www.trjfas.org
ISSN 1303-2712
*Turkish Journal of Fisheries and Aquatic Sciences 18: 119-126 (2018)* DOI: 10.4194/1303-2712-v18_1_13

**PROOF** RESEARCH PAPER

# Determination of Hobbyist Preferences for Livebearer Ornamental Fish Attributes by Conjoint Analysis

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Received 27 October 2016
Accepted 18 May 2017

**Abstract**

This study investigates preferences of ornamental fish hobbyists on selected attributes of livebearer fish species guppy (*Poecilia reticulate)*,golden swordtail (*Xiphophorous hellerii*), platy (*Xiphophorous maculatus*) and molly (*Mollienesia spp.*) using adaptive conjoint analysis. Computer-based surveys were conducted with 453 livebearer hobbyists in İzmir city (Turkey) between September and December, 2014. Results indicated the most important attributes are colour, price, species and size, which have significance for local livebearer producers, importers and retailers in planning their production and market strategies. Conjoint analysis determined price to be the second factor influencing the purchase behaviour of hobbyists' with a 25% relative importance. Colour attribute is the leading factor by 28% relative importance. Multicolour, which is the most leading attribute level, got the highest part-worth score as 3.36. Market simulation indicated that nearly 62 % of the hobbyists' like to purchase a medium size multicolour guppy with 1€/fish price and such favourite attribute combination would get nearly 42% of the livebearers market share. The overall results of this study indicate a promising market share for locally-bred livebearer fish in a variety of colours and sizes, but there is a considerable

*Keywords*: Aquarium, conjoint analysis, consumer preferences, marketing, livebearer.

## Introduction

Aquarium keeping is rated as the second most popular hobby with millions of enthusiasts worldwide (Olivier, 2001). The ornamental fish trade has an approximate value of 6 billion USD(Holthus & Gamain, 2007) each year and includes sales of more than 5300freshwater species and billions of specimens annually (Collins *et al*., 2012; Helfman, 2007; Hulme, 2009; Tlusty *et al*., 2013). [1] The vast majority of ornamental fishes in the aquarium trade are of freshwater origin and farm-raised, where aquaculture provides 90% of the specimens (Whittington & Chong, 2007). Livebearers that belong to the *Poeciliidae* family are the most popular ornamental fish for breeding (Alderton, 2012). Guppies, mollies, platies,swordtails, endlers livebearer and mosquito fish are members of thisfamily (Zin & Han, 2014). The major difference between egg layers and livebearer fish occurs in the hatching stage. While egg layers are spawning matured eggs and let them hatch outside of their body, livebearers keep the eggs inside their body till the hatching phase and give live birth to free-swimming freebies. The newborn fish are large in size, and they can easily protect themselves from predators in the very early stages of their lives compared to the fry of oviparous fish. Livebearers were primarily presented in Europe at the end of the 18th century, and they became the most popular species in Europe and USA in terms of production and trade (Chapman *et al*., 1997). They are much easier to raise and feed than the fry of egg-laying species (Siddiky & Mondal, 2016),consequently, they are the most recommended fish for beginners who are interested in ornamental fish breeding. Moreover, hobbyists can easily get many colours, tail types and pattern variations through selective breeding methods (Alderton, 2012).

Ornamental fish keeping will continue to develop and gain a higher profile worldwide, and this growing interest should drive expansion and improvement within the industry (Olivier, 2003). The majority of researchers have focused on the biological characteristics like feeding, breeding and genetics of livebearers (Arul Joshpin & Meena, 2015; Chitra & Krishnaveni, 2013; Evans & Gasparini, 2013; Ho, 2015; Koldewey *et al*., 2013; Zin & Han, 2014), but there is an important deficiency regarding trade and consumers' preferences for livebearer ornamental fish attributes that drive fish breeders to

producelivebearers that are better suited to the preferences of consumers.

For a successful business, the decision making process of customers among various competing alternatives should be clearly identified (Rao, 2014). One of the most appropriate methods used to determine customer preferences is the conjoint analysis, an efficient tool to analyse multi-attribute choices (Green &Srinivasan, 1978) as a mean for quantifying customers' preferences among multi-attribute alternatives (Currim, 1981). The objective of conjoint analysis is to determine what combination of a limited number of attributes is most influential in respondent choice or decision making (Whittington, 2008).

