18 Comfortable Manual Bag Sealing

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CONTENTS

18.1 MANUAL BAG SEALING

Customers continually expect faster, more efficient, and more thorough service at supermarkets (Carrasco et al. 1995), but also in other shops where bags are sealed. Manual bag sealing is often used in shops where products are sold that have to be protected for hygienic reasons (meat or bread) or to bundle several smaller products (candy). A variety of seals are used to close these bags. Shop assistants use seals mainly to close the plastic bags which the consumer opens at home and often seals again.

For shop assistants, sealing the bags is a repetitive, physically demanding action that takes some time and could cause discomfort because of the physical load in combination with the time pressure. Several studies show the negative effects of highly frequent movements in combination with force exerted in poor working postures (Bongers, 2003; Macfarlane et al. 2000). Opening and closing the bags again can cause some discomfort or annoyance for consumers also, in the event they cannot open the bag or when the seal is not closing the bag well enough. This activity can create a safety hazard as well because children could swallow the sealing devices.

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18.2 DEVELOPMENT

Several systems are available for sealing plastic bags, but both consumers and shop assistants mention that most of them have disadvantages. Some could be hazardous, for example, if children swallow the bag sealing devices. Some are made with adhesive tape, which could be difficult to open, and some take a lot of time to wrap around the plastic bag.

Knowing these potential shortcomings, Twin Seal developed a new system of sealing. Various ideas and prototypes resulted in a system with an adhesive tape that has a piece of paper at each end to keep them from sticking together. The idea is that shop assistants could save time, because a special machine fastens the seals. Consumers could experience more comfort in easily opening the bag, and it should be safer because it is more difficult for children to swallow it.

18.3 USER RESEARCH

An evaluation was set up to study whether the assumed improvements are also experienced by end users. A comparative test of the discomfort, safety, and efficiency of four different types of plastic bag seals was performed. This test was performed by both shop assistants (for sealing) and consumers (for opening and sealing again). The tested seals are a) a paper- or plastic-covered iron wire; b) a metal clip; c) standard adhesive tape; and d) the new adhesive tape with a piece of paper at each end (Fig. 18.1). Systems (c) and (d) are always used in combination with a tape machine (Fig. 18.2), so, these two sealing devices are tested using the tape machines.

The research questions are

1. Which system do shop assistants prefer?
2. Which system do consumers prefer?
3. How do the different kinds of systems score on safety?
4. What is the final evaluation?

18.4 METHODS

Twenty shop assistants (age 16 to 50 years old, average age 31.5 years), twenty-four consumers (age 8 to 85 years old, average age 40.3 years) and five experts on ergonomics and safety participated in the study. The shop assistants evaluated the sealing of the bags, the consumers evaluated the opening and sealing, and the experts evaluated the safety and also the user friendliness and physical load. The shop assistants are employees of the bread and meat products department who have to seal many bags daily.

Three groups of consumers were selected: eight youngsters (age 8 to 19 years, average age 13 years), eight adults (age 26 to 51 years, average 34.4 years) and eight seniors (age 57 to 85 years, average age 73.4 years). Every participant evaluated

