Memories of COVID-19: The Types of Fitted Face Masks Between Public Health Advice and Personal Choice

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Article

Memories of COVID-19: The Types of Fitted Face Masks between Public Health Advice and Personal Choice

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Abstract: As the COVID-19 pandemic begins to abate and national public health systems are treating the SARS-Cov-2 virus as endemic, many public health measures are no longer mandated, but remain recommended with voluntary participation. One of these is the wearing of fitted face masks, initially mandated to contain, or at least slow, the spread of SARS-CoV-2 which is primarily transmitted via aerosols emitted while breathing, coughing, or sneezing. While the habit of once wearing fitted face masks recedes into memory for much of the population, so does the knowledge of the various types of masks that were once *en vogue*. To create a record for the future, this paper provides the first comprehensive documentation of the nature and range of fitted facemasks that circulated during the COVID-19 pandemic.

Keywords: COVID-19; fitted face masks; museum collections; personal protective equipment; public health measures

1. Introduction

During the first three months of 2020 COVID-19, the respiratory disease caused by the SARS-CoV-2 coronavirus [1], rapidly developed into a global pandemic. To contain, or at least slow, the spread of the disease COVID-19, most countries enacted public health measures at national or state levels, ranging from border closures and lockdowns to social distancing measures. Furthermore, given that SARS-CoV-2 is primarily transmitted via aerosols emitted while breathing, coughing, or sneezing [2,3], many governments mandated, or at least recommended, the wearing of fitted face masks [4–7]. The public had the option of wearing a range of face mask types, ranging from single-use surgical masks to self-made fabric masks. Prior to the emergence of COVID-19, the use of fitted face masks was effectively limited to specific professions and their activities:

- sterile, single-use surgical-type masks were used by the medical profession;
- commercial, single-use surgical-type masks were used by the beauty industry (nail salons);
- disposable KN95/P2 type masks, with and without valves, were used in the construction industry to filter-out low levels of dust and paint fumes; and
- full face masks with exchangeable air filters were used for more hazardous work in the construction and manufacturing industry [8–10].

The high demand for face masks during the COVID-19 pandemic led to a rapidly expanded production and use of non-sterile, surgical-type single-use face masks, the majority of which was sourced from Chinese manufacturers [11]. Since these were far more common than washable masks from cotton and other fabrics [12–14], single-use face masks soon posed environmental issues [15,16]. The quantity of single-use face masks manufactured is staggering, with China exporting more than 200 billion masks in 2020 alone [17].

Elsewhere, it had been argued that COVID-19 is global, cross-sectoral disruptor not seen since the 1918/19 influenza pandemic. As part of a project to document the tangible evidence and material culture associated with the COVID-19 pandemic for future social history exhibitions and heritage

 doi:10.20944/preprints202303.0071.v1

studies [18–23], the author systematically documented the usage of reusable vs disposable fitted face masks. This could be achieved through observational studies of face mask use [24], assessments of lost and discarded [14,25] as well as donated masks [13], and through a documentation of the longer-term fate of discarded single-use face masks in the urban and peri-urban environment [15,16,26]. While the majority of mainstream research focused on the environmental aspects of discarded masks [27–40], several authors have conducted work on masks in the social acceptability [41–45] and the future heritage space [46–50].

Now, three years after COVID-19 first became a global health emergency, the majority of people have 'learned to live with the virus' [51,52] with the majority of people, at least in the more affluent countries, being fully vaccinated. While a considerable number of people is still becoming infected each week, with numerous deaths [53], the public health responses of border closures, lockdowns, social distancing, and the wearing of fitted face masks, are gradually receding from public consciousness and are being relegated to memories.

Witnessing the attitudes and behavior patterns of the populace in March 2023 it appears that, the COVID-19 pandemic was an ephemeral event, although it manifested itself as a cross-sectoral disruptor on a global scale. While systemic changes have been advocated to the way we live, work and learn [54–57], the majority of the population seems to be in the process of returning their lives, and health attitudes, to 'normal', i.e., pre-pandemic realities. Fitted face masks will rapidly be relegated to the past and the knowledge of their variety in shape and form will become dim memories. Thus this is the time to document and place on record the nature and range of fitted facemasks that were used by residents before such examples of material culture disappear. The aim of this paper is to provide the first comprehensive documentation of, and to serve as a reference point for, the various types of fitted facemasks that circulated during the COVID-19 pandemic.