The strength of conjoint analysis is the ability to develop market simulation models that can predict consumer responses to product varieties. Market simulation is an important tool for researchers to estimate possible results of new products, product modifications and pricing strategies on consumers' demand or purchase attitudes (Gustafsson *et al*., 2013).

In this study, the preferences of aquarium hobbyists on the main attributes of selected freshwater livebearers were determined using conjoint analysis. In livebearer ornamental fish breeding, where the fish attributes can be easily manipulated during the production stage, full determination of consumer preferences and supplying right varieties to the market would highly improve the market share and value of the products.

The objectives of this study are; (1) to analyse the purchase preferences of aquarium hobbyists for the most popular livebearer species, (2)to determine favourite fish attributes which would maximise consumer satisfaction and willingness of purchase and (3) to estimate market share of best varieties by simulating attribute combinations.

## Materials and Methods

### Theoretical Framework

Conjoint analysis has been used to determine which characteristics of fish are preferred by consumers and the effect of different levels of these properties on consumer preferences in the livebearer aquarium fish segment. Conjoint analysis is a marketing research technique suited to studying customers' preferences and determining trade-offs among the attributes of a product (Rao, 2014). This technique is nowadays widely used in new product planning, pricing policies, development of existing products, advertising work and distribution studies.

Conforming the aims and materials of this study, a computerised version of conjoint analysis called adaptive conjoint analysis (ACA) was used as statistical method (Sawtooth, 2014a). In ACA method, survey software customises the conjoint interview for each respondent, focusing on the attributes, levels, and trade-offs that are most relevant to each respondent (Johnson, 1987). At each step of the conjoint survey, previous answers are used to decide which question to ask next, to obtain more information about the respondent's preferences (Menichetti, 2010). In ACA method, estimates of the respondent's utilities are updated after each paired-comparison response by the formula (1):

$$y_{mj} = w_m \left[\frac{r_{mj}-1}{j_m - 1} - 0.5\right] \quad (1)$$

where;

m: number of attributes, j: number of levels, $w_m$: importance of attribute selected by the respondent, $j_m$ : number of levels of an attribute, $r_{mj}$ : ratings of an attribute levels selected by the respondent (Green *et al*., 1973).

Part-worths, which are the valuation scores of a product or service, can be determined by showing a selected set of potential products to the buyers and analysing the preferences among the products. These part-worths can be used to create market models that estimate market share, revenue and even profitability of new variations (Sheng *et al*., 2008).

The importance of an attribute is represented by a range of its levels (difference between the highest and lowest values) divided by the sum of the ranges across all attributes. This provides the relative importance of each attribute based on the range of its part-worth estimates (Hair, 2006). The relative importance of an attribute is defined as:

$$relative\ \ importance = \frac{range}{\sum ranges}\ x\ 100 \quad (2)$$

Share in a market model is known as "Share of Preferences". This is the expected market share as it does not include aspects such as promotional or distributional factors. Based on part-worth values of each attribute, counting the number of respondents who would choose each product, make possible to estimate the potential market share (share of preferences) in a competitive market situation. Share of preferences model counts the number of times each of the product sets were preferred computing the percentage of preference. Purchase likelihood is another model which assumes respondents buy or choose the product alternative from the competitive set that has the highest total utility. Both models are used in this study to simulate the market conditions and to estimate purchase preferences of consumers based on the part-worth utilities.

### Survey Design and Implementation

The implementation of the conjoint analysis consisted on the following stages in order to provide the best results:

- Identification of all important attributes of

products or services,

- Determination of the levels for each attribute,
- Preparation of the appropriate questionnaire,
- Implementation of the questionnaire,
- Estimation of the effect for all levels of each attribute on preferences for each questionnaire,
- Establishment of some common preference models by grouping consumers with similar preferences,
- Simulation of preference shares among the competitive product alternatives in the market that are considered in the study for the entire market and / or selected market segments.