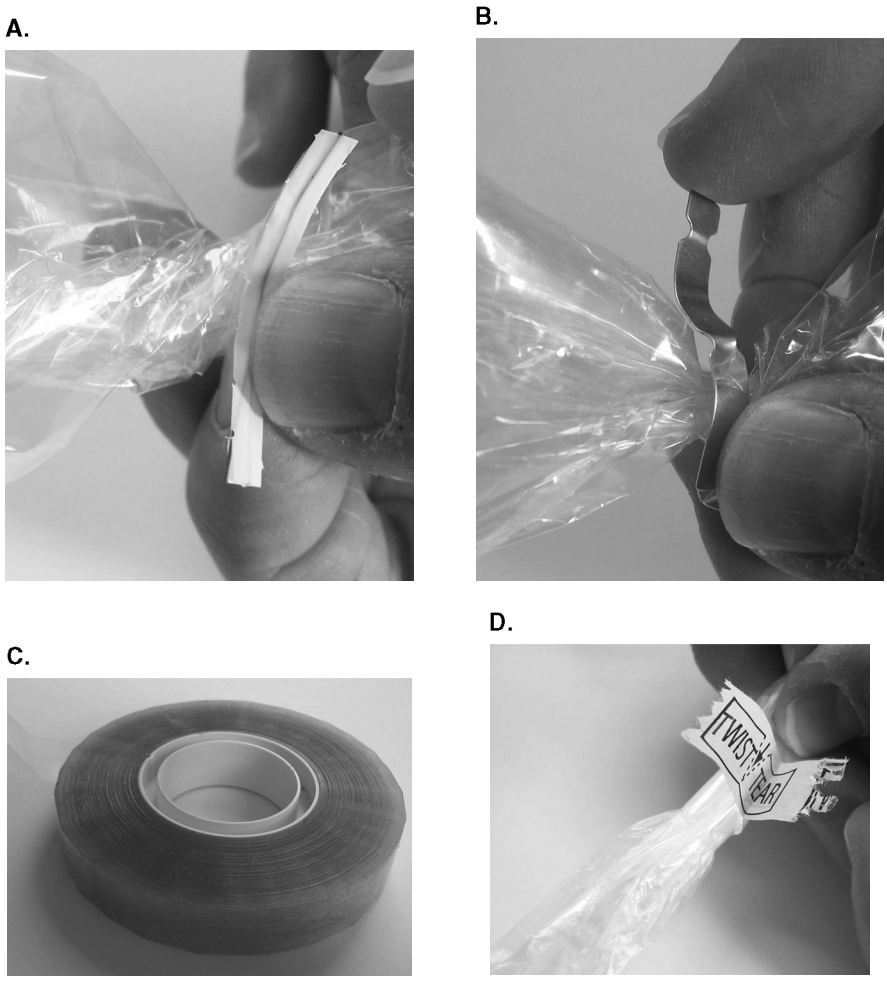

FIGURE 18.1 The four different seals compared in this test: (**A**) a paper- or plastic-covered iron wire; (**B**) a metal clip; (**C**) adhesive tape; and (**D**) the new adhesive tape with a piece of paper at the ends.

the four sealing systems. To answer the four research questions, the study consisted of four activities:

1. During the sealing done by the shop assistants the sealing time was measured while sealing five bags, one after the other. The time started the moment the first bag was picked up and ended when the fifth bag was laid down. The average time for every seal was measured and tested with a t-test for paired comparison ($p < 0.05$). Video recordings were made, and the experts evaluated these recordings. After using all systems, every

FIGURE 18.2 Example of a tape machine often used to seal bags with adhesive tape.

participant was asked to complete a questionnaire with questions about efficiency, safety, and the experienced comfort and discomfort.

2. The opening of the bags was tested by twenty-four consumers. The consumers were selected at sports fields (youngsters), among families and friends (middle age), and in a residence for the elderly (seniors). The subjects were informed that TNO, an independent research organization, would like to know which of the four sealing systems is preferable. After opening five bags with each type of sealing system, every participant was interviewed with questions regarding discomfort, physical load, and user friendliness. Some subjects were also recorded on tape, the recordings to be used in the expert session.

   The video recordings were used in the expert session for further analysis. The experts also sealed bags using the four systems. Their opinions on safety, physical load, and productivity were based on the video and their own experience. The expert panel consisted of five members (two industrial designers, a movement scientist, an ergonomics expert, and a product safety expert).
3. The issue of safety was studied based on the observations and video recordings, as well as in discussions by the expert panel. Also, additional information was gathered by mind-mapping on what and who could be found in the neighborhood of the bag sealing products. In the questionnaires for the consumers and shop assistants, the subjects had to give a safety rating for each system.
4. For the food industry, a total evaluation could help to show which system is best. Therefore, all consumers and shop assistants were asked which element is most important: safety, user friendliness, quality, or work pace. The expert panel made a total judgement over all systems, having all the data available. All separate evaluations and a total expert judgment were

combined in a table (see Table 18.1 in Section 18.5.4) rating the systems as very good, good, neutral, bad, or very bad.