2. Methodology

All fitted face masks discussed in this paper were encountered between March 2020 and December 2022 in Albury, a major regional city in southern New South Wales, Australia. The examples were acquired by the author for personal protective use, or were recorded as part of the above-mentioned documentation of the tangible evidence and material culture associated with the COVID-19 pandemic.

3. Results

In total twelve different designs of fitted face masks are represented in the sample and described here. The total number of examples acquired was much higher [13,58]. A study of single-use polypropylene masks, for example, recorded over 80 examples from different manufacturers [59,60], while a documentation of fabric masks lost or discarded [14], as well as fabric masks donated to charity [13] showed a considerable number of variations in the number and placement of pleats among expandable masks (**Figure 1**) or the shape and ear-loop attachment of one-piece masks (**Figure 2**). For the purposes of this paper such variations were omitted.

3.1. Single-Use Polypropylene Three-Ply Masks

Single-use face masks manufactured from three- or four-ply polypropylene, with a melt-blown filter layer sandwiched between outer layers of spunbonded polypropylene fabric [60], were the most common type of face masks encountered being worn by passers-by during walk-through surveys in Albury, [24] as well as Sydney and Melbourne [61,62]. They were also the most common type encountered lost or discarded on the ground [14,25]. A separate study that examined single-use face masks sold in Australia for their morphological characteristics that could allow archaeologists in the future to positively correlate a given mask encountered in deposits with a manufacturer found that the overwhelming majority (80.3%) of single-use face masks in that study was produced by numerous manufacturers in China [59]. Apart from masks manufactured in Australia (12.4%) also encountered were masks made in India, Indonesia, Japan, Spain and Turkey [59].

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Single-use polypropylene masks were produced in three main types. The most common type are three-ply pleated masks with welded on ear loops such as the mask shown in **Figure 3** (manufactured by Vicare Medical Supplies in Tullamarine, Victoria, Australia). These masks were sold as 'utility masks' and as 'surgical masks'. The latter, which had to be approved for medical use by the Australian Therapeutic Goods Administration, were graded as Level 1–3 depending on their levels of protection and fluid resistance [63]. The majority of masks possess an embedded nose wire that allows to shape the top of the mask when fitted, reducing air emission along the nose, which significantly prevents fogging of spectacles that may be worn and the ingress and egress of unfiltered air.