The sample population of this research consisted of aquarium fish hobbyists in the İzmir city of Turkey. The targeted respondents are the visitors of an annual pet show that nearly 40 000 hobbyists visit every year from İzmir and adjacent cities. Hence, because there is no statistical information about the number of aquarium hobbyists across Turkey, a stratified sample is not possible. However, the results of this study are specific to livebearers market segment that is within the aims of this study.

Since the number of respondents required for an accurate determination of preferences through adaptive conjoint analysis has to be between 150 and 1000, the maximum number of aquarium hobbyists who had resided İzmir city and purchased concerned livebearer species at least once before the survey were selected to make the research more reflective of the population that is focused. Computer-based surveys were sent to the e-mail addresses of 1000 potential respondents conforming to the requirements of focus sample group. Response rate for the computer-based questionnaire between September and December 2014 was nearly 55% and 453 surveys elected for conjoint analysis after deduction of faulty and misleading surveys.

Pre-surveys were conducted with the sample group and ornamental fish dealers at the pet show regarding attributes of livebearer ornamental fishes that are important while making a purchase decision. Based on four important factors identified from thesepre-survey results, a total of 108 (4*3*3*3) possible combinations of attributes and levels were calculated to be applied in conjoint questionnaires. In order to reduce the information overload and respondent's fatigue, the method of orthogonal arrays as proposed by Green (1974) was used to identify 22 stimulus questions.

The respondents were initially asked to rate their preference levels for the four product attributes. Then, asked to state their preference among the attribute levels in order to learn which attributes are most important and which attribute levels are preferred. Next, a series of customised paired-comparison trade-off questions were presented to find out preferences and their strength. Finally, a series of calibrating concepts was composed using those attributes determined to be most important. These concepts were chosen to occupy the entire range from very unattractive to very attractive to the respondent. The respondent was asked a likelihood of purchase question about each concept and the likelihood was expressed by a numeric value between 0 and 100.

The descriptive statistics were evaluated by SPSS v.22 statistical software and questionnaires of ACA were prepared and evaluated by Sawtooth Software SSI Web v.8.2.4. (Sawtooth, 2014a) Market simulation was performed by Sawtooth Software Market Research Tools (SMRT) v.4.23. (Sawtooth, 2014b)

## Results

Descriptive statistics showed that 86% of respondents were male. All respondents resided in the central districts of İzmir city. Aquarium keeping was the primary hobby of 72% of the respondents and 57% of the respondents have experience in keeping ornamental fish for more than three years. Livebearers were the first aquarium fish of 67% of respondents. Approximately, 32% of the survey participants kept only livebearer species; 63% of the respondents were willing to buy new varieties differing from their existing stocks. The annual average expenditure for livebearers was 28 euros (79.5 TL)[1] per hobbyist. Almost 70% of the respondents preferred only locally-bred varieties, but 59% of the hobbyists were not satisfied with the number of varieties on the market (Table 1).

Four important product attributes regarding livebearers were identified as species, colour, size and price by the pre-survey results. Popular livebearer ornamental fish species were determined as guppy **(***Poecilia reticulata)*,golden swordtail **(***Xiphophorous hellerii)*, platy **(***Xiphophorous maculatus)*andmolly (*Mollienesia sp.*). Three colour attributes defined as no colour, single colour and multicolour fish. Size attribute has different values, defined according to the species and market. However, according to commercial scaling, small size is defined as 1-2 cm for total length of a species, while medium size is defined as 2-4 cm and large size is defined as over 4 cm for all species.Price levels were selected by calculating means of the actual retail prices of livebearers in Izmir city. The selected attributes and their levels were listed in Table 2.

The results derived from relative importance of the attributes showed that the colour attribute of fish was the strongest factor influencing respondents' purchase behaviour by 27.79% of relative importance. The second important attribute was price by 25.40%. Species and size attributes were following price attribute by 23.94 and 22.87%, respectively (Table 3). Pearson's R correlation was found to be 0.964 ($P<0.01$), which showed that estimated and observed preferences were suitable at a 1% significance level.