18.5 RESULTS

18.5.1 Sealing by Shop Assistants

Regarding comfort, the average score of the shop assistants was higher for the usual adhesive tape and the adhesive tape with paper than for the other two systems. The majority of the shop assistants called the ordinary adhesive tape and the adhesive tape with paper very easy to use, whereas the plastic-covered wire and the clip were rated difficult or very difficult to use (Fig. 18.3).

The physical workload estimated by the experts based on the video recording is lowest for the tape-and-paper system and the traditional tape system. The traditional tape system is somewhat better, because less force is needed to push the bag downward. Both other systems (wire and clip) have a higher physical load, because various repetitive handlings are needed.

The recorded sealing times for the adhesive tape and the adhesive tape with paper were significantly lower (Fig. 18.4; t-test paired comparison, $p < 0.05$) than for the other two systems.

18.5.2 Opening by Consumers

Fair and *good* ratings in regard to opening the fastener were given for the paper- or plastic-covered iron wire and for the metal clip by all ages of consumers (Fig. 18.5).

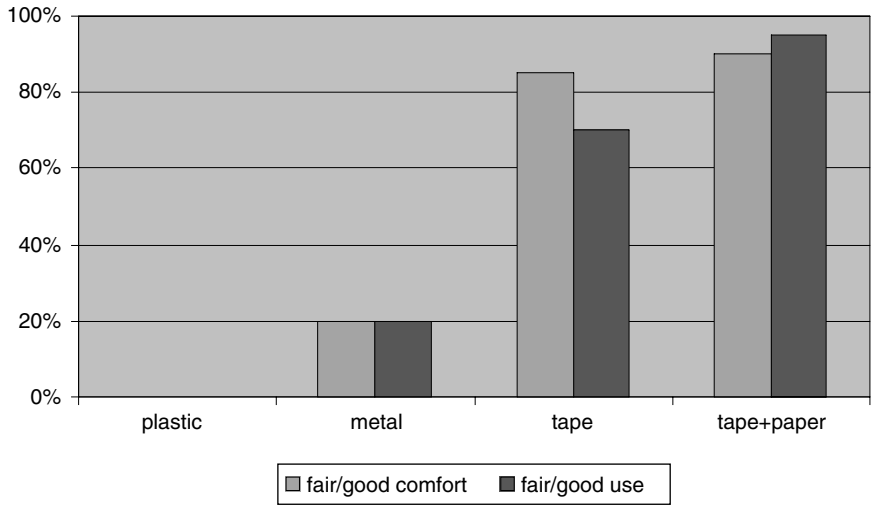

FIGURE 18.3 Percentage of the twenty shop assistants rating the comfort and use of the four bag-sealing systems *fair* or *good*, using a five-item scale (bad, moderate, neutral, fair, good).

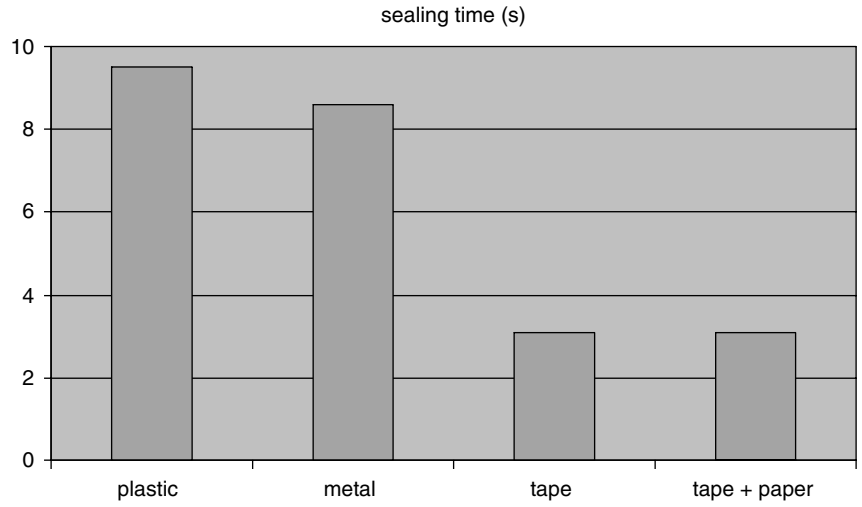

FIGURE 18.4 The recorded sealing time for the four types of sealing systems, averaged over twenty shop assistants, each sealing five bags (100 recordings per tape).