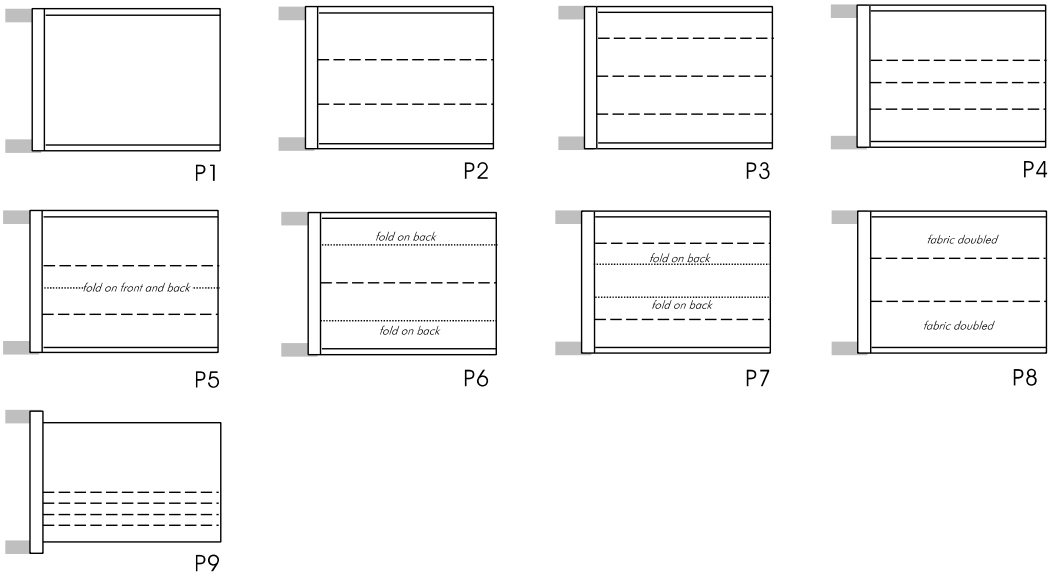

Figure 1. Typology of pleated masks [13].

