent, 2020). The difficulty of habit formation in high-involvement categories is caused by large market changes (e.g. new brand entry) between purchase occasions as purchases are typically dispersed over long periods (Lambert-Pandraud & Laurent, 2020).

Attachment and nostalgia

Previous product and service experience can also lead to attachment and nostalgia. Differing from habits, attachment and nostalgia involve a psychological connection. Attachment to a brand can occur at any point in life, although it usually requires multiple interactions across time and the development of memories concerning the particular brand (Park et al., 2010; Thomson et al., 2005). Therefore, older consumers with more accumulated experiences are more likely to develop an attachment to a brand. For example, Lambert-Pandraud and Laurent (2010) find older consumers remain more attached to previously purchased perfume brands than younger consumers.

While attachment can occur at any time, nostalgic preferences towards brands occur during the formative years of an adult’s life and endure for the rest of their life (Holbrook & Schindler, 1989). Nostalgic preferences have been discovered for music (Holbrook & Schindler, 1989), movie stars (Holbrook & Schindler, 1994), movies (Holbrook & Schindler, 1996), and automobiles (Schindler & Holbrook, 2003), however Lambert-Pandraud and Laurent (2010) find limited support for its impact on perfume brand preferences.

Cognitive decline

Ageing is associated with declines in cognitive performance, such as the speed of processing working memory, and long-term memory (Drolet & Yoon, 2020; Park et al., 2002; Salthouse, 2012). Processing speed, working memory, and long-term memory are inter-related with declines in all three cognitive constructs occurring continuously in a linear trend across an adult's lifespan, beginning as early as the 20s (Park et al., 2002). Working memory holds information in mind in the short-term while it is being processed (Anderson, 1983; Gutchess, 2011), while long-term memory is the repository for facts and knowledge held over a longer period of time (Anderson, 1983; Cowan, 2008).

A negative consequence of cognitive decline is that older adults have greater difficulty recalling words and text (Dixon et al., 1982; Smith, 1977), as well as famous people and faces (Evrard, 2002; Rendell et al., 2005). Cognitive decline is shown to negatively influence the size of a consumer's awareness set (Lambert-Pandraud et al., 2018; Lambert-Pandraud et al., 2017) and is a likely explanation for smaller consideration and repertoire sets (Lambert-Pandraud et al., 2005).

Biological ageing

Biological ageing involves the loss of human functional capacity caused by the deterioration to the cells and tissues within the body over time (Adams & White, 2004; Moschis, 1994). Various biological changes include declines in vision, hearing, and mobility, as well as the onset of age-related of chronic conditions and diseases (Adams & White, 2004; Zmiva & Weitzl, 2016). Although there is a lack of research investigating how biological ageing influences behaviour, it is likely that biological changes influence consumers ability to process information for the types of products and services they require (Gregoire, 2003; Moschis, 1994). For example, an older consumer with hearing problems may struggle to absorb advertising information about new brands, and this will subsequently impact their chances of purchasing new-to-market brands.

1.3 Research questions, contributions, and thesis outline

1.3.1 Problem statement

The main purpose of this thesis is to uncover how ageing influences the consumer behaviour of older consumers. The focus on consumer behaviour in this thesis includes all steps of the brand purchase funnel, including awareness, consideration, and purchase. The results of this research are crucial for marketing academics and practitioners. Multiple academics acknowledge there is limited and conflicting evidence on how age influences consumer behaviour, and that fresh evidence in multiple new contexts is needed (e.g. Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005; Phua et al., 2020). There is also considerable uncertainty on the factors driving differences in brand awareness, consideration and purchase across age, as well as how purchase behaviour changes longitudinally as individuals age (Zniva & Weitzl, 2016). Without this research, marketing practitioners may unwisely neglect or ineffectively target older consumers. As well, marketing academics may inadvertently be using a measure of age (e.g. chronological, cognitive, biological, and social age) that is ineffective at capturing changes in behaviour, and thus forming naïve conclusions on the extent of age-related differences. Therefore, the overarching problem statement of this thesis is:

Whether, how, and why does brand awareness, consideration, and purchase differ between older and younger consumers?

The problem statement led to the development of the following research questions:

RQ1: Do brand mindset metrics (awareness and consideration) patterns differ between older and younger consumers?

RQ2: Do awareness, consideration, and purchase sets differ between older and younger consumers?

RQ3: Does brand loyalty differ between older and younger consumers?

RQ4: How do loyalty and purchase patterns change as consumers' age?

RQ5: What age-related mechanisms drive loyalty and purchase patterns across age?

RQ6: What age measures best predict age-related changes in loyalty?

1.3.2 Contributions

The present thesis makes multiple theoretical, managerial, and methodological contributions to the consumer behaviour field. The thesis first contributes to the ongoing literature and evidence on whether age influences consumer behaviour by:

- Determining whether empirical purchase patterns (double jeopardy and duplication of purchase) extend to brand awareness and consideration data, and whether these patterns are similar between older and younger consumers (Chapter 2).
- Identifying the extent to which age influences the size of consumers awareness, consideration, and purchase sets in new contexts (Chapter 3).
- Establishing whether age-related changes in brand loyalty do exist in some low-involvement categories when adopting the polarisation index (φ) to control for confounding category purchase rates and market shares (Chapter 4).
- Determining how loyalty changes over time as individuals age by utilising a commercial longitudinal panel of pharmaceutical prescription choices (Chapter 5).

The thesis also contributes new knowledge on the mechanisms driving age-related consumer behaviour differences and the most appropriate ageing measure(s) to capture the resulting effects by:

- Investigating the most plausible mechanisms that cause age-related differences in brand awareness, consideration, and purchase (Chapter 3, 4, and 5).
- Determining whether any alternative age measure outperforms chronological age at detecting age-related differences in loyalty (Chapter 4).

Various methodological advances are also made to the general study of age-related consumer behaviour by:

- Determining that “lawlike” double jeopardy and duplication patterns exist between customer mindset metrics (brand awareness and consideration). Marketers can use this methodology to benchmark and monitor brand performance for these customer mindset metrics. Academics can also use this methodology in future brand awareness and consideration studies, especially in determining whether there are any conditions where these patterns do not hold (Chapter 2).
- Establishing that future age-related loyalty studies should adopt φ to measure loyalty differences across age groups (Chapter 4)

- Determining that future age-related loyalty studies can solely rely on using chronological age rather than attempting to develop and use alternative age measures (Chapter 4).

1.3.3 Thesis outline

The problem statement and six research questions are addressed in this thesis through four research papers presented in chapters 2, 3, 4 and 5 (see Table 1). This section outlines the scope of each research paper and its current publication status.

The first research paper (Chapter 2), titled “Empirical generalisations in customer mindset metrics”, investigates i) the existence of double jeopardy and duplication of purchase patterns within two key customer mindset metrics, brand awareness and brand consideration, and ii) assesses whether these patterns hold across various age groups. Examining how age influences brand awareness and consideration patterns is crucial as these mindset metrics are known to impact brand choice. Surprisingly, double jeopardy and duplication of purchase patterns have not been extensively tested within customer mindset metrics. Therefore, the study first tests whether these empirical patterns do in fact exist, before determining whether the patterns are similar across older and younger consumers. The research paper is published in the *Journal of Consumer Behaviour* (ABDC list 2019: A, Cite Score 2020: 4.1, Impact Factor 2020: 3.280, SCImago Journal Rank (SJR) 2020: 0.811) special issue and is currently available online in an early view version.

The second research paper (Chapter 3), titled “Remembering less, or needing less? Age-related differences in the purchase funnel”, extends the first study by examining how age influences the size of consumers brand awareness, consideration, and purchase sets. Importantly, the paper addresses the lack of research on how age influences brand awareness and is the first to comprehensively examine how these changes affect the subsequent stages of the brand purchase funnel, namely consideration and purchase. The paper, therefore, clearly identifies the stage of the brand purchase funnel most adversely affected by age and allows for hypothesis of plausible mechanisms underlying these differences to be made. The research paper is submitted to *Marketing Letters* (ABDC list 2019: A, Cite Score 2020: 3.5, Impact Factor 2020: 2.800, SCImago Journal Rank (SJR) 2020: 1.133).

After determining how age influences the various stages of the brand purchase funnel, the next step is to provide further understanding on age-related differences in brand loyalty in low-involvement categories. This research is important due to the conflicting evidence between high and low-involvement categories, as well as the limitations of using BPMs to assess loyalty in low-involvement categories. Therefore, the third research paper (Chapter 4), titled “Re-examining age-related loyalty for low-involvement purchasing”, provides fresh evidence into whether brand loyalty differs between older and younger consumers in three low-involvement categories. The research first replicates the methodology of Uncles and Lee (2006) and Singh et al. (2012) by assessing BPMs across age groups through collecting Juster-based inputs into the Dirichlet model. In particular, the double jeopardy pattern and market shares of the leading brands are compared across multiple age groups. The paper then extends the prior research in two ways. First, ϕ , is assessed across chronological age groups to control for confounding influences present in prior research. Second, changes in ϕ are assessed across cognitive, biological, and social age, as well as household lifecycles to determine the age measure that best detects age-related changes in loyalty. The research paper is submitted and is currently under first review for the *European Journal of Marketing* (ABDC list: A*, Cite Score 2020: 4.7, Impact Factor: 4.647, SCImago Journal Rank (SJR) 2020: 1.199).

While Chapter 4 establishes whether loyalty patterns differ between older and younger consumers, it does not determine how the loyalty of individual adults change as they age. To address this gap, the fourth and final research paper (Chapter 5), titled “The influence of age on prescribing patterns: Do older physicians prescribe differently?”, investigates how BPMs change over multiple prescription quantities (a measure of experience), as well as longitudinally as physicians age. Due to the ability to compare loyalty measures across prescription quantities and time, further theory is formed into the underlying age-related mechanisms affecting loyalty. The results of this chapter provide important consumer behaviour insights as physicians make prescribing decisions in similar ways to which consumers make purchase decisions. The research is currently a working paper and is targeted for submission to *Social Science and Medicine* (Cite Score 2020: 6.1, Impact Factor: 4.634, SCImago Journal Rank (SJR) 2020: 1.913).

Table 1: Outline of thesis research questions

Overall Thesis Research Questions	Study 1 Chap 2: Empirical generalisations in customer mindset metrics	Study 2 Chap 3: Remembering less, or needing less? Age-related differences in the purchase funnel	Study 3 Chap 4: Re-examining age-related loyalty for low-involvement purchasing	Study 4 Chap 5: The influence of age on prescribing patterns: Do older physicians prescribe differently?
RQ1: Do brand mindset metric (awareness and consideration) patterns differ between older and younger consumers?	✓			
RQ2: Do awareness, consideration, and purchase sets differ between older and younger consumers?		✓		
RQ3: Does brand loyalty differ between older and younger consumers?			✓	✓
RQ4: How do loyalty and purchase patterns change as consumers' age?				✓
RQ5: What age-related mechanisms drive loyalty and purchase patterns across age?		✓	✓	✓
RQ6: What age measures best predict age-related changes in loyalty?			✓	

Chapter 2: Empirical generalisations in customer mindset metrics

Chapter abstract

The first study of this thesis investigates age-related patterns within customer mindset metrics (brand awareness and consideration). Surprisingly, despite growing recognition of the role customer mindset metrics play in brand choice, research has seldom investigated whether law-like patterns, such as double jeopardy (DJ) and duplication of purchase (DoP) seen for brand purchasing, extend to mindset metrics. Therefore, the study first seeks to determine whether two key mindset metrics, brand awareness and brand consideration, also follow DJ and duplication patterns. Then, the study investigates whether these patterns hold across age groups.

This study uses survey data ($n=1,862$) across three repertoire (supermarket store choice, toothpaste, and fruit juice) and two subscription (home broadband and electricity) markets in New Zealand. In the survey participants answered questions on their awareness (spontaneous recall and aided recognition) and consideration of various brands in each category. Quotas were implemented to ensure robust sample sizes across four age groups (39 years and below, 40-59 years, 60-74 years, and 75 years and above) and screening questions were used to ensure respondents were active grocery shoppers and were solely or jointly responsible for paying the home broadband and electricity bills.

The results successfully demonstrate that brands with low recognition suffer twice with lower unaided brand recall and lower purchase consideration. While brand recall and consideration follow a linear DJ trend, brand recognition and consideration follow an exponential DJ trend. We also confirm the existence of Duplication of Awareness and Duplication of Consideration patterns. Brands share greater awareness or consideration levels with other highly recognised or considered brands than with lowly recognised or considered brands. However, contrary to the DoP law, we find consistent market partitioning, with category buyers who are aware of, or consider smaller brands also being aware of, or considering other smaller brands at a slightly greater rate than expected. Comparisons across the four age groups also reveals that older consumers exhibit similar DJ and duplication patterns as younger consumers. These results have implications for the general understanding of mindset metrics, as well as how age influences these patterns by indicating that

mechanisms such as cognitive decline and accumulated experience do not result in older consumers diverging from the established patterns. The results of this study lead to further investigation of how age impacts awareness and consideration, and the subsequent effect this has on brand choice (Chapter 3).

Note: The following paper presented in this chapter is published in the Journal of Consumer Behaviour (ABDC list 2019: A, Cite Score 2020: 4.1, Impact Factor 2020: 3.280, SCImago Journal Rank (SJR) 2020: 0.811) special issue and is currently available online in an early view version.

2.1 Introduction

Empirical generalisations in marketing provide researchers and practitioners with substantial knowledge about consumer buying behaviour. Academics have nonetheless long voiced the need for ongoing replication and extension of empirical generalisations (Ehrenberg, 1995; Goodhardt et al., 1984; Uncles et al., 1995), as this is crucial to “determining the conditions under which existing theories do, and do not, hold” (Wright & Kearns, 1998, p. 1). Empirical generalisations ought to apply across many conditions (Barwise, 1995; Bass, 1995; Uncles & Wright, 2004); however, discovery of circumstances where empirical generalisations do not hold also leads to greater knowledge and ability to theorise (Bass, 1995). Differentiated replication involving deliberate and major extensions provides the greatest opportunity to determine boundary conditions for empirical generalisations (Lindsay & Ehrenberg, 1993; Uncles & Wright, 2004).

In marketing two important patterns described by the well-known NBD-Dirichlet model are double jeopardy (DJ) and duplication of purchase (DoP) patterns (Ehrenberg et al., 2004; Goodhardt et al., 1984; Uncles et al., 1995). As DJ and DoP “repeat over different circumstances and that can be described simply by mathematical, graphic, or symbolic methods” (Bass, 1995, p. G7) they fit the definition of an empirical generalisation. DJ describes how lower market share brands have fewer buyers who typically purchase the brand slightly less often than larger share brands (Ehrenberg et al., 1990; Goodhardt et al., 1984; Sharp, 2010), thus enriching knowledge by highlighting the importance of increasing market penetration for market share growth. Brand managers can use DJ as a benchmark to assess the performance of marketing initiatives aimed at growing share. Likewise, DoP evaluates brand loyalty as it describes the degree to which brands share their buyers with other brands in the same category. The DoP pattern stems from early findings that consumers consistently display polygamous brand loyalty, as they regularly purchase from a repertoire of brands (Brown, 1953; Cunningham, 1956).

While DJ and DoP patterns are well-established for brand purchasing data (see sections 2.0 and 3.0), differentiated replication to determine whether the patterns also hold for various customer mindset metrics (e.g. brand awareness, brand consideration, and brand associations) is minimal. This is surprising given increasing evidence of the importance of mindset metrics in marketing models (Petersen et al., 2018; Venkatesan et al., 2019). Srinivasan et al. (2010) found that mindset metrics account for one-third of total explained

sales variance and serve as valuable early warning signs of changes in market performance. Brand awareness is also required for forming brand image associations (Keller, 1993) and strongly influences entry into the brand consideration set which subsequently impacts brand choice (Hoyer & Brown, 1990; Macdonald & Sharp, 2000, 2003; Shocker et al., 1991).

Here we report the results from a differentiated replication to determine whether DJ and DoP extend to mindset metrics. As research has not extensively tested these patterns for mindset metrics, our differentiated replication extends the known boundary conditions of the empirical patterns to brand awareness and consideration data. For differentiated replication to generate empirical knowledge, many sets of data (MSoD) are required (Ehrenberg, 1995) and so we vary the analysis over more than one condition by investigating whether the patterns hold across five categories and four age groups. If DJ and DoP are found to hold across the MSoD used in this study, then we have evidence that the patterns found in mindset metrics are likely to be empirically generalisable. Alternatively, if the patterns do not hold, these robustness tests will reveal greater understanding of the boundary conditions for generalisations concerning DJ and DoP in mindset metrics. Our study therefore addresses the following research questions:

RQ1: Does the DJ pattern extend to brand awareness and brand consideration measures?

RQ2: If so, does the DJ pattern hold across age groups?

RQ3: Does DoP extend to brand awareness and consideration sets?

RQ4: If so, does DoP hold across age groups?

In the following sections we provide an overview of DJ and DoP, explain the added age condition for differentiated replication, describe the data and method, and then discuss the major findings, implications and future research avenues.

2.2 Double Jeopardy (DJ)

DJ was first observed by William McPhee (1963) among attitudinal responses towards competing comic strips and radio presenters. For example, McPhee (1963) discovered that less popular comic strips were ‘punished twice’ with fewer readers and were less liked by those readers. Since DJ’s initial discovery, the pattern is seen in behavioural brand buying across a wide range of markets such as frequently purchased goods (Dawes, 2008; Ehrenberg

& Goodhardt, 2002; Ehrenberg et al., 2004; Yang, Bi, et al., 2005), cars (Bennett & Graham, 2010; Colombo et al., 2000), pharmaceutical prescribing (Stern, 1994; Stern & Ehrenberg, 2003), store choice (Keng & Ehrenberg, 1984; Uncles & Hammond, 1995; Wright et al., 1998), television programme choice (Barwise, 1986; Barwise & Ehrenberg, 1987; Donthu, 1994), and political choice (Ehrenberg, 1991; Kooyman & Wright, 2017; Solgaard et al., 1998). DJ patterns are also found in luxury and emerging markets (Romaniuk & Sharp, 2016) and also for brand defection (Wright & Riebe, 2010).

DJ describes how large market share brands benefit in two ways when compared to small share brands; they have more buyers, and those buyers purchase the larger brands slightly more frequently than do the buyers of small brands – hence Double Jeopardy (Ehrenberg et al., 1990; Sharp, 2010). DJ demonstrates the need to grow share primarily through increased market penetration.

While most DJ applications use behavioural purchases, prior extensions have examined attitudinal data (e.g. brand image data) given the influence of brand knowledge on choice. Early research showed a clear positive relationship between brand usage and brand image, with a greater proportion of current users holding favourable attitudes towards a brand than former users and never users (Bird et al., 1970; Bird & Ehrenberg, 1970). This relationship extends to market share, with confirmation that small market share brands have fewer users and subsequently a smaller proportion of people associating the brand with each product attribute than large market share brands (Barwise & Ehrenberg, 1985; Dall'Olmo Riley et al., 1997).

Deviations from DJ are rare and typically a result of functional differentiation, or heavy promotion for a given attribute (Barwise & Ehrenberg, 1985; Dall'Olmo Riley et al., 1997). A more recent investigation by Stocchi et al. (2015) found that deviations in brand image metrics occur for less than a quarter of brands across three categories. The deviations for brand image metrics also do not correspond to deviations in brand buying metrics, indicating that brand image data does not simply reflect current brand loyalty (Stocchi et al., 2015) and instead provides additional information on the effects of marketing activity, over and above that provided by current purchasing.

Laurent et al. (1995) investigated DJ for awareness measures and showed an exponential relationship between spontaneous brand recall and aided brand recognition. Yet, to date, there is no evidence to establish whether DJ also exists between brand awareness

(brand recognition and brand recall) and brand consideration. A logical assumption is that as brand recognition and brand recall declines, brand consideration also declines. However, the form this relationship follows is unknown, providing impetus for this study. For example, we can determine whether the relationship follows the exponential DJ pattern seen for brand purchasing data (Habel & Lockshin, 2013) and other behavioural relationships such as the association between distribution and market share (Reibstein & Farris, 1995). Answers will provide marketers with brand consideration benchmarks given a brand's level of recognition and recall.

2.3 Duplication of purchase (DoP)

DoP surfaced in the 1960's when Agostini (1961, 1962) found a systematic pattern of audience duplication among magazine readers in France. Following this discovery, extensive research on television audiences in the United Kingdom and United States revealed an equivalent "Duplication of Viewing Law" (Ehrenberg, 1966; Ehrenberg & Goodhardt, 1969; Goodhardt, 1966; Goodhardt & Ehrenberg, 1969; Headen et al., 1979). The Duplication of Viewing Law predicts that the number of duplicated viewers for any two programs can be predicted simply from audience size, irrespective of any other factors, such as program content (Goodhardt & Ehrenberg, 1969, p. 169).

Extensions from magazine and television audiences to consumer purchasing data revealed the existence of the same pattern, whereby the proportion of customers shared by two brands is predicted by the penetration of those brands (Ehrenberg, 1988; Ehrenberg & Goodhardt, 1970). Essentially, brands share a greater proportion of their customer base with large market share brands than with small market share brands. The high customer sharing between brands found in DoP studies highlights that consumers rarely display sole loyalty to any one brand, instead they buy from a repertoire of brands over time. Additionally, the pattern establishes that every brand shares a similar proportion of their customer base with any given competitive brand (Ehrenberg, 1988; Ehrenberg & Goodhardt, 1970).

Consumer purchasing data reveals the DoP pattern is present for consumer packaged goods (Dawes, 2016; Keng et al., 1998; Uncles et al., 1995), cars (Bennett & Graham, 2010; Colombo et al., 2000), sportswear (Dawes, 2009), fruit and vegetables (Anesbury, Greenacre, et al., 2018), wine and beer (Dawes, 2008; Wilson & Winchester, 2019), and supermarket

store choice (Keng & Ehrenberg, 1984; Uncles & Ehrenberg, 1990b; Uncles & Hammond, 1995). The pattern is also found for activities, such as radio station listening (Lees & Wright, 2013), tourist destinations (Dawes et al., 2009), sport team preference (Baker et al., 2016), leisure activities (Scriven et al., 2015), and exercise and sport choice (Wilson et al., 2019).

Despite the proliferation of research examining DoP patterns for brand purchasing data, research is yet to establish whether the pattern persists for customer mindset metrics such as brand awareness, consideration and associations. Only one prior study investigates and finds that a duplication pattern extends to brand image associations for one product category (laundry powders) (Nenycz-Thiel et al., 2010). Additional research is required in other product and service categories, and countries, before confidently concluding a law-like pattern applies to brand image associations.

Further research is required for other customer mindset metrics, such as brand awareness and brand consideration. Evidence of duplication of awareness and duplication of consideration would reveal any patterns that may in turn govern brand choice. Deviations and category partitions of awareness and consideration may also provide additional insights into why deviations exist for purchase choice.

2.4 Age as an added condition for differentiated replication

When survey data is limited to a few categories only, varying more than one condition can be used to increase the number of sub-samples (Lindsay & Ehrenberg, 1993). Testing DJ and duplication patterns over multiple conditions will then increase the confidence and generalisability of the findings by using many sets of data (MSoD).

Age provides a useful additional condition for the differentiated replication in the present study, as it potentially impacts the two key customer mindset metrics examined; brand awareness and consideration. Substantial evidence indicates that age is associated with declines in cognitive performance (e.g. speed of processing, working memory, and long-term memory) (Drolet & Yoon, 2020; Park et al., 2002; Salthouse, 2012), as well as increases in knowledge (“crystallised intelligence”) attained through repeated consumer experiences (Drolet & Yoon, 2020; Salthouse, 2012). Changes in cognitive performance causes older adults to have greater difficulty recalling words, text, famous people and faces than younger adults (Dixon et al., 1982; Evrard, 2002; Rendell et al., 2005; Smith, 1977).

Some studies demonstrate that older consumers have smaller awareness sets than younger consumers for radio stations (Lambert-Pandraud et al., 2018; Lambert-Pandraud et al., 2017), as well as smaller consideration sets for cars (Evanschitzky & Woisetschläger, 2008; Lambert-Pandraud et al., 2005; Lapersonne et al., 1995; Maddox et al., 1978) and breakfast cereals (Cole & Balasubramanian, 1993). Other research does not find significant differences between older and younger consumers for the number of coffee (Gruca, 1989), toothpaste and detergent (Campbell, 1969) brands considered.

Age-related differences are also evident at a brand purchasing level. Studies in high-involvement categories (e.g. automobiles and perfume) find higher brand loyalty among older consumers as they repurchase their previous brand more often (Evanschitzky & Woisetschläger, 2008; Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005). In contrast, studies in low-involvement categories find older consumers have smaller repertoire (portfolio) sizes (Uncles & Ehrenberg, 1990a; Yang, Zhou, et al., 2005), largely attributed to less frequent category buying due to smaller household sizes (Uncles & Ehrenberg, 1990a). Interestingly, Uncles and Lee (2006) and Singh et al. (2012) find consistent DJ patterns for brand purchasing across age groups for a variety of low-involvement categories. This finding adds credence to the importance of investigating DJ and duplication patterns for customer mindset metrics across age groups, as theoretical and empirical evidence indicates the presence of age-related disparity in cognitive performance and purchase behaviour that nonetheless also varies between categories.

2.5 Data and method

The data used are obtained from an on-line brand survey ($n=1,862$) across three repertoire (toothpaste, fruit juice, and supermarket store choice) and two subscription (home broadband and electricity) markets in New Zealand. Participants were recruited from a commercial panel provider between 22nd October and 18th November 2019 and answered questions about brand awareness (spontaneous recall and aided recognition) and consideration in each category. All respondents were active grocery shoppers and were solely or jointly responsible for paying the home broadband and electricity bills. To ensure robust sample sizes across age groups, quotas split respondents into four age groups (39 years and below, 40-59 years, 60-74 years, and 75 years and above), with sample sizes ranging from $n=416$ to $n=503$.

For each category examined, a logical question order was followed from unaided brand recall, to aided brand recognition, and then brand consideration. For example, with toothpaste, the unaided brand recall question required respondents to list all brands that come to mind when they think of toothpaste sold in New Zealand. Aided brand recognition was then measured by presenting respondents with the names and logos of various toothpaste brands sold in New Zealand and asking, “From the list below, which toothpaste brands do you recognise?” The brands listed were randomised to eliminate order bias, with respondents able to select as many of the presented brands as they wished, and they were also able to enter the name of any brands not listed. Following this, a second randomised list of the same brands was provided to measure brand consideration, with respondents asked, “Assuming you were purchasing toothpaste today, which brands would you seriously consider for purchase?”

Analysis of DJ is performed for (i) brand recall versus brand consideration, and (ii) brand recognition versus brand consideration. Analysis is by both visual inspection of scatterplots and regression to determine the presence, shape and significance of any DJ relationship. While double jeopardy patterns are typically assessed for those who have purchased the brand as a purchase is needed before a consumer can display loyalty, with mindset metrics you can consider a brand without recalling or recognising it. For this reason, the double jeopardy patterns are reported at a total sample level. However, analysis of the double jeopardy pattern for only those that recognise each brand is also reported in Appendix A to highlight the similarity of results when compared to the total sample level. Duplication analysis is performed on responses to aided recognition (for brand awareness) and consideration. We assess brand sharing patterns through a standard duplication table format with brands listed in descending order of awareness and consideration penetration with the duplication coefficient (D) calculated by dividing average awareness or consideration penetration by average duplication for all brands (Ehrenberg et al., 2004; Tanusondjaja et al., 2016). The D-value also allows for the estimated duplication for each brand to be calculated as follows:

$$b_{x,y} = D \times b_x$$

Where $b_{x,y}$ is the proportion of respondents aware of brand Y who are also aware of brand X, calculated by multiplying D by the proportion of respondents aware of brand X (Tanusondjaja et al., 2016). Assessment of the fit is made through the calculation of a Mean

Absolute Error (MAE) and correlation coefficient (r) between the average and estimated duplications. In order to identify significant deviations from the duplication pattern, we adopt the recommendation by Tanusondjaja et al. (2016) to only highlight deviations of awareness or consideration of more than 20% from that expected, as smaller deviations are unlikely to be managerially important.

2.6 Results

2.6.1 Double jeopardy pattern across customer mindset metrics

Table 2 reports brand recognition, recall, and consideration rates across the five categories examined. For each category, the brands are ranked from most to least recognised with large differences observable (e.g. toothpaste brand recognition ranges from 99% for Colgate to 5% for Grin). As brand recognition declines, a clear pattern of decreasing brand recall is observed for all categories. A similar trend is evident for brand consideration. Therefore, we find clear evidence that well-recognised brands have higher unaided brand recall and consideration, whereas brands with low recognition suffer twice, as they also have lower unaided brand recall and lower purchase consideration. A similar pattern is also witnessed when only examining recall and consideration among only those that recognise the brand (see Appendix A). However, further analysis is needed to determine whether the pattern follows the established exponential DJ trend, or if it is better modelled by a linear relationship. While prior studies regularly fit a linear line to assess the DJ pattern (Dowling & Uncles, 1997; Jarvis & Goodman, 2005; Sharp & Sharp, 1997), DJ data traditionally follows an upward sloping curve and an exponential approximation provides the best fit (Habel & Lockshin, 2013). This approach is used by Kooyman and Wright (2017) when assessing DJ patterns for political opinion polls.

Table 2: Differences in brand awareness, brand recall and consideration across brands

Category	Brand	Brand Recognition (%)	Brand Recall (%)	Consideration (%)
Supermarket store choice	Countdown	99	96	74
	New World	99	89	60
	PAK'nSAVE	98	90	67
	Four Square	89	36	7
	Fresh Choice	63	27	10
	SuperValue	55	13	5
	Farro Fresh	33	4	4
	Average	76	51	33
Toothpaste	Colgate	99	93	80
	Macleans	91	51	43
	Sensodyne	86	26	31
	Oral-B	66	10	18
	Red Seal	42	12	13
	Mouthfresh	24	2	8
	Eco Store	15	1	4
	White Glo	10	0	3
	Grin	5	1	2
	Average	49	22	22
Fruit Juice	Just Juice	91	50	53
	Fresh Up	90	23	43
	Keri	88	49	57
	Charlie's	76	27	33
	McCoy	55	9	20
	Simply Squeezed	52	5	24
	Citrus Tree	20	1	7
	Homegrown	17	3	11
	Thexton's	12	1	4
	Average	56	19	28
Broadband	Spark	97	69	44
	Vodafone	96	65	37
	2 degrees	89	33	35
	Slingshot	83	25	23
	Skinny	78	15	19
	Trustpower	69	16	22
	Orcon	60	19	15
	Stuff Fibre	33	3	12
	Flip	33	2	6
	My Republic	26	3	6
	Bigpipe	15	2	4
	Now	6	1	3
	Voyager	5	1	2
	Average	53	20	17
Electricity	Genesis Energy	90	47	35
	Trustpower	86	52	31
	Contact Energy	85	42	32
	Mercury	85	47	34
	Meridian Energy	83	40	29
	Nova Energy	67	10	21
	Electric Kiwi	34	6	18
	Flick Energy	28	4	9
	Pulse Energy	22	5	9
	Average	65	28	24

Table 3 compares the adjusted R^2 of linear and exponential regressions between brand awareness (recall and recognition) and consideration measures for each category. For brand recall and consideration, the average adjusted R^2 value across the five categories is greater for the linear regression, with the linear DJ line providing the best fit in four out of five categories. This indicates that the relationship between brand recall and consideration tends to follow a linear DJ pattern. For brand recognition and consideration, the average adjusted R^2 value is greater for the exponential regression, with the exponential DJ line now providing the best fit in four out of five categories. This indicates that the relationship between brand recognition and consideration tends to follow an exponential DJ pattern. While these results suggest different DJ trends between brand recall and consideration, and brand recognition and consideration, the results on the shape of the DJ line are best seen as indicative, as many markets will need to be examined to provide sufficient statistical power to confirm these relationships.

Table 3: Comparison of linear and exponential double jeopardy fit

Categories	Brand recall vs. Consideration			Brand recognition vs. Consideration		
	Linear Adj. R^2	Exp Adj. R^2	Best fit	Linear Adj. R^2	Exp Adj. R^2	Best fit
Supermarket store choice	0.94	0.97	Exp.	0.56	0.67	Exp.
Toothpaste	0.98	0.65	Linear	0.73	0.93	Exp.
Fruit Juice	0.89	0.66	Linear	0.89	0.92	Exp.
Home broadband	0.88	0.63	Linear	0.86	0.95	Exp.
Electricity	0.85	0.74	Linear	0.93	0.90	Linear
Average	0.91	0.73	Linear	0.79	0.87	Exp.