**Table 1.** Descriptive results of the survey on livebearer owners

| | Number of respondents (n) | Percentage (%) |
|---|---|---|
| Gender | | |
| Male | 390 | 86 |
| Female | 63 | 14 |
| Primary hobbies | | |
| Aquarium | 326 | 72 |
| Music | 68 | 15 |
| Photography | 27 | 6 |
| Gardening-floriculture | 23 | 5 |
| Others | 9 | 2 |
| Experience in aquarium keeping | | |
| Less than 1 years | 104 | 23 |
| 2 years | 91 | 20 |
| 3 years | 95 | 21 |
| 4 years | 68 | 15 |
| 5 years | 54 | 12 |
| More than 5 years | 41 | 9 |
| First-grown aquarium fish species | | |
| Livebearers | 303 | 67 |
| Golden fish | 95 | 21 |
| Cichlids | 36 | 8 |
| Beta | 5 | 1 |
| Others | 14 | 3 |
| Fish varieties in the aquarium | | |
| Only livebearer species | 145 | 32 |
| Livebearers with other tropical species | 308 | 68 |
| Willing to buy new varieties | | |
| Yes | 285 | 63 |
| No | 168 | 37 |
| Origin preference | | |
| Local | 314 | 69 |
| Imported (foreign) | 82 | 18 |
| Both | 59 | 13 |
| Satisfied with the number of varieties on the market | | |
| Yes | 186 | 41 |
| No | 267 | 59 |
| Annual expenditure for livebearers | | |
| 1-10 € | 78 | 17 |
| 11-20 € | 95 | 21 |
| 21-30 € | 145 | 32 |
| 31-40 € | 72 | 16 |
| 41-50 € | 45 | 10 |
| > 50 € | 18 | 4 |

**Table 2.** Livebearer ornamental fish attributes and levels for the conjoint analysis

| Attributes | Levels |
|---|---|
| Species | Guppy, Golden Swordtail, Platy, Molly |
| Colour | No colour, Single colour, Multicolour |
| Size | Small, Medium, Large |
| Price* | 1€ (low), 2€ (medium), 3€ (high) |

*Price levels reflect range of prices observed at time of the study

The multicolour attribute had the highest part-worth score by 3.6, which emphasises the positive effect of colourful fish on purchase preferences of the customers. The part-worth score of single colour fish was only 0.18. The no colour fish (i.e., with transparent skin) had a rather low and negative part-worth score of -3.54, showing that they were generally not preferred by the most aquarium hobbyists.

The second most important factor affecting hobbyists' purchase behaviour was determined as the price attribute. Respondents tended to pay the lowest price of 1 € per fish with the highest part-worth score while 2 €/fish would be rarely accepted. A price of 3

€ per fish was determined as almost unacceptable by the respondents, even for the best fish.

Guppies (*Poecilia reticulate)* were the most preferred livebearer ornamental fish with a 1.37 part-worth score. The 0.17 part-worth score indicated that golden swordtail (*Xiphophorus helleri*) was the second favourite fish in selected livebearers. The part-worth scores of molly (*Mollienesia sp.*) and platy (*Xiphophorous maculatus*) were determined as -0.64 and -0.90, respectively. These negative part-worth scores indicated that they were not extensively preferred by the respondents.

Size was the least influential attribute among others. However, most hobbyists preferred medium size fish by a 1.32 part-worth score. The negative levels of other fish size attributes indicated that large and small size livebearers were rarely preferred by the respondents.

The highest positive part-worth scores of all attributes indicated that multicolour, medium size guppy with 1€ prize is the most favourite attribute combination (FGC). However, the actual attribute combination on the market differs from the favourite attribute combination. Actual attribute combinations for guppy were determined as multicolour, small size with 1€/fish (AGC-1) and multicolour, medium size with 2€/fish (AGC-2) on the market.

Share of preferences and purchase likelihood derived from the conjoint analysis indicated that AGC-1 combination has a slightly higher preference and purchase likelihood as 52.18% and 57.71%, respectively. The AGC-2 combination had 47.82% preference and 56.69% purchase likelihood according to the results of conjoint analysis (Table 4).

The market simulation including favourite guppy combination (FGC) showed that an increase in size and price of fish would decrease the share of preferences among AGC combinations. Multicolour medium size guppy with 2€/fish price (AGC-2) had 17.65% of share in preferences where small size of this fish with 1€/fish has nearly double of AGC-2's share in preferences.