 doi:10.20944/preprints202303.0071.v1

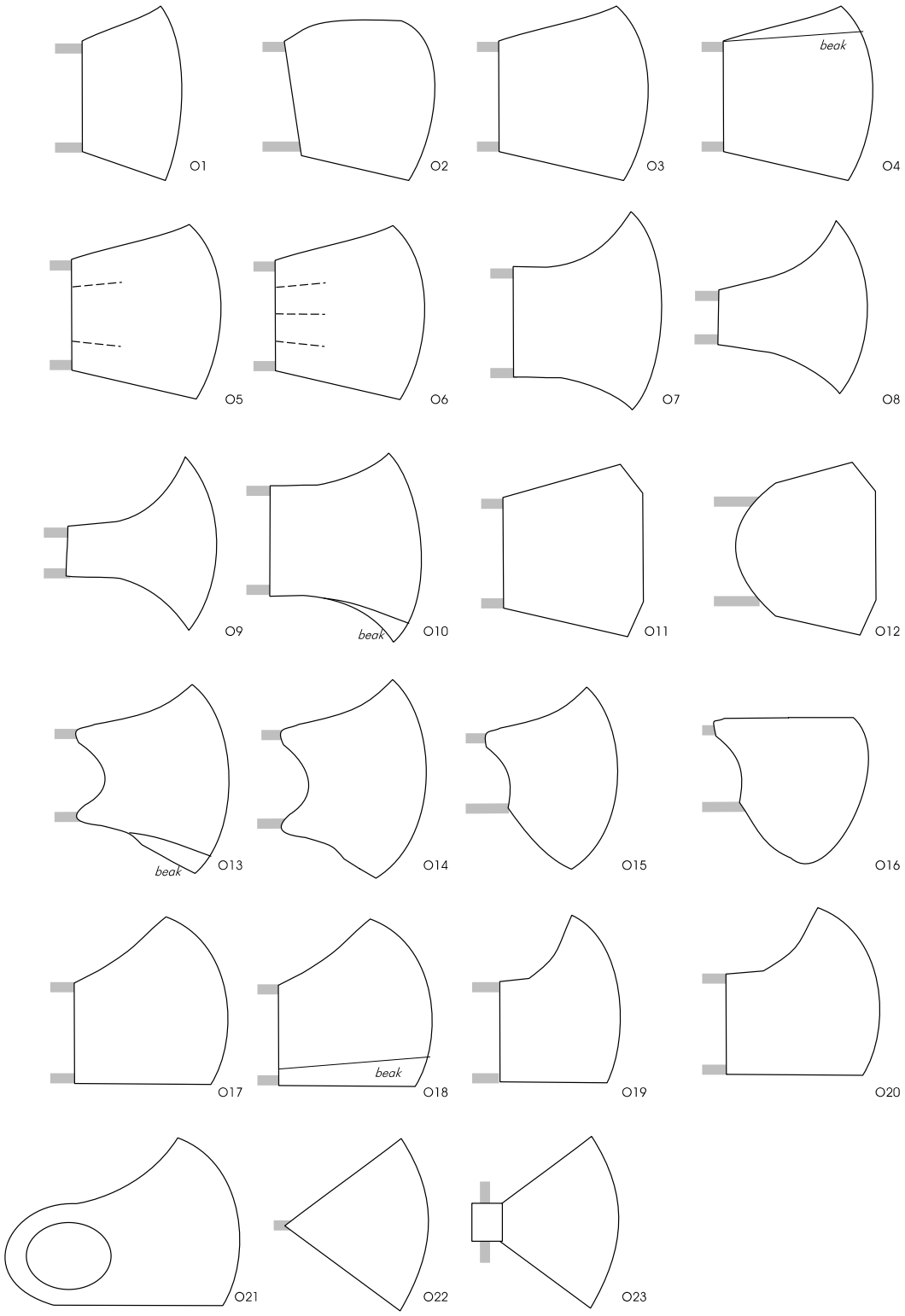

Figure 2. Typology of one-piece fabric (cloth) masks [13].

 doi:10.20944/preprints202303.0071.v1

Figure 3. Single-Use Mask—Polypropylene—Manufacturer Branded.

Pleated masks were also produced with straps, rather than ear loops, which allowed the mask to be fastened around the back of the head rather than placing strain on the earlobes. By and large, the use of these masks was confined to medical settings, particularly surgery. In addition to standard pleat masks, some level 3 masks where fitted with an additional clear polycarbonate anti-splash visor protecting the eyes from projected aerosols (**Figure 4**) (manufactured by A.R.Medicom Inc., Shanghai, China).

A different design were the 'duck bill' shaped masks made from the same type of polypropylene fabric, but cut in a way that they had a better facial fit and lesser chance of billowing open at the cheeks (compare side-ways fit of masks in **Figures 3** and **5**). One design folds out completely (hence duck bill), while the other folds out only partially (**Figure 5**). Both designs have straps that are tightened around the back of the head. The use of these masks, while available on the open market, was largely confined to medical settings (**Figure 5**) (ProShield TN01–11, distributed by BSN Medical, Musgrave, Victoria, Australia, manufactured in China and Japan).

 doi:10.20944/preprints202303.0071.v1

Figure 4. Single-Use Mask—Polypropylene with anti-splash visor—Medical retail.

Figure 5. Single-Use Mask, duck bill type—Polypropylene—Medical retail.

3.2. Single-Use KN95/P2 Polypropylene Masks

P2/N95 respirators form a close seal around the nose and mouth and are effective in removing a minimum of 95% of aerosols (KN95, KF94, Japan DS2 and European FFP2 are equivalents) [63,64]. Like the foregoing masks, P2/N95 respirators were also sold as utility masks (mainly for the construction trade) and as respirators approved for medical use by the Australian Therapeutic Goods Administration. N95 respirators were manufactured in four main types: flat-fold, cupped, duck-billed and beak-shaped.

Flat-fold particulate N95 respirators, offered by various companies, are designed with straps that are tightened around the back of the head (**Figure 6**). Both the top and bottom fold out, with the bottom having a small tab for easy adjustment and the top commonly furnished with a flat nose wire and a Polyurethane foam surface for wearer comfort (**Figure 7**). The respirators are comprised of a polypropylene filter covered with a polypropylene cover web on the outer and inner surfaces (**Figure**

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6 example manufactured for Trident, Berkeley Vale, NSW, Australia by a Chinese supplier; **Figure 7** example by 3M in the USA).

Figure 6. Single-Use P2 Respirator—Polypropylene—Medical retail.

Figure 7. Single-Use flat-fold N95 Respirator. Unfolded, front, back and side view.

 doi:10.20944/preprints202303.0071.v1

Cupped particulate N95 respirators are designed with straps that are tightened around the back of the head. They are comprised of a polyester shell, with polypropylene and polypropylene cover web on outer and inner surfaces. The top is commonly furnished with a flat nose wire and a dense Polyurethane foam surface for wearer comfort. Apart from the nose wire that allows to adjust the top, the rest of the mask shape cannot be adjusted (**Figure 8**) (example manufactured by 3M in the USA).

Figure 8. Single-Use cupped N95 Respirator—Polyester and Polypropylene—Medical retail.