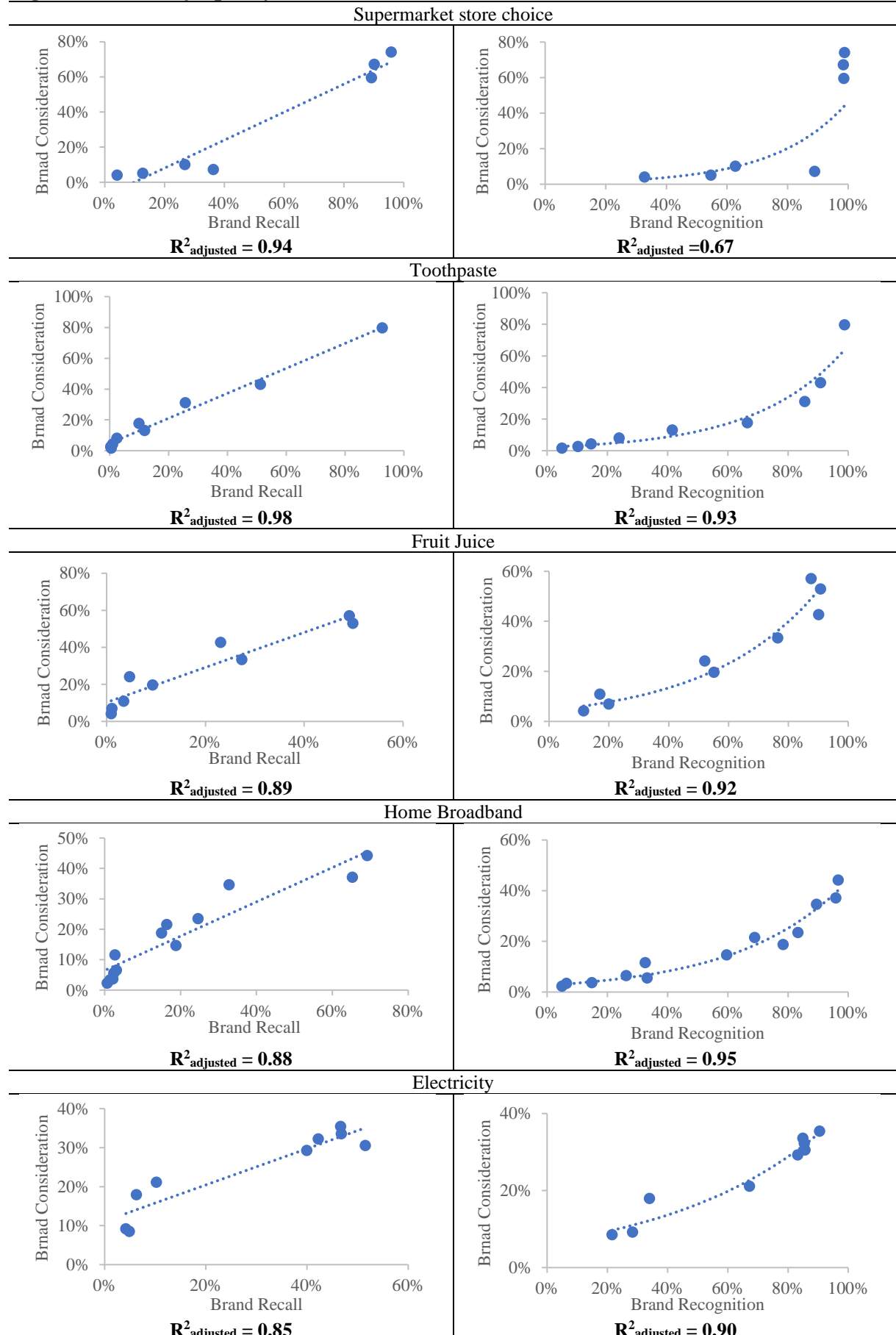
Nonetheless, the regressions do confirm the presence of a significant DJ relationship between brand recall and consideration for supermarket store choice ($F_{1,5}=88.040$, $p=.000$, $R^2_{\text{adjusted}}=.936$), toothpaste ($F_{1,7}=405.288$, $p=.000$, $R^2_{\text{adjusted}}=.981$), fruit juice ($F_{1,7}=64.191$, $p=.000$, $R^2_{\text{adjusted}}=.888$), home broadband ($F_{1,11}=85.717$, $p=.000$, $R^2_{\text{adjusted}}=.876$), and electricity ($F_{1,7}=47.043$, $p=.000$, $R^2_{\text{adjusted}}=.852$). The results similarly confirm a significant DJ relationship brand recognition and consideration for supermarket store choice ($F_{1,5}=13.404$, $p=.015$, $R^2_{\text{adjusted}}=.674$), toothpaste ($F_{1,7}=110.711$, $p=.000$, $R^2_{\text{adjusted}}=.932$), fruit juice ($F_{1,7}=93.807$, $p=.000$, $R^2_{\text{adjusted}}=.921$), home broadband ($F_{1,11}=207.306$, $p=.000$, $R^2_{\text{adjusted}}=.945$), and electricity ($F_{1,7}=74.745$, $p=.000$, $R^2_{\text{adjusted}}=.902$). Although we report only the linear regression results for brand recall and consideration, and only the exponential

regression results for brand recognition and consideration, similarly significant results are found no matter whether a linear or exponential slope is assumed for each regression. Therefore, there is clear evidence of a DJ pattern for customer mindset metrics.

The DJ lines are displayed graphically in Figure 1. Linear regressions are shown for brand recall and consideration and exponential regressions are shown for brand recognition and consideration. Figure 1 allows for further examination of the fits of DJ to customer mindset metrics together with detection of any meaningful deviations. An intuitive visual assessment of brand recognition and consideration, for example, identifies six notable deviations from the expected DJ line across the five categories and 47 brands examined. Four of these deviations occur for supermarket store choice with the three main supermarkets in New Zealand (Countdown, New World, and PAK'nSAVE) sitting largely above the double jeopardy line. This suggests these brands are considered more often than expected given their brand recognition. A plausible explanation for these deviations is the high physical availability of these supermarkets with stores spread across the country. Four Square sits below the double jeopardy line indicating it is not considered as much as expected. While Four Square has numerous outlets throughout the country and regularly advertises, it is a 'mini-supermarket' with a limited product range and therefore a lower potential impact on consumer consideration of shopping at the store.

For toothpaste, one obvious deviation above the double jeopardy line is Colgate, a brand that dominates shelf space in most retailers and has remarkably high brand awareness (99% recognition). There are no large deviations from the double jeopardy line for fruit juice and broadband, while for electricity, Electric Kiwi is considered more often than expected.

Figure 1: Double jeopardy lines for customer mindset metrics



2.6.2 Age-related differences in double jeopardy across customer mindset metrics

We now assess the robustness of DJ for this data by examining whether the pattern continues to hold across different age groups. Table 4 compares the adjusted R^2 and slope of the DJ line for each age group against the sample average for all five categories. Again, we compare linear statistics for brand recall and consideration and exponential statistics for brand recognition and consideration. By examining DJ across age groups, we now have 25 sets of data, increasing confidence in concluding whether an empirical generalisation in customer mindset metrics exists.

The adjusted R^2 for the *linear* relationship between brand recall and brand consideration remains relatively consistent across most age groups examined. The only large difference from the sample average is observed in the electricity market for the under 40 age group. The slope also remains consistent across age groups, indicating that an increase in brand recall has a similar impact on brand consideration, irrespective of age. Therefore, the consistent adjusted R^2 values and slopes across age groups in most categories indicates the linear DJ pattern between brand recall and brand consideration is found to hold across a wider range of conditions.

For the *exponential* relationship between brand recognition and brand consideration, the adjusted R^2 declines slightly across age groups for supermarket store choice but remains stable across age groups for the other four categories examined. There is some variability in the slope of the exponential DJ for brand recognition and brand consideration. However, the variation is rather minor and does not show a consistent trend across categories, despite older consumers (75 years and over) having slightly steeper double jeopardy slopes in the fruit juice, home broadband and electricity categories. Nonetheless, the adjusted R^2 values remain similar and high across age groups, indicating that the exponential DJ pattern between brand recognition and brand consideration is also found to hold.

Table 4: Comparison of double jeopardy lines across age groups

		Brand recall vs. consideration (linear)		Brand recognition vs. Consideration (exponential)	
Age Group	n	Adjusted R ²	Slope	Adjusted R ²	Slope
Supermarket store choice (next 4 weeks)					
<40yrs	416	0.94	0.79	0.82	3.77
40-59yrs	484	0.94	0.82	0.70	4.47
60-74yrs	503	0.89	0.82	0.57	4.55
>74yrs	459	0.89	0.74	0.59	3.92
Sample average		0.94	0.80	0.67	4.17
Toothpaste (next 3 months)					
<40yrs	416	0.97	0.87	0.97	3.17
40-59yrs	484	0.97	0.82	0.94	3.29
60-74yrs	503	0.99	0.77	0.77	4.16
>74yrs	459	0.98	0.80	0.89	4.13
Sample average		0.98	0.81	0.93	3.38
Fruit Juice (next 4 weeks)					
<40yrs	416	0.85	0.87	0.92	3.02
40-59yrs	484	0.88	0.91	0.93	2.56
60-74yrs	503	0.86	0.90	0.94	2.70
>74yrs	459	0.90	1.09	0.92	3.22
Sample Average		0.89	0.94	0.92	2.72
Home Broadband					
<40yrs	416	0.89	0.55	0.91	2.70
40-59yrs	484	0.86	0.54	0.95	2.70
60-74yrs	503	0.84	0.54	0.94	2.82
>74yrs	459	0.89	0.63	0.91	3.31
Sample average		0.88	0.56	0.95	2.80
Electricity					
<40yrs	416	0.58	0.51	0.75	1.90
40-59yrs	484	0.93	0.49	0.89	1.85
60-74yrs	503	0.77	0.43	0.75	1.90
>74yrs	459	0.83	0.46	0.91	2.15
Sample average		0.85	0.46	0.90	1.86

2.6.3 Duplication of awareness patterns

Next, we determine whether a duplication pattern exists between brands in consumers' awareness and consideration sets. We begin by assessing the 'Duplication of Awareness' pattern with Table 5 displaying results for fruit juice (a repertoire market) and Table 6 for home broadband (a subscription market). The other three studied categories are omitted for

reasons of space but showed similar results to the reported categories (see Table 9 for duplication fit statistics).

For Table 5, the awareness penetration column shows large variability with 91% of respondents aware of Just Juice, while only 12% are aware of Thexton's. The columns to the right indicate the cross-sharing of awareness for each brand. For example, of those respondents that are aware of Just Juice, 93% are aware of Fresh Up (a brand with high awareness), while only 13% are aware of Thexton's (a brand with low awareness). The average duplication row further demonstrates a decline in duplication from left to right as the awareness penetration decreases across the brands. Therefore, a clear Duplication of Awareness pattern exists where brands share greater awareness levels with highly recognised brands than they do with lowly recognised brands. For fruit juice awareness, The D-value is 1.13, indicating that on average, the proportion of respondents aware of a brand who are also aware of another brand is 1.13 times the awareness penetration of that brand.

An intuitive comparison of the average and estimated duplication reveals average duplication is slightly lower than estimated for brands with high awareness and slightly higher than estimated for brands with low awareness. Overall, the differences are small, indicating a strong fit between the average and estimated duplication, albeit with a minor systematic deviation among smaller share brands. This is confirmed by calculating the Mean Absolute Error (MAE) of 0.06 and r-value of 0.97, providing further evidence that the Duplication of Awareness for fruit juice is close to expected.

Turning to Table 6, a similar Duplication of Awareness pattern is evident for home broadband with greater awareness sharing with the more recognised brands. The D-value is 1.17, signalling that consumers aware of one brand are only slightly more likely to be aware of another brand than the average respondent. Similar to fruit juice, there are slightly lower average duplications than estimated for the brands with high awareness and slightly higher average duplications than estimated for the brands with low awareness. The MAE is 0.19 and r-value is 0.96, indicating a marginally weaker fit of the pattern.

Table 5: Duplication of awareness analysis – Fruit Juice (a repertoire market example)

Participants aware of brand	Awareness Penetration	Percentage of participants who are also aware of brand								
		Just Juice	Fresh Up	Keri	Charlie's	McCoy	Simply Squeezed	Citrus Tree	Homegrown	Thexton's
Just Juice	91	-	93	89	79	58	55	22	17	13
Fresh Up	90	93	-	90	80	59	54	22	17	13
Keri	88	93	92	-	80	60	55	22	18	13
Charlie's	76	94	94	92	-	64	60	24	18	14
McCoy	55	96	96	95	89	-	66	30	20	17
Simply Squeezed	52	95	94	93	89	70	-	30	28	16
Citrus Tree	20	98	98	97	93	83	78	-	25	27
Homegrown	17	93	90	93	83	65	84	30	-	18
Thexton's	12	99	99	96	92	81	73	47	27	-
Average duplication		95	95	93	86	68	66	28	21	16
Awareness Penetration		91	90	88	76	55	52	20	17	12
Average penetration	56									
Average duplication	63									
Duplication coefficient (D)	1.13									
Estimated duplication (D x Pen)		103	102	99	87	62	59	23	19	13

Note: Deviations 20% greater than the average duplication are bolded and underlined. Deviations 20% less than the average duplication are bolded and italicised. Estimated duplication is higher than 100% for some brands due to extremely high awareness levels – however, the maximum duplication possible is 100%.

Table 6: Duplication of awareness analysis – Home broadband (a subscription market example)

Participants aware of brand	Awareness Penetration	Percentage of participants who are also aware of brand												
		Spark	Vodafone	2degrees	Slingshot	Skinny	Trustpower	Orcon	Flip	Stuff Fibre	My Republic	BigPipe	Now	Voyager
Spark	97	-	97	91	85	80	70	61	34	34	27	15	7	5
Vodafone	96	98	-	92	86	81	71	61	34	34	27	15	7	5
2degrees	89	99	98	-	88	84	73	64	36	35	28	16	7	5
Slingshot	83	98	98	95	-	86	75	68	39	37	31	17	7	6
Skinny	78	99	98	96	91	-	76	66	39	37	30	18	7	6
Trustpower	69	99	98	95	91	86	-	71	42	42	34	19	8	6
Orcon	60	99	98	95	95	87	82	-	48	44	39	23	8	7
Flip	33	99	99	97	98	93	88	85	-	54	53	35	11	10
Stuff Fibre	33	100	99	96	95	88	89	80	55	-	48	30	11	11
MyRepublic	26	100	99	97	97	89	89	89	67	60	-	40	11	12
BigPipe	15	100	99	96	97	94	90	92	78	67	70	-	11	18
Now	6	98	98	97	94	91	82	73	55	58	46	25	-	17
Voyager	5	99	99	96	93	92	88	88	65	72	64	53	22	-
Average duplication		99	98	95	93	88	81	75	49	48	41	26	10	9
Awareness Penetration		97	96	89	83	78	69	60	33	33	26	15	6	5
Average penetration	53													
Average duplication	62													
Duplication coefficient (D)	1.17													
Estimated duplication (D x Pen)		114	113	105	98	92	81	70	39	38	31	17	8	6

Note: Deviations 20% greater than the average duplication are bolded and underlined. Deviations 20% less than the average duplication are bolded and italicised. Estimated duplication is higher than 100% for some brands due to extremely high awareness levels – however, the maximum duplication possible is 100%.

2.6.4 Deviations from duplication of awareness pattern

Next, we investigate meaningful deviations (20% or more) from the Duplication of Awareness pattern, to determine situations where certain brands share higher or lower than expected awareness levels with another brand. For fruit juice, there are 5 deviations 20% greater than expected (bolded and underlined) and 10 deviations 20% less than expected (bolded and italicised in Table 5). These 15 deviations all involve co-sharing of awareness with the four smallest brands (in terms of awareness penetration). The deviations that indicate less co-sharing of awareness than expected all involve the awareness sharing between the three largest brands (in terms of awareness penetration) and the four smallest brands. In contrast, the positive deviations that indicate greater co-sharing of awareness than expected all involve the sharing within the four smallest brands.

For home broadband, about a third of brand duplications deviate by 20% from the average– 16 deviations are 20% greater and 38 deviations are 20% less than expected (Table 6). Similar to fruit juice, the negative deviations involve the awareness sharing between the seven biggest brands and the seven smallest brands and the positive deviations involve the awareness sharing within the six smallest brands.

This substantive finding across three repertoire and two subscription markets indicates that respondents who are aware of smaller brands are also more likely to be aware of other smaller brands. Therefore, there appears to be variation from the typical DoP pattern where every brand shares a similar proportion of their customer base with a particular brand (Ehrenberg, 1988; Ehrenberg & Goodhardt, 1970). In other words, brand awareness metrics show a market partition between larger and smaller share brands. While the cause of these partitions is unknown, possible explanations include a natural monopoly effect where larger brands monopolise the light buyers and light searchers (see 2.7.1 for further discussion).

2.6.5 Duplication of consideration patterns

We now move to ‘Duplication of Consideration’ analysis. For ease of comparison between awareness, we again report results for fruit juice in Table 7 and home broadband in Table 8. As before, the other studied categories showed similar results (see Table 9 for duplication fit statistics).

For fruit juice and home broadband, clear Duplication of Consideration patterns are present with the average duplication declining as the proportion of category buyers considering each brand declines. A D-value of 1.37 for fruit juice and 1.76 for home broadband, demonstrates higher duplication of consideration than for brand awareness (1.13 for fruit juice and 1.17 for broadband). Similar to the findings for brand awareness, average duplications are under-estimated for brands with high consideration and over-estimated for the brands with low consideration. For fruit juice, a MAE of 0.10 and r-value of 0.87 demonstrates a good fit between average and expected duplication. For home broadband, a MAE of 0.18 and r-value is 0.67, indicates a slightly weaker fit between average and expected duplication. To further explore the fit of the duplication of consideration pattern, we now report on the meaningful deviations.

2.6.6 Deviations from duplication of consideration pattern

Large deviations (20% or more) are more frequent for brand consideration than for brand awareness. Duplication of Consideration for fruit juice shows that 40 out of 72 brand duplications deviate by 20% from the average – 25 deviations are 20% less and 15 are 20% more than expected (Table 7). Whereas for home broadband 97 out of 156 brand duplications deviate by 20% from the average duplication – 59 deviations are 20% less and 38 deviations are 20% more than expected (Table 8).

Therefore, despite a clear decline in duplication as consideration penetration declines, there is not a similar degree of consideration sharing with any particular brand. This is similar to findings for brand awareness but is more pronounced for brand consideration. In other words, the results indicate a stronger market partition, with greater sharing of consideration between brands with low consideration penetration (smaller brands). Therefore, a greater proportion of category buyers who consider a small brand are more likely to consider other smaller brands compared to those who consider larger brands only. Again, a plausible explanation for this market partition is a natural monopoly effect (see 2.7.1 for further discussion).

Table 7: Duplication of consideration analysis – Fruit Juice (a repertoire market example)

Participants considering brand	Consideration Penetration	Percentage of participants who also consider brand								
		Keri	Just Juice	Fresh Up	Charlie's	Simply Squeezed	McCoy	Homegrown	Citrus Tree	Thexton's
Keri	57	-	57	46	35	25	24	10	11	6
Just Juice	53	62	-	64	34	23	21	10	9	6
Fresh Up	43	62	79	-	34	25	22	10	10	7
Charlie's	33	60	54	44	-	44	33	19	12	7
Simply Squeezed	24	59	50	44	61	-	30	27	14	6
McCoy	20	69	56	47	56	37	-	19	19	12
Homegrown	11	53	50	41	59	60	35	-	19	13
Citrus Tree	7	88	67	59	57	47	53	29	-	21
Thexton's	4	78	78	69	53	37	55	35	35	-
Average duplication		66	61	52	49	37	34	20	16	10
Consideration Penetration		57	53	43	33	24	20	11	7	4
Average penetration	28									
Average duplication	38									
Duplication coefficient (D)	1.37									
Estimated duplication (D x Pen)		78	72	58	46	33	27	15	9	6

Note: Deviations 20% greater than the average duplication are bolded and underlined. Deviations 20% less than the average duplication are bolded and italicised.

Table 8: Duplication of consideration analysis – Home Broadband (a subscription market example)

Participants considering brand	Consideration Penetration	Percentage of participants who also consider brand												
		Spark	Vodafone	2degrees	Slingshot	Trustpower	Skinny	Orcon	Stuff Fibre	My Republic	Flip	BigPipe	Now	Voyager
Spark	44	-	41	33	23	22	18	14	13	7	6	4	4	3
Vodafone	37	49	-	38	26	24	19	17	13	8	6	5	4	4
2degrees	35	42	41	-	34	25	32	22	15	9	9	6	5	3
Slingshot	23	44	42	51	-	27	34	29	19	12	13	9	6	6
Trustpower	22	46	42	41	30	-	24	18	17	11	8	6	5	5
Skinny	19	43	37	59	43	27	-	26	21	13	15	8	7	6
Orcon	15	44	43	52	46	27	34	-	23	19	18	14	10	8
Stuff Fibre	12	51	43	46	39	31	34	30	-	22	19	16	13	11
My Republic	6	49	45	48	45	37	37	44	40	-	31	31	21	19
Flip	6	47	41	58	54	33	50	47	38	37	-	27	23	18
BigPipe	4	49	46	54	55	33	42	54	49	55	41	-	36	32
Now	3	48	40	54	41	32	37	43	46	41	38	40	-	33
Voyager	2	64	62	52	60	50	50	52	55	55	45	52	50	-
Average duplication		48	43	49	41	31	34	33	29	24	21	18	15	12
Consideration Penetration		44	37	35	23	22	19	15	12	6	6	4	3	2
Average penetration	17													
Average duplication	31													
Duplication coefficient (D)	1.76													
Estimated duplication (D x Pen)		78	65	61	41	38	33	26	20	11	10	7	6	4

Note: Deviations 20% greater than the average duplication are bolded and underlined. Deviations 20% less than the average duplication are bolded and italicised.

2.6.7 Age-related comparisons of duplication of awareness and consideration patterns

We now turn to analysis by age groups. This provides a robustness check by determining whether duplication of customer mindset metrics continues to hold for disaggregate as well as aggregate data, as well as providing assessment of a demographic variable that might be expected to show variations in duplication. Table 9 provides a comparison of key duplication statistics for brand awareness and consideration across the five categories and four age groups. Average duplication, D-value, correlation (r), and MAE are listed in the left-hand columns for brand awareness and right-hand columns for brand consideration.

The Duplication of Awareness pattern holds across age groups. The correlation between the average and expected duplications for each age group are 0.94 and over, and do not vary much from the sample average. The MAE's are similarly low for each age group and category, indicating the data strongly fits expected norms. The average duplication is relatively similar across age groups (± 6 points from the average) for supermarket store choice, fruit juice, home broadband, and electricity. Consumers aged 75 years and above have slightly smaller awareness duplication for toothpaste, fruit juice and home broadband. This is caused by smaller awareness sets in those categories and therefore fewer brands that can be duplicated. The D-value is also similar across age groups in the three repertoire markets examined, whereas age-related declines in the D-value are witnessed across all age groups for the two subscription markets. This indicates that compared to younger consumers, older consumers who are aware of a brand in a subscription market are slightly less likely to be aware of another brand in the category, indicating that age-related effects are apparent, but do not undermine the applicability of the overall Duplication of Awareness pattern.

The Duplication of Consideration pattern similarly holds across age groups with correlations close to the sample average in each of the categories. The MAE's for consideration are slightly more variable than found for awareness, although remain relatively small for each age group, ranging from 0.06 to 0.21. Older consumers (60 years and above) are found to have smaller average duplications than younger consumers in four out of five categories (excluding toothpaste), caused by smaller consideration sets among older consumers. The D-value declines across all age groups for supermarket store choice, home broadband and electricity, while remaining steady until 60 years of age before declining for fruit juice. Toothpaste shows an opposite trend, with the D-value higher for older consumer (60 years and above) than younger consumers. Therefore, older consumers considering a

toothpaste brand are more likely to consider other toothpaste brands than younger consumers. Whereas, in the other four categories, older consumers considering a brand are typically less likely to consider other brands than younger consumers. Note again that these age-related differences have little impact on the overall fit of the Duplication of Consideration pattern.

Table 9: Comparison of duplication statistics across age groups

		Brand Awareness				Brand Consideration			
		Ave. Dup				Ave. Dup			
Age Group	n	(%)	D	r	MAE	(%)	D	r	MAE
Supermarket store choice									
<40yrs	416	76	1.07	0.97	0.06	49	1.41	0.88	0.18
40-59yrs	484	80	1.03	0.98	0.03	42	1.23	0.96	0.08
60-74yrs	503	81	1.02	0.99	0.03	37	1.16	0.98	0.06
>74yrs	459	79	1.03	0.99	0.03	34	1.13	0.96	0.06
Sample average		79	1.04	0.98	0.03	41	1.26	0.96	0.09
Toothpaste									
<40yrs	416	64	1.16	0.95	0.07	36	1.41	0.85	0.12
40-59yrs	484	62	1.12	0.96	0.07	31	1.26	0.81	0.11
60-74yrs	503	52	1.15	0.97	0.09	34	1.65	0.61	0.21
>74yrs	459	48	1.20	0.94	0.12	31	1.63	0.76	0.17
Sample average		58	1.19	0.94	0.12	32	1.42	0.84	0.09
Fruit Juice									
<40yrs	416	65	1.16	0.96	0.08	43	1.34	0.87	0.11
40-59yrs	484	67	1.10	0.98	0.05	44	1.36	0.87	0.11
60-74yrs	503	63	1.12	0.98	0.06	34	1.36	0.83	0.10
>74yrs	459	57	1.15	0.97	0.06	29	1.25	0.82	0.10
Sample average		63	1.13	0.97	0.06	38	1.37	0.87	0.10
Home Broadband									
<40yrs	416	61	1.24	0.94	0.20	33	1.91	0.56	0.20
40-59yrs	484	66	1.18	0.94	0.21	36	1.86	0.60	0.21
60-74yrs	503	64	1.13	0.96	0.18	29	1.66	0.69	0.17
>74yrs	459	56	1.13	0.97	0.16	23	1.48	0.61	0.15
Sample average		62	1.17	0.96	0.19	31	1.76	0.67	0.18
Electricity									
<40yrs	416	69	1.24	0.94	0.06	42	1.71	0.56	0.10
40-59yrs	484	74	1.12	0.96	0.06	40	1.49	0.76	0.07
60-74yrs	503	75	1.08	0.97	0.05	30	1.26	0.74	0.07
>74yrs	459	71	1.09	0.97	0.06	23	1.10	0.64	0.07
Sample average		73	1.12	0.96	0.05	35	1.43	0.75	0.06

2.7 Discussion

2.7.1 Conclusions

Double Jeopardy

This study provides new insights on the interactions between customer mindset metrics, demonstrating that brands with low recognition are ‘punished twice’ with lower unaided brand recall and lower purchase consideration. Interestingly, the DJ pattern between brand recall and brand consideration appears to follow a linear trend, whereas the DJ pattern

between brand recognition and brand consideration appears to follow an exponential trend, similar to that found for brand purchasing data (Habel & Lockshin, 2013) and for brand recognition and recall (Laurent et al., 1995). The respective linear and exponential DJ patterns are evident across repertoire and subscription markets and continue to hold particularly well across different age groups.

The apparent difference in the shape of the DJ line between brand recall and brand consideration, and brand recognition and brand consideration, is intriguing. The shape of the double jeopardy line may reflect whether cueing of the brand in memory is direct or indirect. Brand recognition involves direct cueing with retrieval depending just on the strength of the brand concept node itself. The result is an exponential double jeopardy line that provides relatively greater benefit for bigger brands. Brand recall involves indirect cueing that also depends on the network of associations that connect the brand to the category entry point. The result is a linear shape that provides relatively less penalty for smaller brands. The idea that big brands benefit relatively less from spreading activation (the linear double jeopardy line) than direct recognition (the exponential double jeopardy line) is entirely consistent with prior work demonstrating that familiar brands may sometimes be harder to remember due to activation confusion (Stocchi et al., 2016).

Although speculative, this explanation points to the possibility of a more general boundary condition for empirical generalisations about customer mindset metrics related to the type of memory access employed, and so bears further investigation. For example, mindset metrics for other attributes, such as pack size, could also be investigated using both direct cues (“do you recognise the 500 g pack”) and indirect cues (“what pack sizes does this category have?”). If such experiments confirm that differences in memory access are associated with the shape of the double jeopardy line, this would be a substantive result. Meanwhile, while more data is required to confirm the variation between linear and exponential DJ lines for different customer mindset metrics, the result already demonstrates neither a linear nor an exponential double jeopardy line can be automatically assumed to apply to new areas of enquiry.

Duplication

The results clearly demonstrate the presence of Duplication of Awareness and Duplication of Consideration patterns. These findings are consistent with the DoP law where the proportion

of customers a brand shares with other brands is in line with the penetration of those brands (Ehrenberg, 1988; Ehrenberg & Goodhardt, 1970). However, we discover a boundary condition to this pattern, or a consistent market partition, for the amount of sharing that occurs with brands that have low brand awareness and consideration. The reason for increased sharing of awareness and consideration among smaller brands is unknown. However, the differences in brand sharing are larger and more frequent for brand consideration than brand awareness. One possible explanation is that consumers who search for alternative brands outside the largest brands (most well-known and considered) are likely to be exposed to multiple smaller brands, subsequently becoming aware and considering several of these smaller brands. Whereas, customers satisfied with the largest brands do not need to search for new alternatives (Heilman et al., 2000), and therefore are less likely to become aware of and consider the smaller brands due to lower brand exposure.

An alternative explanation is the tendency for larger brands to monopolise lighter buyers (Ehrenberg et al., 2004; McPhee, 1963). This natural monopoly effect is present in brand image associations (Stocchi et al., 2017) and so might reasonably be expected in brand awareness and brand consideration data as well. Light buyers may therefore explain the lower than expected awareness and consideration sharing between the larger and smaller brands. Whereas, the higher than expected awareness and consideration sharing between multiple smaller brands may be due to heavy buyers purchasing a greater variety of smaller brands over time. This is in line with prior research that indicates that heavy buyers with more product related experiences and knowledge have a higher likelihood of recognising and purchasing smaller brands (Alba & Chattopadhyay, 1985; Heilman et al., 2000). These explanations give different predictions for the character of consumers in the low awareness and consideration partitions – they could be either heavy searchers, heavy buyers, or both. Future research could investigate this matter further by assessing search and purchase quantity and conducting separate duplication tables for heavy searchers versus light searchers and heavy buyers to versus light buyers.

While we observe partitioning for smaller brands in customer mindset metrics, these differences do not consistently occur in prior studies using brand purchasing data. One plausible explanation is that the repertoire of brands a customer switches between at point of purchase are smaller than those they consider. Customers are more likely to fall back on purchasing the larger brands due to their high physical and mental availability and subsequently purchase fewer smaller brands. This may result in less sharing among smaller

brands at a purchase level, than is found at an awareness and consideration level. Another explanation is that the pattern may not have been observed for purchase data simply due to the aggregation of smaller brands to aid statistical tractability; if so, additional research could determine whether the partition for smaller brands does in fact exist within unaggregated purchase data.

Lastly, comparison of key statistics reveal that older and younger consumers exhibit similar Duplication of Awareness and Duplication of Consideration patterns. Although, there are some age-related differences in the average duplication rates, this is driven by the differing awareness and consideration sets sizes found across age groups. Therefore, older consumers have similar duplication of awareness and consideration patterns to younger consumers, and this is a further extension and robustness test of the overall findings.

2.7.2 Implications, limitations, and future research

This study provides marketers with additional knowledge that ‘lawlike’ patterns exist between brand awareness and consideration, regardless of age. A clear theoretical contribution of this study is the extension of the DJ and DoP patterns to new boundary conditions. The addition of a new condition (age) to the extension provides further robustness and confidence that these empirical generalisations hold for customer mindset metrics. However, a boundary condition not seen in traditional DoP analysis indicates that different degrees of awareness and consideration sharing occurs within a partition of smaller brands (low awareness and consideration) in each category.

While these findings are consistent across the repertoire and subscription markets tested, they apply to just five categories and one country. Differentiated replication is needed to determine whether these patterns hold in other categories and other countries. This could provide further contributions by investigating reasons for the market partitioning found for Duplication of Awareness and Duplication of Consideration.

The results also show the influence of age on brand awareness and consideration, with evidence indicating that older consumers and younger consumers exhibit similar mindset metric patterns. This implies that cognitive decline and accumulated knowledge through experience, often referred to as crystallised intelligence (Cattell, 1987), does not result in consumers diverging from the established patterns. Further research could explore whether

the DJ pattern found for brand image data by Stocchi et al. (2015) and DoP pattern found for brand image association by Nenycz-Thiel et al. (2010) also holds across age groups. This could demonstrate whether cognitive decline and experience accumulated over an adult's lifespan impacts brand knowledge, and whether this is the source of age-related variations in awareness, consideration, and even purchase.

Brand managers can use the DJ and duplication patterns to benchmark and measure brand performance in customer mindset metrics. Monitoring of brand awareness and consideration levels can be extremely useful for marketing practitioners due to its impact on sales (Srinivasan et al., 2010). Customer mindset metrics also have relatively long wear-in times (or lags) before impacting sales, therefore allowing marketing action to be taken before market performance is affected (Srinivasan et al., 2010). Brand managers must therefore collect awareness and consideration data on their brand and competitors to ensure they establish DJ and duplication benchmarks in order to assess brand performance for the mindset metrics. Comparison of awareness and consideration levels to expected benchmarks based on the empirical patterns will allow for correct marketing decisions. For example, if a brand has lower consideration than expected given their level of awareness, marketing activities can be used to increase the quantity of favourable brand associations to increase the probability that the brand is considered and subsequently purchased. However, a naive analysis, that did not consider the appropriate DJ and duplication benchmarks, could easily conclude that a brand was under or over-performing relative to the competition when in fact the results may be perfectly normal for a brand of that size. It is somewhat concerning to consider that, while brand managers are steadily learning to apply such benchmarks to behavioural data, there has been little consideration of similar benchmarks for commonly used mindset metrics.

Likewise, for duplication analysis, identifying patterns and understanding deviations can inform marketing strategy. For example, the proportion of category buyers that consider Homegrown who also consider Just Juice is less than expected. Deviations such as this could be investigated further by brand managers through additional research but are likely to be a result of functional and promotional differences between the brands. A plausible explanation is that Homegrown produces naturally raw pasteurised fruit juices sold at a higher price point, whereas Just Juice produces reconstituted fruit juices sold at a lower price point. While this is unlikely to concern Just Juice greatly as they are a market leader, further negative consideration deviations with other premium juice brands may indicate additional category

partitions and the need to ensure the master brand has a premium juice brand competing for consideration against Homegrown.

Another managerial implication for recent brand entrants is that older consumers should be targeted in the same way as younger consumers. The consistency of the DJ and duplication patterns across age demonstrates that older consumers have the cognitive capacity to remember new brands and will consider these brands relative to their awareness levels. This finding highlights that brand managers should not neglect targeting and marketing products towards older consumers. Brand managers must focus on firstly building brand awareness among older *and* younger consumers to ensure the brand can be considered and subsequently purchased. This is especially the case for smaller brands, as there is clear evidence that they can enter the awareness and consideration sets of older consumers who are already aware of and considering well-established brands.