The favourite guppy combination (FGC) had the 49.35% of preferences in market simulation. The price was the only difference between AGC-2 and FGC and the lowest price as 1€/fish had a positive effect on buyer preferences according to share of preferences. Lowering the price for a medium size guppy to 1€/fish increased the share of preferences from 17.65% to 49.35% among AGC-2 and FGC, respectively. Purchase likelihood of FGC as 61.56% was followed by AGC-1 (57.71%) and AGC-2 (56.69%) (Table 5).

Market simulation that compared favourite guppy combination with the other livebearer species in actual attribute combinations on the market revealed that FGC would get 42.33% of market share based on buyer preferences. Multicolour medium

**Table 3.** Conjoint analyse results for average utilities and relative importance of attributes and levels

| Attributes and Levels | Average Utilities (Part-worth score) | Relative Importance (%) |
|---|---|---|
| Livebearer species | | 23.94 |
| Guppy | 1.3709 | |
| Molly | -0.6391 | |
| Platy | -0.9022 | |
| Swordtail | 0.1704 | |
| Colour | | 27.79 |
| No colour | -3.5372 | |
| Single colour | 0.1801 | |
| Multicolour | 3.3571 | |
| Size | | 22.87 |
| Small | -1.2093 | |
| Medium | 1.3234 | |
| Large | -0.1141 | |
| Price | | 25.40 |
| 1 € | 0.4494 | |
| 2 € | 0.0267 | |
| 3 € | -0.4760 | |
| Pearson's R = 0.964 (p=0.000) | | |

**Table 4.** Share of preferences and purchase likelihood of actual guppy combinations (AGC)

| Product | Colour | Size | Price | Share of preferences (%) | Standard Error | Purchase Likelihood (%) |
|---|---|---|---|---|---|---|
| AGC-1 | Multi | Small | 1 € | 52.18 | 1.47 | 57.71 |
| AGC-2 | Multi | Medium | 2 € | 47.82 | 1.43 | 56.69 |

swordtail would have nearly the half of FGC market share with nearly 23% of preferences. The least preferred combinations were single colour large molly and single colour medium platy by 17.75 and 16.94 % market share, respectively (Table 6).

## Discussion

In ornamental fish market, consumer expectations have become very important to know and marketing strategies are being planned according to such information. Therefore, domestic producers, importers, wholesalers, service providers and retailers have to pay more importance to market research and need to focus on consumer expectations, behaviours, wishes and changes occurring in consumer characteristics. The statistical techniques used in marketing research allow such firms to be more successful in determining consumer choice. Conjoint analysis is an advanced statistical method that provides more accurate predictions about consumer preferences for new or modified products. In this context, the results obtained from conjoint analysis in this study provide important information about the expectations of livebearer hobbyists which would guide domestic producers, importers and retailers in the livebearers market.

Results of conjoint analysis revealed that colour is the most important factor affecting purchase attitude of livebearer hobbyists. Furthermore, a significant portion of livebearer fish hobbyists prefer multicolour fish. Similarly, Livengood and Chapman (2007) reported that most people choose colourful fish, corals and other invertebrates.In freshwater ornamental fish species, guppy is more advantageous than the others with its fancy colour variations.

Price attribute is the second factor that strongly impacts the likelihood of purchase results in this study. This special market segment would highly benefit from the price fluctuations as the customers in this segment give sharp responses to the price variations. Contrary to the findings of Alencastro (2004)who reported the price as an unimportant factor affecting purchasing behaviour of the hobbyists, livebearer customers in this study were tend to buy the low or medium priced fish and not accepting the price as an indicator of higher quality. The other attributes and factors are highly influencing the price acceptation of consumers as reported by Akpinar *et al*. (2009). This study revealed that discount in prices would very likely increase the probability of purchase and market share in livebearer market segment, remarkably. However, there is a limited option available for the price promotions of the imported fish due to many agents in distribution channel and very strict profit margins whereas domestic producers have more options.

