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Fast track article

Mobile app adoption in different life stages: An empirical analysis

Remo Manuel Frey^{a,*}, Runhua Xu^a, Alexander Ilic^b^a *ETH Zurich, Weinbergstrasse 56/58, 8092 Zurich, Switzerland*^b *University of St. Gallen, Dufourstrasse 40a, 9000 St. Gallen, Switzerland*

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ABSTRACT

The analysis of individuals' current life stages is a powerful approach for identifying and understanding patterns of human behavior. Different stages imply different preferences and consumer demands. Thus, life stages play an important role in marketing, economics, and sociology. However, such information is difficult to be obtained especially in the digital world. This work thus contributed to both theory and practice from two aspects. First, we conducted a large-scale empirical study with 1435 participants and showed that a person's mobile app adoption pattern is strongly influenced by her current life stage. Second, we presented a data-driven, highly-scalable, and real-time approach of predicting an individual's current life stage based on the apps she has installed on smartphone. Result showed that our predictive models were able to predict life stages with 241.0% higher precision and 148.2% higher recall than a random guess on average.

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1. Introduction

Research on people's life stages can be traced back to the early 1930s. It started in sociology and then entered marketing research to explain behavioral differences among people at different stages. Researchers in fields like insurance [1], healthcare [2], and retailing [3] claimed that life stages have a significantly impact on individual's choice of decision-making. For Instance, young families buy baby food, do not dive into nightlife, and prefer to travel locally [4], whereas singles without children tend more to eat outside, experience new things, and travel around the world. Contemporary traveling-related patterns were examined by Collins and Tisdell in 2002 [5].

Based on the known life stage, companies can offer personalized product recommendations or conduct better segmented-marketing to improve customer satisfaction or to reduce costs [6–9]. However, an individual's current life stage remains unknown until being measured. Questionnaire and face-to-face interviews have been widely used in research and practice to gain knowledge about one's life stage [10]. But the downside of those approaches is obvious—it is costly and not scalable [11].

With the fast penetration of digitalization in our daily life, life stages become more difficult to know in the digital world because we cannot even guess one's life stage from her look and feel. However, digitalization on the other hand also brings new opportunities. Recent research in reality mining has shown a possibility to predict a smartphone user's demographics, interest, and personality based on her phone logs or apps installed [12–15]. As smartphones are the most personal devices we own and the apps we install reflect our preference and behavior [16], we thus suspect that it is possible to predict a smartphone user's current life stage by analyzing the installed mobile apps in real-time.

* Corresponding author.

E-mail addresses: rfrey@ethz.ch (R.M. Frey), rxu@ethz.ch (R. Xu), alexander.ilic@unisg.ch (A. Ilic).<http://dx.doi.org/10.1016/j.pmcj.2017.01.006>

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For a thorough investigation, a large-scale field study was conducted with 1435 participants. As a first step, people's adoption behavior in different life stages is analyzed to examine whether an individual's app installation behavior is significantly associated with her current life stage. To the best of our knowledge, no study has been conducted to understand the relationship between app adoption patterns and different life stages. The present paper tries to address the research gap. In a second part, a predictive model for determining an individual's life stage is developed. The model is evaluated and compared with a random guess. Results show that user's app adoption behavior can serve as useful feature to predict her current life stage, which enables a whole bunch of new research and business opportunities.

The rest of the paper is structured as follows: The related work section reviews previous literature on background of life stage research, life stage prediction, reality mining, and app adoption. Afterwards, we explain our research design before presenting the research results. In the last section, we discuss privacy aspects and limitations and provide an outlook on future works.

2. Related work

2.1. Life cycle analysis

The concept of life cycle was introduced in sociology in the early 1930s by Sorokin et al. [17]. His work was the starting point for the so-called academic rural sociology, which tried to respond to urgent contemporary questions related to poverty, migration, and revolts. Twenty years later, the concept of life cycle found entrance into the marketing research. A life cycle contains several life stages like having family or getting retired. During lifetime, individuals move from one stage to another, triggered by major life events like having a first child or retiring. Lansing and Kish [18] called it 'family life cycle'. They claimed that people's attitude and behavior might be associated less with the biological process of aging, but more with the individual family status. Lydall [19] and Lansing and Morgan [20] discovered the correlation between life cycles and financial factors like income, saving, and asset ownership.

Baek and Hong [21] found that life stages are a significant factor that affects an individual's installment debt and credit card debt, which contributes to practical implications for financial counselors and educators, lenders, consumers, and policy makers. In insurance industry, researchers argued that changes in life stages significantly impact an individual's choice of different insurance products [1,22]. Artle and Varaiya [23] revealed the fact that people in different life stages have different consumer behavior related to homeownership. Rabe and Taylor [24] supported such arguments with a panel study on British households and found that couples who have new babies are more likely to move into a better neighborhood.

Research in the field of life stages has a long tradition and its findings are still of high relevance in many industries today. It helps to understand hidden mechanisms in the whole societies as well as the behavior of an individual. However, there is no common definition of life stages in previous literature. Lansing and Kish [18] proposed nine life stages including marital status, children, and age. Wells and Gubar [25] supported the use of additionally information about people's working life with the same number of life stages. The established model of Gilly and Enis [26] incorporated the increasing number of single-person house-holds, cohabitation by non-legally married adults, delayed parenting, and rising divorce rates. Wilkes [27] studied expenditures across the life cycle by dividing the people in three main groups ('under age 35'; 'age 35+, not retired'; 'age 35+, retired') and 15 subgroups, again with a focus on marital status, children, and age. Du and Kamakura [28] suggested 13 life stages and considered different household sizes in his model.

In 1966, Wells and Gubar already recognized that the definition of life stages (hereinafter referred to as categories) is not trivial: "If a category is too narrow, it will include such a small proportion of the sample that it will be all but unpopulated except large surveys. If it is too broad, it will cover such a wide variety of consumers that it will not identify anybody. And, if it is inappropriately selected, so that it merges groups with very different consumption patterns, it will not discriminate no matter how broad or narrow it is". [25] In addition, the authors mentioned the problem with people who do not fit into one of the defined life stages. They proposed to force them into one of the defined stages or to remove them from the study.

2.2. Life stage prediction

In summary, people in distinct life stages have different consumer behaviors. Therefore, knowing the current life stage of an individual can lead to new business or marketing opportunities. Thanks to a better customer segmentation, personalized product recommendation can be offered with a higher accuracy. But until today, most of the studies regarding life stages are limited to descriptive level. Kapinus and Johnson [29] reviewed the utility of family life cycles and demonstrated the usefulness as a predictive tool. Nevertheless, scientific publications that go a step further and try to predict individuals' life stages are scarce. As one of the few studies, Jiang and Zhu [30] built a Maximum Entropy Semi Markov Model to segment and predict life stages based on observed purchasing data. They suggested to use their concept in recommender systems and presented its effectiveness in offline and online experiments. Du and Kamakura [28] developed also a Markov Model, but for the opposite purpose: They used historic data from US households for a period of 34 years to identify empirically the most typical life stages and the transition probabilities in between. Then, the authors suggested firms to predict expenditures on durable goods based on customers' most likely life stage.

Bayer [31] applied a path analysis to predict a specific life stage change: the marriage. Out of four independent variables, the expected age at marriage, stated some prior to marriage, was the best single predictor. Yang [32] observed and analyzed

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