2.7.3 Concluding remarks

Replication and extensions of DJ and DoP are vital for gaining important insights into consumer buying behaviour. The present study extends the conditions under which the lawlike patterns hold by applying the DJ and DoP to brand awareness and consideration data. We successfully demonstrate a DJ pattern between brand awareness and consideration as brands with lower recognition suffer twice with lower unaided brand recall and lower purchase consideration. We also highlight the existence of Duplication of Awareness and Duplication of Consideration patterns, with some minor partitioning between the larger and smaller brands. These findings have useful theoretical implications by establishing new conditions where the DJ and DoP hold. Useful practical implications are also provided for brand managers as these patterns can be used to benchmark and measure their awareness and consideration levels against competitors.

We, the candidate and the candidate's Primary Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of candidate:	Philip Mecredy
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In which chapter is the manuscript /published work:	Chapter 2
Please select one of the following three options:	
<input checked="" type="radio"/> The manuscript/published work is published or in press <ul style="list-style-type: none">Please provide the full reference of the Research Output: Mecredy, P. J., Wright, M. J., Feetham, P. M., & Stern, P. (2021). Empirical generalisations in customer mindset metrics. Journal of Consumer Behaviour.	
<input type="radio"/> The manuscript is currently under review for publication – please indicate: <ul style="list-style-type: none">The name of the journal:The percentage of the manuscript/published work that was contributed by the candidate: 60.00Describe the contribution that the candidate has made to the manuscript/published work: Literature review, survey development and implementation, data analysis, drafting manuscript, preparing and submitting manuscript, and assisting with manuscript revisions.	
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Candidate's Signature:	Philip Mecredy <small>Digitally signed by Philip Mecredy Date: 2021.09.14 14:20:08 +1200</small>
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Chapter 3: Remembering less, or needing less? Age-related differences in the purchase funnel

Chapter abstract

The first study of this thesis (Chapter 2) determined that DJ and duplications patterns exist within customer mindset metrics and that these patterns hold across older and younger consumers. Despite this substantial contribution, the study does not address whether awareness and consideration set sizes differ between older and younger consumers and how these differences influence brand choice. These insights are important as little is known about the role age plays in the brand purchase funnel (awareness, consideration, and purchase) or the underlying mechanisms. Study two therefore builds on the findings of Chapter 2 by analysing the same survey data set (n=1,862) in three repertoire and two subscription markets to establish how age influences the various stages of the brand purchase funnel and the mechanisms driving any age-related differences.

Initial findings show an inverse-U shape for brand recognition and brand recall, inverse-U or linear decline for brand consideration, and linear decline for purchase sets across increasing age groups - all familiar from prior research. However, when results control for the average number of brands bought, to reflect changes in category requirements, older consumers are aware of and consider a greater number of brands than younger consumers. Therefore, age-related differences in brand awareness and consideration, and the mechanisms driving these changes, are not associated with age-related increases in loyalty. Instead, findings suggest age-related increases in loyalty are more likely caused by mechanisms that impact the purchase stage of the brand purchase funnel, such as a combination of accumulated experience, development of purchase habits, and declining category purchase rates.

The results have multiple implications for marketers as they show older consumers have the cognitive capacity to remember new (as well as old) brands. Evidence that accumulated experience is likely driving age-related loyalty indicates that marketers will need to adjust marketing strategies for older consumers to disrupt their purchase habits and encourage variety seeking. While these findings provide an initial understanding of how age influences progression through the brand purchase funnel, more research is needed to confirm

the underlying mechanisms driving age-related loyalty. Study three (Chapter 3) explores this further by using a range of BPMs and ϕ to examine loyalty in the same three repertoire markets and by testing whether difference exist across chronological age and various alternative age measures.

Note: The following paper presented in this chapter has been submitted to Marketing Letters (ABDC list 2019: A, Cite Score 2020: 3.5, Impact Factor 2020: 2.800, SCImago Journal Rank (SJR) 2020: 1.133).

3.1 Introduction

Most national populations are rapidly ageing due to longer life expectancies, ageing baby-boomers, and declining birth rates (United Nations, 2015). One consequence is that older adults are becoming an ever increasingly valuable segment of active consumers. Baby-boomers (born 1943-1963) account for \$548 billion of annual spending in the United States, the greatest of any generational cohort (Epsilon, 2019).

Despite the financial importance of older consumers, little research has explored how age influences the size of brand awareness, consideration and purchase sets (see Lambert-Pandraud & Laurent, 2020), three important components of the brand purchase funnel (Shocker et al., 1991). Several reasons why the brand purchase funnel may operate differently for older consumers include the effects of age-related loyalty, cognitive decline, purchase inertia, and accumulated experience. Therefore, it is important to determine whether age-related differences in awareness, consideration, and purchase exist. Should observable age-related differences occur, this would enable researchers to investigate the mechanisms responsible for these differences, and practitioners to consider different strategies to target older consumers. As it stands, marketers may, for example, be inadvertently targeting less productive stages of the brand purchase funnel for older consumers.

Research in this area to date is limited to a few prominent studies exploring how age influences the size of brand awareness (e.g. Lambert-Pandraud et al., 2017; Thoma & Wechsler, 2021), consideration (e.g. Cole & Balasubramanian, 1993; Lambert-Pandraud et al., 2005), and purchase (e.g. Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005; Uncles & Lee, 2006) sets. This insufficient research is combined with conflicting results between high and low-involvement categories, highlighting that the evidence of how age influences each stage of the brand purchase funnel is inconclusive. In particular, research examining the influence of age on brand awareness is rare (Lambert-Pandraud et al., 2018; Lambert-Pandraud et al., 2017) and does not determine how age-related differences in brand awareness subsequently influence consideration and purchase. To better understand the complex relationship between age and progression through the brand purchase funnel, more evidence is required across a range of new contexts, including how age-related changes in awareness subsequently influence consideration and purchase.

To address this gap, the current study assesses the impact of age on brand awareness in new contexts (consumer goods, store choice, and services) and is also the first study to

comprehensively examine how age-related changes to brand awareness are related to consideration and purchase. The results have important implications for marketers as they identify the stage in the brand purchase funnel most affected by age. These findings will indicate whether marketing strategies are needed to influence, for example, long-term and working memory to build brand awareness and consideration, or instead to penetrate the purchase set of older consumers by altering well-established habits.

3.2 Literature review

3.2.1 Possible mechanisms for age-related differences in the brand purchase funnel

Multiple mechanisms may underpin age-related differences in the brand purchase funnel. For example, older consumers typically have smaller household sizes and so buy from certain categories less frequently, resulting in smaller purchase sets (Uncles & Ehrenberg, 1990a; Yang, Zhou, et al., 2005). Therefore, older consumers may appear to be more loyal than younger consumers simply due to their reduced category purchase rate. This highlights the importance of controlling for purchase rates across age groups when assessing loyalty.

Biological ageing involves declines in vision, hearing, and mobility, as well as the onset of age-related of chronic conditions and diseases (Adams & White, 2004; Zniva & Weitzl, 2016). Declines in mobility may cause difficulty accessing retailers, while hearing or vision issues may impact the processing of new information about brands (Lambert-Pandraud & Laurent, 2020). These changes are most likely to occur in later life rather than developing steadily across an adult's lifespan.

Cognitive decline involves deteriorations in speed of processing, working memory, and long-term (semantic) memory (Drolet & Yoon, 2020; Park et al., 2002; Salthouse, 2012). Reductions in the speed of processing is one of the most well-documented and accepted phenomena of ageing and are manifested in age-related decreases in working memory (Salthouse, 1996) - the memory that holds information in mind in the short-term while it is being processed (Anderson, 1983; Gutchess, 2011). These declines in processing speed and working memory also contribute to age-related reductions in long-term memory (Park et al., 1996) - the repository for facts and knowledge held over a longer period of time (Anderson, 1983; Cowan, 2008). Park et al. (2002) further highlight the closely connected relationship

between processing speed, working memory and long-term memory by demonstrating that all three cognitive constructs decline relatively continuously across age from the 20s to 80s.

These inter-related cognitive constructs all impact the brand purchase funnel, although some will likely affect certain stages of the funnel more than others. For example, reduction in long-term memory is likely to cause declines in brand awareness (recall and recognition) sets. These long-term memory effects are likely to be larger for brand recall sets, as research has found older consumers perform worse on recall tasks compared to recognition tasks (Craik & McDowd, 1987). Declines in working memory may also impact brand awareness. This is because working memory affects the ability to process information on new brands and retrieve information on old brands from long-term memory (Gutchess, 2011; Park & Gutchess, 2004). Working memory is nonetheless likely to have a larger influence on consideration and choice than long-term memory as older adults seek to reduce their cognitive effort when making purchase decisions (Lambert-Pandraud et al., 2005).

However, older consumers are often able to compensate for declines in long-term and working memory through accumulated knowledge (“crystallised intelligence”) gained through past category experience (Salthouse, 2012). This accumulated knowledge can lead to the formation of habits where consumers repeatedly purchase a brand without a strong psychological connection (Wood & Neal, 2009). Habits are formed at any point in time through the repeated purchasing of a brand and lead to an automatic propensity to repeat the behaviour (Drolet et al., 2017; Lambert-Pandraud & Laurent, 2020), resulting in reduced purchase sets for a given level of category purchasing.

These mechanisms affect each stage of the brand purchase funnel differently. For example, if older consumers have smaller awareness sets than younger consumers and this flows through to smaller purchase sets (higher loyalty), this may suggest older consumers are more loyal due to cognitive decline and consequent changes in working or long-term memory. Whereas, if older consumers have similar awareness sets as younger consumers, but smaller purchase sets, this may suggest the greater loyalty is caused by accumulated experience and the formation of purchase habits rather than age-related changes to consumer memory. In the next sections we provide a more detailed consideration of these mechanisms at each stage of the brand purchase funnel.

3.2.2 Age influence on the awareness sets

There is conclusive evidence that memory declines with age (Park & Festini, 2017; Park et al., 2002), with meta-analysis demonstrating that free recall tasks are more adversely affected by age than recognition tasks (Rhodes et al., 2019). Despite substantial research on how age influences recall and recognition, there is little research within a consumer setting. Most recently, Thoma and Wechsler (2021) found that older consumers recall fewer brands than younger consumers, but no age-related differences were found for the number of brands recognised. A positive association was also found between the brands recalled from semantic memory and phenomenologically richer auto-biographical memories, with stronger links between semantic and episodic memory for older consumers (Thoma & Wechsler, 2021).

Two studies in the context of French radio stations discovered older consumers have smaller unaided brand recall and aided brand recognition (awareness) sets than younger consumers (Lambert-Pandraud et al., 2017) and spontaneously recall fewer ‘known’ radio brands (Lambert-Pandraud et al., 2018). For older radio brands, age had a direct positive impact on brand awareness up until consumers’ early 60s, with no significant direct impact afterwards. Whereas, for newer brands, age did not have a direct impact on brand awareness up until the early 60s, with a strongly negative direct impact afterward. This indicates that while older consumers are more aware of older radio brands (than newer brands), there is a clear inflexion point in the direct impact of age on the awareness of both older and newer brands once a consumer is sixty (Lambert-Pandraud et al., 2017).

The evidence suggests that the relationship between age and brand awareness is non-linear. Lambert-Pandraud et al. (2018) indicate that the relationship between age and brand recognition has an inverted-U shape, predicted by a quadratic regression, while Lambert-Pandraud et al. (2017) use an augmented spline regression to model this relationship due to a distinct turning point at 60 years of age. It is important to note that these studies focused on media choice and that age-related brand awareness patterns may differ for consumer-packaged goods, store choice, and services. Therefore, we address the following:

RQ1: How do the awareness sets (recognition and recall) of consumers vary with increasing age for consumer-packaged goods, store choice, and services?

3.2.3 Age influence on the consideration and purchase sets

Multiple studies indicate that older consumers consider fewer new car brands for purchase compared to younger consumers (Evanschitzky & Woisetschläger, 2008; Lambert-Pandraud et al., 2005; Lapersonne et al., 1995). However, the impact of age on consideration sets is not conclusive in low-involvement product categories. Prior research found that older people consider fewer cereal brands than younger consumers (Cole & Balasubramanian, 1993), yet insignificant relationships are witnessed for coffee (Gruca, 1989), toothpaste and laundry detergent (Campbell, 1969).

Studies in high-involvement categories (e.g. automobiles and perfume) found older consumers have smaller purchase sets than younger consumers as they tend to repurchase their previous brand more often (Evanschitzky & Woisetschläger, 2008; Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005). Although older consumers also have smaller purchase set sizes in some low-involvement categories (Uncles & Ehrenberg, 1990a; Yang, Zhou, et al., 2005), this is largely attributed to older consumers having smaller household sizes and thus buying from the category less frequently (Uncles & Ehrenberg, 1990a).

In summary, the literature signals that older consumers tend to have smaller consideration and purchase sets than younger consumers, although this may vary by category, due to either real increases in brand loyalty or reduced category purchase rates. These studies are limited to a few contexts and infrequently investigate whether consideration and purchase sets also decline in a linear fashion. An exception is research by Evanschitzky and Woisetschläger (2008) that found a linear relationship between age and size of brand consideration sets. This limited prior research leads to further research questions:

RQ2: How do consideration sets vary with increasing age?

RQ3: How do purchase sets vary with increasing age?

3.2.4 Age and the entire brand purchase funnel

While past research has investigated the effect of age at various stages of the purchase choice funnel, no prior studies provide a comprehensive examination of age-related differences across its entirety. Doing so will provide evidence on how age-related changes in awareness

sets subsequently affect consideration and purchase sets, and therefore provide important knowledge about the underlying mechanisms that govern brand choice. In fact, Lambert-Pandraud and Laurent (2020) stress that determining whether cognitive factors impact purchasing in contexts that rely more heavily on recognition (e.g. consumer-packaged goods) is an important question for future research. Such knowledge will also guide marketing strategies aimed at increasing the purchase propensity of older consumers. This guides us to the final research question:

RQ4: What impact do age-related differences in the awareness set have on consideration and purchase sets?

3.3 Methodology

3.3.1 Data collection

An on-line survey of the New Zealand public (n=1,862) was used to collect data on brand awareness, consideration, and purchase choice across three repertoire (toothpaste, fruit juice, and supermarket store choice) and two subscription (home broadband and electricity) markets. All participants were obtained from a commercial panel provider and were screened to ensure they participated in grocery shopping and were jointly or solely responsible for paying utility bills.

3.3.2 Survey Design

For each category, respondents began with an unaided brand recall question, followed by aided brand recognition and consideration questions. For unaided brand recall, only the category prompt was provided. For the aided brand recognition and consideration set questions, the names and logos of the competing brands were provided in a randomised tick list format. Respondents were able to select multiple brands and enter the name of any brands not listed. Following this, the Juster scale (Juster, 1966), an eleven-point purchase probability scale, was used to assess purchase penetrations for the five leading brands and ‘any other’ brands for supermarket store choice, fruit juice and toothpaste (see Appendix B for more detail).

3.3.3 Analysis procedure

The analysis follows a three-stage process, firstly to illustrate the age-related patterns and to test whether these differences are significant, then it models the impact of age on the funnel elements, and finally the analysis takes into account category purchase rates to overcome the confounds of prior studies.

The analysis begins by comparing the average awareness (aided brand recognition and unaided brand recall), consideration, and purchase set sizes across the four age groups (39 years and below, 40-59 years, 60-74 years, and 75 years and above). For simplicity, we focus on interpreting the overall pattern seen across the brand awareness, consideration, and purchase sets for each age group and category (see Appendix C for significance tests). Analysis of the pattern is further enhanced through regression analysis and by comparing fit statistics of linear and quadratic regressions for the relationship between age and i) brand recognition, ii) brand recall, iii) brand consideration, and iv) brand purchase set size.

Next, ratio analysis is performed for the three repertoire markets to determine the impact age-related changes in brand awareness has on consideration and purchase. As noted, older consumers typically have smaller household sizes than younger consumers which is associated with smaller purchase sets (Uncles & Ehrenberg, 1990a; Yang, Zhou, et al., 2005), and this will also confound consideration and awareness sets. Ratio analysis controls for these confounds by reporting the number of brands recognised, recalled, and considered for every brand purchased. Controlling for differing purchase rates across age groups in the three repertoire markets allows for a more effective assessment of the stages of the brand purchase funnel most adversely affected by age and will help determine the impact of various age-related mechanisms on brand choice. The ratio analysis however is not required for subscription markets as consumers tend to subscribe to one brand, rather than purchasing multiple different brands as witnessed for repertoire markets.

3.4 Results

Table 10 shows the average size of consumers awareness (unaided and aided), consideration and purchase sets across age groups for each category. Brand recognition sets appear to grow across age groups until 75 years of age for supermarket store choice, broadband, and electricity, and 65 years of age for toothpaste and fruit juice, before declining. This apparent

inverse U-shaped pattern between age and brand recognition is confirmed by comparing fit statistics for linear and quadratic regressions (see Table 11). For each category assessed, the R^2 is higher and standard error (S) is lower for the quadratic regression. Compared to the linear regression, the quadratic regression significantly improves the explanatory power of age on brand recognition for all five categories studied (see Appendix D for detailed results).

Brand recall sets follow a similar inverse-U shaped pattern across age as found for brand recognition. Brand recall sets increase across age until reaching a turning point and declining from 60 years of age for fruit juice and broadband, and 75 years of age for supermarket store choice, toothpaste, and electricity. Regression analysis determined slightly lower S values, as well as small but statistically significant increases in the R^2 for the quadratic regressions in all categories, compared to the linear regressions. The quadratic regression was found to improve the explanatory power of age on brand recall for all five categories studied (see Appendix D for detailed results).

Older consumers have smaller consideration sets than younger consumers, with declines in the number of brands considered for all repertoire and subscription markets observed after the 40-59 year-old age group. Prior to these declines, consideration set size increases for the two subscription markets and remains stable for the three repertoire markets between the under 40 year-old and 40-59 year-old age groups. Turning to the regression analysis, the R^2 and S remain similar between the linear and quadratic regressions for all three repertoire markets. Although the difference between the linear and quadratic regression is significant for fruit juice, the improvement is minimal and shows no practical difference from a linear relationship. Whereas, for the two subscription markets examined, the quadratic regressions both significantly and practically improve the explanatory power of age on brand consideration. Therefore, the relationship between age and brand consideration appears to follow a linear relationship for repertoire markets and a quadratic relationship for subscription markets.

Purchase sets decline at a greater rate across age groups than consideration sets. For supermarket store choice, toothpaste, and fruit juice, purchase set size is found to decrease steadily across the age groups examined, with some minor stabilisation witnessed after 60 years of age for supermarket store choice and fruit juice. For each category, the quadratic regression analysis does not decrease the S or significantly improve the R^2 from the linear regression, and indeed the plot of the quadratic shows a linear form. These findings

demonstrate a linear pattern between age and purchase set size for the repertoire markets examined.

Overall, the results show consumers consider and purchase fewer brands as they age. These declines are not solely caused by reductions in brand awareness, as the analysis so far indicates varied shapes for the relationships between age, brand awareness (recognition and recall), consideration and purchase. The consistent results for brand recognition and recall indicate that awareness measures tend to follow a quadratic pattern, increasing in size across age before reaching a turning point and declining across the subsequent older age groups. Consideration sets show a similar quadratic relationship with age for subscription markets, but a negative linear relationship for repertoire markets. For purchase sets, there is a linear relationship with age for the repertoire markets. No purchase set analysis is undertaken for the subscription markets as consumers do not typically subscribe to more than one brand.

Table 10: Awareness, consideration, and purchase set size across age groups

		Brand awareness measures		Ave. consideration set size	Ave. purchase set size
Age Group	n	Ave. # of brands recognised	Ave. # of brands recalled		
Supermarket (next 4 weeks)					
<40yrs	416	5.0	3.4	2.4	2.9
40-59yrs	484	5.4	3.6	2.4	2.6
60-74yrs	503	5.6	3.9	2.2	2.3
>74yrs	459	5.4	3.7	2.1	2.2
Average		5.4	3.7	2.3	2.5
Toothpaste (next 3 months)					
<40yrs	416	4.9	2.0	2.3	2.6
40-59yrs	484	4.9	2.2	2.2	2.3
60-74yrs	503	4.1	2.2	1.9	1.7
>74yrs	459	3.6	2.0	1.7	1.5
Average		4.4	2.1	2.0	2.0
Fruit Juice (next 4 weeks)					
<40yrs	416	5.1	2.1	2.9	2.5
40-59yrs	484	5.5	2.3	2.9	2.1
60-74yrs	503	5.0	1.9	2.3	1.4
>74yrs	459	4.4	1.7	2.1	1.3
Average		5.0	2.0	2.5	1.8
Home Broadband					
<40yrs	416	6.4	2.5	2.3	N/A
40-59yrs	484	7.3	2.9	2.5	N/A
60-74yrs	503	7.4	2.8	2.3	N/A
>74yrs	459	6.5	2.5	2.1	N/A
Average		6.9	2.7	2.3	N/A
Electricity					
<40yrs	416	5.0	2.2	2.3	N/A
40-59yrs	484	6.0	3.1	2.5	N/A
60-74yrs	503	6.3	3.3	2.2	N/A
>74yrs	459	5.8	3.0	2.0	N/A
Average		5.8	2.9	2.2	N/A

Table 11: Regression fit statistics for the impact of age on brand awareness, consideration, and purchase sets

	Linear fit statistics				Quadratic fit statistics					Change statistics	
	R ²	S	F	β1 (impact of age)	R ²	S	F	β1 (linear impact of age)	β2 (quadratic impact of age)	R ² change	F change
Brand recognition set											
Supermarket store choice	0.017	1.229	31.884**	0.009 (<i>t</i> =5.647)	0.038	1.216	36.680**	0.072** (<i>t</i> =7.168)	-0.001** (<i>t</i> =-6.387)	0.021	40.793**
Toothpaste	0.109	1.497	227.207**	-0.028 (<i>t</i> =15.073)	0.129	1.481	137.241**	0.051** (<i>t</i> =4.147)	-0.001** (<i>t</i> =-6.499)	0.020	42.238**
Fruit juice	0.020	1.804	38.331**	-0.014 (<i>t</i> =-6.191)	0.041	1.785	39.817**	0.079** (<i>t</i> =5.356)	-0.001** (<i>t</i> =-6.363)	0.021	40.489**
Home broadband	0.001	2.507	1.729	0.004 (<i>t</i> =1.315)	0.034	2.446	33.185**	0.166** (<i>t</i> =8.146)	-0.001** (<i>t</i> =-8.036)	0.034	64.582**
Electricity	0.028	2.021	53.635**	0.018 (<i>t</i> =7.324)	0.059	1.989	58.644**	0.146** (<i>t</i> =8.892)	-0.001** (<i>t</i> =-7.867)	0.031	61.897**
Brand recall set											
Supermarket store choice	0.016	1.135	30.831**	0.008 (<i>t</i> =5.553)	0.023	1.131	22.274**	0.042** (<i>t</i> =4.467)	0.000** (<i>t</i> =-3.675)	0.007	13.509**
Toothpaste	0.001	1.070	1.415	0.002 (<i>t</i> =1.190)	0.014	1.063	12.772**	0.044** (<i>t</i> =5.034)	0.000** (<i>t</i> =-4.910)	0.013	24.111**
Fruit juice	0.018	1.361	34.554**	-0.010 (<i>t</i> =-5.878)	0.026	1.356	25.081**	0.033** (<i>t</i> =2.990)	0.000** (<i>t</i> =-3.917)	0.008	15.341**
Home broadband	0.000	1.788	0.074	-0.001 (<i>t</i> =-0.271)	0.016	1.774	15.417**	0.080** (<i>t</i> =5.443)	-0.001** (<i>t</i> =-5.546)	0.016	30.760**
Electricity	0.042	1.587	82.027**	0.018 (<i>t</i> =9.057)	0.072	1.563	71.585**	0.115** (<i>t</i> =8.944)	-0.001** (<i>t</i> =-7.655)	0.029	58.604**
Brand consideration set											
Supermarket store choice	0.015	1.088	27.530**	-0.007 (<i>t</i> =-5.247)	0.016	1.088	14.658**	0.005 (<i>t</i> =0.532)	0.000 (<i>t</i> =-1.332)	0.001	1.775
Toothpaste	0.039	1.190	76.405**	-0.013 (<i>t</i> =-8.741)	0.041	1.189	39.572**	0.003 (<i>t</i> =0.308)	0.000 (<i>t</i> =-1.634)	0.001	2.670
Fruit juice	0.039	1.611	75.920**	-0.017 (<i>t</i> =-8.713)	0.041	1.610	40.177**	0.010 (<i>t</i> =0.746)	0.000* (<i>t</i> =-2.073)	0.002	4.299*
Home broadband	0.001	1.820	2.168	-0.003 (<i>t</i> =-1.472)	0.009	1.814	8.301**	0.053** (<i>t</i> =3.533)	-0.001** (<i>t</i> =-3.797)	0.008	14.418**
Electricity	0.004	1.721	7.663**	-0.006 (<i>t</i> =-2.768)	0.013	1.714	11.797**	0.050** (<i>t</i> =3.523)	-0.001** (<i>t</i> =-3.984)	0.008	15.871**
Brand repertoire set											
Supermarket store choice	0.085	0.894	173.201**	-0.015 (<i>t</i> =13.161)	0.086	0.894	87.043**	-0.021** (<i>t</i> =-2.904)	0.000 (<i>t</i> =0.946)	0.000	0.896
Toothpaste	0.141	1.051	304.768**	-0.023 (<i>t</i> =17.458)	0.141	1.051	153.071**	-0.013 (<i>t</i> =-1.474)	0.000 (<i>t</i> =-1.149)	0.001	1.321
Fruit juice	0.123	1.271	261.218**	-0.025 (<i>t</i> =16.162)	0.123	1.271	130.692**	-0.031** (<i>t</i> =-2.929)	0.000 (<i>t</i> =0.518)	0.000	0.269

Note: * $p < .05$, ** $p < .01$

Table 12 reports the ratio analysis for repertoire markets, showing the number of brands recognised, recalled, and considered by age group, normalised to the number of brands purchased. For example, the table shows that, on average, for each fruit juice brand purchased, 2.7 brands are recognised, 1.1 brands are recalled, and 1.0 brands are considered. This analysis allows further inspection of the role brand awareness and consideration play in contributing to purchase across age groups. Normalised standard errors and confidence intervals are reported.

When controlling for the number of brands purchased in the three repertoire markets, the number of brands recognised and recalled increase significantly across age groups up to the 60-74 year-old age group, and then either stabilise or decline slightly across the 75+ year-old age group. For every brand purchased, older consumers are therefore aware of a greater number of brands than younger consumers. If cognitive decline and changes in long-term and working memory were driving age-related loyalty, we would not expect older consumers to be aware of significantly more brands than younger consumers when controlling for the number of brands purchased. Therefore, the ratio analysis suggests that older consumers have the cognitive capacity to recall and recognise a wide range of brands and that declines in long-term and working memory cannot obviously explain any declines in brand loyalty (measured by purchase set size).

While linear declines in consideration set size were initially found, a different trend is present when controlling for the number of brands purchased. For every brand purchased, significant increases in the number of brands considered are seen until the 60-74 year-old age group for toothpaste and fruit juice, before stabilising across the 75+ year-old age group. A similar significant increase occurs for supermarket store choice, albeit to the 40-59 year-old age group, before remaining stable across older age groups. This demonstrates older consumers do not have smaller consideration sets than younger consumers when accounting for the number of brands purchased, and so working memory and processing speed are not majorly impacting age-related loyalty. Rather, the general increase in brand recognition, recall and consideration sets in the ratio analysis suggests the greatest contributors to increasing age-related loyalty are declines in category purchase rates, accumulated experience and the formation of purchase habits, or both.

Table 12: Brand purchase funnel ratios across age groups for repertoire markets

		For every brand purchased								
Age Group	n	Ave. # of brands recognised			Ave. # of brands recalled			Ave. # of brands considered		
		M	Std. Error	95% CI [LL, UL]	M	Std. Error	95% CI [LL, UL]	M	Std. Error	95% CI [LL, UL]
Supermarket (next 4 weeks)										
<40yrs	416	1.702	0.024	[1.654, 1.749]	1.158	0.019	[1.121, 1.194]	0.834	0.021	[0.793, 0.876]
40-59yrs	484	2.118	0.022	[2.075, 2.161]	1.410	0.021	[1.370, 1.451]	0.930	0.019	[0.892, 0.968]
60-74yrs	503	2.442	0.021	[2.401, 2.484]	1.702	0.022	[1.659, 1.745]	0.980	0.020	[0.942,1.019]
>74yrs	459	2.439	0.024	[2.393, 2.486]	1.684	0.023	[1.638, 1.730]	0.954	0.021	[0.913, 0.996]
Average		2.159	0.012	[2.137, 2.182]	1.476	0.011	[1.455, 1.497]	0.923	0.010	[0.903, 0.943]
Toothpaste (next 3 months)										
<40yrs	416	1.867	0.037	[1.795, 1.939]	0.759	0.020	[0.719, 0.798]	0.884	0.027	[0.831, 0.936]
40-59yrs	484	2.158	0.031	[2.097, 2.219]	0.975	0.022	[0.931, 1.019]	0.983	0.025	[0.933, 1.033]
60-74yrs	503	2.369	0.032	[2.306, 2.431]	1.306	0.027	[1.253, 1.359]	1.102	0.027	[1.049, 1.154]
>74yrs	459	2.342	0.033	[2.278, 2.406]	1.320	0.030	[1.261, 1.380]	1.138	0.030	[1.079, 1.196]
Average		2.156	0.018	[2.121, 2.192]	1.053	0.012	[1.029, 1.077]	1.010	0.014	[0.983, 1.037]
Fruit Juice (next 4 weeks)										
<40yrs	416	2.020	0.038	[1.945, 2.094]	0.841	0.026	[0.790, 0.891]	1.147	0.034	[1.082, 1.213]
40-59yrs	484	2.561	0.038	[2.486, 2.635]	1.090	0.031	[1.029, 1.151]	1.363	0.038	[1.288, 1.438]
60-74yrs	503	3.631	0.056	[3.521, 3.741]	1.350	0.043	[1.265, 1.435]	1.669	0.050	[1.571, 1.767]
>74yrs	459	3.303	0.058	[3.189, 3.416]	1.247	0.044	[1.160, 1.333]	1.583	0.046	[1.493, 1.673]
Average		2.748	0.023	[2.703, 2.794]	1.095	0.017	[1.061, 1.129]	1.399	0.021	[1.358, 1.440]

Note: *M* represents the mean, CI represents confidence interval, and LL and UL represent the lower limit and upper limit of the confidence interval, respectively.

3.5 Discussion

3.5.1 Main findings

We find older consumers have smaller awareness, consideration, and purchase sets than younger consumer across both repertoire and subscription markets. However, while brand purchase set size steadily declines across age, brand awareness and consideration follow a different trend. Brand recognition and recall sets follow an inverse-U quadratic pattern with brand recognition and recall sets increasing in size across age before slowing down and then declining. Brand consideration also follows a similar quadratic pattern across age for subscription markets but follows a linear pattern for repertoire markets.

These findings allow us to hypothesis on the mechanisms that cause age-related increases in brand loyalty. Cognitive changes to long-term and working memory appear to have a limited impact on brand loyalty as older consumers generally recognise and recall more brands than younger consumers when accounting for the number of brands purchased. Additionally, the slight increases in the brand consideration sets until the 60-74 age group, when controlling for the numbers of brands purchased, provides further evidence that working memory and the cognitive effort required to consider multiple brands are not greatly impacting age-related loyalty.

Biological changes are expected later in life and therefore present a plausible explanation for the declines in awareness set size seen between the two oldest age groups studied (60-74 years, and 75 years and above). However, declines in consideration and purchase set size do not accelerate across these age groups, reaffirming the minimal impact of age-related differences in brand awareness on consideration and purchase.

This research clearly demonstrates that the purchase stage of the brand purchase funnel is most adversely affected by age. So, what mechanisms cause increases in brand loyalty across age? Declining category purchase rates and formation of purchase habits through the accumulation of category experience provide the most plausible explanations for higher loyalty among older consumers, indicating a potentially fruitful avenue for further research.

3.5.2 Practical Implications

After adjusting for the quantity of brands purchased, older consumers continue to recognise and recall a large number of brands. While declining category purchase rates and formation of purchase habits over time cause declines in consideration and purchase sets, the results clearly show older consumers have cognitive capacity to remember new (as well as old) brands. Marketers should therefore attempt to build brand awareness among older consumers in the same way as younger consumers, through advertising and deepening the network of associations consumers have with the brand, and strengthening category entry points.

To overcome the effects of well-established purchase habits and declining category purchase rates, marketers will need to adjust strategies to challenge the habitual repeat purchase behaviour of older consumers and encourage variety seeking and product trial. Marketers should nonetheless be encouraged that increases in age-related brand loyalty appear to be largely driven by purchase rates and habits as these can be altered with effective marketing, whereas cognitive decline and biological ageing are less subject to intervention.

3.5.3 Limitations and future research directions

The present research addresses a clear need to understand how age influences each stage of the brand purchase funnel. While this study provides insights in repertoire and subscription markets, the study is limited to five categories and one geographic region. Future research could replicate this study in new product categories and countries.

The results also provide an indication of plausible mechanisms that may cause awareness, consideration, and purchase sets to differ across age groups. Future research could adopt alternative measures of cognitive and biological age to determine if they are associated with greater age-related declines in awareness, consideration, and purchase sets than chronological age.



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Chapter 4: Re-examining age-related loyalty for low-involvement purchasing

Chapter abstract

The first two studies (Chapters 2 and 3) determined how age influences mindset metrics (awareness and consideration) and the subsequent impact this has on brand choice. However, the purchase set size used to measure loyalty within repertoire markets for study two is confounded by category purchase rates. Prior studies in low-involvement categories also examine age-related loyalty using BPMs confounded by category purchase rates. This indicates that a more reliable loyalty measure independent of category purchase rate effects is needed for low-involvement repertoire markets. This research is important as the confounds in prior research leads to uncertainty on whether age-related increases in brand loyalty seen in high-involvement categories extend to low-involvement categories.