The youngsters and middle-aged consumers also rate the adhesive tape with a piece of paper in between *fair* or *good*. Not all groups appreciate the use of the adhesive tape system in opening bags.

Regarding comfort, a comparable result was found (Fig. 18.5). *Fair* and *good* comfort ratings for opening were recorded by all ages for the paper- or plastic-covered

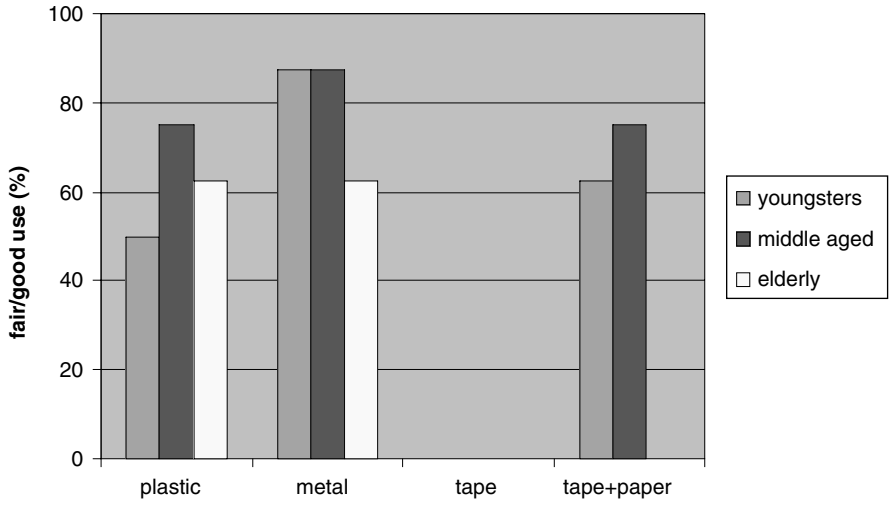

FIGURE 18.5 The opinion of consumers on the opening of plastic bags sealed with the four systems, given as the percentage of consumers (youngsters, middle-aged, elderly) rating each of the four systems *fair* or *good*.

iron wire and for the metal clip. The youngsters and middle-aged consumers also rated the adhesive tape with a piece of paper in between *fair* or *good*. The comfort rating by all groups for the adhesive tape system was *low* or *neutral* when opening bags. The seniors rated the comfort level relatively low for all systems.

When we asked the preferences of the groups, the seniors preferred the metal clip (56%) (although the seniors did not experience any seal as comfortable). The adults did appreciate the adhesive tape with paper (50%), and the youngsters preferred the adhesive tape with paper as well (46%). The seniors mentioned problems with opening the adhesive tape with paper, because this action requires muscle strength and fine coordination.

18.5.3 Safety

The experts' opinion is that safety is an important item, and they mentioned the risks of using the different seals. One of these risks is that a loose plastic-covered iron wire, or a clip, could fall or slide into an area where children could find it. A child could put it into the mouth and swallow it. The experts also mentioned the danger that a small part of the clip might break off and could also be swallowed. For both the ordinary adhesive tape and the adhesive tape with paper, the swallowing risk is smaller.

Other risks that were mentioned by the experts are that one could possibly be pricked or cut by the sharp edges of the plastic-covered wire, or the clip. Shop assistants can hurt their hands at the sides of the machines that apply the adhesive tape seal. This is confirmed by shop assistants, who say that they sometimes cut their fingers on the metal clip or are pricked by the plastic-covered wire. Six out of nine shop assistants who regularly worked with the metal clip mentioned cutting injuries to the fingers, and two mentioned the hand. Two out the thirteen shop assistants who worked regularly with tape mentioned hand injuries, and one mentioned finger injuries.

Both the expert panel and the consumers mentioned the possibility of getting injured by the use of a knife, fork, or scissors to open both kinds of adhesive tape seals. This risk is higher when using the adhesive tape without paper, because the chance that a consumer will use a scissor or knife to open that type of seal is higher. Figure 18.6 presents the total safety score for the four seals that was given by the shop assistants and the consumers.