Medical-type, beaked particulate N95 respirators, offered by various companies, are designed with straps that are tightened around the back of the head. The respirators are comprised of a polypropylene filter (sometimes with an additional hot-air blown cotton layer) covered with a polypropylene cover web. Apart from the flat nose wire that allow to adjust the top, the rest of the mask shape cannot be adjusted (**Figure 9**) (example manufactured by BYD Care in China). Consumer-grade, beaked particulate N95 respirators, offered by various companies, are of the same design, but can have less dense spunbonded and melt-blown polypropylene fabric. All consumer-grade beaked respirators are fitted with standard ear loops (**Figure 10**) (example distributed by Craftright, i.e Bunnings, manufactured in China).

Consumer-grade, particulate N95 / P2 respirators, had been sold prior to the pandemic and were used by the professional building trade. They commonly have straps that are tightened around the back of the head rather than ear loops. Examples are duck-billed P2 masks sold to the general building trade (**Figure 11**, example manufactured in China for Scott Safety) as well as cupped masks fitted with filter valves specifically for the gardening (**Figure 12**, example manufactured in China for Scott Safety) and painting trade (**Figure 13**; example manufactured in Korea for 3M Australia). In addition, some consumer-grade, beaked particulate N95 respirators were sold with activated carbon filters (**Figure 14**) (example manufactured by JinJiang in China).

 doi:10.20944/preprints202303.0071.v1

Figure 9. Single-Use P2 Respirator, beak shaped—Polypropylene—Medical retail.

Figure 10. Single-Use P2 Respirator, beak shaped—Commercial retail.

 doi:10.20944/preprints202303.0071.v1

Figure 11. P2 Respirator, duckbill shaped—Commercial retail.

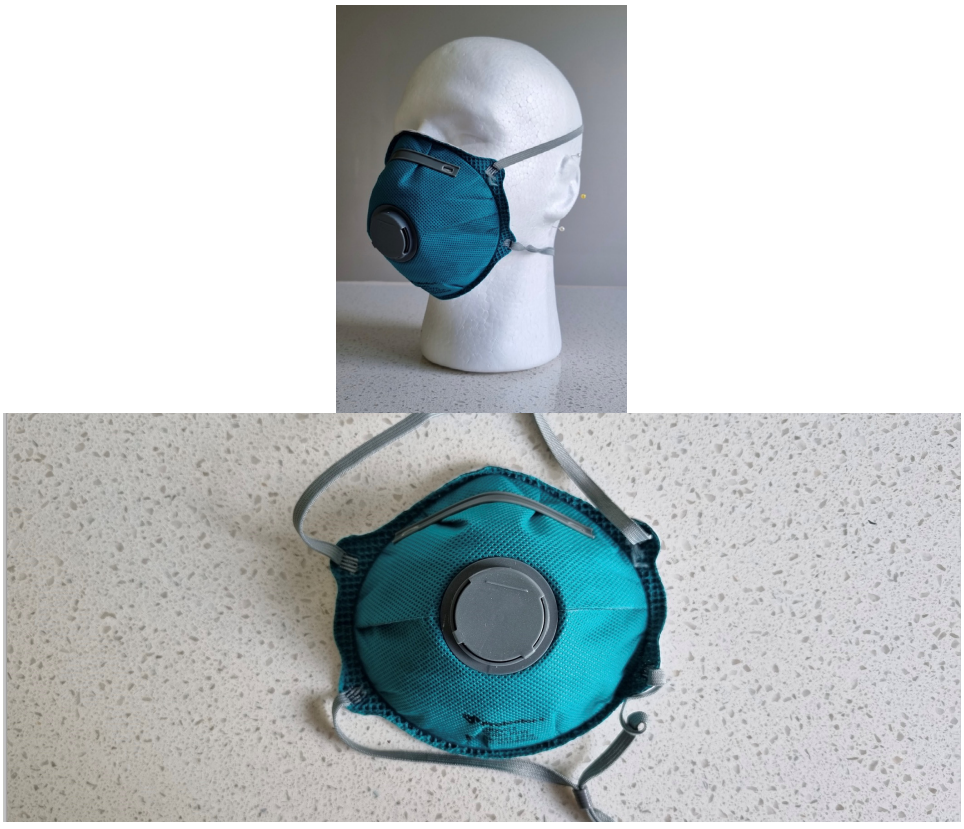

Figure 12. P2 Respirator, cupped —Commercial retail (gardening).

 doi:10.20944/preprints202303.0071.v1

Figure 13. P2 Respirator, cupped —Commercial retail (paint fumes).