To overcome these concerns, study three investigates brand loyalty by analysing the same survey data ($n=1,862$) of the three low-involvement repertoire markets (supermarket store choice, toothpaste, and fruit juice) used in the first two studies. The research first assesses BPMs across age groups by collecting Juster-based inputs into the Dirichlet model. Then, the polarisation index (ϕ) is adopted as the measure of loyalty to control for confounding influences present in prior studies. Results for chronological age are also compared with the results for measures of cognitive, biological, and social age, as well as household lifecycle to gain greater understanding of the mechanisms driving any differences in loyalty across age groups.

The results detect age-related differences in brand loyalty in two of the three low-involvement categories studied. The third category does not show detectable loyalty for any age group. While differences in brand loyalty are broadly present across all age measures, no alternative measure outperforms chronological age in detecting variations in age-related loyalty. This study has numerous implications for marketers as it provides the first evidence that age-related brand loyalty is present in low-involvement categories. However, the effects are small, and easily obscured by confounding factors. It also provides academics and practitioners with clear evidence that future age-related loyalty research in repertoire markets

should adopt the method of analysing differences in polarisation (ϕ) for chronological age groups.

Note: The following paper presented in this chapter is submitted and is currently under first review for the European Journal of Marketing (ABDC list: A, Cite Score 2020: 4.7, Impact Factor: 4.647, SCImago Journal Rank (SJR) 2020: 1.199).*

4.1 Introduction

Researchers have devoted relatively little attention to understanding how age influences consumer loyalty patterns (Evanschitzky & Woisetschläger, 2008; Lambert-Pandraud et al., 2005; Uncles & Lee, 2006). Some marketing practitioners and advertisers hold onto erroneous beliefs that older consumers have low spending power and are loyal to well-established brands, resulting in heavier investment in younger consumers (Moschis, 2003; Thompson & Thompson, 2009; Yoon & Cole, 2008). In particular, older consumers are under-represented in advertisements with only 15% of media images in the United States depicting consumers aged 50 years and above (AARP, 2019). Yet, evidence does not support this neglect as Phua et al. (2020) show older consumers regularly buy new brands and Anesbury et al. (2021) find that dead sub-brands were more likely to have skewed towards younger buyers.

The neglect of older consumers by both academics and practitioners is surprising given the mature segment continues to grow in size and purchasing power. By 2050, it is predicted that consumers aged 60 years and over will represent 21.5% of the world's population, while those aged 80 years and over will represent close to 30% of the population in Europe, North America, and Oceania (United Nations, 2015). As the global population ages, baby boomers (born 1943-1963) have become the wealthiest generation and account for the greatest annual spend (\$548 billion) of any generational cohort in the United States (Epsilon, 2019).

Existing research on how age influences brand loyalty is restricted to a few studies that focus predominately on cars, perfume, and fast-moving consumer goods (FMCGs). In the high-involvement categories of cars and perfume, older consumers have smaller consideration sets, higher brand loyalty, and a greater preference for well-established brands compared to younger consumers (Evanschitzky & Woisetschläger, 2008; Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005; Maddox et al., 1978). In contrast, research in low-involvement categories reports that while there are age-related differences in category purchase rates, brand loyalty patterns appear not to differ across age groups (Singh et al., 2012; Uncles & Ehrenberg, 1990a; Uncles & Lee, 2006).

These contradictory results create a puzzle for theorists interested in age-related loyalty. However, a limitation of existing studies of low-involvement categories is that the brand performances measures (BPMs) used to measure loyalty may be confounded by

differing category purchase rates and market shares across age groups. Therefore, to conclude whether or not age-related differences in brand loyalty extend from high-involvement categories to low-involvement categories, fresh research is needed using loyalty measures independent of these confounds. A further limitation is the use of chronological age, as it is viewed as an unsophisticated measure due to heterogeneity among older consumers (Nelson & Dannefer, 1992). Researchers have considered other age-related explanations of consumer behaviour such as cognitive, sociological and biological age (e.g. Evanschitzky & Woisetschläger, 2008), as well as the impact of life circumstances and events (Eastman & Liu, 2012; Mathur et al., 2003, 2008). However, as Zniva and Weitzl (2016) indicate these alternative measures are used sparingly across studies and it is not clear whether research using chronological age is sufficient to establish generalisations about age-related loyalty.

Given the need for improved understanding of how age influences consumer behaviour, the relative lack of prior research, presence of contradictory findings, potential for confounding influences, and questions over the most appropriate measure of age-related differences, the present research seeks to resolve these past uncertainties and thereby encourage fresh research into age-related loyalty. It does so by adding (i) substantive new evidence and (ii) addressing two key methodological concerns that contribute to uncertainty about prior findings in age-related loyalty. Specifically, the research addresses the following questions:

RQ1: Does brand loyalty differ between older and younger consumers in low-involvement categories, once the potentially confounding effects of category buying rates and brand shares are taken into account?

RQ2: Which measures of age best describes patterns of brand loyalty for older consumers?

Using an online survey (n=1,862) we therefore investigate age-related loyalty patterns for store and product choice, using three low-involvement categories: supermarket store choice, toothpaste and fruit juice. Loyalty patterns are explored using benchmarks from the NBD-Dirichlet (Dirichlet) model, a commonly used stochastic model that describes purchasing in a stationary and unsegmented market (Ehrenberg et al., 2004; Goodhardt et al., 1984). As mentioned earlier, the descriptive brand performance metrics typically reported when using the Dirichlet model (see. Table 14) are dependent upon both the frequency with which the category is purchased and also the number and market shares of competing brands in the category.

To overcome these potential confounds we report a loyalty measure that is independent of category purchasing rates and individual market shares; the polarisation index (ϕ). We then compare results for ϕ across alternative age measures (chronological, cognitive, sociological and biological age) as well as household lifecycle (HLC) to determine which measure best captures variations in brand loyalty between age segments.

Consistent with previous literature we find that brand loyalty remains relatively low for all chronological age groups, with most consumers regularly switching between a portfolio (repertoire) of brands. However, unlike previous research, results do show differences in brand loyalty across age groups for two of the three low-involvement categories studied, suggesting that prior conflicting results may be in part due to confounding factors in the methods used. While age-related differences in brand loyalty are broadly present for all alternative age measures, none consistently outperform chronological age in detecting variations in loyalty. These results provide fresh evidence on the relationship between age and loyalty and provide a methodological blueprint for future age-related research – that is, the measurement of loyalty through the polarisation index (ϕ), and confidence in the use of chronological age as a measure.

4.2 Literature Review

4.2.1 Age-related patterns of purchasing

The first comprehensive analysis of the influence of age on consumer purchasing was the examination of repeat purchase rates for automobiles by Lambert-Pandraud et al. (2005). Results from 28,913 French car buyers revealed higher brand loyalty among older consumers who repurchased their previous car brand more often than younger consumers. Specifically, 42% of under 40 year-olds repurchased their previous brand, compared to 54% for the 40-59 year-olds, 66% for the 60-74 year-olds, and 72% for the over 74 year-olds. Evanschitzky and Woisetschläger (2008) found similar results with data from 988 German respondents, confirming that chronological age had a positive influence on brand loyalty in the automobile category. A subsequent study of the French perfume market found older women also remain more attached to their previously purchased brand while younger women were more innovative consumers who switched more frequently between perfume brands (Lambert-Pandraud & Laurent, 2010). The findings in the French perfume market show age-related

differences in brand loyalty are likely to occur in multiple high-involvement categories, and are not confined to automobiles.

However, age-related differences in brand loyalty have not been detected for BPMs in studies of low-involvement purchase categories. While research confirms the presence of age-related differences in the *frequency* with which consumers purchase low-involvement categories, the *brand loyalty* patterns within such categories typically do not differ across age groups (Singh et al., 2012; Uncles & Ehrenberg, 1990a; Uncles & Lee, 2006; Yang, Zhou, et al., 2005).

For example, Uncles and Ehrenberg (1990a) discovered that the portfolio size (number of brands purchased) of older consumers is similar to younger consumers once adjusted for differences in category buying rates. Uncles and Lee (2006) and Singh et al. (2012) demonstrated that brand choice does not vary with age as leading brands (in terms of market share) are consistent across age groups. Additionally, these authors reveal similar Double Jeopardy patterns are present for each age group; that is, brands with smaller market shares have fewer buyers who tend to purchase the brand slightly less frequently. Double Jeopardy is a lawlike pattern reported across many product categories, countries, and time periods (Ehrenberg et al., 1990; Sharp, 2010; Wright et al., 1998), so the existence of consistent Double Jeopardy patterns found across all age groups indicates each age-group continues to exhibit typical loyalty.

4.2.2 Measuring behavioural loyalty

When examining age-related loyalty, the BPMs commonly obtained from panel data include market share, penetration, portfolio size, purchase frequency, share-of-category requirements and sole loyalty rates, with the latter three commonly reported as measures of brand loyalty (Ehrenberg et al., 2004). Analysis of BPMs reveal many lawlike patterns of buying behaviour observable across a wide range of product and service categories, countries, and time periods, including the Double Jeopardy pattern mentioned above and used in some previous studies to examine loyalty across age groups (Singh et al., 2012; Uncles & Lee, 2006). These lawlike patterns are consistently and accurately benchmarked through the application of the NBD-Dirichlet model of purchase incidence and brand choice (Goodhardt et al., 1984). The NBD component models category purchase rate as a mixed gamma-poisson process, with individual poisson purchasing means being gamma distributed across the population of

buyers. The Dirichlet (multivariate Beta) component models the distribution of brand choices, given that a category purchase is made, using the S parameter, calculated as the weighted mean of the sum of the parameters of the Beta distribution (α , β) for each brand.

The Dirichlet S parameter therefore represents the average consistency of choices (loyalty) across the whole category and population studied. This measure applies irrespective of the category purchase rate (NBD parameters) or particular brand (market share). The BPMs used in prior studies therefore do not provide a pure measure of loyalty, but instead represent the expression of underlying loyalty (S parameter) for a particular category purchase rate and particular set of market shares. Hence comparisons of BPMs are not true measures of differences in underlying loyalty as they may be confounded by any differences in category purchase rates and market shares between age groups. In contrast, comparisons between age groups using the S parameter directly as a measure of loyalty would not be subject to any such confounds.

The S parameter is nonetheless somewhat cumbersome. It ranges from zero to infinity, with a value of zero indicating individual brand choice is totally consistent and every buyer is 100% loyal to a single brand, and a value of infinity indicating that individual brand choice constantly changes with no consistency (loyalty) whatsoever. It is useful to transform S into the more intuitive measure φ , known as the *polarisation index*, as follows:

$$\varphi = \frac{1}{1 + S} \quad \text{where } 0 \leq \varphi \leq 1$$

In contrast to the S parameter, φ ranges from zero to one, and so is more easily interpretable. If φ is zero, there is zero loyalty (maximum brand switching), whereas if φ is one there is 100% loyalty (no brand switching at all) – hence the closeness of φ to one indicate the degree of *polarisation* of loyalty. As with S, φ is independent of category purchase rates and unaffected by brand share.

φ was first used to analyse television program loyalty by Sabavala and Morrison (1977) and nowadays is regularly used to measure loyalty in the wine industry (Casini et al., 2009; Corsi et al., 2011; Jarvis & Goodman, 2005; Jarvis et al., 2007; Krystallis & Chrysochou, 2010). Studies have also measured φ in other FMCG categories, such as dairy products, cigarettes, soft drinks and healthy food (Anesbury, Nguyen, et al., 2018; Krystallis, 2013; Krystallis & Chrysochou, 2011; Sjoström et al., 2014). While φ is easily derived from the Dirichlet S parameter, it also represents a transformation of the Hendry model switching

constant, the Bass correlation measure, and the parameters of the Beta distribution (Sabavala & Morrison, 1977) and so can be seen a more general expression of the probabilistic choices widely found in the study of buyer behaviour.

Should age-related loyalty be present, older age-segments would have a higher value of φ than younger age-segments. How this would translate into changes to observed BPMs is illustrated below by simulation, using the DIRICHLET program (Kearns, 2009) to generate theoretical BPMs for different values of φ for the average brand in one of the studied age groups (Table 13). In this simulation only φ varies, and not category purchase rate or market share, to give an intuitive demonstration of how BPMs change with φ while confounding factors are held constant.

Table 13: Relationship between φ , S and Dirichlet BPMs for toothpaste (under 40 year-olds)

φ	S	Dirichlet BPMs for the average brand			
		Repeat buying (%)	Portfolio size	Purchase frequency	Sole loyalty (%)
0.01	99.00	48	2.7	1.5	4
0.10	9.00	55	2.5	1.7	5
0.20	4.00	61	2.2	1.8	7
0.30	2.33	66	2.0	2.1	11
0.40	1.50	70	1.9	2.3	15
0.50	1.00	74	1.7	2.5	21
0.60	0.67	78	1.5	2.8	29
0.70	0.43	82	1.4	3.1	41
0.80	0.25	86	1.2	3.5	55
0.90	0.11	92	1.1	4.0	74
0.99	0.01	97	1.0	4.6	97

The simulation illustrates that increases in φ affect loyalty-related BPMs to varying degrees. Changes in repeat buying and portfolio size are rather consistent with a 0.1 increase in φ resulting in roughly a 5% increase in repeat buying and 0.1 - 0.2 reduction in portfolio size for the simulated data. In contrast, purchase frequency and sole loyalty increase exponentially. For example, as φ increases from 0.10 to 0.20 there are small changes in purchase frequency (+0.1) and sole loyalty (+2%); however, as φ increases from 0.80 to 0.90 there are larger changes in purchase frequency (+0.5) and sole loyalty (+19%).

Clearly the polarisation index φ has attractive properties as a measure of loyalty, being easily calculated from the parameters of the Dirichlet model, theoretically accurate as a measure of underlying loyalty, and unaffected by confounding influences from differing

market shares and category purchase rates. The present study therefore adopts φ as the measure of loyalty.

4.2.3 Alternative age measures

Despite heavy use in consumer research, *chronological age* as a measure faces long-standing criticism due to heterogeneity in health and behaviour among older adults (Nelson & Dannefer, 1992). According to Moschis (2012), age-related changes in behaviour vary as individuals age psychologically, biologically, and socially at different rates and stages throughout their lifetime, leading to substantial differences between older adults. Some therefore argue that chronological age is an ineffective determinant of purchase behaviour (Ahmad, 2002; Barak & Schiffman, 1981). A few researchers apply alternative age measures, such as cognitive, sociological, and biological age (e.g. Evanschitzky & Woisetschläger, 2008), as well as life events (Eastman & Liu, 2012; Mathur et al., 2003, 2008) to predict purchase behaviour. A more recent literature review by Zniva and Weitzl (2016) highlights that these alternative age measures are used infrequently and suggests future work consider alternative age measures. Details of each age measure are provided below.

- *Cognitive age* is a self-reported measure based on the age a person feels, looks, acts, and their perceived interests (Barak & Schiffman, 1981) with most adults reporting they feel younger than their chronological age (Mathur & Moschis, 2005). Marketers have occasionally applied cognitive age as an alternative to chronological age in predicting consumer behaviour (Evanschitzky & Woisetschläger, 2008; Mathur & Moschis, 2005; Szmigin & Carrigan, 2000; Teller et al., 2013). In particular, Evanschitzky and Woisetschläger (2008) found cognitive age has a positive influence on brand loyalty. However, cognitive age may not provide better predictive power than chronological age as they are highly correlated (Evanschitzky & Woisetschläger, 2008).
- *Biological age* reflects declines in physiological abilities over time due to accumulated damage to the cells and tissues within the body (Adams & White, 2004; Moschis, 2012). Biological changes in later life can involve declines in hearing and vision, and onset of chronic conditions and diseases, and is regularly measured through self-reported health status (Zniva & Weitzl, 2016). For example, Evanschitzky and Woisetschläger (2008) measured biological age using self-reported responses on difficulties in mobility; however, they found biological age did not have a significant impact brand loyalty in the automobile category. An alternative method is to measure biological age through objective reports of health status

(Zniva & Weitzl, 2016) such as lengthy hospitalization or rehabilitation, hearing impairment, assistance in day-to-day living, diagnosis of a chronic condition or long-term illness, and eye issues (Mathur and Moschis (2005).

- *Social age* represents changes to the roles and relationships that adults experience later in life (Moschis, 2012) leading to reductions in social network size (Carstensen, 1992; Lang & Carstensen, 1994). Reductions in social network size result in less word-of-mouth and subsequently impact decision-making and purchase behaviour (East et al., 2014). While marketers have rarely investigated the impact of *social age* on consumer behaviour (Zniva & Weitzl, 2016) it can be measured through the frequency and impact of social interactions (Evanschitzky and Woisetschläger (2008).
- *Life events* consist of expected (e.g. retirement, empty nest) and unexpected (e.g. death of a spouse, major accident) life-altering events associated with ageing (Moschis, 2012; Zniva & Weitzl, 2016). As adults experience such events they tend to shift into older age-related roles that also impact the psychological, biological, and social ageing dimensions (Moschis, 2012; Zniva & Weitzl, 2016). Studies by Mathur et al. (2003, 2008) demonstrate that life events can cause stress and altered brand preferences. Other studies measure similar effects by examining how household lifecycle (HLC) affects loyalty patterns (e.g. Trinh et al., 2014), as this efficiently captures many life events (e.g. Birth of children, empty nest, and retirement) and therefore presents a simplified measure for comparison against other age measures.

In summary, age-related differences in loyalty are limited to a small number of studies over the last 30 years with contradictory results. The lack of literature, potential confounding effects of category purchase rates and market shares on loyalty-related BPMs, and the unquestioning use of chronological age in the face of widespread criticism, all justify the need for further research.

4.3 Methodology

4.3.1 Data collection – online survey

Data were gathered from a cross-sectional online survey of the New Zealand public (n=1,862) with respondents recruited by a commercial panel provider. Respondent demographics were subject to quota selection to ensure the sample is broadly representative of the New Zealand population with respondents ranging between 18 and 96 years of age.

Respondents were questioned about their purchasing in three categories using the Juster scale, an eleven-point purchase probability scale that has multiple visual, verbal, and

numeric cues. The scale was developed by the US Bureau of the Census (Juster, 1966) and has since been subject to many further applications and tests (e.g. Day et al., 1991; Gabor & Granger, 1972; Wright & MacRae, 2007). It is a prospective, prompted, scale that seeks considered reports of underlying purchase propensities. The scale is therefore less subject than other methods to recall biases, such as telescoping of recalled events forward or backward in time, over-reporting from clumping of adjacent time periods together, or under-reporting due to memory decay. Meta-analysis demonstrates Juster estimates of demand are unbiased with relatively low dispersion for established products and services (Wright & MacRae, 2007), while comparison of Juster-based market statistics to corresponding panel data shows them to be accurate as well as sufficient to estimate the Dirichlet model (Wright et al., 2002).

Shopper panel data does not contain measures of cognitive, social, or biological age required for this study, so a survey is optimal for collecting data on these various age measures. The use of Wright et al.'s (2002) method for calculating BPMs from Juster-based inputs allows direct comparison of age measures and BPMs *for the same respondents*. The use of Juster-based inputs follows precedent as both Uncles and Lee (2006) and Singh et al. (2012) applied this method of data collection to study age-related loyalty. For formulas of the Juster-based estimators for BPMs, and for detailed empirical validation of these formulas, see Wright et al. (2002).

4.3.2 Product categories and behavioural loyalty measures

Three categories are investigated; toothpaste, fruit juice, and supermarket store choice. In each category, respondents are asked to provide Juster-based probabilities of purchase and most likely purchase frequencies for the five leading brands and 'any other' brands. Supermarket patronage and fruit juice purchases are framed as likelihoods over a four-week period and toothpaste purchases are framed as likelihoods over a three-month period. The timeframes selected are based on the purchase incidence of each category and the recommendation by Uncles and Lee (2006) to measure purchase probabilities over slightly longer time periods. The toothpaste category is chosen as it was studied by Singh et al. (2012), while fruit juice and supermarket store choice provide an extension of prior work by using categories not yet investigated, and in the case of supermarkets also represent the first study of age-related loyalty in supermarket store choice.

The BPMs investigated are market share, brand penetration, and purchase frequency, all based on purchase occasions. Average portfolio size is also reported, calculated as the sum of all brand penetrations. While shopping data may be subject to debate over the most appropriate aggregation of pack sizes and purchase quantities, and differences between the buyer and the user, the approach taken here - to measure purchase occasions by the buyer - are standard in panel data analysis.

The common methods used to fit the Dirichlet model and deriving theoretical norms are from either individual panel data records using the BUYER software (Uncles, 1989), counts of purchase frequencies using maximum likelihood iteration in EXCEL (Rungie, 2003), or aggregate market statistics using the DIRICHLET software (Kearns, 2009). The DIRICHLET software is the most commonly applied in practice and is suitable for Juster-based estimates of BPMs. ‘Theoretical’ Dirichlet BPMs are therefore estimated using DIRICHLET from penetrations and average purchase frequencies for the overall category and for each brand, repeated for each age group. The Dirichlet S parameter, used to calculate ϕ , is obtained as described earlier from the Beta distribution estimated for each brand.

4.3.3 Selection of age groups and age measures

For *chronological age*, the present study adopts the three groupings used by Uncles and Lee (2006); 39 years and below, 40-59 years, and 60-74 years, as well as an additional 75 years and above age group used by Lambert-Pandraud et al. (2005) to represent “old-old” consumers. The inclusion of the “old-old” is in line with the recommendation by Cole et al. (2008) of adjusting the age categories as people live, work, and stay active longer nowadays.

Cognitive age is measured using a multi-dimensional scale developed by Barak and Schiffman (1981) that asks respondents to select the age they ‘feel’, ‘look’, ‘act’, and perceive their ‘interests’ reflect. Each dimension is recorded on an ordinal scale inclusive of ten-year age-decade reference groups ranging from ‘teens’ to ‘90s’.

Biological age is measured through Mathur and Moschis (2005) approach to recording experienced biological life events. Respondents indicate whether they have personally experienced lengthy hospitalisation or rehabilitation, hearing impairment, an eye problem that cannot be corrected with glasses, needed assistance in day-to-day living, or been

diagnosed with a chronic condition or long-term illness. A summated 0-5 point age index is used to represent an individual's biological age (Mathur & Moschis, 2005).

Social age is measured following the approach developed by Carstensen (1992) and subsequently amended by Evanschitzky and Woisetschläger (2008). Respondents report the degree of emotional closeness, satisfaction, and frequency of interactions they have with family members, friends, and colleagues on 7-point Likert scales (Evanschitzky & Woisetschläger, 2008). Responses across the Likert scales are summed to provide social age.

Life events are measured using an adjusted version of Murphy and Staple's (1979) household lifecycle. Respondents are split into four categories based on their age, marital and parental status. 'Pre-family' includes respondents under 35 years old, either single, married or living with a partner, with no dependent children; 'family' includes respondents under 65 years old, married or living with a partner, with dependent children; 'post/no family' includes respondents 35 years and above, married or living with a partner, with no dependent children; and 'single elderly' includes respondents 65 years and above, single, separated, widowed, or divorced, with no dependent children. While the traditional HLC is becoming less relevant due to an increase in non-traditional households, such as single parent households (Wilkes, 1995), most respondents fall within the four HLC categories used. Respondents that do not fall within the four categories are removed from the HLC analysis due to insufficient group sample sizes – there are not enough of them to provide a meaningful analysis.

4.3.4 Analytical approach

The first task is to replicate prior work by Uncles and Lee (2006) and Singh et al. (2012) comparing BPMs obtained from the NBD-Dirichlet model using probabilistic Juster-scale estimators across chronological age groups (RQ1). Next, prior research is extended through application of polarisation index ϕ to chronological age groups to assess whether controlling for in category purchase rates and market shares leads to any different conclusions (RQ1). Finally, the analysis of ϕ is extended to alternative age measures to determine which best captures the maximum variation in loyalty present for different groups (RQ2).

Studies of age-related effects are also potentially subject to confounding influences from cohort membership and the specific time period chosen (Jaspers & Pieters, 2014; Rentz & Reynolds, 1981; Yoon et al., 2009). For example, loyalty found for people born in the

1950's could be due to age, but also cohort effects for 50's baby boomers or history effects related to the specific time period for which data is collected. The present design controls for history effects as the survey timing does not differ between age groups; however, it does not directly control for cohort effects. To the extent that core results from prior studies are replicated with the different time periods and countries studied, cohort effects can nonetheless be ruled out as an explanation for loyalty differences.

4.4 Results

4.4.1 Differences in category purchasing across age groups (RQ1)

Table 14 reports category purchasing statistics by chronological age group. Penetration rates do not vary much for supermarket store choice, although there are differences across age groups for the toothpaste and fruit juice categories. Conversely, average category purchase frequency and portfolio size get progressively smaller across the age groups, in all three categories.

Table 14: Category performance measures across chronological age groups

Age Groups	n	Category Penetration (%)	Ave. category purchase frequency	Average Portfolio Size
<i>Supermarkets (next 4 weeks)</i>				
<40 years	416	100	9.9	2.9
40-59 years	484	99	9.3	2.6
60-74 years	503	99	9.0	2.3
>74 years	494	99	8.6	2.2
Average		99	9.2	2.5
<i>Toothpaste (next 3 months)</i>				
<40 years	416	98	4.6	2.7
40-59 years	484	96	4.1	2.4
60-74 years	503	94	3.1	1.8
>74 years	494	90	2.9	1.7
Average		94	5.6	2.2
<i>Fruit Juice (next 4 weeks)</i>				
<40 years	416	88	5.6	2.9
40-59 years	484	83	4.5	2.6
60-74 years	503	66	3.1	2.1
>74 years	494	66	3.2	2.0
Average		76	4.1	2.4

The source of age-related differences in purchase frequency is unknown. One explanation is the reduction of household sizes across age groups in the sample (Uncles & Ehrenberg, 1990a). The average household size varied from 3.4 persons for the under 40 year-olds to 3.0 persons for the 40-59 year-olds, 2.0 persons for the 60-74 year-olds, and finally 1.7 persons for the over 74 year-olds. Another possible reason is that older consumers have difficulty accessing supermarkets (Meneely et al., 2009). Difficulty accessing retailers would affect supermarket patronage and subsequently the purchase frequency of products sold within the supermarkets.

Smaller portfolio sizes among older consumers indicate less brand switching and so could superficially be interpreted as evidence of age-related loyalty. However, a competing explanation can be found in lower category purchase frequencies among older consumers, as research shows that portfolio size decreases as the category buying rate declines (Banelis et al., 2013). As the older age groups buy from categories less frequently, there is less opportunity to switch brands, leading to smaller portfolios than found in younger age groups. Thus, patterns in portfolio size highlight the difficulties of disentangling purchase rate and loyalty effects, emphasising the need for a measure of loyalty that does not confound the two.

4.4.2 Differences in brand performance measures across age groups (RQ1)

The DIRICHLET program estimates the Dirichlet model from category penetration, category purchase rate, brand penetration and brand average purchase frequency. The fit of the model is typically assessed on the last two of these metrics. When examining brand performance measures, it is useful to first consider the overall fit of the Dirichlet model as well as the typical patterns of purchase loyalty present (Table 15). For each age group, fruit juice brands are listed in Juster-derived market share order with BPMs derived from the Juster scale (O) reported together with the corresponding theoretically predicted measures from DIRICHLET (T). BPMs are not reported for supermarket choice and toothpaste to avoid repetition of results as very similar patterns are observed in these categories.

Table 15: NBD-Dirichlet fit to brand performance measures by chronological age (fruit juice)

Age groups	Brands ranked by market share	Market share (%)	Brand Penetration (%)		Ave. purchase frequency	
		O	O	T	O	T
<i><40 years</i>	1st	30	62	63	2.4	2.4
	2nd	25	60	58	2.1	2.2
	3rd	20	50	51	2.0	1.9
	4th	10	26	33	1.9	1.5
	5th	9	32	30	1.4	1.5
	6th	5	21	19	1.1	1.3
	Average	17	42	42	1.8	1.8
<i>40-59 years</i>	1st	31	55	55	2.1	2.1
	2nd	28	52	53	2.0	2.0
	3rd	21	45	44	1.8	1.8
	4th	9	28	24	1.2	1.4
	5th	9	21	24	1.6	1.4
	6th	2	13	8	0.7	1.2
	Average	17	36	35	1.6	1.6
<i>60-74 years</i>	1st	33	38	39	1.8	1.7
	2nd	23	33	31	1.5	1.5
	3rd	16	27	23	1.2	1.4
	4th	15	15	23	2.1	1.4
	5th	11	19	17	1.1	1.3
	6th	2	6	4	0.8	1.1
	Average	17	23	23	1.4	1.4
<i>>74 years</i>	1st	35	40	41	1.9	1.8
	2nd	24	32	32	1.6	1.6
	3rd	16	26	24	1.3	1.4
	4th	12	17	20	1.5	1.4
	5th	12	14	19	1.8	1.4
	6th	1	5	3	0.6	1.1
	Average	17	22	23	1.4	1.5

Comparisons between observed and theoretical brand performance measures reveal Juster estimates strongly reflect theoretical expectations. The closeness of observed and theoretical penetration and purchase frequency values within each age group is consistent with findings in Australia and Japan by Uncles and Lee (2006) and Singh et al. (2012) respectively. Further, a clear Double Jeopardy pattern exists in each age group as brands with high market shares have a greater number of buyers (penetration) who purchase the brand slightly more often (purchase frequency) than brands with low market shares. The consistent

presence of the Double Jeopardy pattern across each age group shows that older consumers have similar within-category loyalty patterns to younger consumers. This pattern also occurs in the supermarket and toothpaste categories (not shown). Overall, the results demonstrate that observed measures derived from the Juster scale fit the Dirichlet theoretical norms and that each age group displays typical Dirichlet-like purchase and loyalty patterns.

Differences in the proportion of consumers purchasing the average brand are observed across age groups. For example, the average fruit juice brand is purchased by 42% of consumers aged under 40 years old, 36% of 40-59 year-olds, 23% of 60-74 year-olds, and 22% of over 74 year-olds. These differences in brand penetration are reflective of the decrease in category purchase rate across age groups (Table 15). In other words, a smaller proportion of older consumers (60 years and over) purchase fruit juice and this leads to a smaller proportion purchasing each brand. Age-related differences in category purchase rate similarly explain the decreasing purchase frequency across age groups for the average brand.

Turning to consider market leading brands, Table 16 displays the top six brands in market share order across each age group for the three categories. In each case, there is little change in the order across age groups. There are some exceptions, but these are minor; for example, PAK'nSAVE is ranked 2nd in terms of market share for the under 40 year-olds and 40-59 year-olds. However, it is ranked 3rd for the 60-74 year-olds and over 74 year-olds age, with New World holding greater market share among these older consumers. Minor differences in the fruit juice category are also reported with Just Juice ranked 1st for the two youngest age groups and 2nd for the two oldest age groups.

Table 16: Leading brands across age groups for all categories

Brands ranked by market share	Age Groups			
	<40 years	40-59 years	60-74 years	>74 years
<i>Supermarkets (next 4 weeks)</i>				
1st	36% Countdown	36% Countdown	35% Countdown	37% Countdown
2nd	32% PAK'nSAVE	29% PAK'nSAVE	31% New World	32% New World
3rd	15% New World	22% New World	26% PAK'nSAVE	23% PAK'nSAVE
4th	7% Four Square	5% Four Square	5% Four Square	4% Other
5th	5% Other	5% Other	3% Other	3% Four Square
6th	5% SuperValue	1% SuperValue	1% SuperValue	2% SuperValue
<i>Toothpaste (next 3 months)</i>				
1st	44% Colgate	46% Colgate	45% Colgate	47% Colgate
2nd	16% Macleans	19% Macleans	21% Macleans	21% Macleans
3rd	15% Sensodyne	14% Sensodyne	17% Sensodyne	17% Sensodyne
4th	11% Oral-B	8% Red Seal	7% Other	6% Oral-B
5th	9% Red Seal	8% Oral-B	5% Red Seal	5% Red Seal
6th	5% Other	4% Other	5% Oral-B	4% Other
<i>Fruit Juice (next 4 weeks)</i>				
1st	30% Just Juice	31% Just Juice	33% Keri	35% Keri
2nd	25% Keri	28% Keri	23% Just Juice	24% Just Juice
3rd	20% Fresh Up	21% Fresh Up	16% Fresh Up	16% Fresh Up
4th	10% Other	9% McCoy	15% Other	12% McCoy
5th	9% McCoy	9% Other	11% McCoy	12% Other
6th	5% Thexton's	2% Thexton's	2% Thexton's	1% Thexton's

The similarity in market shares among leading brands between age groups is consistent with prior research on age-related loyalty. The result is expected given research shows that competing brands have similar customer profiles (Anesbury et al., 2017; Hammond et al., 1996; Kennedy & Ehrenberg, 2001). Each brand has a similar proportion of younger and older consumers, as do their competitors, so a brand with a high market share in one age group is expected to have a similar market share in the other age groups. Overall, the similarity of leading brand market shares across all age groups provides evidence of no major age-related differences in brand loyalty patterns.

4.4.3 Polarisation index (ϕ) across chronological age groups (RQ1)

The analysis so far indicates that while age-related purchase patterns are consistent across age groups, there is mixed evidence given age-related differences in portfolio size but no age-

related differences to other patterns of loyalty. As noted earlier, differences in age-related loyalty could potentially be explained or indeed obscured as a function of the category buying rate and changes to the market share of individual brands. To overcome these potential confounds, Table 17 reports ϕ across chronological age groups for the three categories. When interpreting the polarisation index, recall that ϕ values close to one indicate high loyalty and limited brand switching.

Table 17: Polarisation index (ϕ) across chronological age

Age Groups	n	Supermarkets	Toothpaste	Fruit Juice
<40 years	416	.21 (.02)	.03 (.02)	.03 (.01)
40-59 years	484	.24 (.02)	.06 (.02)	.04 (.02)
60-74 years	503	.36 (.02)	.14 (.03)	.03 (.03)
>74 years	494	.35 (.02)	.20 (.04)	.05 (.03)

Note: Standard errors in parenthesis, calculated from software provided by Rungie *et al.* (2005) with n = group sample size, q = category purchase frequency (rounded), u = average brand market share (17%), and ϕ as reported.