The adhesive tape seal with paper was evaluated as the safest by the expert panel. This rating is somewhat different from that given by users. Figure 18.6 shows the total score for safety of the four seal systems given by the shop assistants and consumers. In fact, all systems are evaluated safe enough. Figure 18.8 shows shots of the video recordings that were used in the expert session.

18.5.4 Overall Score

Most of the shop assistants (59.3%) prefer adhesive tape with paper (Fig. 18.7). Looking at the consumers' results, the preference is less evident. Their preferences differ and show an equal division. Approximately 30% prefer the plastic-covered

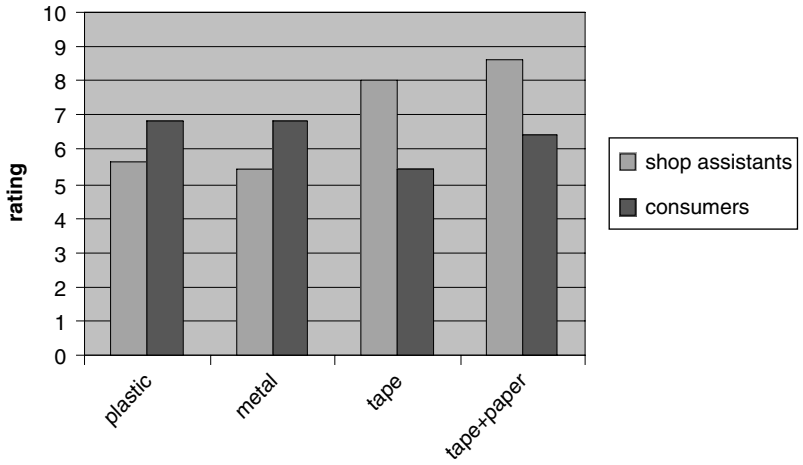

FIGURE 18.6 Ratings given by the twenty-four consumers and twenty shop assistants regarding the safety of the different systems (0 = unsafe, 10 = extremely safe).

iron wire, the clip, or the adhesive tape with paper (34.6%, 30.8%, and 30.8%, respectively). If a division is made between the three ages, it is clear that the elderly prefer the metal clip and the young and middle-aged groups prefer the tape with paper, followed by the plastic-covered iron wire.

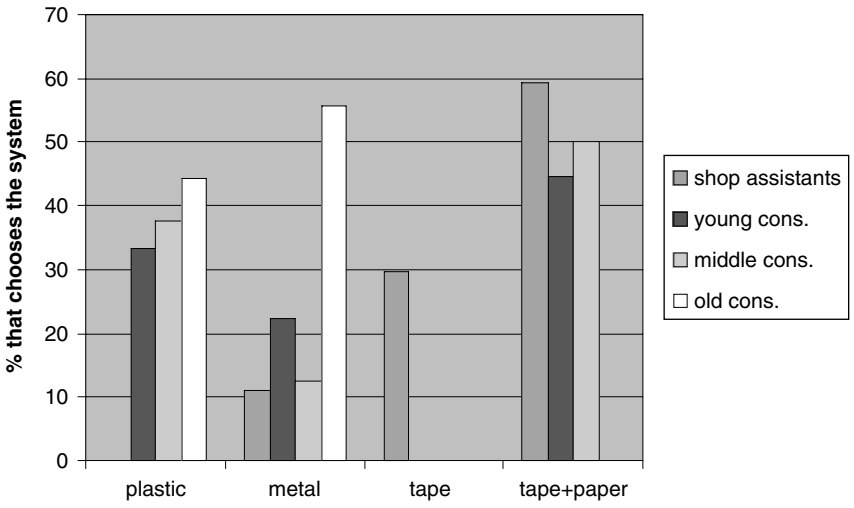

FIGURE 18.7 Percentage of the consumers and shop assistants who preferred one or another of the sealing systems. The total is higher than 100%, because almost half of the subjects mentioned two preferences.