Figure 14. Single-Use P2 Respirator, beak shaped with valve—Commercial retail.

 doi:10.20944/preprints202303.0071.v1

3.3. Fabric Masks, Commercial Production

Given the shortage of single-use surgical masks in the face of an unprecedented demand for fitted face masks, public health advice in early 2020 suggested that wearing a cloth mask, albeit providing a lesser protection, was better than wearing no mask at all [65]. Commercial production soon commenced, with corporations and major clothing retailers soon recognizing the promotional and commercial opportunity this provided. The masks were manufactured in a large variety of shapes, both with sewn-on and integrated ear loops (**Figure 2**).

Companies and government agencies purchased masks in corporate colors that were decorated with slogans and/or company logos and that were made part of the corporate uniforms. These masks were commonly manufactured from cotton, polyester or a viscose/cotton mix, commonly with a with a polytetrafluoroethylene membrane as a filter core. The length of the elastic strips used for the ear loops could be adjusted with a sliding shortener. The early mask designs had a rounded shape and lacked a nose wire (**Figure 15**, Australia Post, manufacturer unknown) [14]. Similarly, companies and corporations, distributed masks as promotional items, commonly fitted with nose wires based on then best practice advice (**Figure 16**; Albury-Wodonga Student Representative Committee, Charles Sturt University, manufacturer unknown).

Figure 15. Fabric Mask—Cotton without nosewire—Company Branded (for staff use).

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Figure 16. Fabric Mask—Cotton with nose wire—Promotionally Branded.

The corporate promotional giftware and novelty industry soon saw a market niche offering in short-runs using customer supplied designs. This allowed, *inter alia*, community organizations to create fabric face masks designed by community members, such as the mask with an Indigenous Australian motif produced by a disability service provider (**Figure 17**; Mercy Connect, Albury, manufacturer unknown) [12].

Not surprisingly, major clothing retailers soon recognized the commercial opportunity this provided. Especially in the early days, soon after the initial wave of lockdown period finished, the majority of masks were either plain black or mono color on the outside and often white on the inside (**Figure 18**a–d). Clothing retailers, in particular those servicing the teen and young adult market, quickly realized that fitted face masks as mandatory items, could function as compulsory accessories, and soon produced such masks in a variety of colors and patterns, often with slogans (**Figure 19**; with slogan "Social distancing like a pro"), some of which carried the same pattern as clothing sold by the same chain (**Figure 20**).

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Figure 17. Fabric Mask— Cotton with nose wire —Community designed (branded).

Figure 18. Fabric Mask—Cotton—Commercial retail offerings. a) Bonds (Australia, June 2020); b) Fashion F (China, mid 2021), c) Cotton On (China, mid 2021); d) Sexy Socks (South Africa, April 2020).

Figure 19. Fabric Mask—Cotton—Commercial retail (branded).

 doi:10.20944/preprints202303.0071.v1

Figure 20. Fabric Mask—Cotton—Commercial retail. Mask with three filter insets [13].

The materials used for these masks varied from 100% cotton or 100% polyester on both sides (depending on pattern and colors) to combinations [66–68], 100% cotton (inner) and or 100% polyester (outer) [68] as well as viscose/cotton mixes (**Figure 20**, 70% viscose, 30% cotton) [69]. Common to most was that they were fitted with a polytetrafluoroethylene membrane as a filter core in the fabric 'sandwich'.