The results in Table 17 reveal extremely clear patterns of age-related loyalty for the categories examined. Brand loyalty is low for all categories and age groups, as indicated by ϕ being less than 0.50 and close to zero in the case of fruit juice showing an absence of loyalty in this category. Low brand loyalty is expected as consumers tend to switch regularly between a portfolio of brands in low-involvement categories. Despite low loyalty, there are clear differences in ϕ across chronological age groups in the supermarket (0.21 to 0.35) and toothpaste (0.03 to 0.20) categories, while ϕ does not differ across age groups in the juice category. This indicates that older consumers are more loyal to supermarket and toothpaste brands than younger consumers even after controlling for category purchase rates and market shares.

The presence of age-related loyalty for low-involvement categories is confirmed for two out of the three categories investigated, and this includes the first reports in the literature on age-related loyalty for low-involvement products and store choice. Interestingly, using ϕ to control for decreasing toothpaste purchase rates across age groups revealed differences in brand loyalty not previously detected by Singh *et al.* (2012) for toothpaste purchases in Japan. While differences in the toothpaste markets between Japan and New Zealand may exist, the results highlight the advantage of ϕ for detecting age-related differences in loyalty not captured by examining BPMs directly. Conversely, the difference in portfolio size shown in

descriptive analysis of fruit juice is shown to be a function of category purchase rates and not a result of any differences in loyalty. No age-related differences are found for fruit juice; however, this can be accounted for by the absence of loyalty in that category. Before loyalty can differ, it must first be present.

4.4.4 Relationship between chronological age and alternative age measures (RQ2)

What about alternative age measures as explanations of age-related loyalty? Table 18 shows chronological age (mean = 57.1) has a strong positive correlation ($r=.85$, $p<.01$) with cognitive age (mean = 51.6), suggesting that as consumers age chronologically their perceived age also increases, albeit lagged by five and half years. Similar relationships between chronological and cognitive age are found in previous studies (Mathur & Moschis, 2005; Wilkes, 1995). Not surprisingly, the HLC stage is also highly correlated with chronological age ($r=.84$, $p<.01$) as people typically pass through life stages as they age chronologically. Chronological age is also positively correlated with biological age ($r=.31$, $p<.01$) and social age ($r=.16$, $p<.01$), demonstrating that people experience more biological life events and have fewer meaningful social interactions as they age.

Table 18: Correlation of age-related measures

	Chron. Age	Cog. Age	HLC Stage	Bio. Age	Soc. Age
Chron. Age	1				
Cog. Age	.849*	1			
HLC Stage	.841*	.731*	1		
Bio. Age	.309*	.359*	.300*	1	
Soc. Age	.160*	.186*	.222*	.171*	1

Note: * $p<0.01$

For ease of comparison with the chronological age groups reported earlier, each alternative age measure is also split into four groups for further analysis. Quartile groups are formed through box-and-whisker plots for cognitive and social age, while for biological and HLC measures groups were formed by combining sub-groups.

Table 19 reports the polarisation index across groups for each age measure, based on a separate estimation of the Dirichlet for each quartile group. The maximum difference reported in Table 19 highlights the variation in ϕ captured by each age measure – in effect the

discriminatory ability of the measures. This discriminatory ability is generally low indicating age-related loyalty effects are modest.

Table 19: Comparison of the polarisation index (ϕ) across age groups

Age Groups	n	Supermarkets	Toothpaste	Juice
<i>Chronological age</i>				
<40 years	416	.21 (.02)	.03 (.02)	.03 (.01)
40-59 years	484	.24 (.02)	.06 (.02)	.04 (.02)
60-74 years	503	.36 (.02)	.14 (.03)	.03 (.03)
>74 years	494	.35 (.02)	.20 (.04)	.05 (.03)
<i>Max difference</i>		.15	.18	.02
<i>Cognitive age</i>				
35 years and below	441	.19 (.02)	.02 (.02)	.02 (.02)
36 – 50 years	434	.30 (.02)	.09 (.03)	.05 (.02)
51 – 64 years	468	.36 (.02)	.12 (.03)	.04 (.03)
65 years and above	519	.37 (.02)	.19 (.03)	.04 (.03)
<i>Max difference</i>		.18	.16	0.03
<i>Household lifecycle</i>				
Pre-family	161	.21 (.03)	.03 (.03)	.03 (.02)
Family	412	.22 (.02)	.04 (.02)	.03 (.02)
Post/no Family	628	.35 (.02)	.16 (.04)	.03 (.02)
Single Elderly	266	.40 (.04)	.17 (.05)	.07 (.04)
<i>Max difference</i>		.19	.14	0.04
<i>Biological age</i>				
0	797	.26 (.02)	.06 (.02)	.03 (.02)
1	463	.30 (.02)	.08 (.03)	.03 (.02)
2	321	.33 (.03)	.13 (.03)	.04 (.03)
3+	281	.36 (.03)	.12 (.03)	.11 (.03)
<i>Max difference</i>		.09	.07	.08
<i>Social Age</i>				
Quartile 1 (youngest)	467	.25 (.02)	.10 (.02)	.03 (.02)
Quartile 2	493	.30 (.02)	.10 (.02)	.04 (.02)
Quartile 3	474	.33 (.02)	.10 (.03)	.04 (.03)
Quartile 4 (oldest)	428	.34 (.03)	.03 (.03)	.02 (.02)
<i>Max difference</i>		.10	.07	.01

Note: Number may vary from individual age groups due to rounding. Standard errors in parenthesis.

Although loyalty remains low for all categories and all age groups, these findings suggest that as consumers' age chronologically and cognitively, as well as progressing through stages in the HLC, they become increasingly loyal towards supermarket choice and toothpaste brands. Decreased mobility and access to supermarkets and fewer suitable toothpaste options as older adults require dentures may be plausible reasons for greater

loyalty among older consumers in the respective categories. In the case of juice, no age measures appear to detect any large differences in ϕ across age groups. This suggests that no ageing process affects loyalty for juice brands as there does not appear to be any loyalty in this category.

Further examination of the performance of alternative age-group measures describing age-related loyalty is therefore restricted to the supermarket and toothpaste categories. Chronological age, cognitive age, and HLC exhibit similar variation in ϕ between age groups for both the supermarket category (0.15, 0.18, and 0.19 respectively) and toothpaste category (0.18, 0.16, 0.14 respectively). The consistency is not surprising given the strong correlation between these measures (Table 18). In contrast, biological age and social age exhibit lower variation in ϕ for both the supermarket category (0.09 and 0.10 respectively) and toothpaste category (0.07 and 0.07 respectively).

Thus, chronological and cognitive age, as well as HLC are the best discriminators of age-related loyalty patterns, while biological and social age are the worst. Interestingly, despite the literature suggesting that chronological age is an unsophisticated age measure, no alternative age measures appear to provide better discrimination of age-related loyalty patterns. As no age measure detects age-related loyalty for juice, the findings further suggest that age-related loyalty may be category specific, even within low-involvement categories.

4.5 Discussion and implications

4.5.1 Discussion

The present research extends studies by Uncles and Lee (2006) and Singh et al. (2012) that cast doubt on the impact of chronological age on brand loyalty. Extensions to these studies are made in two important ways. First, through application of the polarisation index as a loyalty measure independent of category purchase rates and market shares. Second, through examination of whether alternative age measures (cognitive age, biological age, social age, and HLC) are any better as discriminators of loyalty differences than is chronological age.

To ensure differences in results were not due to differences in method, the analysis first confirmed that the original findings of Uncles and Lee (2006) and Singh et al. (2012) could be reproduced using the same methods. This allowed demonstration of the presence of age-related differences in category purchase patterns and brand performance measures in our

data, as well as similarity in Double Jeopardy patterns and consistency in leading brands across the four chronological age groups. The similarity of results across widely separate countries and time periods also allows the exclusion of cohort effects as an explanation of the results. Nonetheless, as with prior studies, age-related differences in category purchase rates and variations in market share could not be ruled out as explanations of the observed differences in brand performance measures.

However, use of the polarisation index (φ) to address the potential confounding influences revealed that older consumers *are* more loyal than younger consumers in the supermarket and toothpaste categories, even though overall levels of loyalty were low. The result supports previous findings of age-related loyalty in high-involvement product categories (Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005), as well as making several further novel contributions. First, it applies an approach to measuring age-related loyalty that is not confounded by differences in category purchase rates or market shares. Second, by applying this approach, it successfully identifies patterns of age-related brand loyalty that previous studies by Uncles and Lee (2006) and Singh et al. (2012) were unable to confirm. It is understandable that these prior studies failed to detect differing loyalty across age groups, as they had relied on descriptive measures such as portfolio size, purchase frequency and sole loyalty that are confounded by changes to category purchase rates and market shares. Third, it extends research on age-related loyalty to store choice and highlights the generalisability of these findings beyond product choice. Fourth, it demonstrates that loyalty can vary considerably between categories.

Another substantial contribution of the present research is the assessment of the relative discriminatory ability of chronological age in identifying age-related loyalty patterns. The results for chronological age are similar to both cognitive age and HLC, whereas biological and social age are less effective at capturing age-related differences in loyalty. The poor performance of biological and social age suggests that changes in our ability to process information, or gather WOM, do not greatly impact age-related loyalty in low-involvement categories. Further, no alternative age measure performs better at predicting age-related loyalty to merit a major overhaul of age measurement. Therefore, our research indicates there is no need to develop and adopt more sophisticated age measures when predicting differences in loyalty. Chronological age is sufficient and in the absence of further evidence there is no reason to think that cognitive age and HLC capture any other constructs than those represented by chronological age.

4.5.2 Implications

As age-related loyalty differences are confirmed for two low-involvement categories, while the third category shows no loyalty for any age group, the basic result of age-related loyalty is more general than previously thought and so bears greater examination. The apparent previous disconfirmation of age-related differences in loyalty extending from high-involvement categories to low-involvement categories has now been partially reversed. Greater knowledge of loyalty patterns is now needed across a range of other categories to determine how widely these findings hold, and what natural variation in loyalty exists between categories. Further as chronological age captures age-related loyalty differences as well as any other age measure, it is sufficient for academics and practitioners to rely solely on chronological age when attempting to predict changes in loyalty (although cognitive age and household life cycle are acceptable substitutes). In contrast, the present results rule out biological or social age as superior explanations of age-related loyalty.

From a methodological perspective, a further contribution is the identification of an improved method to measure age-related loyalty. Applying the polarisation index across age groups avoids confounds from market share and category purchase rate effects. The methodology carried out in the present study should therefore be adopted in future studies in other categories and countries.

A managerial implication is that advertisers and marketing practitioners should not ignore the mature market as older consumers still purchase from a wide portfolio of brands. The evidence of older consumers regularly switching between multiple brands runs counter to negative stereotypes that older consumers are already highly loyal to well-established brands (Yoon & Cole, 2008). Instead, the research provides encouragement to actively market new products and brands towards the mature market. Marketing strategies for older consumers should be similar to younger consumers and brands need to ensure they develop product variations for their tastes and preferences, advertise in channels used by them, and ensure they are portrayed in advertising. The presence of age-related loyalty offers some reward for marketing efforts, while the low overall level of loyalty indicates that older consumers can still be induced to include other brands in their portfolio. Practitioners must gain a clear understanding of age-related loyalty in the industry in which they operate to ensure they develop effective strategies to target their customer base. Companies can use this knowledge

to form realistic expectations for entering the portfolio of older consumers and growing market share among this segment.

4.6 Limitations and future research

This research addresses calls for further investigation of age-related loyalty patterns, and whether alternative age measures are more accurate at predicting these patterns. It does so by investigating age-related loyalty in three low-involvement categories. Further work should consider applying the polarisation index to other categories, not just low-involvement categories as noted earlier, but also high-involvement categories as the present research found cross-category differences in age-related loyalty. Work should also be extended from physical products and store choice to services, as studies of age-related loyalty for service brands are lacking.

The close relationships between chronological age, cognitive age, and household life cycle raise questions about the underlying mechanism. The use of ϕ ruled out differing purchase rates through the HLC as an explanation for age-related loyalty. But perhaps HLC has a secondary effect, through reduced demand for variety, hence leading to more brand loyalty? This hypothesis, although appealing, does not account for differing loyalty in the supermarket category or the lack of loyalty in the juice category. Similarly, while reduced cognitive capability might be thought to account for age related loyalty, this hypothesis is inconsistent with the perception of cognitive age as being lower than chronological age, and with the finding that social and biological age have smaller effects on age-related loyalty. Perhaps experience, or inertia, is the common factor at play? Clearly, there are opportunities for more research into the precise mechanisms underlying age-related loyalty.

The present study uses a cross-sectional survey design. Age-related differences may in theory be confounded by cohort effects; however, the consistency in results across multiple time period and countries indicates rules out cohort effects as the explanation for the patterns of age-related loyalty observed. Nonetheless, another area for future research is to track how loyalty does change longitudinally as the same group of consumers age. This would require extensive (multi-year) longitudinal data that is not subject to too much panel attrition. Such data is challenging if not impossible to obtain from consumer panels, however, it may be

available in specialist areas such as pharmaceutical prescribing or public health cohort studies.

A final avenue for future research is to explore where in the sales funnel age-related differences occur. The current study demonstrates that older consumers are more loyal and have smaller portfolios of brands, and so switch between fewer supermarket and toothpaste brands than younger consumers. However, it is not clear whether older consumers have smaller portfolios of brands because they also have smaller awareness and consideration sets. If age-related differences are occurring at an awareness level, this will indicate underlying reasons why older consumers are more brand loyal in certain categories, and provide implications for practice. Investigating the impact of age on awareness and consideration sets will therefore highlight the relative importance of building mental availability among older consumers.



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Chapter 5: The influence of age on prescribing patterns: Do older physicians prescribe differently?

Chapter abstract

Study three (Chapter 4) found that brand loyalty for supermarket store choice and toothpaste increases across age groups. However, findings showed consumers displayed no loyalty for fruit juice, and thus no age-related differences in loyalty were detected in this category. These findings provide fresh evidence that age-related loyalty differences typically found for high-involvement categories also extend to some low-involvement categories (in this case supermarket store choice and toothpaste). While this finding indicates that older consumers are more loyal than younger consumers, it does not determine how the loyalty of individual adults changes as they age.

To address this gap and investigate how loyalty changes as adults' age, study four draws upon a pharmaceutical prescribing panel with over 2.7 million new or switch prescription decisions from 1,500 United Kingdom general practitioners between 1984 and 2010. A pharmaceutical panel is used for this study as consumer panels are typically subject to panel attrition and seldom provide extensive multi-year data that is required to detect the effects of any ageing mechanisms. This study begins by conducting cross-sectional comparisons of BPMs (armamentarium size and share-of-category requirements) across multiple prescription quantities and age groups. Controlling for various prescription quantities overcomes the potential confounds of prescribing rates. Then, the analysis tracks the prescribing of a sub-set of continuously reporting physicians (n=57) across a fifteen-year period.

The results from cross-sectional analysis indicate that prescription drug loyalty does not differ between older and younger physicians. However, as the number of prescriptions increase, all doctors tend to prescribe a wider variety of drugs and become less reliant on their core armamentarium. Findings from the longitudinal analysis confirms that as physicians age and accumulate prescribing experience they become less reliant on their core armamentarium and prescribe a greater variety of drugs. This demonstrates that cognitive decline does not cause physicians to become increasingly loyal in their prescribing habits as

they age. Rather, physicians appear to use their accumulated experience to become less reliant on their core armamentarium.

The finding that accumulated experience is the primary driver of age-related loyalty patterns is consistent with results of study two (Chapter 3). Although, accumulated experience causes physicians to become more disloyal, as opposed to more loyal as seen for consumers in low-involvement repertoire markets. This finding is valuable for marketers and suggests that the type of decision making employed, as well as the frequency at which these decisions are made, may influence age-related loyalty patterns.

Note: The following paper presented in this chapter is a working paper intended to be submitted to Social Science and Medicine (Cite Score 2020: 6.1, Impact Factor: 4.634, SCImago Journal Rank (SJR) 2020: 1.913).

5.1 Introduction

Healthcare systems worldwide are under ever increasing pressure due to changing demographics. Longer life expectancies, ageing baby-boomers, and declining birth rates will result in the world's population of over 60 year olds increasing to 1.4 billion by 2030 and 2.1 billion by 2050 (United Nations, 2015). One consequence is that physicians in developed countries are now working past the traditional retirement age of 65 (Hara et al., 2018; Silver et al., 2016). In 2015, nearly a quarter of licensed physicians in the United States were aged over 64 years (American Medical Association, 2015).

The ageing physician workforce raises questions about the impact of age on clinical performance. Numerous studies indicate that older physicians with more experience tend to perform worse on knowledge-based examinations, provide lower quality of care, and have worse patient outcomes than do their younger colleagues (see Choudhry et al., 2005 for a systematic review). A common explanation for the deterioration in medical knowledge, quality of care, and patient outcomes is age-related cognitive decline (Durning et al., 2010; Soonsawat et al., 2018). However, the effect of cognitive decline across individuals is highly variable and this suggests not all older physicians will experience substantial declines in clinical performance (Eva, 2002; Glisky, 2007). There is also research showing that physicians can compensate for declining cognitive performance by drawing on past experience to intuitively process information and make fast decisions (Eva, 2002; Soonsawat et al., 2018). The use of accumulated experience to compensate for declines in cognitive performance presents continual challenges for assessing the competency of ageing physicians (American Medical Association, 2015).

The analysis of prescription choice in the medical literature focuses predominately on therapy prescribing rates and rarely applies established benchmarks or considers loyalty to specific drugs; it therefore fails to effectively evaluate the complex interaction between age-related factors and prescribing decisions. Examination of the impact of age upon prescribing would benefit from more sophisticated analysis of patterns and loyalty metrics, such as those found in the consumer behaviour literature. Such brand performance measures (BPMs) include prescribing rates, portfolio (armamentarium) size, and share-of-category requirements (SCR). Therefore, this research investigates whether physician age affects prescribing behaviour by analysing data derived from a panel that includes records of over 2.7 million

new or switch prescription decisions from over 1500 GPs in the United Kingdom between 1984 and 2010.

The analysis is conducted in two stages. Stage one involves exploratory analysis to compare BPMs (armamentarium size and SCR) for the first 500 prescriptions (n=719) and 5000 prescriptions (n=159) written by physicians during the period. This analysis is then replicated for five different therapeutic classes using physicians' first 100 and 500 prescriptions in the respective classes. The different prescription quantities used to compare BPMs assesses how accumulated prescribing experience impacts loyalty patterns. Further breakdowns are also made by age groups (39 years and below, 40-49 years, and 50 years and above) to examine the effects of both ageing and accumulated experience on prescribing patterns. Stage two involves longitudinal analysis that tracks the prescribing of a sub-set of continuously reporting individual physicians (n=57) across a fifteen-year period from 1988 to 2002 to determine whether individual physicians change their prescribing behaviour and brand loyalty patterns as they age.

The research delivers important contributions to the medical and pharmaceutical literature as it provides a better understanding of how well-established loyalty benchmarks differ between the prescribing patterns of younger and older physicians. Analysing longitudinal changes in loyalty allows an assessment of whether these changes are a result of new drug launches over time, a natural ageing process, reduced prescribing rates, or increased experience with the category. Determining whether prescribing patterns change as physicians age and the underlying reasons for these changes will provide further evidence to medical professionals and policy makers on the need for competency screening of older physicians to minimise poor patient outcomes prevalent among this group (American Medical Association, 2015).

The longitudinal insights also have relevance for the general study of age-related consumer behaviour, as prior studies predominately incorporate cross-sectional designs that are subject to cohort effects. Consumer panels with multi-year data subject to minimal panel attrition are difficult to acquire and therefore longitudinal pharmaceutical data provides an optimal alternative to contribute to age-related consumer behaviour knowledge by disentangling age and cohort effects.

The rest of the article is organised as follows: We first review the medical literature on differing prescribing behaviours between younger and older physicians, followed by the

consumer behaviour literature to identify differences in brand choice between younger and older consumers. Next, we discuss potential explanations for differing prescribing patterns between younger and older physicians. We then outline the research questions, followed by an overview of the data set and method. The results of stage one and two are then reported, followed by the conclusion, implications, and further research avenues.

5.2 Prescribing behaviour of older physicians

There is extensive research that examines how a physician's age influences prescribing patterns and quality of patient care, and a systematic review of 62 studies undertaken by Choudhry et al. (2005) is a landmark paper in this field. We supplement an overview of Choudhry's work with more recent literature that continues to indicate older physicians with more experience tend to perform worse on knowledge-based examinations, provide lower quality of care, and have worse patient outcomes.

Research conclusively demonstrates that older physicians perform worse than younger physicians on medical and surgical knowledge assessments (Choudhry et al., 2005). For example, interviews of 76 surgeons and 46 anaesthesiologists by Salem-Schatz et al. (1990) revealed a significant negative association between age and knowledge of blood transfusion indications and risks. Younger physicians also have significantly greater knowledge of AIDS than older physicians (Gemson et al., 1991; Shapiro, 1989). The reduced knowledge among older physicians is primarily attributed to the decreased ability to acquire new or changing knowledge rather than the retention of their stable knowledge (Day et al., 1988). Ayanian et al. (1994) also demonstrate that older physicians are less knowledgeable about key advances in the treatment of myocardial infarctions and are more likely to believe in disproven therapies. This indicates that age-related differences in medical knowledge and prescribing patterns may be more pronounced in rapidly evolving therapeutic classes.

Research using actual prescribing data demonstrates that prescribing rates differ between younger and older physicians. Charles et al. (2006) discovered that for every 100 problems managed by physicians in Australia, older physicians had higher prescribing rates than younger physicians. Research in specific therapeutic classes also suggests that older physicians are more likely to prescribe chloramphenicol (Becker et al., 1971), and are more likely to prescribe antibiotics to elderly patients for acute upper respiratory tract infections

(Silverman et al., 2017). In contrast, some studies have indicated that older physicians are less likely to prescribe β -adrenergic blocking agents (Fehrenbach et al., 2001) and aspirin (Beaulieu et al., 2001), while Beaulieu et al. (2001) found no effect of physicians age on the prescribing rates of β -blockers or lipid-lowering agents. The mixed findings demonstrate that age-related differences in prescription rates are influenced by the therapeutic class prescribed suggesting that we may find BPMs are similarly influenced by the type of drugs prescribed.

A more recent literature review on the adoption of new-to-market drugs by Lubl y (2014) revealed mixed evidence regarding the influence of age on innovative prescribing behaviour. Most studies have found that innovative, early adopters of new-to-market pharmaceuticals are younger or more recent medical school graduates (e.g. Bourke & Roper, 2012; Glass & Rosenthal, 2005; Lo-Ciganic et al., 2016; Van den Bulte & Lilien, 2001). In contrast, other studies have found early adopters are more likely to comprise of older, more experienced physicians (e.g. Groves et al., 2010) or that no significant relationship exists between age and innovative adoption (e.g. Corrigan & Glass, 2005; Steffensen et al., 1999).

Studies have also identified that older physicians are more likely to prescribe inappropriate medication than younger physicians (Anderson et al., 1997; Beers et al., 1993; Cadieux et al., 2007; Dhalla et al., 2002; Stolley et al., 1972). For example, using a criteria developed by Beers et al. (1991), Anderson et al. (1997) identified seven drugs across four categories (antidepressants, oral hypoglycemic agents, sedative hypnotic drugs, and non-steroidal anti-inflammatories) that an expert panel agreed should be avoided in the elderly. Across these four categories, older physicians had higher rates of inappropriate drug prescribing compared to younger physicians, with the largest difference found for sedative hypnotics. However, contrasting results were discovered by Epstein et al. (2001) and Roy-Byrne et al. (2002) as physicians age did not affect prescribing patterns for depression and panic disorders, respectively.

A physician's age is also linked to a lower quality of patient care (Epstein et al., 2008) and higher mortality rates (Hartz et al., 1999; Norcini et al., 2000; Tsugawa et al., 2017). For example, when treating patients with acute myocardial infarction, Norcini et al. (2000) discovered that among 4,546 physicians, patient mortality rates increased by 0.5% for every year since a physician had graduated from medical school. Hartz et al. (1999) also found mortality rates from coronary bypass surgery increased with the age of the surgeon.

Overall, there is clear evidence that older physicians perform worse on knowledge-based assessments and that prescribing patterns differ between younger and older physicians, with older physicians more likely to prescribe inappropriate medication. Research also demonstrates physician age is associated with declining quality of patient care and increased mortality rates. However, as discussed previously, these studies do not examine well-established loyalty benchmarks that are known to be principal explanations of consumer choice. Assessment of BPMs such as armamentarium size and SCR across age groups will assist in determining whether loyalty patterns differ with a physician's age, and thus provide a possible explanation for changes in physician prescribing behaviour. To understand how loyalty patterns may differ across physician age groups we draw on findings from the consumer behaviour literature that assesses loyalty and purchase differences between older and younger consumers.

5.3 Consumer purchasing in the mature market

Increases in brand loyalty across age groups is known to be present in consumer markets, particularly 'high-involvement' categories such as cars and perfume. A comprehensive study by Lambert-Pandraud et al. (2005) using secondary survey data of 28,913 recent car buyers in France discovered higher brand loyalty among older consumers as they repurchased their previous car brand more often than younger consumers. Older consumers were also found to have a higher preference for well-established national car brands (Lambert-Pandraud et al., 2005). Confirmation of the positive influence age has on repeat buying rates and preferences for well-established car brands was found using a survey of 988 recent car buyers in Germany (Evanschitzky & Woisetschläger, 2008). Outside of the car market, Lambert-Pandraud and Laurent (2010) found that older consumers were less innovative than younger consumers as they were more likely to remain attached to their previously purchased brand (Lambert-Pandraud & Laurent, 2010). Research in the French perfume market demonstrated that age-related increases in loyalty are present in other high-involvement categories outside of cars and signal the possibility of similar behaviour among pharmaceutical prescribing.

While pharmaceutical prescribing involves patient health and is thought to utilise high-involvement decision making, physicians prescribe drugs at a much more frequent rate to which consumers buy from high-involvement categories. Physicians tend to prescribe at a frequency similar or greater to which consumers buy within low-involvement categories

where category experience is accumulated. This signals the importance of drawing upon consumer behaviour literature in low-involvement categories too. These studies reveal that age-related increases in brand loyalty seen in 'high-involvement' categories are not found in various 'low-involvement' categories, such as fast-moving consumer goods (FMCGs). Studies across a variety of fast-FMCG categories determine that older consumers have slightly smaller portfolio sizes than younger consumers (Uncles & Ehrenberg, 1990a; Yang, Zhou, et al., 2005), although this is due to older consumers having smaller household sizes and therefore purchasing products less frequently (Uncles & Ehrenberg, 1990a). When adjusting for category purchase rates, it was found that the portfolio size of older consumers was as large as younger consumers (Uncles & Ehrenberg, 1990a).

Comparisons of BPMs across a variety of low-involvement categories by Uncles and Lee (2006) and Singh et al. (2012) also found that category penetration (the proportion of people buying from a category at least once) and category purchase frequencies (the number of times the average consumer purchases from the category) differed across age groups in most categories. However, these studies found that within-category brand loyalty patterns and the market shares of the leading brands were consistent across all age groups (Singh et al., 2012; Uncles & Lee, 2006).

Analysis of consumers' consideration sets provides additional indication of category differences in how older and younger consumers make brand choices. Numerous studies of car purchases indicate that older consumers consider fewer brands than younger consumers prior to purchase (Evanschitzky & Woisetschläger, 2008; Lambert-Pandraud et al., 2005; Lapersonne et al., 1995; Maddox et al., 1978). In contrast, for low-involvement categories, Campbell (1969) found no relationship between age and consideration sets for toothpaste and laundry soap, while Gruca (1989) found a small insignificant relationship for coffee brands.

Overall, while a few studies have demonstrated age-related increases in brand loyalty for high-involvement categories, the evidence is inconclusive in low-involvement categories. If pharmaceutical prescribing requires high-involvement and deliberative decision making similar to that used for high-involvement purchases, the findings in consumer behaviour literature suggests that there may be age-related prescribing differences. However, if the accumulated experience gained by physicians results in decision making similar to that used for low-involvement purchases, then the findings in the consumer behaviour literature suggests that there will not be age-related prescribing differences.

5.4 Possible explanations for age-related differences in prescribing patterns

In this section we discuss three possible explanations (cognitive decline, accumulated experience, and usage decline) for age-related differences in pharmaceutical brand loyalty that are considered in this study. The three variables considered are regularly proposed as reasons for age-related differences in the medical and consumer behaviour literature and provide plausible explanations on how age affects the prescribing behaviour of physicians in the United Kingdom.

5.4.1 Cognitive decline

Cognitive decline is experienced by adults and involves continuous declines in speed of processing, working memory, and long-term memory across an adult's lifespan, beginning in the 20s (Park et al., 2002). Cognitive decline is commonly proposed to explain differences in physicians' knowledge and prescribing behaviour (Djulfegovic et al., 2014; Durning et al., 2010; Eva, 2002; Soonsawat et al., 2018). Computerised cognitive tests on 1,002 physicians and 581 other adults (control group) revealed a slight decline in cognitive performance of physicians from 30 to 60 years old, with more rapid declines experienced after 60 years old (Powell & Whitla, 1994). Research also indicates that a number of older physicians referred to medical boards for poor performance, inappropriate prescribing, or behaviour problems are cognitively impaired (Peisah & Wilhelm, 2007; Perry & Crean, 2005; Turnbull et al., 2006).

However, the effect of cognitive decline across individuals is highly variable and this would suggest that not all older physicians will make inferior prescribing decisions (Glisky, 2007). Research by Day et al. (1988) also highlights that cognitive decline has a minimal effect on "crystallised intelligence" gained through accumulated prescribing experience, but has a greater effect on the ability to acquire new or changing knowledge. This demonstrates that the ability to conduct analytical (deliberative) processing may decline as physicians age, while non-analytical processing (experience-based and habitual) may remain relatively stable across age (Eva, 2002).

The consumer behaviour literature also proposes cognitive decline as a likely explanation on why older consumers have smaller awareness sets (Lambert-Pandraud et al., 2018; Lambert-Pandraud et al., 2017) and consideration sets, as well as being more loyal to well-established brands (Lambert-Pandraud et al., 2005). In particular, cognitive decline is a

reason why consumers' ability to process information declines with age (Drolet et al., 2011; Phillips & Sternthal, 1977). It is expected that cognitive decline has a greater effect on older consumers' ability to process information in high-involvement categories as more deliberative processing is required compared to low-involvement categories where more habitual decision making is involved, albeit habitually polygamous, with loyalty to a repertoire of brands. Evidence in the automobile category supports this idea as older consumers are found to gather and process less information by considering fewer car brands, dealers and models before purchasing a new car (Evanschitzky & Woisetschläger, 2008; Furse et al., 1984; Johnson, 1990; Lambert-Pandraud et al., 2005; Maddox et al., 1978; Srinivasan & Ratchford, 1991).

The medical and consumer behaviour literature indicates that cognitive decline will likely impact physicians prescribing patterns. Older physicians are likely to show declines in their ability to process new drug information and consider new alternatives in a similar way that consumers information processing ability and consideration of recent (new) brands declines with age. Therefore, cognitive decline may mean that older physicians are less likely to prescribe new drugs and instead remain more reliant on previously prescribed drugs.

5.4.2 Accumulated experience

Another plausible explanation for why prescribing patterns may (or may not) differ with age is accumulated experience. As physicians age they will have prescribed more drugs, as well as being exposed to more information on each drug and receiving greater word-of-mouth advice from colleagues. This accumulated experience allows physicians to gain what is known as "crystallized intelligence" (Salthouse, 2012).

Research suggests that older physicians tend to rely more on intuitive processing, by drawing on this accumulated experience to compensate for cognitive decline (Eva, 2002; Soonsawat et al., 2018). For example, when presented with minimal case histories of patients and asked to provide a diagnosis, older and more experienced physicians were found to provide more accurate diagnoses than younger physicians (Hobus et al., 1987). This may be a result of the assertion that diagnostic decisions comprise of rapid and unconscious matching of patient problems to past diagnoses, which involves intuitive processing that benefits from experience (Norman & Brooks, 1997). However, relying on experience can be detrimental because lower quality of care outcomes are associated with age (Choudhry et al., 2005), and

drug availability and treatment methods are constantly evolving, requiring physicians to spend time deliberating and processing new information.

The consumer behaviour literature also reveals that as consumers' age they gain crystallised intelligence through accumulated product related experiences such as advertising exposure, information searches, word-of-mouth, as well as past decision making and product usage. This accumulated experience leads to greater familiarity within certain product categories and the ability to reduce the cognitive load required for decision making (Alba & Hutchinson, 1987; Drolet et al., 2011). This allows decisions and tasks that typically require deliberative processing to become more automatic and intuitive (Alba & Hutchinson, 1987). As older physicians have greater prescribing expertise and are more familiar with the pharmaceutical category, this research hypothesises that older physicians may have smaller armamentarium sets and be more reliant on previously prescribed drugs than younger physicians.

5.4.3 Usage decline

Usage decline is another plausible explanation for differing prescribing patterns between older and younger physicians. Usage decline is commonly proposed in the consumer behaviour literature for age-related differences in BPMs such as portfolio size and SCR. For example, studies have found that older consumers have smaller portfolio sizes as a result of smaller household sizes and therefore buy from certain categories less frequently (Uncles & Ehrenberg, 1990a; Yang, Zhou, et al., 2005). Usage decline is likely to affect prescribing patterns in similar ways. For example, older physicians who are close to retirement are likely to take more time away from work and see fewer patients, and therefore have fewer opportunities to prescribe. Therefore, it is important that analysis in future studies control for differing prescribing rates between younger and older physicians.

