

Segmenting Consumer Knowledge and Attitudes: Behavioral Insights for End-of-First-Use Electronics

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Abstract—The goal of this study is to find patterns in how consumers disposition electronic devices at End-of-First-Use, i.e. store, recycle, resell, trade in, donate/give or and throw in the trash. K-means clustering was used on survey data from 3,747 U.S. respondents across 10 device categories to divide the population into three clusters of consumers based on stated attitudes and knowledge of data privacy, environmental benefits, convenience and other aspects of End-of-First-Use options. We then measure the reported intended disposition of devices for each cluster and compare with the general population. Cluster 1 has higher data security concerns when recycling, reselling or donating, and less knowledge and trust in End-of-First-Use options overall. The intended behavior of cluster 1 shows higher than average uncertainty in what to do at End-of-First-Use and more intent to store (lower values for other options - recycling, reselling and donating). Cluster 2 shows higher knowledge and trust in recycling, reselling, and donation, and slightly higher than average concern about data security of these options. The intended behavior of cluster 2 shows higher intent to resell, trade-in or donate, and lower levels of being uncertain of what to do and of storing. Cluster 3 expresses much less concern about data security, and lower utility of a stored device. Their intended behavior shows less storage and higher levels of other End-of-First-Use options. While cluster analysis does not yield causal connections, the groups show consistent trends in stated knowledge and attitudes towards different End-of-First-Use options and corresponding planned behaviors. These results indicate there are subgroups of the general population with similar reported attitudes, knowledge and behaviors. The three subgroups do not have distinct demographic characteristics, i.e. knowledge and attitudes regarding disposition of electronics does not depend strongly on age, education level, income and similar factors. Understanding segmentation is useful to investigate more effective interventions to influence behavior for better sustainability outcomes.

Keywords—e-waste; behavior; clustering; End-of-First-Use; electronics

I. EXTENDED ABSTRACT

The increasing ownership of electronic devices has led to growing challenges around their disposal and end-of-life management. While often termed "e-waste," many devices at their end-of-first-use (EoFU) are still functional and could be reused. However, consumers face multiple options when deciding what to do with their old devices: store them, recycle, resell, trade in, donate/give away, or dispose in trash. Understanding how consumers make these decisions and what drives their behavior is crucial for promoting more sustainable EoFU practices.

This study investigates patterns in how consumers dispose of electronic devices at End-of-First-Use (EoFU) through storage, recycling, reselling, trade-in, donation, or discarding in trash. The research utilized a comprehensive survey covering multiple aspects of device disposition, including convenience, environmental motivation, data security, and perceived value. Using K-means clustering on data from 3,747 U.S. respondents across 10 device categories, we identified three distinct consumer clusters based on stated attitudes and knowledge regarding data privacy, environmental benefits, convenience, and other aspects of EoFU options.

Cluster 1 (36.6% of respondents) exhibited higher data security concerns when recycling, reselling, or donating, along with less knowledge and trust in EoFU options overall. This cluster showed higher uncertainty about EoFU decisions and greater tendency to store devices rather than pursue other options like recycling, reselling, or donating. Cluster 2 (34.7%)

demonstrated higher knowledge and trust in recycling, reselling, and donation, with slightly elevated concern about data security. This group showed higher intent to resell, trade-in, or donate devices, with lower levels of uncertainty and storage. Cluster 3 (28.7%) expressed much less concern about data security and lower perceived utility of stored devices, resulting in less device storage and higher levels of other EoFU options. Figure 1 summarized these results.

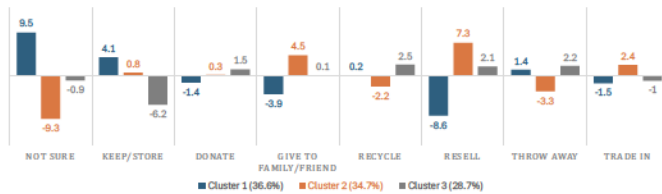


Figure 1 - Differences in intended behavior for End-of-First-Use option compared to the general population (percentages)

Statistical validation confirmed the significance of the cluster separation, with Kruskal-Wallis H tests showing p-values < 0.001 for all measured variables. The study included a diverse range of internet-connected devices: smartphones, tablets, wearables, gaming consoles, AR/VR devices, streaming devices, security devices, connected kitchen appliances, smart TVs, and smart home equipment.

A key finding is that these behavioral patterns were not strongly correlated with demographic characteristics such as age, education level, income, or device type ownership. This suggests that knowledge and attitudes regarding electronics disposition are driven more by individual perspectives and experiences rather than traditional demographic factors. The clusters showed consistent internal trends in stated knowledge and attitudes towards different EoFU options and corresponding planned behaviors.

The study makes two primary contributions to the literature. First, it treats the EoFU decision as a multicriteria choice among different options, considering how consumers evaluate multiple dimensions of each alternative simultaneously. This provides a more holistic view compared to prior studies that examined fewer options or did not assess consumers' comprehensive evaluation of each option. Second, the use of cluster analysis offers an important methodological alternative to prevalent regression-based approaches in the field. While cluster analysis does not yield causal inferences connecting knowledge/attitudes with behavior, it is free from assumptions such as functional structure and independence of dependent variables that are required by traditional statistical methods.

These findings have important implications for designing interventions to promote more sustainable EoFU behaviors. For example, higher than average data security concerns in cluster 1, suggest that educational initiatives focusing on proper data erasure methods could help reduce device storage

and increase recycling or resale. Cluster 2's positive disposition toward sustainable options indicates they may be early adopters for new recycling or resale programs. Cluster 3's lower knowledge levels but reduced data concerns suggest they might benefit from general education about the environmental benefits of different EoFU options.

These results provide a foundation for developing targeted interventions to influence consumer behavior toward more sustainable EoFU outcomes. One proposed application is the development of an End-of-First-Use ChatBot powered by large language models, which could be trained on the identified clusters to efficiently determine a user's cluster membership and provide tailored information about recycling locations, data wiping protocols, and resale opportunities. Future research will focus further on addressing data security concerns to encourage more sustainable EoFU behavior across all consumer segments.