While the majority was being imported from China as soon as supply chains reopened [67,68,70,71], local Australian production also occurred [66], as well as imports from as far afield as South Africa (**Figure 18**d) [72]. The early masks were limited to a recommended 20 washes after which the fabric would lose its filtering capabilities [66], but later masks were fitted with pockets for replaceable PM 2.5 filters (**Figure 20**). In addition to accessorizing promoted by clothing retailers, masks with novelty designs such as flowers, animals, faces, superheroes and the like soon came on the market, primarily distributed through online channels (**Figures 21** and **22**, Maskit Brand, manufactured in China, distributed by Gibson Gifts). Some of these were sold with and without replaceable PM 2.5 filters.

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Figure 21. Fabric Masks— Cotton with filter insert —Commercial, novelty market.

Figure 22. Fabric Masks— Cotton with filter insert —Commercial, novelty market.

While the majority of masks were cotton or polyester fabric with sewn-on elastic ear loops, some were single piece masks with integrated ear loops made from polyester fiber blend, cotton/Spandex blends, neoprene or reticulated polyurethane foam (**Figures 23** and **24**). Since these masks did not have a filter insert, their efficacy relied solely on the nature of the fabric. Recommendations for discarding used masks after a set number of washing cycles depended on the material, with polyurethane foam masks reputedly lasting 8–10 cycles [73], although most retailers asserted reuse and washability, but did not provide any recommendations on the length of use [74–77].

The overwhelming majority of reusable fabric face masks were of various shapes of the one-piece design (**Figure 2**). Some fashion accessory retailers also distributed pleated masks with silk inner and outer layers and a dense cotton filter layer (**Figure 25**, distributed by Lovisa) [78].

 doi:10.20944/preprints202303.0071.v1

Figure 23. Fabric Masks—Polyester Fiber Blend—Commercial retail (neutral).

Figure 24. Fabric Masks—Neoprene—Commercial retail (neutral).

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Figure 25. Fabric Masks—Silk—Commercial retail (monochrome). Pleated type.

3.4. Fabric Masks, Artisanal Production

The shortage of single-use surgical type and N95 type face masks during the early period of the pandemic, coupled with the mandate to wear face masks and the advice that fabric face masks would provide adequate, albeit not perfect, protection, resulted in a cottage industry of artisanal productions. Some of the productions were simple and ill-fitting face coverings (**Figure 26**), that provided little, if any protection. Soon after the shortage of surgical type face masks had become evident, public health departments published design instructions for simple masks, [79] while national drapery chains offered sewing templates [80,81]. A wide range of mask types were produced both of pleated (**Figures 1** and **27**) and one-piece designs (**Figure 2)** both with (**Figure 28**) and without nose wires (**Figures 29** and **30**) [13]. Some artisanal designs even included removeable filter layers (**Figure 31**). All artisanal productions used cotton of various density (thread count) as raw material, with a wide range of design patterns.

Figure 26. Fabric Mask—Cotton—Artisanal production. Flat sheet design.

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Figure 27. Fabric Masks—Cotton—Artisanal production. Pleated type.

Figure 28. Fabric Masks—Cotton—Artisanal production. Beaked type with ear loops.

 doi:10.20944/preprints202303.0071.v1

Figure 29. Fabric Masks—Cotton—Artisanal production. Rounded type without ear loops.

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Figure 30. Fabric Mask—Cotton—Artisanal production. Two incomplete home-made masks with pins attached, as well as two templates used, donated to charity in mid 2022. The newspaper clipping dates to 25 September 2020 suggesting the commencement of artisanal production [13].

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Figure 31. Fabric Mask—Cotton—Artisanal production. Pleated type mask with self-made filter and instructions [13].

4. Discussion and Conclusions

The wearing of fitted masks was advocated by public health authorities to a) partially protect the wearer from inhaling ambient air that may contain a virus load and b) from preventing the wearer, if infected with SARS-Cov-2, from freely shedding the virus. While masks with exhalation valves (which made breathing easier), had the same level of protection for the wearer, they were declared unsuitable for many health settings, as the valves either had no filter, of the filtering of the exhaled air was insufficient [82–85]

In the Australian setting, the first few months of the pandemic saw a general shortage of medical quality protective equipment (PPE), in particular face masks, as well as a shortage of hand sanitizer. In part this was caused by panic buying and associated hoarding [86], which also extended to other goods, such as household pantry staples and toilet paper [18]. On a more significant scale, the

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shortages were the result of complex, global supply chains that were predicated on on-time delivery based on predictable demand volumes [87–89] with production concentrated in a few countries, primarily China. While the speed of spread of the pandemic soon overwhelmed these supply chains [86], restrictions on the movement of people and goods, coupled with border closures, effectively severed of most them [90–92]. This led to investigations of sterilization options for the safe reuse of PPE [86,93–97], as well as a repurposing of local production to meet demand, such as gin distilleries pivoting to produce hand sanitizer [18], and a restarting of local PPE production [98,99].