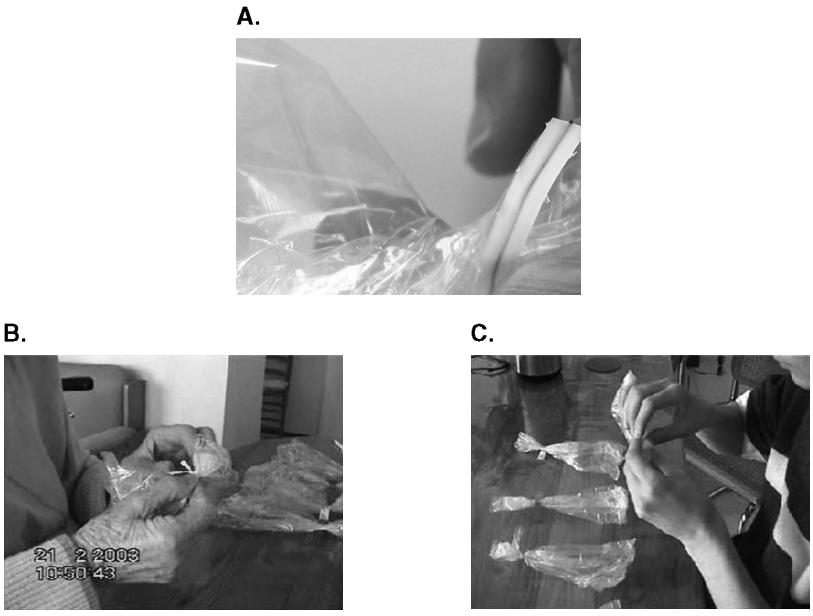

FIGURE 18.8 Screen shots from the video recordings used by the expert panel: (**A**) plastic-covered iron wire is used to seal a bag; (**B**) an older woman is reclosing the bag with plastic covered iron; (**C**) middle aged man is opening a bag with adhesive tape.

Table 18.1 summarizes the judgments of the shop assistants, the consumers, and the expert panel. The table with the total score has some arbitrary elements, but the expert panel agreed on the scores. Because of positive ratings for safety, physical load, comfort in use, and the high speed mentioned by shop assistants, the tape-and-paper system was evaluated as the best, which means that the development of this system was successful.

TABLE 18.1
Summary of the Scores for the Four Sealing Systems

	Shop assistant			Consumer		Expert		Total score
	Speed	Safety	Comfort and use	Speed	Comfort and use	Physical load	Safety	
Plastic-covered wire	–	+/–	–	+	+	––	–	–
Metal clip	–	–	–	+	+	–	–	–
Tape	++	++	+	––	––	++	–	+/–
Tape with paper	++	++	+	+/–	+/–	+	+	++

++ (very good); + (good); = (neutral); – (bad); ––(very bad)

18.6 CONCLUSIONS

Improvement of a simple activity such as sealing a bag could play a role in the prevention of musculoskeletal injuries or some other type of hazardous situation. The new system was developed and rated positive in regard to comfort by most of the end users, and it can certainly be seen as an improvement. This new system should be promoted, but further instruction to end users is needed regarding safety. If possible, innovations should be found to make unsealing easy for everyone, including the elderly.

The following conclusions can be drawn from this study:

- For sealing plastic bags, the adhesive tape with paper is the best of the four systems, closely followed by the plain adhesive tape. Both seals score well as far as speed and safety are concerned. These two seals are also the best in regard to comfort. Consumers prefer the system of the adhesive tape with paper and it is evaluated safer by the experts. The physical load involved in sealing with adhesive tape is evaluated more positively than in sealing with adhesive tape with paper.
- Consumers think that the plastic-covered iron wire and the clip open fastest, and they think these are the easiest ones to use. The consumers prefer the plastic-covered iron wire, clip, and adhesive tape with paper to the plain adhesive tape.
- The young and middle-aged prefer the adhesive tape with paper. For seniors, there is no seal available that is easy and comfortable to use, in their opinion. Safety is rated higher in sealing with adhesive tape with paper.
- According to the shop assistants, sealing bags with both systems using adhesive tape is the easiest and fastest. However, the consumers mention that the seal without paper is the most difficult to open. They also mention the difficulty of resealing bags that have been opened. In short, there is still no seal that is experienced to be comfortable by all shop assistants and all consumers.
- If we had to recommend a seal it would be the seal using adhesive tape with paper, because sealing plastic bags is a daily recurring, intensive activity for shop assistants.

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