5.5 Research Questions

Due to the absence of research applying well-established loyalty benchmarks to assess age-related differences in prescribing patterns, we draw on BPMs regularly used to evaluate consumer buying patterns and apply them to prescription data. This allows the present research to address the following questions:

RQ1: Does brand loyalty (armamentarium size and SCR) differ between older and younger physicians?

RQ2: How do loyalty prescribing patterns change as physicians age?

RQ3: What age-related mechanisms drive loyalty and prescribing patterns across age?

5.6 Data and method

The data set used in this study is derived from a commercial panel of UK physicians operated by ISIS research, which became part of Synovate, but is no longer operating. This continuous longitudinal panel records all new and switch prescriptions between 1986 and 2010. The entire data set includes records of over 2.7 million new or switch prescriptions from over 1500 participating physicians across all the main therapeutic classes.

A restriction of the data set is that it does not record the age of each physician at the time of each prescription. However, for the purpose of this study an estimated age is inferred from the qualification decade of each physician and the elapsed time to the year each prescription is written. This method of calculating physician age is also used by Tamblyn et al. (2003) for their research on the adoption of new prescription drugs.

The following analysis is performed in two stages and uses different sub-sets of data from the entire panel. Stage one comprises of a cross-sectional analysis of BPMs (armamentarium size and SCR) across three age groups (39 years and below, 40-49 years, and 50 years and above) based on the age of physicians at their first recorded prescription. These BPMs are calculated across age groups using different prescription quantities. The first 500 and 5,000 new or switch prescriptions written by physicians are used for prescriptions across all therapeutic classes, while the first 100 and 500 prescriptions written are used in five specific therapeutic classes (anti-inflammatory and antirheumatics, psychoanaleptics, analgesics, drugs for acid related disorders, and calcium channel blockers). The comparison of BPMs across various prescription quantities provides an initial assessment of how accumulated experience influences prescribing patterns.

The mean average absolute deviations (MADs) are calculated across age groups for each BPM to provide a robust assessment of the differences in armamentarium size and SCR across age groups. The MAD calculates the average of the deviations for each age group's armamentarium size and SCR from the average armamentarium size and SCR, respectively. This method is regularly used to observe differences in brand user profiles across age groups

(Anesbury et al., 2017; Phua et al., 2020; Uncles et al., 2012), but also has validity in comparing BPMs across age groups.

Stage two involves longitudinal analysis of continuous prescribing by physicians (n=57) over a 15-year period from 1988 to 2002. To ensure sufficient prescribing data in each year, the longitudinal analysis is only performed on prescriptions written by physicians across all therapeutic classes. Similar to the cross-sectional analysis, armamentarium size and SCR are calculated at an individual level and averaged across the given year.

5.7 Results

5.7.1 Stage one: cross-sectional analysis of BPMs across age groups

Table 20 reports armamentarium size and SCR (top 1, 5 and 10 drugs) for the first 500 prescriptions written by 719 physicians and first 5,000 prescriptions written by 159 physicians. The results indicate that as the prescription quantity increases from 500 to 5,000, the average number of drugs prescribed (armamentarium size) by each physician increases considerably (141% increase) from 72 to 174. Whereas, the SCR for the top 1, 5 and 10 drugs all decrease by just over 15%. This demonstrates that as physicians prescribe more often and accumulate experience over time, their core armamentarium (top drugs prescribed) remains relatively stable despite prescribing a significantly greater range of drugs.

Table 20: Brand performance measures for first 500 and 5,000 prescriptions

Prescription Quantity	n	Portfolio Size	SCR (%)		
			Top 1	Top 5	Top 10
All Pharmaceuticals					
First 500	719	72	15	41	58
First 5,000	159	174	12	35	50
% Change		↑141%	↓17%	↓16%	↓15%

Next, we turn to consider how armamentarium size and SCR differ within specific therapeutic classes. Table 21 displays the armamentarium size and SCR (top 1, 2 and 5 drugs) for the first 100 and 500 prescriptions made by physicians in five therapeutic classes. Sample sizes range from 69 to 567 across the therapeutic classes and prescription quantities. On average, across the therapeutic classes, armamentarium sizes increase by 56% as the prescription quantity increases from 100 to 500 prescriptions, with all classes showing

relatively consistent increases in armamentarium sizes (ranging from 38% to 69%). For SCR, four out of five therapeutic classes show consistent declines for the top one (ranging from 8% to 20%), two (ranging from 5% to 17%), and five (ranging from 3% to 8%) drugs prescribed. For analgesics, the SCR measures do not decline across the prescription quantities despite the average number of analgesics prescribed by physicians increasing by 38%. While this suggests that loyalty to the core armamentarium remains stable across prescription quantity, it does not differ greatly from the small decreases in SCR found in the other four classes, nor does it indicate any meaningful increase in loyalty as physicians accumulate analgesic prescribing experience. Overall, the consistency of armamentarium and SCR changes across most therapeutic classes indicates that accumulated experience has similar effects on prescribing patterns irrespective of the type of illness and pharmaceutical category prescribed. The increase in armamentarium size and decrease in SCR as prescription quantities increase clearly indicates that accumulated experience does not cause physicians to increase their loyalty to their core armamentarium.

Table 21: Brand performance measures for first 100 and 500 category prescriptions

Prescription Quantity	n	Portfolio Size	SCR (%)		
			Top 1	Top 2	Top 5
Anti-inflammatory and antirheumatic drugs					
First 100	567	8.3	49	73	94
First 500	332	13.5	46	69	91
% Change		↑63%	↓8%	↓5%	↓3%
Psychoanaleptics (anti-depressants)					
First 100	539	9.5	44	65	90
First 500	161	16.1	35	55	84
% Change		↑69%	↓19%	↓15%	↓7%
Analgesics					
First 100	499	10.2	44	64	89
First 500	151	14.0	43	65	90
% Change		↑38%	↓0%	↑0%	↑1%
Drugs for acid disorders					
First 100	567	8.8	39	62	91
First 500	198	13.9	33	55	87
% Change		↑58%	↓15%	↓11%	↓5%
Calcium channel blockers					
First 100	404	9.1	40	63	90
First 500	69	13.9	32	52	82
% Change		↑53%	↓20%	↓17%	↓8%
Ave. % Change		↑56%	↓12%	↓10%	↓4%

To further consider how age influences prescribing patterns, Table 22 displays armamentarium size and SCR (top 1, 5 and 10 drugs) for the first 500 and 5,000 prescriptions across three age groups (39 years and below, 40-49 years, and 50 years and above)¹. The results indicate that armamentarium size and SCR measures remain extremely consistent across age groups for the first 500 prescriptions made by physicians. Similar consistency is also found in the BPMs across age groups for the first 5,000 prescriptions. The average MADs for the first 500 and 5,000 prescriptions confirm these findings as they are consistently below 3 points across the armamentarium size and SCR measures.

Table 22: Brand performance measures across age groups for all prescriptions

Age at first prescription	First 500					First 5,000				
	n	Port Size	SCR (%)			n	Port Size	SCR (%)		
			Top 1	Top 2	Top 10			Top 1	Top 2	Top 10
<i>All Pharmaceuticals</i>										
<40yrs	322	71	15	41	58	79	173	11	34	49
40-49yrs	268	73	15	42	59	64	176	13	35	50
50+yrs	129	72	14	41	58	16	172	15	38	52
<i>All doctors</i>	719	72	15	41	58	159	174	12	35	50
<i>Ave. MAD</i>		1	0	0	0		2	1	1	1

Table 23 provides further breakdowns across the five therapeutic classes assessed earlier. For each therapeutic class, there are no major observable differences in armamentarium size and SCR for the first 100 and 500 prescriptions. The MADs confirm the similarities in BPMs across age groups as they remain very low (5 points and below) across each therapeutic class and prescription quantity. This demonstrates that there are no age-related differences in loyalty patterns for physician prescribing behaviour. The consistency in BPMs across various therapeutic classes demonstrate that the type of illness and therapeutic class prescribed does not cause older physicians to prescribe differently to younger physicians. Furthermore, as the BPMs hold across age groups for various prescription quantities, the findings indicate that accumulated experience beginning at any age has a similar impact on prescribing patterns.

¹ Sub-analysis was also conducted using four age brackets (<40years, 40-49 years, 50-59 years, and 60+ years) where sufficient sample sizes allowed. The BPMs remained relatively consistent across age groups despite being subject to greater fluctuations due to smaller sample sizes.

Table 23: Brand performance measures across age groups and therapeutic classes

Age at first prescription	First 100					First 500				
	n	Port Size	SCR (%)			n	Port Size	SCR (%)		
			Top 1	Top 2	Top 5			Top 1	Top 2	Top 5
<i>Anti-inflammatory and antirheumatic drugs</i>										
<40yrs	299	8.1	50	74	94	139	13.3	45	69	91
40-49yrs	240	8.5	49	71	93	138	13.8	46	69	90
50+yrs	126	8.3	48	72	94	55	13.4	45	68	91
<i>All doctors</i>	665	8.3	49	73	94	332	13.5	46	69	91
<i>Ave. MAD</i>		0.2	0	1	1		0.2	1	1	0
<i>Psychoanaleptics (anti-depressants)</i>										
<40yrs	242	9.4	44	65	91	75	16.1	33	53	83
40-49yrs	204	9.7	43	64	90	66	16.2	37	56	84
50+yrs	93	9.5	45	66	90	20	15.8	38	59	85
<i>All doctors</i>	539	9.5	44	65	90	161	16.1	35	55	84
<i>Ave. MAD</i>		0.1	1	1	0		0.2	2	2	1
<i>Analgesics</i>										
<40yrs	220	10.2	44	65	89	62	14.7	43	65	89
40-49yrs	185	10.0	45	65	89	63	12.9	45	66	91
50+yrs	94	10.4	40	62	88	26	15.0	40	60	88
<i>All doctors</i>	499	10.2	44	64	89	151	14.0	43	65	90
<i>Ave. MAD</i>		0.1	2	1	0		0.9	2	2	1
<i>Drugs for acid disorders</i>										
<40yrs	258	8.8	39	62	92	96	13.8	33	55	87
40-49yrs	208	8.9	38	62	91	74	14.1	34	56	87
50+yrs	101	8.8	39	61	91	28	13.8	32	53	86
<i>All doctors</i>	567	8.8	39	62	91	198	13.9	33	55	87
<i>Ave. MAD</i>		0.1	0	0	0		0.1	1	1	0
<i>Calcium channel blockers</i>										
<40yrs	175	9.2	44	71	94	36	13.9	32	51	82
40-49yrs	159	8.9	36	57	87	23	14.1	33	53	83
50+yrs	70	9.2	40	63	89	10	13.4	32	53	84
<i>All doctors</i>	404	9.1	40	63	90	69	13.9	32	52	82
<i>Ave. MAD</i>		0.1	3	5	2		0.3	1	1	1

5.7.2 Stage two: Longitudinal analysis of BPMs across age

The analysis so far indicates that there are no differences in armamentarium size and SCR across age groups for drug prescribing by UK physicians. However, it does not reveal how prescribing behaviour changes as physicians age and therefore Table 24 reports longitudinal analysis that tracks the prescribing of individual physicians (n=57) across a fifteen-year period from 1988 to 2002.

Table 24 reports prescribing rates, armamentarium size and SCR for all prescriptions, rather than for specific therapeutic classes, as the prior results indicate that there are no age-

related differences across categories. Prescribing rates, armamentarium size and SCR are reported for all physicians, as well as for two age groups (under 45 years and 45 years and above) based on the age of each physician in 1988 at the beginning of the longitudinal comparisons.

Prescribing rates tend to increase steadily for the first eight or nine years before subsequently declining. For each year, older physicians (45 years and above) have greater prescribing rates than younger physicians (under 45 years). Armamentarium size tends to follow a similar increasing pattern as physicians age, with a slight decline at the end of the 15-year period as prescribing rates decline. Older physicians also have larger armamentarium sizes than younger physicians, indicating that they prescribe a greater variety of drugs each year. However, this is expected as prescribing rates are known to positively impact BPMs, such as portfolio size and SCR (Banelis et al., 2013; Trinh, 2014). In other words, because older physicians prescribe more drugs each year, they have a greater chance at prescribing a wider variety of drugs, thus resulting in a slightly greater armamentarium size than younger physicians.

Despite differing prescribing rates across the younger or older physicians, the SCR for the top 1, 5 and 10 drugs remain remarkably consistent across age groups. For both younger and older physicians, the SCR tends to gradually decline across the 15-year period. A plausible explanation for declining SCR as physicians age is that the pharmaceutical industry is rapidly evolving with numerous new drugs developed each year, causing physicians to adopt new drugs as they become available and thus relying less on their core armamentarium. Therefore, the growth in armamentarium size and decline in SCR provide no evidence of any increasing loyalty as physicians age and accumulate prescribing experience. Older physicians appear to have similar prescribing patterns as younger physicians and these patterns appear to change in a similar manner over time. Importantly, no increases in brand loyalty are witnessed as the older physicians group reach 60 years of age where declines in cognitive performance are more likely to occur.

Table 24: Longitudinal comparison of brand performance measures (1988 – 2002)

Year	Prescribing Rate			Port Size			SCR - Top 1 (%)			SCR - Top 5 (%)			SCR - Top 10 (%)		
	<45yrs	45+yrs	All	<45yrs	45+yrs	All	<45yrs	45+yrs	All	<45yrs	45+yrs	All	<45yrs	45+yrs	All
1988	392	481	422	54	56	54	19	17	18	49	48	49	66	66	66
1989	401	481	428	56	62	58	17	16	17	46	46	46	64	63	63
1990	394	482	423	56	64	59	16	15	15	45	44	44	63	61	62
1991	416	442	425	59	63	60	16	15	15	45	42	44	63	59	62
1992	416	493	441	59	63	61	16	16	16	46	43	45	62	60	62
1993	400	512	437	55	62	57	17	15	16	47	43	45	64	60	63
1994	404	512	440	60	70	64	16	14	16	46	40	44	63	58	61
1995	432	521	462	64	71	66	15	13	14	43	41	42	61	58	60
1996	420	544	461	65	74	68	14	12	13	41	40	41	57	57	57
1997	417	509	448	67	73	69	13	13	13	39	40	39	56	57	56
1998	400	479	427	66	71	68	13	12	13	39	39	39	57	56	57
1999	376	436	396	68	75	70	13	12	13	38	38	38	55	55	55
2000	352	372	359	63	68	64	12	11	12	38	38	38	56	55	56
2001	350	397	365	63	71	65	12	11	12	38	36	37	56	53	55
2002	332	360	341	58	66	61	14	12	13	41	38	40	59	55	58

Note: Physician age is calculated during 1988 and allocated to the under 45 years (n=38) and 45 years and above (n=19) age groups

5.8 Discussion

5.8.1 Conclusions

The present research applies well-established loyalty benchmarks to panel data comprising of new or switch prescriptions written by UK physicians. Cross-sectional comparisons of armamentarium size and SCR are made across multiple prescription quantities and age groups to determine whether brand loyalty differs between older and younger physicians (**RQ1**). Results from this study reveal that armamentarium size and SCR measures are similar across age groups, demonstrating that there are no prescription drug loyalty differences between older and younger physicians. The consistency in armamentarium size and SCR across age groups is found to hold across a wide variety of illnesses and therapeutic classes.

Next, this study uses longitudinal assessment of BPMs to determine how loyalty and prescribing patterns change as individual physicians age (**RQ2**). The longitudinal analysis demonstrates that there are no increases in loyalty to prescription drugs as individual physicians age. Despite the influence that yearly variations of prescribing rates have on armamentarium size, the general increase in armamentarium size across a majority of the 15-year period provides no evidence of increasing prescription drug loyalty as physicians age. Yearly comparisons of SCR measures (of the top 1, 5 and 10 drugs prescribed) also remain similar across age groups (under 45 years and 45 years and above), with a steady decline in SCR measures across the 15-year period as both younger and older physicians age. This confirms that as physicians age they become less reliant on their core armamentarium and prescribe a greater variety of drugs.

Furthermore, the cross-sectional and longitudinal analysis provide crucial evidence to ascertain what age-related mechanisms drive loyalty and prescription patterns across age (**RQ3**). Findings from the cross-sectional analysis highlights that accumulated experience beginning at any age has a similar impact on prescribing patterns, with physicians' core armamentarium remaining relative stable even when physicians accumulate experience, prescribe more often, and prescribe a greater range of drugs. Importantly, older physicians that accumulate prescribing experience do not show any increases in prescription drug loyalty. Findings from the longitudinal analysis provide further support that accumulated experience does not cause physicians to increase their prescription drug loyalty as the SCR measures are shown to decline steadily as physicians age. The longitudinal analysis also does not provide any indication that cognitive decline causes physicians to become increasingly

loyal in their prescribing habits as the SCR measures for older doctors (45 years and above at the beginning of the longitudinal assessment) continues to predominately decrease across the 15-years of prescribing.

5.8.2 Implications

The findings contribute to the medical literature and will assist medical professionals and policy makers in their decisions to use competency assessments of older physicians to minimise poor patient outcomes prevalent among this group. While there is ongoing concern regarding how cognitive decline impacts the competency of ageing physicians (Choudhry et al., 2005; Soonsawat et al., 2018), we find no evidence to suggest that cognitive decline influences well-established loyalty measures for prescriptions made by physicians before 65 years of age. Therefore, the present research supports regular competency assessments of physicians beginning at 65 or 70 years of age (American Medical Association, 2015; Moutier et al., 2013; Skowronski & Peisah, 2012; Soonsawat et al., 2018). The present research also supports the recommendation by Moutier et al. (2013) that establishing a mandatory retirement age for physicians is not necessary. Instead our research supports the concept of succession planning through gradual reduction in working hours, caseloads, and responsibilities so that ageing physicians can adjust to cognitive changes and successfully transition into retirement (American Medical Association, 2015; Silver et al., 2016). To increase competency among older physicians, continuous professional development for older physicians is also essential (Durning et al., 2010) as they have a decreased ability to acquire new or changing knowledge (Ayanian et al., 1994; Day et al., 1988).

Additionally, the present research provides important contributions to the consumer behaviour literature due to pharmaceutical prescribing regularly requiring deliberative decision making, similar to that used by consumers making high-involvement purchases. Prior studies exploring age-related consumer behaviour differences are also predominately cross-sectional, and therefore the longitudinal assessment of prescribing behaviour provides new evidence about how consumer purchasing patterns may change as individual consumers age. Our findings contrast with studies in high-involvement categories (cars and perfume) that indicate older consumers are more brand loyal than younger consumers (Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005). A plausible explanation for the contrasting results is that physicians prescribe drugs at a much more frequent rate than

consumers buy cars and perfume. The greater accumulated prescribing experience among physicians may lead to superior crystallised intelligence that is less subject to the effects of cognitive decline (Day et al., 1988) than found among consumers for car and perfume purchasing.

5.8.3 Limitations and future research directions

A limitation of the present study is that the panel data comprises of a limited number of recorded prescriptions by physicians aged 65 years and over as they tended to enter retirement and drop off the panel. Future research could explore alternative prescription panels with a greater number of physicians aged 65 years and over to determine whether BPMs differ within this group as the impact of cognitive decline is shown to accelerate after 60 years of age (Powell & Whitla, 1994).

The present study also provides a further consumer behaviour research avenue. As accumulated experience may compensate for cognitive decline, future age-related consumer behaviour studies should consider splitting older consumers into heavy and light consumers based on purchase quantities. Comparison of BPMs between heavy and light consumers will allow for a greater understanding of how accumulated purchase experience influences consumer choice in high and low-involvement categories.



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Name of candidate:	Philip Mecredy
Name/title of Primary Supervisor:	Prof. Malcolm Wright
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<p>Please select one of the following three options:</p> <p><input type="radio"/> The manuscript/published work is published or in press</p> <ul style="list-style-type: none"> • Please provide the full reference of the Research Output: <p><input type="radio"/> The manuscript is currently under review for publication – please indicate:</p> <ul style="list-style-type: none"> • The name of the journal: • The percentage of the manuscript/published work that was contributed by the candidate: 60.00 • Describe the contribution that the candidate has made to the manuscript/published work: Literature review, data analysis, drafting manuscript, and preparing the manuscript for submission. <p><input checked="" type="radio"/> It is intended that the manuscript will be published, but it has not yet been submitted to a journal</p>	
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Chapter 6: General Conclusions

This chapter draws conclusions from the four studies in this thesis that investigated whether, how, and why brand awareness, consideration, and purchase choices differ between older and younger consumers. Specifically, this chapter addresses the overarching research aim by summarising the main findings relative to the six research questions. Following the summary of the main findings, this chapter discusses the important contributions of the thesis, and then identifies the limitations of this research and future research directions.

6.1 Main findings

6.1.1 Do brand mindset metrics (awareness and consideration) patterns differ between older and younger consumers?

Analysis of brand awareness and consideration data across three repertoire and two subscription markets found that older consumers and younger consumers exhibit similar mindset metric patterns (Chapter 3). In particular, findings from study one first, confirm that double jeopardy (DJ) and duplication of purchase (DoP) patterns regularly found for purchase data extend to brand awareness and consideration data, and second, demonstrate that both older and younger consumers adhere to these patterns.

The DJ pattern found for brand mindset metrics shows that brands with low recognition suffer twice with lower unaided brand recall and lower purchase consideration. Further examination determines that the DJ pattern between brand recall and brand consideration follows a linear trend but follows an exponential trend for brand recognition and brand consideration. Importantly, comparison of these relationships across four age groups shows these patterns hold irrespective of age, and therefore demonstrate that older consumers have similar DJ patterns for brand mindset metrics as younger consumers.

The Duplication of Awareness and Duplication of Consideration patterns show that brands share greater awareness and consideration levels with other highly recognised or considered brands than they do with lowly recognised or considered brands, respectively. Comparison of key duplication statistics demonstrates that the Duplication of Awareness and Duplication of Consideration patterns are evident across both older and younger age groups.

This confirms that older and younger consumers not only follow similar DJ patterns but also similar duplication patterns for brand mindset metrics.

6.1.2 Do awareness, consideration and purchase sets differ between older and younger consumers?

Although study one determined that older consumers follow similar double jeopardy and duplication patterns for brand mindset metrics, analysis of the same online brand choice survey in study two indicates that the number of brands recalled, recognised, considered, and purchased still varies with age (Chapter 4). An inverse-U shape relationship is found for brand recognition and brand recall across age, demonstrating that awareness sets tend to increase with age before slowing down and then declining in later life. This pattern is found to hold across both repertoire and subscription markets. An inverse-U pattern is also found for brand consideration in the two subscription markets examined, while a linear decline across age is found for brand consideration and brand purchase sets in the three repertoire markets tested. Therefore, study two clearly finds that older consumers tend to have smaller awareness, consideration, and purchase sets than younger consumers. However, when results are controlled for different purchase rates across age groups, older consumers are found to be aware of and consider a greater number of brands for every brand bought than younger consumers (Chapter 4). Therefore, in some repertoire markets, while increases in brand loyalty (declining purchases sets) do occur across age groups, this is not caused by age-related differences in brand awareness and brand consideration, and their associated mechanisms. Section 5.1.5 provides further findings regarding the mechanisms causing age-related differences in loyalty and at the various stages of the brand purchase funnel.

6.1.3 Does brand loyalty differ between older and younger consumers?

Study three investigates age-related brand loyalty in the same three repertoire markets by examining other BPMs (e.g. market share, brand penetration and purchase frequency), rather than relying solely on the number of brands purchased as the sole determinant of brand loyalty. Comparison of these BPMs across age groups confirms the prior findings of Uncles and Lee (2006) and Singh et al. (2012) that there are similar DJ patterns and consistency in the leading brands across age groups. Alongside declining purchase sets across age groups,

study three also finds declining brand purchase penetrations and brand purchase frequencies (Chapter 4). While these measures signal increasing loyalty among older consumers, these changes appear to reflect decreasing category purchase rates across age groups.

Importantly, study three provides substantial new evidence on whether age-related increases in brand loyalty exist in low-involvement repertoire markets by adopting the polarisation index (ϕ). This method overcomes the potential confounds of category purchase rates on BPMs that are regularly used to measure loyalty. The use of ϕ detected increases in brand loyalty across age groups in two (supermarket store choice and toothpaste) out of three low-involvement categories examined. While these changes in loyalty are small and the overall levels of loyalty are low across all age groups, the results do confirm that increasing age-related loyalty previously thought to be restricted to high-involvement product categories does extend to some low-involvement categories.

Study four also assesses age-related loyalty for prescription choice by examining BPMs across age groups (Chapter 5). Instead of using the polarisation index to overcome the confounding effects of purchase rates, this study controls for prescription rates by assessing the BPMs over specific prescription quantities. By controlling for prescribing rates, the study finds that the portfolio size and SCR measures remain extremely consistent across physician age groups. This finding is consistent for the first 500 and 5,000 prescriptions made, as well as the first 100 and 500 prescriptions in five specific therapeutic classes. Nevertheless, given that increasing loyalty across age groups was found for supermarket store choice and toothpaste but not for fruit juice and prescription choice (Chapter 5), the findings suggest that age-related loyalty can vary greatly between categories.

6.1.4 How do loyalty and purchase patterns change as consumers' age?

The findings discussed from study three and four so far provide cross-sectional results on whether loyalty varies across age groups. The second stage of study four uses longitudinal prescription data to determine how loyalty differs as individual physicians age (Chapter 5). Over a 15-year period, the study finds that portfolio size increases, and SCR decreases steadily as physicians age. This demonstrates that physicians grow to be increasingly disloyal as they age by becoming less reliant on their core armamentarium and prescribing a greater variety of drugs. Additionally, longitudinal comparison of SCR measures between age groups

(under 45 years and 45 years and above at first prescription) demonstrates that both older and younger physicians become less reliant on their core armamentarium as they age.

6.1.5 What age-related mechanisms drive loyalty and purchase patterns across age?

This thesis provides substantive new insights into the mechanisms that underlie age-related loyalty and purchase patterns. As discussed, the findings of study two demonstrate that declining purchase sets across age groups are not primarily caused by age-related differences in brand awareness and consideration sets (Chapter 3). This finding therefore indicates that cognitive changes to long-term and working memory do not greatly impact brand loyalty differences across age groups. While biological ageing may explain declines in awareness set size between the two oldest age groups (60-74 years, and 75 years and above), it does not appear to impact age-related loyalty as the decline in purchase set size across age groups is not accelerated by this reduction in awareness set size. Rather, study two finds that most age-related differences in loyalty are driven by mechanisms that affect the purchase stage of the brand purchase funnel. Two mechanisms that affect the purchase stage of the brand purchase funnel that are the most likely explanation for age-related loyalty increases in low-involvement repertoire markets are i) declining purchase rates as consumer progress through the household lifecycle, and ii) the formation of purchase habits through the accumulation of category experience.

Study four also demonstrates that cognitive decline does not influence prescribing patterns of physicians (Chapter 5). Should cognitive decline influence prescribing patterns, it would be expected that older physicians become increasingly loyal with their prescribing habits as they attempt to reduce the cognitive demands involved in decision making. However, the findings rule out cognitive decline as an explanatory mechanism as the SCR measures of older doctors (45 years and above at first prescription) decline across 15-years of prescribing. These results suggest that as physicians age and acquire more prescribing experience, they become less loyal and reliant on their core armamentarium. Cross-sectional analysis across various prescription quantities indicates a similar trend where loyalty measures decline as physicians prescribe more, confirming that accumulated prescribing experience causes physicians to become less loyal.

The consistent findings from study two and four imply that accumulated experience, rather than cognitive decline or biological ageing, is the primary driver of age-related loyalty

patterns in low-involvement repertoire markets and for pharmaceutical prescribing (Chapter 3 and 5). Although accumulated experience is associated with consumers in low-involvement repertoire markets becoming increasingly *loyal* through the development of purchase habits, accumulated experience is associated with physicians becoming increasingly *disloyal* when making prescription choices. So why is accumulated experience associated with different age-related loyalty patterns across the different categories? Pharmaceutical prescribing regularly requires deliberative decision making as physicians match appropriate pharmaceuticals to specific patient problems. This deliberative thinking is similar to consumers making high-involvement purchases, but physicians make prescription decisions at a much more frequent rate than which consumers purchase from high-involvement categories such as cars and perfume. The accumulated prescribing experience leads to greater crystallised intelligence (i.e. the knowledge that comes from prior experiences) among physicians that can mitigate the effects of cognitive decline to a larger degree than is found for high-involvement consumer purchasing. Physicians also make pharmaceutical decisions for a range of different patients and medical problems, whereas consumers predominately make purchase decisions for themselves or immediate household. Therefore, the need to make appropriate choices for multiple end users is another plausible explanation for why age-related loyalty patterns for pharmaceutical prescribing differ from previous findings in high-involvement categories (Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005) and from the present findings found in this thesis for some low-involvement repertoire markets.

6.1.6 What age measures best predict age-related changes in loyalty?

The result of study three also demonstrate that chronological age is effective at predicting and capturing age-related differences in loyalty and there is no need to develop and adopt a more sophisticated measure of age when assessing loyalty (Chapter 4). The discriminatory ability of chronological age at capture age-related differences in loyalty is similar to cognitive age and HLC measures. All three measures are much more effective at capturing age-related differences in loyalty than biological and social age measures. The similar performance of chronological age, cognitive age, and HLC is because the age measures are highly correlated with one another and therefore suggest that cognitive age and HLC do not capture any other constructs than those represented by chronological age. Thus, chronological age appears to be

an appropriate measure to predict age-related loyalty and there is little need to assess alternative age measures when attempting to capture these changes.

6.2 Thesis implications

6.2.1 Theoretical implications

Overall, the thesis provides multiple advances to the extant literature regarding the consumer behaviour of older adults. First, the study extends the well-documented double jeopardy and duplication patterns (Ehrenberg et al., 2004) to brand awareness and consideration data. These ‘lawlike’ patterns are found to exist across multiple categories, as well as older and younger age groups. The addition of a new condition (age) to the extension, provides MSoD and therefore further confidence that these empirical generalisations extend to customer mindset metrics.

Second, the research extends findings of an inverse-U shape relationship between age and brand recognition currently limited to media choice (Lambert-Pandraud et al., 2018; Lambert-Pandraud et al., 2017) to consumer-packaged goods, store choice and service categories. The research also provides new evidence on how age-related changes in brand awareness impact consideration and purchase. The differing patterns found across the brand purchase funnel indicate that increasing loyalty across age groups is not caused solely by brand awareness. This provides new knowledge on the underlying mechanisms that cause increasing loyalty across age groups as it rules out mechanisms such as cognitive decline and biological ageing that more adversely impact brand awareness. Rather, the research suggests that the formation of purchase habits as consumers accumulate experience and declining purchase rates as consumers age are plausible explanations for age-related loyalty increases in low-involvement categories.

Third, by adopting the polarisation index (φ), the thesis delivers the first evidence of increasing brand loyalty in low-involvement categories. This extends prior studies that could not detect age-related differences in loyalty in low-involvement categories due to the reliance on BPMs confounded by purchase rates (Singh et al., 2012; Uncles & Lee, 2006). While the increases in loyalty across age groups are small, they do confirm that prior findings of increasing loyalty across age groups for some high-involvement categories (Lambert-

Pandraud & Laurent, 2010; Lambert-Pandraud et al., 2005) do extend to low-involvement categories.

Lastly, the thesis provides the first longitudinal assessment of how loyalty differs as individuals age by utilising a longitudinal panel of pharmaceutical prescription choices. The study determines that accumulated experience prescribing experience can compensate for cognitive decline in repertoire markets.

6.2.2 Managerial implications

When consumers make a brand purchase, they transition through the stages of the brand purchase funnel. The findings of this thesis provide useful implications on how marketers of both well-established and new-to-market brands can transition older consumers through the brand purchase funnel. These findings are particularly useful for marketers of brands competing within low-involvement repertoire markets but can also assist marketers in other categories, such as high-involvement products and services, as many of the findings hold across categories.

For marketers of new-to-market brands, the results suggest that these brands can successfully enter the awareness sets of older consumers and lead to brand consideration and purchase. Importantly, marketers of new-to-market brands should not neglect targeting older consumers based on negative stereotyping regarding their cognitive abilities. In fact, when purchase rates are controlled for, older consumers have the cognitive ability to recall and recognise more brands than younger consumers. Another reason why new-to-market brands should target older consumers is because they display similar mindset metric DJ and duplication patterns as younger consumers and thus will consider each brand relative to their awareness penetration. Once new-to-market brands enter the awareness set of older consumers, they will have more difficulty transitioning from consideration to purchase due to the formation of purchase habits over time. However, new-to-market brands can still successfully target and penetrate the purchase sets of older consumers as loyalty in repertoire markets is generally low across all age groups, with older consumers regularly switching between competing brands. Marketers will need to adjust marketing strategies to encourage variety seeking and product trial to disrupt the habitual purchases from the established purchase set held by older consumers.

For well-established brands, the presence of age-related loyalty within some low-involvement repertoire markets indicates that there are some age-related loyalty benefits for effective marketing efforts over time. Well-established brands typically hold high market share and thus will benefit from DJ and duplication effects for awareness, consideration, and purchase. Well-established brands should continue to market to older consumers to maintain this advantage. Reducing marketing efforts on the assumption that older consumers are highly loyal will likely negatively impact well-established brands by reducing mental availability, and this will subsequently impact purchase behaviour.

6.2.3 Methodological implications

Aside from targeting implications for marketers, the results of this thesis provides direction on how practitioners and academics should evaluate age-related differences in awareness, consideration, and purchase. First, the DJ and duplication patterns can be used to measure brand performance in customer mindset metrics across age groups to detect any meaningful age-related deviations from the expected pattern. Second, ϕ should be used to measure age-related loyalty when appropriate samples sizes are achieved to avoid the confounds of market share and category purchase rates on BPMs. Third, chronological age should be used to predict age-related changes in loyalty, while cognitive age measures and HLC serve as acceptable substitutes. Biological and social age measures should not be used as they are unable to capture age-related changes in loyalty as well as chronological age.