While masks were generally in short supply during the early days of the pandemic, this in particular applied to masks with higher levels of protection (N95) and among these masks with tighter and better fitting designs, such as flat-fold masks [100]. The shortage of standard masks soon resulted in a 'run' on P2 and N95 masks used for the professional building and gardening trade [101], outstripping supply within a week or two.

Fitted face masks made from fabric, rather than polypropylene, were seen as a stop-gap measure given the shortage of single-use surgical masks in the face on an unprecedented demand for fitted face masks, where in essence almost every adult and every older child required more than one of these. To offset the initial shortage in commercially manufactured, single use face masks, the public health advice in 2020 had been that wearing a cloth mask, while having a lesser capability of filtering out pathogens and thus providing a lesser level of protection than single-use surgical masks, was better than wearing no mask at all [65]. Initially designed as a stopgap measure, public health departments [79] as well as newspapers [102] provided design instructions for simple, easy to sew fabric masks. Given the national health emergency, and the collective and community good will, national drapery chains published cutting and sewing templates for fitted face masks and made them available free of charge for home makers and small-scale artisanal creators [80,81]. The fact that these masks were washable and thus reusable, favorably contrasted in the minds of many with the environmental concerns about volumes of single-use PPE entering the municipal waste streams [103–107] and the environment in general [27–40]. Thus, even after single-use surgical type masks became available once supply chains recovered, many continued to use fabric masks. This was aided by the fact that commercial production soon commenced, with major clothing retailers quickly recognizing the commercial opportunity this provided [18]. At the same time, many corporations, as well as community organizations, recognized the opportunity for branding and promotional use [12,18,108–110].

While a lower effectiveness of cloth masks had soon been demonstrated [111–116], public health advice maintained that any mask was better than no mask [65]. The emergence of the more infectious Delta and Omicron variants of SARS-Cov-2 in late 2021 and early saw public health advice formally counselling against the use of fabric masks as they were deemed to be less effective than P2 / KN 95 masks [117,118] echoing earlier concerns [119,120]. The artisanal production of fabric masks ended almost immediately, with existing stock often donated to charities [13], which at this point did not offer such masks for sale or hand-out, but added them into the non-retail (rag) fabric stream.

Fabric masks continued to be sold by clothing retailers, as well as online stores, but were offered at discounts, with the lines being discontinued. After the mandate to wear fitted face coverings in all but health care settings was repealed (in Australia) in April 2022 [121], demand for single-use surgical as well as N95 masks dropped dramatically. At the time of writing (February 2023), single-use surgical as well as N95 masks are freely available, but their offerings in pharmacies and chemists have been reduced, with many mainstream supermarkets no longer stocking them in sizeable quantities.

As the incidence of COVID-19 infections continues to decrease due to high vaccination rates, as reporting on the pandemic has become the exception, rather than the once daily norm, the pandemic has begun to recede in public consciousness as a past to be overcome and rapidly forgotten. This paper has placed on record and contextualized the wide range of face masks used and worn during the pandemic and may serve as a future reference point of the various mask types.

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Conflicts of Interest: The authors declare no conflict of interest.

Nota bene: This paper forms part of project to document the tangible evidence and material culture associated with the COVID-19 pandemic as for future social history exhibitions and heritage studies. For the past three years, the author has extensively worked a various aspects of that theme, many of which are brought together in this paper. It this unavoidable that the paper contains a high number of self-citations. The author seeks the indulgence of editor and reviewers in this matter.

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