Market simulation is one of the key strengths of conjoint analysis that can cumulate the most desired attributes in one product and more closely reflect the real market. Market simulation in this study revealed that a favourite guppy combination (FGC) presented to the hobbyists would get 42% of the livebearers market share. Also such fish variety with favourite attributes would get more than the half of specified guppy market with 61%purchase likelihood.These results indicate that the target market segment has a relatively strong preference for a medium size multicolour guppy. Moreover, simulations including price variations showed that respondent's purchase likelihood for multicolour guppy tend to increase if the price was lower. The actual and potential buyers are very likely to react positively to colour and price variations.

The small differences among the percentages of relative importance show that all attributes have nearly similar weight in hobbyists' decisions in this study. As in the guppy case, the introduction of a fish variety whose attributes are optimised through the preferences of customers would increase the value of the product as well as improve its market share within the related product group. Livebearers can be easily produced in different varieties through selection in breeding (Alderton, 2012) and many different

**Table 5.** Share of preferences and purchase likelihood between actual (AGC-1 and AGC-2) and favourite guppy (FGC) combinations

| Product | Colour | Size | Price | Share of preferences (%) | Standard Error | Purchase Likelihood (%) |
|---|---|---|---|---|---|---|
| AGC-1 | Multi | Small | 1 € | 33.01 | 1.07 | 57.71 |
| AGC-2 | Multi | Medium | 2 € | 17.65 | 0.88 | 56.69 |
| FGC | Multi | Medium | 1 € | 49.35 | 0.70 | 61.56 |

**Table 6.** Market simulation for livebearers segment with favourite guppy combination (FGC)

| Species | Colour | Size | Price | Share of preferences (%) | Standard Error |
|---|---|---|---|---|---|
| FGC | Multi | Medium | 1 € | 42.33 | 1.72 |
| Swordtail | Multi | Medium | 2 € | 22.98 | 1.12 |
| Molly | Single | Large | 2 € | 17.75 | 1.15 |
| Platy | Single | Medium | 2 € | 16.94 | 1.00 |

varieties with a range of colours are readily available in the market as broodstock. They are the most recommended ornamental fish for beginners due to their tolerance to the wide range of aquarium conditions, interesting reproductive biology, and affordable prices. Their ease of breeding means that it is the first species many hobbyists begin to breed (Aquarium Industries, 2015). Locally-bred varieties are preferred by a majority of the hobbyists for health, price and high tolerance to aquarium conditions. However, hobbyists are not satisfied with the number of domestic varieties. The overall results of this study indicate a strong potential market for locally-bred livebearer fish in a variety of colours and sizes, but there is considerable resistance to price attributes. The domestic ornamental fish producers would easily benefit from the selective breeding on livebearer market. Maceda- Veiga *et al*. (2014) emphasized that demand of aquarium keepers force domestic producers to produce fish with new or more extreme shapes and colours. Moreover, producing ornamental fish with the characteristics demanded by the potential market is a good opportunity for local and small-scale producers to compete with the domination of imported products on the ornamental fish market. The results derived from this study can be used by producers to optimise the livebearer domestic production. Also, producers would be able to target the right market for their current varieties if the desired varieties cannot be produced. Besides of producers, importers and retailers can benefit from such market research studies dealing with the customer preferences to offer the right species and maximise their profits.

## Conclusions

The empirical results have some interesting and meaningful implications for ornamental fish producers and pet traders to understand the essential characteristics of livebearer species for the successful growth of livebearers in the ornamental fish market. It is important to note that the results of this study are limited to a group of ornamental fish hobbyists and do not cover the whole population. However, this study would be a good example for those who are willing to understand hobbyists' preferences on the attributes of a fish variety in order to realize the full profit potential of livebearer ornamental fish. Studies focusing on hobbyists' preferences and production are limited and more market research covering bigger sample sizes and additional species would be useful in obtaining a better state of overall demand. Since several ornamental fish species are available from domestic aquaculture production, observations obtained from this study could apply to other ornamental species. Moreover, information derived from conjoint analysis can be used to guide aquaculture management and marketing strategies of ornamental fish as indicated by Steenkamp (1987)and more studies focusing on buyer preferences and attribute combinations for less preferred fish would improve their market share gradually.

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