Marketers should use this blueprint to examine age-related loyalty in the industry which they operate as this research has identified category-based differences even within various low-involvement repertoire markets. Gaining an understanding of age-related loyalty within a specific category will ensure marketers are able to form realistic expectations for entering the purchase set and gaining market share among older consumers. It will also allow marketers to target the most relevant stage of the brand purchase funnel and develop effective strategies for brand growth within older demographics.

6.3 Limitations and future research

Despite providing substantial knowledge on the consumer behaviour of older adults, the research has multiple limitations that create potential avenues for future research.

First, the four studies in this thesis incorporate data from six categories, two countries, and two data sets. Study one and two use the same survey data collected for three repertoire markets (supermarket store choice, toothpaste, and fruit juice) and two subscription markets (home broadband and electricity) in New Zealand to examine mindset metric patterns and the brand purchase funnel, respectively. Study three also uses the same survey data to examine age-related loyalty patterns for the three repertoire markets, while study four incorporates prescription panel data from the United Kingdom. Further research should consider investigating age-related loyalty patterns within new categories and countries. For mindset metrics, replication and extension of DJ, Duplication of Awareness, and Duplication of Consideration patterns to new categories and countries will test the boundary conditions of these empirical patterns and identify any circumstances of age-related deviations from these patterns. Future applications of these mindset metric patterns could include other services such as retail and hospitality, as well as high-involvement durables, such as cars and consumer electronics. For brand loyalty, further research should measure ϕ across age groups in other low-involvement categories to determine the scale of age-related loyalty increases within this context. Research on age-related loyalty can also be extended outside of low-involvement categories to services as studies in this context are lacking.

Second, while the results indicate that accumulated experience is the most probable cause of age-related loyalty differences, the studies do not provide explicit tests of each alternative mechanism. The close relationships between chronological age, cognitive age, and household life cycle also raise questions about the underlying mechanism. The present research adopted Barak and Schiffman's (1981) cognitive age measure that asks respondents to report their self-perceived age on multiple dimensions and an adjusted version of Murphy and Staple's (1979) HLC, both of which are heavily impacted by chronological age. A plausible option for future research is a short cognitive test to measure cognitive age and use a HLC less reliant on chronological age to determine whether these mechanisms directly impact ϕ across age groups. Clearly, there are multiple opportunities to shed more light on the precise mechanisms underlying age-related loyalty in various contexts.

Third, studies two and three use Juster-based purchase probabilities for each brand to calculate purchase set size. While this methodology is validated as an accurate measure of purchase behaviour (Day et al., 1991; Gabor & Granger, 1972; Wright & MacRae, 2007), it does not directly measure actual purchase behaviour. Future studies could collect actual purchase panel data, and supplement it with survey data for the same customers that assesses

awareness and consideration, as well as collecting responses to various age measures. Despite the appeal of this approach, access to a consumer panel that allows for each participant to be surveyed may be difficult.

Fourth, as accumulated experience is found to compensate for cognitive decline and is likely a primary determinant of age-related loyalty, future studies should consider splitting older consumers into light, medium and heavy buyers based on purchase rates. Comparing older consumers across light, medium, and heavy buyers against a range of BPMs and ϕ will provide further evidence regarding the effect accumulated purchase experience has on brand loyalty. It will also indicate whether other age-related mechanisms cause age-related differences in loyalty in the absence of accumulated experience. This approach can be applied to high- and low-involvement categories to further uncover the role accumulated experience plays when consumers are using deliberative and intuitive processing, respectively.

Finally, due to panel attrition and retirement, the longitudinal panel used to assess loyalty in study four has a limited number of physicians aged 65 years and over. To better capture the age-related effects of cognitive decline and biological ageing, future research should explore alternative prescription panels with a greater number of physicians aged 65 years and over to determine how loyalty differs among older physicians. Additionally, as accumulated experience impacts age-related loyalty patterns differently across pharmaceutical and low-involvement categories, future studies should also focus on longitudinal analysis of consumer panel data. Longitudinal consumer data sets with enough years of continuous reporting to track the effects of age-related mechanisms may be difficult to attain due to panel attrition. However, the rise in loyalty card data in recent decades may provide researchers with adequate longitudinal data with sufficient older consumers.

References

- AARP. (2019). *Media Image Landscape: Age Representation in Online Images*. https://www.aarp.org/content/dam/aarp/research/surveys_statistics/life-leisure/2019/age-representation-in-online-media-images.doi.10.26419-2Fres.00339.001.pdf
- Adams, J. M., & White, M. (2004). Biological ageing: a fundamental, biological link between socio-economic status and health? *The European Journal of Public Health*, 14(3), 331-334. <https://doi.org/10.1093/eurpub/14.3.331>
- Agostini, J.-M. (1961). How to estimate unduplicated audiences. *Journal of Advertising Research*, 1(3), 11-14.
- Agostini, J.-M. (1962). Analysis of magazine accumulative audience. *Journal of Advertising Research*, 2(4), 24-27.
- Ahmad, R. (2002). The older or ageing consumers in the UK: are they really that different? *International Journal of Market Research*, 44(3), 337-360. <https://doi.org/10.1177/147078530204400305>
- Alba, J. W., & Chattopadhyay, A. (1985). Effects of context and part-category cues on recall of competing brands. *Journal of Marketing Research*, 22(3), 340-349. <https://doi.org/10.2307/3151430>
- Alba, J. W., & Hutchinson, J. W. (1987). Dimensions of consumer expertise. *Journal of consumer research*, 13(4), 411-454. <https://doi.org/10.1086/209080>
- American Medical Association. (2015). *Competency and the ageing physician. Report 5 of the Council on Medical Education (A-15)*. AMA. <https://www.cppph.org/wp-content/uploads/2016/02/AMA-Council-on-Medical-Education-Aging-Physician-Report-2015.pdf>
- Anderson, G. M., Beers, M. H., & Kerluke, K. (1997). Auditing prescription practice using explicit criteria and computerized drug benefit claims data. *Journal of evaluation in clinical practice*, 3(4), 283-294. <https://doi.org/10.1046/j.1365-2753.1997.t01-1-00005.x>
- Anderson, J. R. (1983). Retrieval of information from long-term memory. *science*, 220(4592), 25-30. <https://doi.org/10.1126/science.6828877>
- Anesbury, Z., Greenacre, L., Wilson, A. L., & Huang, A. (2018). Patterns of fruit and vegetable buying behaviour in the United States and India. *International Journal of Market Research*, 60(1), 14-31. <https://doi.org/10.1177/1470785317751997>
- Anesbury, Z., Nguyen, Y., & Bogomolova, S. (2018). Getting a “sweet” deal: does healthfulness of a sub-brand influence consumer loyalty? *European Journal of Marketing*, 52(9/10), 1802-1826. <https://doi.org/10.1108/ejm-04-2017-0285>
- Anesbury, Z., Winchester, M., & Kennedy, R. (2017). Brand user profiles seldom change and seldom differ. *Marketing Letters*, 28(4), 523-535. <https://doi.org/10.1007/s11002-017-9437-2>
- Anesbury, Z. W., Bellman, S., Driesener, C., Page, B., & Sharp, B. (2021). Ageism Kills Brands. *Australasian Marketing Journal*, 1-7. <https://doi.org/10.1177/18393349211017316>
- Ayanian, J. Z., Hauptman, P. J., Guadagnoli, E., Antman, E. M., Pashos, C. L., & McNeil, B. J. (1994). Knowledge and practices of generalist and specialist physicians regarding drug therapy for acute myocardial infarction. *New England Journal of Medicine*, 331(17), 1136-1142. <https://doi.org/10.1056/nejm199410273311707>

- Baker, B. J., McDonald, H., & Funk, D. C. (2016). The uniqueness of sport: Testing against marketing's empirical laws. *Sport Management Review*, 19(4), 378-390. <https://doi.org/10.1016/j.smr.2016.02.002>
- Banelis, M., Riebe, E., & Rungie, C. M. (2013). Empirical evidence of repertoire size. *Australasian Marketing Journal*, 21(1), 59-65. <https://doi.org/10.1016/j.ausmj.2012.11.001>
- Barak, B., & Schiffman, L. G. (1981). Cognitive age: A nonchronological age variable. *ACR North American Advances*, 8, 602-606.
- Barwise, T. P. (1986). Repeat-viewing of prime-time TV series. *Journal of Advertising Research*, 26(4), 9-14.
- Barwise, T. P. (1995). Good empirical generalizations. *Marketing Science*, 14(3_supplement), G29-G35. <https://doi.org/10.1287/mksc.14.3.g29>
- Barwise, T. P., & Ehrenberg, A. S. (1985). Consumer beliefs and brand usage. *Journal of the Market Research Society*, 27(2), 81-93.
- Barwise, T. P., & Ehrenberg, A. S. (1987). The liking and viewing of regular TV series. *Journal of consumer research*, 14(1), 63-70. <https://doi.org/10.1086/209093>
- Bass, F. M. (1995). Empirical generalizations and marketing science: A personal view. *Marketing Science*, 14(3_supplement), G6-G19. <https://doi.org/10.1287/mksc.14.3.g6>
- Beaulieu, M. D., Blais, R., Jacques, A., Battista, R., Lebeau, R., & Brophy, J. (2001). Are patients suffering from stable angina receiving optimal medical treatment? *Qjm*, 94(6), 301-308. <https://doi.org/10.1093/qjmed/94.6.301>
- Becker, M. H., Stolley, P. D., Lasagna, L., McEvilla, J. D., & Sloane, L. M. (1971). Characteristics and attitudes of physicians associated with the prescribing of chloramphenicol. *HSMHA health reports*, 86(11), 993. <https://doi.org/10.2307/4594369>
- Beers, M. H., Fingold, S. F., Ouslander, J. G., Reuben, D. B., Morgenstern, H., & Beck, J. C. (1993). Characteristics and quality of prescribing by doctors practicing in nursing homes. *Journal of the American Geriatrics Society*, 41(8), 802-807. <https://doi.org/10.1111/j.1532-5415.1993.tb06173.x>
- Beers, M. H., Ouslander, J. G., Rollinger, I., Reuben, D. B., Brooks, J., & Beck, J. C. (1991). Explicit criteria for determining inappropriate medication use in nursing home residents. *Archives of internal medicine*, 151(9), 1825-1832. <https://doi.org/10.1001/archinte.1991.00400090107019>
- Bennett, D., & Graham, C. (2010). Is loyalty driving growth for the brand in front? A two-purchase analysis of car category dynamics in Thailand. *Journal of Strategic Marketing*, 18(7), 573-585. <https://doi.org/10.1080/0965254x.2010.529156>
- Bird, M., Channon, C., & Ehrenberg, A. S. (1970). Brand image and brand usage. *Journal of Marketing Research*, 7(3), 307-314. <https://doi.org/10.2307/3150287>
- Bird, M., & Ehrenberg, A. S. (1970). Consumer attitudes and brand usage. *Journal of the Market Research Society*, 12(4), 233-247.
- Bourke, J., & Roper, S. (2012). In with the new: the determinants of prescribing innovation by general practitioners in Ireland. *The European Journal of Health Economics*, 13(4), 393-407. <https://doi.org/10.1007/s10198-011-0311-5>
- Brown, G. H. (1953). Brand Loyalty-fact of fiction. *Advertising Age*, 23, 53-55.
- Cadieux, G., Tamblyn, R., Dauphinee, D., & Libman, M. (2007). Predictors of inappropriate antibiotic prescribing among primary care physicians. *Canadian Medical Association Journal*, 177(8), 877-883. <https://doi.org/10.1503/cmaj.070151>
- Campbell, B. M. (1969). *The existence of evoked set and determinants of its magnitude in brand choice behavior* [Doctoral Dissertation, Columbia Graduate School of Business, Columbia University].

- Carrigan, M., & Szmigin, I. (1998). The usage and portrayal of older models in contemporary consumer advertising. *Journal of Marketing Practice: Applied Marketing Science*, 4(8), 231-248. <https://doi.org/10.1108/EUM00000000004544>
- Carstensen, L. L. (1992). Social and emotional patterns in adulthood: support for socioemotional selectivity theory. *Psychology and Aging*, 7(3), 331-338. <https://doi.org/10.1037/0882-7974.7.3.331>
- Casini, L., Rungie, C., & Corsi, A. M. (2009). How loyal are Italian consumers to wine attributes? *Journal of Wine Research*, 20(2), 125-142. <https://doi.org/10.1080/09571260903169522>
- Cattell, R. B. (1987). *Intelligence: Its structure, growth and action*. Elsevier. [https://doi.org/10.1016/s0166-4115\(08\)x6006-6](https://doi.org/10.1016/s0166-4115(08)x6006-6)
- Charles, J., Britt, H., & Valenti, L. (2006). The independent effect of age of general practitioner on clinical practice. *Medical Journal of Australia*, 185(2), 105. <https://doi.org/10.5694/j.1326-5377.2006.tb00485.x>
- Choudhry, N. K., Fletcher, R. H., & Soumerai, S. B. (2005). Systematic review: the relationship between clinical experience and quality of health care. *Annals of Internal medicine*, 142(4), 260-273. [https://doi.org/10.1016/s0098-1672\(08\)70399-0](https://doi.org/10.1016/s0098-1672(08)70399-0)
- Cole, C., & Balasubramanian, S. (1993). Age differences in consumers' search for information: Public policy implications. *Journal of consumer research*, 20(1), 157-169. <https://doi.org/10.1086/209341>
- Cole, C., Laurent, G., Drolet, A., Ebert, J., Gutchess, A., Lambert-Pandraud, R., Mullet, E., Norton, M. I., & Peters, E. (2008). Decision making and brand choice by older consumers. *Marketing Letters*, 19(3-4), 355-365. <https://doi.org/10.1007/s11002-008-9058-x>
- Colombo, R., Ehrenberg, A. C., & Sabavala, D. J. (2000). Diversity in analyzing brand-switching tables: The car challenge. *Canadian Journal of Marketing Research*, 19, 23-36.
- Corrigan, M. H., & Glass, H. E. (2005). Physician participation in clinical studies and subsequent prescribing of new drugs. *Pharmacy and Therapeutics*, 30(1), 60-66.
- Corsi, A. M., Rungie, C., & Casini, L. (2011). Is the polarization index a valid measure of loyalty for evaluating changes over time? *Journal of Product & Brand Management*, 20(2), 111-120. <https://doi.org/10.1108/10610421111121107>
- Cowan, N. (2008). What are the differences between long-term, short-term, and working memory? *Progress in brain research*, 169, 323-338. [https://doi.org/10.1016/S0079-6123\(07\)00020-9](https://doi.org/10.1016/S0079-6123(07)00020-9)
- Craik, F. I., & McDowd, J. M. (1987). Age differences in recall and recognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 13(3), 474-479. <https://doi.org/10.1037/0278-7393.13.3.474>
- Cunningham, R. M. (1956). Brand loyalty-what, where, how much. *Harvard business review*, 34(1), 116-128.
- Dall'Olmo Riley, F., Ehrenberg, A., Castleberry, S., Barwise, T., & Barnard, N. (1997). The variability of attitudinal repeat-rates. *International journal of research in marketing*, 14(5), 437-450. [https://doi.org/10.1016/s0167-8116\(97\)00023-2](https://doi.org/10.1016/s0167-8116(97)00023-2)
- Dawes, J. (2008). Regularities in buyer behaviour and brand performance: The case of Australian beer. *Journal of Brand Management*, 15(3), 198-208. <https://doi.org/10.1057/palgrave.bm.2550099>
- Dawes, J. (2009). Brand loyalty in the UK sportswear market. *International Journal of Market Research*, 51(4). <https://doi.org/10.2501/s1470785309200670>

- Dawes, J. (2016). Testing the robustness of brand partitions identified from purchase duplication analysis. *Journal of Marketing Management*, 32(7-8), 695-715. <https://doi.org/10.1080/0267257x.2015.1128961>
- Dawes, J., Romaniuk, J., & Mansfield, A. (2009). Generalized pattern in competition among tourism destinations. *International Journal of Culture, Tourism and Hospitality Research*. <https://doi.org/10.1108/17506180910940333>
- Day, D., Gan, B., Gendall, P., & Esslemont, D. (1991). Predicting purchase behaviour. *Marketing Bulletin*, 2(5), 18-30.
- Day, S. C., Norcini, J. J., Webster, G. D., Viner, E. D., & Chirico, A. M. (1988). The effect of changes in medical knowledge on examination performance at the time of recertification. In *Proceedings of the Annual Conference on Research in Medical Education* (Vol. 27, pp. 139-144).
- Dhalla, I. A., Anderson, G. M., Mamdani, M. M., Bronskill, S. E., Sykora, K., & Rochon, P. A. (2002). Inappropriate prescribing before and after nursing home admission. *Journal of the American Geriatrics Society*, 50(6), 995-1000. <https://doi.org/10.1046/j.1532-5415.2002.50252.x>
- Dixon, R. A., Simon, E. W., Nowak, C. A., & Hultsch, D. F. (1982). Text recall in adulthood as a function of level of information, input modality, and delay interval. *Journal of Gerontology*, 37(3), 358-364. <https://doi.org/10.1093/geronj/37.3.358>
- Djulgovic, B., Beckstead, J. W., Elqayam, S., Reljic, T., Hozo, I., Kumar, A., Cannon-Bowers, J., Taylor, S., Tsalatsanis, A., & Turner, B. (2014). Evaluation of physicians' cognitive styles. *Medical Decision Making*, 34(5), 627-637. <https://doi.org/10.1177/0272989x14525855>
- Donthu, N. (1994). Double jeopardy in television program choice. *Journal of the Academy of Marketing science*, 22(2), 180-185. <https://doi.org/10.1177/0092070394222007>
- Dowling, G. R., & Uncles, M. (1997). Do customer loyalty programs really work? *Sloan management review*, 38, 71-82.
- Drolet, A., Bodapati, A. V., Suppes, P., Rossi, B., & Hochwarter, H. (2017). Habits and free associations: Free your mind but mind your habits. *Journal of the Association for Consumer Research*, 2(3), 293-305.
- Drolet, A., Schwarz, N., & Yoon, C. (2011). *The aging consumer: perspectives from psychology and economics*. Routledge. <https://doi.org/10.4324/9780203852941>
- Drolet, A., & Yoon, C. (2020). *The Aging Consumer: Perspectives from Psychology and Marketing*. Routledge. <https://doi.org/10.4324/9780429343780>
- Durning, S. J., Artino, A. R., Holmboe, E., Beckman, T. J., van der Vleuten, C., & Schuwirth, L. (2010). Aging and cognitive performance: challenges and implications for physicians practicing in the 21st century. *Journal of Continuing Education in the Health Professions*, 30(3), 153-160. <https://doi.org/10.1002/chp.20075>
- East, R., Uncles, M. D., & Lomax, W. (2014). Hear nothing, do nothing: The role of word of mouth in the decision-making of older consumers. *Journal of Marketing Management*, 30(7-8), 786-801. <https://doi.org/10.1080/0267257x.2013.841275>
- Eastman, J. K., & Liu, J. (2012). The impact of generational cohorts on status consumption: an exploratory look at generational cohort and demographics on status consumption. *Journal of Consumer Marketing*, 29(2), 93-102. <https://doi.org/10.1108/07363761211206348>
- Ehrenberg, A. S. (1966). Laws in marketing: A tail-piece. *Journal of the Royal Statistical Society. Series C (Applied Statistics)*, 15(3), 257-267. <https://doi.org/10.2307/2985303>
- Ehrenberg, A. S. (1988). *Repeat buying facts, theory and applications*. Oxford University Press.

- Ehrenberg, A. S. (1991). Politicians double jeopardy: A pattern and exceptions. *Journal of the Market Research Society*, 33(4), 347-353.
<https://doi.org/10.1177/147078539103300408>
- Ehrenberg, A. S. (1995). Empirical generalisations, theory, and method. *Marketing Science*, 14(3_supplement), G20-G28. <https://doi.org/10.1287/mksc.14.3.g20>
- Ehrenberg, A. S., & Goodhardt, G. (2002). Double jeopardy revisited, again. *Marketing Research*, 14(1), 40.
- Ehrenberg, A. S., & Goodhardt, G. J. (1969). Practical applications of duplication of viewing law. *Journal of the Market Research Society*, 11(1), 6-24.
- Ehrenberg, A. S., & Goodhardt, G. J. (1970). A model of multi-brand buying. *Journal of Marketing Research*, 7(1), 77-84. <https://doi.org/10.2307/3149510>
- Ehrenberg, A. S., Goodhardt, G. J., & Barwise, T. P. (1990). Double jeopardy revisited. *Journal of Marketing*, 54(3), 82-91. <https://doi.org/10.2307/1251818>
- Ehrenberg, A. S., Uncles, M. D., & Goodhardt, G. J. (2004). Understanding brand performance measures: using Dirichlet benchmarks. *Journal of Business Research*, 57(12), 1307-1325. <https://doi.org/10.1016/j.jbusres.2002.11.001>
- Epsilon. (2019). Age matters: A guide to cross-generation marketing. <https://us.epsilon.com/resources/cross-generational-marketing>
- Epstein, S. A., Gonzales, J. J., Weinfurt, K., Boekeloo, B., Yuan, N., & Chase, G. (2001). Are psychiatrists' characteristics related to how they care for depression in the medically ill?: Results from a National Case-Vignette Survey. *Psychosomatics*, 42(6), 482-489. <https://doi.org/10.1176/appi.psy.42.6.482>
- Epstein, S. A., Hooper, L. M., Weinfurt, K. P., DePuy, V., Cooper, L. A., Harless, W. G., & Tracy, C. M. (2008). Primary care physicians' evaluation and treatment of depression: Results of an experimental study using video vignettes. *Medical Care Research and Review*, 65(6), 674-695. <https://doi.org/10.1177/1077558708320987>
- Eva, K. W. (2002). The aging physician: changes in cognitive processing and their impact on medical practice. *Academic Medicine*, 77(10), S1-S6. <https://doi.org/10.1097/00001888-200210001-00002>
- Evanschitzky, H., & Woisetschlager, D. (2008). Too old to choose? The effects of age and age related constructs on consumer decision making. *Advances in Consumer Research*, 35, 630-636.
- Evrard, M. (2002). Ageing and lexical access to common and proper names in picture naming. *Brain and Language*, 81(1-3), 174-179. <https://doi.org/10.1006/brln.2001.2515>
- Fader, P. S., & Schmittlein, D. C. (1993). Excess behavioral loyalty for high-share brands: Deviations from the Dirichlet model for repeat purchasing. *Journal of Marketing Research*, 30(4), 478-493. <https://doi.org/10.1177/002224379303000407>
- Fehrenbach, S. N., Budnitz, D. S., Gazmararian, J. A., & Krumholz, H. M. (2001). Physician characteristics and the initiation of beta-adrenergic blocking agent therapy after acute myocardial infarction in a managed care population. *The American journal of managed care*, 7(7), 717-723.
- Furse, D. H., Punj, G. N., & Stewart, D. W. (1984). A typology of individual search strategies among purchasers of new automobiles. *Journal of consumer research*, 10(4), 417-431. <https://doi.org/10.1086/208980>
- Gabor, A., & Granger, C. (1972). Ownership and acquisition of consumer durables: Report on the Nottingham consumer durables project. *European Journal of Marketing*, 6(4), 234-248. <https://doi.org/10.1108/eum0000000005145>
- Gemson, D. H., Colombotos, J., Elinson, J., Fordyce, E. J., Hynes, M., & Stoneburner, R. (1991). Acquired immunodeficiency syndrome prevention: knowledge, attitudes, and

- practices of primary care physicians. *Archives of internal medicine*, 151(6), 1102-1108. <https://doi.org/doi.org/10.1001/archinte.151.6.1102>
- Glass, H. E., & Rosenthal, B. (2005). Post-launch clinical investigator drug prescribing in the US. *International journal of pharmaceutical medicine*, 19(2), 97-104. <https://doi.org/10.2165/00124363-200519020-00005>
- Glisky, E. L. (2007). Changes in cognitive function in human aging. In *Brain aging: Models, methods, and mechanisms, Chap.4*. (pp. 3-20). CRC Press. <https://doi.org/10.1201/9781420005523-1>
- Goodhardt, G. J. (1966). Constant in duplicated television viewing. *Nature*, 212(5070), 1616-1616. <https://doi.org/10.1038/2121616a0>
- Goodhardt, G. J., & Ehrenberg, A. S. (1969). Duplication of television viewing between and within channels. *Journal of Marketing Research*, 6(2), 169-178. <https://doi.org/10.2307/3149668>
- Goodhardt, G. J., Ehrenberg, A. S., & Chatfield, C. (1984). The Dirichlet: A comprehensive model of buying behaviour. *Journal of the Royal Statistical Society. Series A (General)*, 621-655. <https://doi.org/10.2307/2981696>
- Gregoire, Y. (2003). The impact of aging on consumer responses: what do we know? *ACR North American Advances*.
- Groves, K. E., Schellinck, T., Sketris, I., & MacKinnon, N. J. (2010). Identifying early prescribers of cyclooxygenase-2 inhibitors (COX-2s) in Nova Scotia, Canada: Considerations for targeted academic detailing. *Research in Social and Administrative Pharmacy*, 6(3), 257-267. <https://doi.org/10.1016/j.sapharm.2009.09.003>
- Gruca, T. S. (1989). Determinants of choice set size: an alternative method for measuring evoked sets. *NA-Advances in Consumer Research*, 16.
- Gutchess, A. H. (2011). Cognitive psychology and neuroscience of aging. In *The ageing consumer: perspectives from psychology and economics* (pp. 3-23). Routledge. <https://doi.org/10.4324/9780203852941>
- Habel, C., & Lockshin, L. (2013). Realizing the value of extensive replication: A theoretically robust portrayal of double jeopardy. *Journal of Business Research*, 66(9), 1448-1456. <https://doi.org/10.1016/j.jbusres.2012.05.012>
- Hammond, K., Ehrenberg, A. S., & Goodhardt, G. J. (1996). Market segmentation for competitive brands. *European Journal of Marketing*, 30(12), 39-49. <https://doi.org/10.1108/03090569610153291>
- Hara, K., Kunisawa, S., Sasaki, N., & Imanaka, Y. (2018). Future projection of the physician workforce and its geographical equity in Japan: a cohort-component model. *BMJ open*, 8(9), e023696. <https://doi.org/10.1136/bmjopen-2018-023696>
- Hartz, A. J., Kuhn, E. M., & Pulido, J. (1999). Prestige of training programs and experience of bypass surgeons as factors in adjusted patient mortality rates. *Medical care*, 93-103. <https://doi.org/10.1097/00005650-199901000-00013>
- Headen, R. S., Klompmaker, J. E., & Rust, R. T. (1979). The duplication of viewing law and television media schedule evaluation. *Journal of Marketing Research*, 16(3), 333-340. <https://doi.org/10.1177/002224377901600305>
- Heilman, C. M., Bowman, D., & Wright, G. P. (2000). The evolution of brand preferences and choice behaviors of consumers new to a market. *Journal of Marketing Research*, 37(2), 139-155. <https://doi.org/10.1509/jmkr.37.2.139.18728>
- Hobus, P., Schmidt, H., Boshuizen, H., & Patel, V. (1987). Contextual factors in the activation of first diagnostic hypotheses: expert-novice differences. *Medical Education*, 21(6), 471-476. <https://doi.org/10.1111/j.1365-2923.1987.tb01405.x>

- Holbrook, M. B., & Schindler, R. M. (1989). Some exploratory findings on the development of musical tastes. *Journal of consumer research*, 16(1), 119-124.
<https://doi.org/10.1086/209200>
- Holbrook, M. B., & Schindler, R. M. (1994). Age, sex, and attitude toward the past as predictors of consumers' aesthetic tastes for cultural products. *Journal of Marketing Research*, 31(3), 412-422. <https://doi.org/10.2307/3152228>
- Holbrook, M. B., & Schindler, R. M. (1996). Market segmentation based on age and attitude toward the past: Concepts, methods, and findings concerning nostalgic influences on customer tastes. *Journal of Business Research*, 37(1), 27-39.
[https://doi.org/10.1016/0148-2963\(96\)00023-9](https://doi.org/10.1016/0148-2963(96)00023-9)
- Howard, J. A., & Sheth, J. N. (1969). *The theory of buyer behavior*. Wiley.
- Hoyer, W. D., & Brown, S. P. (1990). Effects of brand awareness on choice for a common, repeat-purchase product. *Journal of consumer research*, 17(2), 141-148.
<https://doi.org/10.1086/208544>
- Jarvis, W., & Goodman, S. (2005). Effective marketing of small brands: niche positions, attribute loyalty and direct marketing. *Journal of Product and Brand Management*, 14(5), 292-299. <https://doi.org/10.1108/10610420510616322>
- Jarvis, W., Rungie, C., & Lockshin, L. (2007). Revealed preference analysis of red wine attributes using polarisation. *International Journal of Wine business research*, 19(2), 127-138. <https://doi.org/10.1108/17511060710758687>
- Jaspers, E., & Pieters, R. (2014). The Age of Materialism: Age, Period, & Cohort Effects Across the Life Cycle. *ACR North American Advances*, 42, 106-112.
- Johnson, M. M. (1990). Age differences in decision making: A process methodology for examining strategic information processing. *Journal of Gerontology*, 45(2), P75-P78.
<https://doi.org/10.1093/geronj/45.2.p75>
- Juster, F. T. (1966). Consumer buying intentions and purchase probability: An experiment in survey design. *Journal of the American Statistical Association*, 61(315), 658-696.
<https://doi.org/10.1080/01621459.1966.10480897>
- Kahn, B. E., Kalwani, M. U., & Morrison, D. G. (1988). Niching versus change-of-pace brands: Using purchase frequencies and penetration rates to infer brand positionings. *Journal of Marketing Research*, 25(4), 384-390. <https://doi.org/10.2307/3172949>
- Kearns, Z. (2009). Dirichlet no solver software. *Massey University, New Zealand*.
- Keller, K. L. (1993). Conceptualizing, measuring, and managing customer-based brand equity. *The Journal of Marketing*, 57(1), 1-22.
<https://doi.org/10.1177/002224299305700101>
- Keng, K. A., & Ehrenberg, A. S. (1984). Patterns of store choice. *Journal of Marketing Research*, 21(4), 399-409. <https://doi.org/10.2307/3151466>
- Keng, K. A., Uncles, M., Ehrenberg, A., & Barnard, N. (1998). Competitive brand-choice and store-choice among Japanese consumers. *Journal of Product & Brand Management*. <https://doi.org/10.1108/10610429810244657>
- Kennedy, R., & Ehrenberg, A. (2001). There is no brand segmentation. *Marketing Research*, 13(1), 4-7.
- Kooyman, C., & Wright, M. J. (2017). Double jeopardy benchmarks for political polls. *Australasian Marketing Journal (AMJ)*, 25(3), 180-184.
<https://doi.org/10.1016/j.ausmj.2017.07.001>
- Kotler, P., & Keller, K. L. (2015). *Marketing Management* (15th ed.). Peason Education.
- Krystallis, A. (2013). Uncovering attribute-based determinants of loyalty in cigarette brands. *Journal of Product & Brand Management*, 22(2), 104-117.
<https://doi.org/10.1108/10610421311320988>

- Krystallis, A., & Chrysochou, P. (2010). An exploration of loyalty determinants in Greek wine varieties. *EuroMed Journal of Business*, 5(2), 124-137. <https://doi.org/10.1108/14502191011065473>
- Krystallis, A., & Chrysochou, P. (2011). Health claims as communication tools that enhance brand loyalty: The case of low-fat claims within the dairy food category. *Journal of Marketing Communications*, 17(3), 213-228. <https://doi.org/10.1080/13527260903432836>
- Lambert-Pandraud, R., & Laurent, G. (2010). Why do older consumers buy older brands? The role of attachment and declining innovativeness. *Journal of Marketing*, 74(5), 104-121. <https://doi.org/10.1509/jmkg.74.5.104>
- Lambert-Pandraud, R., & Laurent, G. (2020). Impact of age on brand choice. In *The Aging Consumer: Perspectives from Psychology and Marketing* (2nd ed., pp. 163-181). Taylor & Francis Group. <https://doi.org/10.4324/9780429343780-11>
- Lambert-Pandraud, R., Laurent, G., & Gourvennec, B. (2018). Investigating Brand Verbal Fluency: When known brands do not come to mind. *International Journal of Market Research*, 60(3), 304-315. <https://doi.org/10.1177/1470785318757172>
- Lambert-Pandraud, R., Laurent, G., & Lapersonne, E. (2005). Repeat purchasing of new automobiles by older consumers: empirical evidence and interpretations. *Journal of Marketing*, 69(2), 97-113. <https://doi.org/10.1509/jmkg.69.2.97.60757>
- Lambert-Pandraud, R., Laurent, G., Mullet, E., & Yoon, C. (2017). Impact of age on brand awareness sets: a turning point in consumers' early 60s. *Marketing Letters*, 28(2), 205-218. <https://doi.org/10.1007/s11002-016-9407-0>
- Lang, F. R., & Carstensen, L. L. (1994). Close emotional relationships in late life: Further support for proactive aging in the social domain. *Psychology and Aging*, 9(2), 315-324. <https://doi.org/10.1037/0882-7974.9.2.315>
- Lapersonne, E., Laurent, G., & Le Goff, J.-J. (1995). Consideration sets of size one: An empirical investigation of automobile purchases. *International journal of research in marketing*, 12(1), 55-66. [https://doi.org/10.1016/0167-8116\(95\)00005-m](https://doi.org/10.1016/0167-8116(95)00005-m)
- Laurent, G., Kapferer, J.-N., & Roussel, F. (1995). The underlying structure of brand awareness scores. *Marketing Science*, 14(3_supplement), G170-G179.
- Lees, G., & Wright, M. (2013). Does the duplication of viewing law apply to radio listening? *European Journal of Marketing*, 47(3/4), 674-685. <https://doi.org/10.1108/03090561311297535>
- Li, F., Habel, C., & Rungie, C. (2009). Using Polarisation to Reveal Systematic Deviations in Dirichlet Loyalty Estimation. *Marketing Bulletin*, 20(1), 1-15.
- Lindsay, R. M., & Ehrenberg, A. S. (1993). The design of replicated studies. *The American Statistician*, 47(3), 217-228. <https://doi.org/10.1080/00031305.1993.10475983>
- Lo-Ciganic, W.-H., Gellad, W. F., Huskamp, H. A., Choudhry, N. K., Chang, C.-C. H., Zhang, R., Jones, B. L., Guclu, H., Richards-Shubik, S., & Donohue, J. M. (2016). Who were the early adopters of dabigatran? An application of group-based trajectory models. *Medical care*, 54(7), 725. <https://doi.org/10.1016/j.jval.2016.03.157>
- Loos, E., & Ivan, L. (2018). Visual ageism in the media. In *Contemporary perspectives on ageism* (pp. 163-176). Springer Cham. https://doi.org/10.1007/978-3-319-73820-8_11
- Lublóy, Á. (2014). Factors affecting the uptake of new medicines: a systematic literature review. *BMC health services research*, 14(1), 469. <https://doi.org/10.1186/1472-6963-14-469>
- Macdonald, E., & Sharp, B. (2000). Brand awareness effects on consumer decision making for a common, repeat purchase product: A replication. *Journal of Business Research*, 48(1), 5-15. [https://doi.org/10.1016/s0148-2963\(98\)00070-8](https://doi.org/10.1016/s0148-2963(98)00070-8)

- Macdonald, E., & Sharp, B. (2003). *Management perceptions of the importance of brand awareness as an indication of advertising effectiveness* [Doctoral dissertation, Massey University, Department of Marketing].
- Maddox, R. N., Gronhaug, K., Homans, R. E., & May, F. E. (1978). Correlates of information gathering and evoked set size for new automobile purchasers in Norway and the US. *NA-Advances in Consumer Research*, 5, 167-170.
- Mathur, A., & Moschis, G. P. (2005). Antecedents of cognitive age: A replication and extension. *Psychology & Marketing*, 22(12), 969-994.
<https://doi.org/10.1002/mar.20094>
- Mathur, A., Moschis, G. P., & Lee, E. (2003). Life events and brand preference changes. *Journal of Consumer Behaviour*, 3(2), 129-141. <https://doi.org/10.1002/cb.128>
- Mathur, A., Moschis, G. P., & Lee, E. (2008). A longitudinal study of the effects of life status changes on changes in consumer preferences. *Journal of the Academy of Marketing science*, 36(2), 234-246. <https://doi.org/10.1007/s11747-007-0021-9>
- McPhee, W. N. (1963). *Formal theories of mass behaviour*. Free Press.
- Meneely, L., Burns, A., & Strugnell, C. (2009). Age associated changes in older consumers retail behaviour. *International Journal of Retail & Distribution Management*, 37(12), 1041-1056. <https://doi.org/10.1108/09590550911005010>
- Moschis, G. P. (1994). Consumer behavior in later life: multidisciplinary contributions and implications for research. *Journal of the Academy of Marketing science*, 22(3), 195-204. <https://doi.org/10.1177/0092070394223001>
- Moschis, G. P. (2003). Marketing to older adults: an updated overview of present knowledge and practice. *Journal of Consumer Marketing*, 20(6), 516-525.
<https://doi.org/10.1108/07363760310499093>
- Moschis, G. P. (2012). Consumer behavior in later life: Current knowledge, issues, and new directions for research. *Psychology & Marketing*, 29(2), 57-75.
<https://doi.org/10.1002/mar.20504>
- Moutier, C. Y., Bazzo, D. E., & Norcross, W. A. (2013). Approaching the issue of the aging physician population. *Journal of Medical Regulation*, 99(1), 10-18.
<https://doi.org/10.30770/2572-1852-99.1.10>
- Murphy, P. E., & Staples, W. A. (1979). A modernized family life cycle. *Journal of consumer research*, 6(1), 12-22. <https://doi.org/10.1086/208744>
- Nedungadi, P., & Hutchinson, J. (1985). The prototypicality of brands: Relationships with brand awareness, preference and usage. *ACR North American Advances*.
- Nelson, E. A., & Dannefer, D. (1992). Aged heterogeneity: Fact or fiction? The fate of diversity in gerontological research. *The Gerontologist*, 32(1), 17-23.
<https://doi.org/10.1093/geront/32.1.17>
- Nenycz-Thiel, M., Sharp, B., Dawes, J., & Romaniuk, J. (2010). Competition for memory retrieval between private label and national brands. *Journal of Business Research*, 63(11), 1142-1147. <https://doi.org/10.1016/j.jbusres.2009.10.010>
- Norcini, J. J., Kimball, H. R., & Lipner, R. S. (2000). Certification and specialization: do they matter in the outcome of acute myocardial infarction? *Academic Medicine*, 75(12), 1193-1198. <https://doi.org/10.1097/00001888-200012000-00016>
- Norman, G. R., & Brooks, L. R. (1997). The non-analytical basis of clinical reasoning. *Advances in health sciences education*, 2(2), 173-184.
<https://doi.org/10.1023/a:1009784330364>
- Park, C. W., MacInnis, D. J., Priester, J., Eisingerich, A. B., & Iacobucci, D. (2010). Brand attachment and brand attitude strength: Conceptual and empirical differentiation of two critical brand equity drivers. *Journal of Marketing*, 74(6), 1-17.

- Park, D. C., & Festini, S. B. (2017). Theories of memory and aging: A look at the past and a glimpse of the future. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 72(1), 82-90. <https://doi.org/10.1093/geronb/gbw066>
- Park, D. C., & Gutchess, A. (2004). Long-term memory and aging: A cognitive neuroscience perspective. In *Cognitive neuroscience of Aging: Linking cognitive and cerebral aging* (pp. 218-245). Oxford Press.
<https://doi.org/10.1093/acprof:oso/9780195156744.003.0009>
- Park, D. C., Lautenschlager, G., Hedden, T., Davidson, N. S., Smith, A. D., & Smith, P. K. (2002). Models of visuospatial and verbal memory across the adult life span. *Psychology and Aging*, 17(2), 299. <https://doi.org/10.1037/0882-7974.17.2.299>
- Park, D. C., Smith, A. D., Lautenschlager, G., Earles, J. L., Frieske, D., Zwahr, M., & Gaines, C. L. (1996). Mediators of long-term memory performance across the life span. *Psychology and Aging*, 11(4), 621-627. <https://doi.org/10.1037/0882-7974.11.4.621>
- Peisah, C., & Wilhelm, K. (2007). Physician don't heal thyself: a descriptive study of impaired older doctors. *International psychogeriatrics*, 19(5), 974-984.
<https://doi.org/10.1017/s1041610207005431>
- Percy, L., & Rossiter, J. R. (1992). A model of brand awareness and brand attitude advertising strategies. *Psychology & Marketing*, 9(4), 263-274.
- Perry, W., & Crean, R. D. (2005). A retrospective review of the neuropsychological test performance of physicians referred for medical infractions. *Archives of clinical neuropsychology*, 20(2), 161-170. <https://doi.org/10.1016/j.acn.2004.04.002>
- Petersen, J. A., Kumar, V., Polo, Y., & Sese, F. J. (2018). Unlocking the power of marketing: understanding the links between customer mindset metrics, behavior, and profitability. *Journal of the Academy of Marketing science*, 46(5), 813-836.
<https://doi.org/10.1007/s11747-017-0554-5>
- Peterson, R. T. (1992). The depiction of senior citizens in magazine advertisements: A content analysis. *Journal of business ethics*, 11(9), 701-706.
<https://doi.org/10.1007/bf01686350>
- Phillips, L. W., & Sternthal, B. (1977). Age differences in information processing: a perspective on the aged consumer. *Journal of Marketing Research*, 444-457.
<https://doi.org/10.1177/002224377701400402>
- Phua, P., Kennedy, R., Trinh, G., Page, B., & Hartnett, N. (2020). Examining older consumers' loyalty towards older brands in grocery retailing. *Journal of Retailing and Consumer Services*, 52, 1-7. <https://doi.org/10.1016/j.jretconser.2019.101893>
- Powell, D. H., & Whitla, D. K. (1994). *Profiles in cognitive aging*. Harvard University Press.
- Prieler, M., Ivanov, A., & Hagiwara, S. (2017). The representation of older people in East Asian television advertisements. *The International Journal of Aging and Human Development*, 85(1), 67-89. <https://doi.org/10.1177/0091415016677972>
- Prieler, M., Kohlbacher, F., Hagiwara, S., & Arima, A. (2015). The representation of older people in television advertisements and social change: The case of Japan. *Ageing and Society*, 35(4), 865-887. <https://doi.org/10.1017/S0144686X1400004X>
- Reibstein, D. J., & Farris, P. W. (1995). Market share and distribution: A generalization, a speculation, and some implications. *Marketing Science*, 14(3_supplement), G190-G202. <https://doi.org/10.1287/mksc.14.3.g190>
- Rendell, P. G., Castel, A. D., & Craik, F. I. (2005). Memory for proper names in old age: A disproportionate impairment? *The Quarterly Journal of Experimental Psychology Section A*, 58(1), 54-71. <https://doi.org/10.1080/02724980443000188>
- Rentz, J. O., & Reynolds, F. D. (1981). Separating age, cohort and period effects in consumer behavior. *ACR North American Advances*, 8, 596-601.

- Rhodes, S., Greene, N. R., & Naveh-Benjamin, M. (2019). Age-related differences in recall and recognition: A meta-analysis. *Psychonomic Bulletin & Review*, 26(5), 1529-1547. <https://doi.org/10.3758/s13423-019-01649-y>
- Romaniuk, J., & Sharp, B. (2004). Conceptualizing and measuring brand salience. *Marketing theory*, 4(4), 327-342. <https://doi.org/10.1177/1470593104047643>
- Romaniuk, J., & Sharp, B. (2016). *How Brands Grow. Part 2: Including Emerging Markets, Services and Durables, New Brands and Luxury Brands*. Oxford University Press.
- Rossiter, J. R. (2014). 'Branding' explained: Defining and measuring brand awareness and brand attitude. *Journal of Brand Management*, 21(7), 533-540. <https://doi.org/10.1057/bm.2014.33>
- Rossiter, J. R., & Percy, L. (1987). *Advertising and promotion management*. McGraw-Hill Book Company.
- Roy-Byrne, P., Russo, J., Dugdale, D. C., Lessler, D., Cowley, D., & Katon, W. (2002). Undertreatment of panic disorder in primary care: role of patient and physician characteristics. *The Journal of the American Board of Family Practice*, 15(6), 443-450.
- Rungie, C. (2003). How to estimate the parameters of the Dirichlet model using likelihood theory in Excel. *Marketing Bulletin*, 14(3), 1-9.
- Rungie, C., Brown, B., Laurent, G., & Rudrapatna, S. (2005). A standard error estimator for the polarization index: assessing the measurement error in one approach to the analysis of loyalty. *Marketing Bulletin*, 16(2), 1-11.
- Sabavala, D. J., & Morrison, D. G. (1977). A model of TV show loyalty. *Journal of Advertising Research*, 17(6), 35-43.
- Salem-Schatz, S. R., Avorn, J., & Soumerai, S. B. (1990). Influence of clinical knowledge, organizational context, and practice style on transfusion decision making: Implications for practice change strategies. *Jama*, 264(4), 476-483. <https://doi.org/10.1001/jama.264.4.476>
- Salthouse, T. (2012). Consequences of age-related cognitive declines. *Annual review of psychology*, 63, 201-226. <https://doi.org/10.1146/annurev-psych-120710-100328>
- Salthouse, T. A. (1996). The processing-speed theory of adult age differences in cognition. *Psychological review*, 103(3), 403-428. <https://doi.org/10.1037/0033-295x.103.3.403>
- Schiffman, L. G., O'Cass, A., Paladino, A., & Carlson, J. (2014). *Consumer Behaviour* (6th ed.). Pearson Australia.
- Schindler, R. M., & Holbrook, M. B. (2003). Nostalgia for early experience as a determinant of consumer preferences. *Psychology & Marketing*, 20(4), 275-302. <https://doi.org/10.1002/mar.10074>
- Scriven, J., Yabar, D. P.-B., Clemente, M., & Bennett, D. (2015). The competitive landscape for leisure: Why wide appeal matters. *International Journal of Market Research*, 57(2), 277-298. <https://doi.org/10.2501/ijmr-2015-019>
- Shapiro, J. A. (1989). General practitioners' attitudes towards AIDS and their perceived information needs. *British Medical Journal*, 298(6687), 1563-1566. <https://doi.org/10.1136/bmj.298.6687.1563>
- Sharp, B. (2010). *How brands grow. What marketers don't know*. Oxford University Press.
- Sharp, B., & Sharp, A. (1997). Loyalty programs and their impact on repeat-purchase loyalty patterns. *International journal of research in marketing*, 14(5), 473-486. [https://doi.org/10.1016/s0167-8116\(97\)00022-0](https://doi.org/10.1016/s0167-8116(97)00022-0)
- Sharp, B., Wright, M., & Goodhardt, G. (2002). Purchase loyalty is polarised into either repertoire or subscription patterns. *Australasian Marketing Journal*, 10(3), 7-20. [https://doi.org/10.1016/s1441-3582\(02\)70155-9](https://doi.org/10.1016/s1441-3582(02)70155-9)

- Shocker, A. D., Ben-Akiva, M., Boccara, B., & Nedungadi, P. (1991). Consideration set influences on consumer decision-making and choice: Issues, models, and suggestions. *Marketing Letters*, 2(3), 181-197. <https://doi.org/10.1007/bf02404071>
- Silver, M. P., Hamilton, A. D., Biswas, A., & Warrick, N. I. (2016). A systematic review of physician retirement planning. *Human Resources for Health*, 14(1), 67. <https://doi.org/10.21767/2254-9137.100064>
- Silverman, M., Povitz, M., Sontrop, J. M., Li, L., Richard, L., Cejic, S., & Shariff, S. Z. (2017). Antibiotic prescribing for nonbacterial acute upper respiratory infections in elderly persons. *Annals of Internal medicine*, 166(11), 765-774. <https://doi.org/10.7326/117-0438>
- Singh, J., Riley, F., Hand, C., & Maeda, M. (2012). Measuring brand choice in the older customer segment in Japan. *International Journal of Market Research*, 54(3), 347-368. <https://doi.org/10.2501/ijmr-54-3-347-368>
- Sjostrom, T., Corsi, A. M., Driesener, C., & Chrysochou, P. (2014). Are food brands that carry light claims different? *Journal of Brand Management*, 21(4), 325-341. <https://doi.org/10.1057/bm.2014.10>
- Skowronski, G. A., & Peisah, C. (2012). The greying intensivist: ageing and medical practice—everyone's problem. *Medical Journal of Australia*, 196(8), 505-507. <https://doi.org/10.5694/mja11.11579>
- Smith, A. D. (1977). Adult age differences in cued recall. *Developmental Psychology*, 13(4), 326. <https://doi.org/10.1037/0012-1649.13.4.326>
- Solgaard, H. S., Smith, D. E., & Schmidt, M. (1998). Double jeopardy patterns for political parties. *International Journal of Public Opinion Research*, 10(2), 109-120. <https://doi.org/10.1093/ijpor/10.2.109>
- Solomon, M., Bamossy, G., Askegaard, S., & Hogg, M. (2006). *Consumer behaviour: a European perspective* (3rd ed.). Prentice Hall.
- Soonsawat, A., Tanaka, G., Lammando, M. A., Ahmed, I., & Ellison, J. M. (2018). Cognitively Impaired Physicians: How Do We Detect Them? How Do We Assist Them? *The American Journal of Geriatric Psychiatry*, 26(6), 631-640. <https://doi.org/10.1016/j.jagp.2018.01.203>
- Srinivasan, N., & Ratchford, B. T. (1991). An empirical test of a model of external search for automobiles. *Journal of consumer research*, 18(2), 233-242. <https://doi.org/10.1086/209255>
- Srinivasan, S., Vanhuele, M., & Pauwels, K. (2010). Mind-set metrics in market response models: An integrative approach. *Journal of Marketing Research*, 47(4), 672-684. <https://doi.org/10.1509/jmkr.47.4.672>
- Steffensen, F. H., Sørensen, H. T., & Olesen, F. (1999). Diffusion of new drugs in Danish general practice. *Family Practice*, 16(4), 407-413. <https://doi.org/10.1093/fampra/16.4.407>
- Stern, P. (1994). Prescriptions for branded and generic pharmaceuticals. *Journal of Brand Management*, 2(3), 177-183. <https://doi.org/10.1057/bm.1994.48>
- Stern, P., & Ehrenberg, A. (2003). Expectations vs. reality. *Marketing Research*, 15(1), 40-40.
- Stocchi, L., Driesener, C., & Nenycz-Thiel, M. (2015). Brand image and brand loyalty: Do they show the same deviations from a common underlying pattern? *Journal of Consumer Behaviour*, 14(5), 317-324. <https://doi.org/10.1002/cb.1522>
- Stocchi, L., Pare, V., Fuller, R., & Wright, M. (2017). The Natural Monopoly effect in brand image associations. *Australasian Marketing Journal (AMJ)*, 25(4), 309-316. <https://doi.org/10.1016/j.ausmj.2017.11.003>

- Stocchi, L., Wright, M., & Driesener, C. (2016). Why familiar brands are sometimes harder to remember. *European Journal of Marketing*. <https://doi.org/10.1108/ejm-10-2014-0648>
- Stolley, P. D., Becker, M. H., Lasagna, L., McEvilla, J. D., & Sloane, L. M. (1972). The relationship between physician characteristics and prescribing appropriateness. *Medical care*, 17-28. <https://doi.org/10.1097/00005650-197201000-00003>
- Szmigin, I., & Carrigan, M. (2000). The older consumer as innovator: does cognitive age hold the key? *Journal of Marketing Management*, 16(5), 505-527. <https://doi.org/10.1362/026725700785046038>
- Tamblyn, R., McLeod, P., Hanley, J. A., Girard, N., & Hurley, J. (2003). Physician and practice characteristics associated with the early utilization of new prescription drugs. *Medical care*, 895-908. <https://doi.org/10.1097/00005650-200308000-00004>
- Tanusondjaja, A., Nenycz-Thiel, M., & Kennedy, R. (2016). Understanding shopper transaction data: how to identify cross-category purchasing patterns using the duplication coefficient. *International Journal of Market Research*, 58(3), 401-419. <https://doi.org/10.2501/ijmr-2016-026>
- Teller, C., Gittenberger, E., & Schnedlitz, P. (2013). Cognitive age and grocery-store patronage by elderly shoppers. *Journal of Marketing Management*, 29(3-4), 317-337. <https://doi.org/10.1080/0267257x.2013.766627>
- Thoma, D., & Wechsler, J. (2021). Older and more personal: Stronger links between brand-name recall and brand-related autobiographical memories in older consumers. *Psychology & Marketing*, 38(9), 1384-1392. <https://doi.org/10.1002/mar.21533>
- Thompson, N. J., & Thompson, K. E. (2009). Can marketing practice keep up with Europe's ageing population? *European Journal of Marketing*, 43(11/12), 1281-1288. <https://doi.org/10.1108/03090560910989885>
- Thomson, M., MacInnis, D. J., & Whan Park, C. (2005). The ties that bind: Measuring the strength of consumers' emotional attachments to brands. *Journal of Consumer Psychology*, 15(1), 77-91. https://doi.org/10.1207/s15327663jcp1501_10
- Trinh, G. (2014). Predicting variation in repertoire size with the NBD model. *Australasian Marketing Journal*, 22(2), 111-116. <https://doi.org/10.1016/j.ausmj.2014.01.002>
- Trinh, G., Wright, M., & Stern, P. (2014). The Relationship between Household Lifecycle and Brand Loyalty. *Advances in Consumer Research*, 42, 387-391. <https://doi.org/10.2139/ssrn.1842083>
- Tsugawa, Y., Newhouse, J. P., Zaslavsky, A. M., Blumenthal, D. M., & Jena, A. B. (2017). Physician age and outcomes in elderly patients in hospital in the US: observational study. *bmj*, 357, j1797. <https://doi.org/10.1136/bmj.j1797>
- Turnbull, J., Cunningham, J., Unsal, A., Norman, G., & Ferguson, B. (2006). Competence and cognitive difficulty in physicians: a follow-up study. *Academic Medicine*, 81(10), 915-918. <https://doi.org/10.1097/01.acm.0000238194.55648.b2>
- Tynan, A. C., & Drayton, J. L. (1985). The Methuselah market. *Journal of Marketing Management*, 1(1-2), 75-85. <https://doi.org/10.1080/0267257x.1985.9963976>
- Uncles, M., Ehrenberg, A., & Hammond, K. (1995). Patterns of buyer behavior: Regularities, models, and extensions. *Marketing Science*, 14(3_supplement), G71-G78. <https://doi.org/10.1287/mksc.14.3.g71>
- Uncles, M., & Ehrenberg, A. S. (1990a). Brand choice among older consumers. *Journal of Advertising Research*, 30(4), 19-22.
- Uncles, M., & Ehrenberg, A. S. (1990b). The buying of packaged goods at US retail chains. *Journal of Retailing*, 66(3), 278.

- Uncles, M., & Hammond, K. (1995). Grocery store patronage. *International Review of Retail, Distribution and Consumer Research*, 5(3), 287-302.
<https://doi.org/10.1080/09593969500000019>
- Uncles, M., Kennedy, R., Nenycz-Thiel, M., Singh, J., & Kwok, S. (2012). In 25 years, across 50 categories, user profiles for directly competing brands seldom differ. *Journal of Advertising Research*, 52(2), 252-261. <https://doi.org/10.2501/jar-52-2-252-261>
- Uncles, M., & Lee, D. (2006). Brand purchasing by older consumers: An investigation using the Juster scale and the Dirichlet model. *Marketing Letters*, 17(1), 17-29.
<https://doi.org/10.1007/s11002-006-3756-z>
- Uncles, M., & Wright, M. (2004). Empirical generalisation in marketing. *Australasian Marketing Journal*, 12(3), 5-18. [https://doi.org/10.1016/s1441-3582\(04\)70102-0](https://doi.org/10.1016/s1441-3582(04)70102-0)
- Uncles, M. D. (1989). *Buyer: Buyer Behaviour Software: a Manual for Version 89.1*. London Business School.
- United Nations. (2015). *World population aging 2015*.
http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Report.pdf
- Van den Bulte, C., & Lilien, G. L. (2001). Medical innovation revisited: Social contagion versus marketing effort. *American journal of sociology*, 106(5), 1409-1435.
<https://doi.org/10.1086/320819>
- Venkatesan, R., Bleier, A., Reinartz, W., & Ravishanker, N. (2019). Improving customer profit predictions with customer mindset metrics through multiple overimputation. *Journal of the Academy of Marketing science*, 47(5), 771-794.
<https://doi.org/10.1007/s11747-019-00658-6>
- Wilkes, R. E. (1995). Household life-cycle stages, transitions, and product expenditures. *Journal of consumer research*, 22(1), 27-42. <https://doi.org/10.1086/209433>
- Wilson, A. L., Nguyen, C., Bogomolova, S., Sharp, B., & Olds, T. (2019). Analysing how physical activity competes: a cross-disciplinary application of the Duplication of Behaviour Law. *International Journal of Behavioral Nutrition and Physical Activity*, 16(1), 123. <https://doi.org/10.1186/s12966-019-0847-9>
- Wilson, D., & Winchester, M. (2019). Extending the double jeopardy and duplication of purchase laws to the wine market. *International Journal of Wine business research*.
<https://doi.org/10.1108/ijwbr-12-2017-0072>
- Wood, W., & Neal, D. T. (2009). The habitual consumer. *Journal of Consumer Psychology*, 19(4), 579-592. <https://doi.org/10.1016/j.jcps.2009.08.003>
- Wright, M., & Kearns, Z. (1998). Progress in marketing knowledge. *Journal of Empirical Generalisations in Marketing Science*, 3, 1-21.
- Wright, M., & MacRae, M. (2007). Bias and variability in purchase intention scales. *Journal of the Academy of Marketing science*, 35(4), 617-624. <https://doi.org/10.1007/s11747-007-0049-x>
- Wright, M., & Riebe, E. (2010). Double jeopardy in brand defection. *European Journal of Marketing*, 44(6), 860-873. <https://doi.org/10.1108/03090561011032748>
- Wright, M., Sharp, A., & Sharp, B. (1998). Are Australasian brands different? *Journal of Product & Brand Management*, 7(6), 465-480.
<https://doi.org/10.1108/10610429810244648>
- Wright, M., Sharp, A., & Sharp, B. (2002). Market statistics for the Dirichlet model: Using the Juster scale to replace panel data. *International journal of research in marketing*, 19(1), 81-90. [https://doi.org/10.1016/s0167-8116\(02\)00049-6](https://doi.org/10.1016/s0167-8116(02)00049-6)

- Yang, Z., Bi, Z., & Zhou, N. (2005). The double jeopardy phenomenon and the mediating effect of brand penetration between advertising and brand loyalty. *Journal of Advertising Research*, 45(2), 211-221. <https://doi.org/10.1017/s0021849905050233>
- Yang, Z., Zhou, N., & Chen, J. (2005). Brand choice of older Chinese consumers. *Journal of International Consumer Marketing*, 17(4), 65-81. https://doi.org/10.1300/j046v17n04_04
- Ylänne, V. (2015). Representations of ageing in the media. In *Routledge handbook of cultural gerontology* (pp. 369-375). Routledge <https://doi.org/10.4324/9780203097090-57>
- Yoon, C., & Cole, C. A. (2008). Aging and consumer behavior. In C. P. Haugtvedt, Herr, P.M. and Kardes, F.R. (Ed.), *Handbook of consumer psychology* (pp. 247-270). Lawrence Erlbaum Associates. <https://doi.org/10.4324/9780203809570.ch9>
- Yoon, C., Cole, C. A., & Lee, M. P. (2009). Consumer decision making and aging: Current knowledge and future directions. *Journal of Consumer Psychology*, 19(1), 2-16. <https://doi.org/10.1016/j.jcps.2008.12.002>
- Zniva, R., & Weitzl, W. (2016). It's not how old you are but how you are old: A review on aging and consumer behavior. *Management Review Quarterly*, 66(4), 267-297. <https://doi.org/10.1007/s11301-016-0121-z>

Appendices

Appendix A: Double jeopardy pattern for those that recognise each brand

Category	Brand	Brand Recognition (%)	Brand Recall (%)	Consideration (%)
Supermarket store choice	Countdown	99	96	75
	New World	99	90	60
	PAK'nSAVE	98	91	68
	Four Square	89	41	8
	Fresh Choice	63	42	16
	SuperValue	55	23	9
	Farro Fresh	33	12	4
	Average	76	56	34
Toothpaste	Colgate	99	93	80
	Macleans	91	56	47
	Sensodyne	86	30	36
	Oral-B	66	15	25
	Red Seal	42	28	31
	Mouthfresh	24	10	31
	Eco Store	15	5	24
	White Glo	10	3	22
	Average	49	28	36
Fruit Juice	Just Juice	91	54	57
	Fresh Up	90	26	47
	Keri	88	55	64
	Charlie's	76	35	42
	McCoy	55	16	33
	Simply Squeezed	52	9	41
	Citrus Tree	20	5	27
	Homegrown	17	20	55
	Thexton's	12	7	27
	Average	56	25	44
Broadband	Spark	97	71	45
	Vodafone	96	68	38
	2 degrees	89	36	38
	Slingshot	83	29	27
	Skinny	78	19	23
	Trustpower	69	24	29
	Orcon	60	31	23
	Stuff Fibre	33	8	29
	Flip	33	7	14
	My Republic	26	11	6
	Bigpipe	15	14	19
	Average	53	27	27
Electricity	Genesis Energy	90	51	38
	Trustpower	86	60	38
	Contact Energy	85	49	36
	Mercury	85	54	35
	Meridian Energy	83	47	33
	Nova Energy	67	19	29
	Electric Kiwi	34	18	40
	Flick Energy	28	15	23
	Pulse Energy	22	23	28
	Average	65	37	33

Note: Brands under 10% recognition are removed due to low sample size

Appendix B: Juster Scale explanation for study 2

The Juster scale is validated as a purchase measure through a range of tests and applications (Day et al., 1991; Gabor & Granger, 1972; Wright & MacRae, 2007), with meta-analysis demonstrating that it provides accurate and unbiased demand estimates for established products and services (Wright & MacRae, 2007). Juster purchase probabilities were estimated over the next four weeks for supermarket store choice and fruit juice, while a three-month time period was used to account for the lower category purchase rate for toothpaste. Average purchase set size was then calculated as the sum of the average probability of purchase for each brand in the category, for that age group (e.g. purchase probabilities of 0.9 for Brand A, 0.6 for Brand B, and 0.3 for Brand C would give a purchase set size of $0.9+0.6+0.3 = 1.8$ brands).

Appendix C: Statistical tests for cross-group comparisons of awareness, consideration, and purchase set size for study 2

Results of the nonparametric Kruskal-Wallis test are reported to determine whether significant differences between one or more age groups ($p < .05$) exist for brand recognition, recall, consideration and purchase set size. The Kruskal-Wallis test is used as the assumptions of normality and homogeneity of variance required for a parametric test are violated by the data.

Age-related differences are apparent for aided recognition with the number of brands recognised growing across age groups until 75 years of age for supermarket store, broadband, and electricity, and 65 years of age for toothpaste and fruit juice, before declining. Results of Kruskal-Wallis tests confirm statistically significant differences between one or more age groups for supermarket store choice $\chi^2(3) = 44.051$, $p = 0.000$, toothpaste $\chi^2(3) = 267.058$, $p = 0.000$, fruit juice $\chi^2(3) = 75.911$, $p = 0.000$, broadband $\chi^2(3) = 61.716$, $p = 0.000$, and electricity $\chi^2(3) = 75.144$, $p = 0.000$.

Brand recall sets follow a similar trend, increasing across age until reaching a turning point and declining from 60 years of age for fruit juice and broadband, and 75 years of age for supermarket store choice, toothpaste, and electricity. Kruskal-Wallis tests confirm statistically significant differences between one or more age groups for supermarket store choice $\chi^2(3) = 50.361$, $p = 0.000$, toothpaste $\chi^2(3) = 20.550$, $p = 0.000$, fruit juice $\chi^2(3) =$

58.983, $p = 0.000$, broadband $\chi^2(3) = 18.208$, $p = 0.000$, and electricity $\chi^2(3) = 107.520$, $p = 0.000$.

The number of brands considered decline after the 40-59 year-old age group for all repertoire and subscription markets. Prior to these declines, consideration set size increases for the two subscription markets and remains stable for the three repertoire markets between the under 40 year-old and 40-59 year-old age groups. Results of Kruskal-Wallis tests confirm statistically significant differences for consideration set size between one or more age groups for supermarket store choice $\chi^2(3) = 22.134$, $p = 0.000$, toothpaste $\chi^2(3) = 56.293$, $p = 0.000$, and fruit juice $\chi^2(3) = 73.810$, $p = 0.000$, broadband $\chi^2(3) = 9.107$, $p = 0.028$, and electricity $\chi^2(3) = 14.089$, $p = 0.003$.

Purchase sets decline steadily across the age groups examined. This decline occurs at a faster rate across than the decline in consideration sets sizes across age groups. Results of Kruskal-Wallis tests confirm statistically significant differences between one or more age groups for supermarket store choice $\chi^2(3) = 128.249$, $p = 0.000$, toothpaste $\chi^2(3) = 235.060$, $p = 0.000$, and fruit juice $\chi^2(3) = 234.454$, $p = 0.000$.

Appendix D: Comparison of linear and quadratic regressions for study 2

The relationship between brand recognition and age is better fitted by a quadratic regression in all categories as the R^2 is consistently higher and standard errors (S) are lower than the linear regression. Compared to the linear regression, the quadratic regression significantly improved the explanatory power of age on brand recognition by an additional 2.1% for supermarket store choice ($F_{1,1859} = 40.793$, $p = .000$), 2.0% for toothpaste ($F_{1,1859} = 42.238$, $p = .000$), 2.1% for fruit juice ($F_{1,1859} = 40.489$, $p = .000$), 3.4% for broadband ($F_{1,1859} = 64.582$, $p = .000$), and 3.1% for electricity ($F_{1,1859} = 61.897$, $p = .000$).

A similar result is witnessed for brand recall, with slightly lower S values, as well as small but statistically significant increases in the R^2 for the quadratic regressions in all categories. Compared to the linear regression, the quadratic regression was found to improve the explanatory power of age on brand recall by an additional 0.7% for supermarket store choice ($F_{1,1859} = 013.509$, $p = .000$), 1.3% for toothpaste ($F_{1,1859} = 24.111$, $p = .000$), 0.8% for fruit juice ($F_{1,1859} = 15.341$, $p = .000$), 1.6% for broadband ($F_{1,1859} = 30.760$, $p = .000$), and 2.9% for electricity ($F_{1,1859} = 58.604$, $p = .000$).

For consideration sets, the R^2 and S remain similar between the linear and quadratic regressions for all three repertoire markets. While a quadratic regression significantly improves the explanatory power of age on brand consideration by 0.2% for fruit juice ($F_{1,1859} = 4.299$, $p = .038$), this improvement is very minimal and does not provide sufficient evidence to suggest that the relationship between age and consideration set size is non-linear for fruit juice. Whereas, for the two subscription markets examined, the quadratic regressions significantly improve the explanatory power of age on brand consideration by an additional 0.8% for broadband ($F_{1,1859} = 14.418$, $p = .000$) and 0.8% for electricity ($F_{1,1859} = 15.871$, $p = .000$). Therefore, the relationship between age and brand consideration appears to follow a linear relationship for repertoire markets and a quadratic relationship for subscription markets.

For purchase sets, the quadratic regression analysis does not decrease the S or significantly improve the R^2 from the linear regression in any of the three repertoire markets, and, as expected, the plots of the quadratic shows a linear form. These findings confirm a linear decline in purchase set size across age for supermarket store choice ($F_{1,1859} = 173.201$, $p = .000$, $R^2 = .085$), toothpaste ($F_{1,1859} = 304.768$, $p = .000$, $R^2 = .141$), and fruit juice ($F_{1,1859} = 261.218$, $p = .000$, $R^2 = .123$).