

Digital complements or substitutes? A quasi-field experiment from the Royal National Theatre

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Abstract Digital broadcast technologies have expanded the virtual capacity of live performing arts venues, but they have also raised concerns about possible cannibalisation of box office revenues. We report the results of a quasi-field experiment involving the Royal National Theatre’s live broadcasts of theatre to digital cinemas in the UK and find that, if anything, live broadcasts generate greater, not fewer, audiences at the theatre.

Keywords Digital technology · Theatre · Field experiment · Cannibalisation

JEL Classification Z11 · O33 · C93

1 Introduction

Content industries like music and film have long experienced the fact that technological progress brings with it destruction of old business models as well as the creation of new. Successive waves of new distribution technologies for recorded music (Connolly and Krueger 2006) and film (Waterman 2005) have created new opportunities for businesses to profit. Similar developments have occurred in the live performing arts. Recent advances in digital technology have enabled production companies to capture performances of opera, theatre, dance and music and to transmit them to audiences by satellite to cinemas or via the internet as streamed content or as

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video on demand. For example, in 2006, the Metropolitan Opera in New York began broadcasting by satellite HD performances into digital cinemas (Elberse and Perez (2008)), with other companies following suit in subsequent years, including the San Francisco Opera, London's Royal Opera House and Royal National Theatre, and the Berlin Philharmonic Orchestra (Bakhshi and Throsby 2012).

Whilst the new channels for conveying cultural content to consumers have expanded audiences for these companies' product, they have also raised fears that they will cannibalise traditional revenue sources if existing or potential customers who have access to the venues to attend in situ performances simply switch to the new formats.¹ On the other hand, it is possible that the increased exposure of the product that is generated by the cinema showing may stimulate demand for the live performance. In this paper, we investigate the question of whether digital distribution acts as a substitute or complement for the traditional modes by which a performing company reaches its audience. We do this by analysing a quasi-field experiment using data from a particular case of satellite transmission of a live theatre performance to cinemas.

2 The quasi-field experiment

In 2009, the Royal National Theatre in London (NT) became the world's first theatre to start broadcasting its plays directly to digital cinemas, in a project known as NT Live.² In the project's first broadcast, which took place on June 25th, Nicholas Hytner's production of Ted Hughes' translation of Racine's *Phèdre* was seen live on 73 digital cinema screens at 70 unique venues in the UK and was relayed to 210 further sites in the rest of the world. The NT significantly expanded its 'virtual capacity' through the broadcast with a total of 14,000 people across the UK seeing that evening's production in real time (not counting those seeing the performance itself at the NT on that night), and a further 14,000 seeing it live in Europe or on the same day in North America (allowing for time zone differences). Including those cinema audiences in other countries who saw the production at a later date, it is estimated that more than 50,000 saw the June 25th performance of *Phèdre*, equivalent to the production's total audience at the NT over the play's three-month run.

As part of a research project on the role of new technologies in cultural institutions, the present authors undertook an empirical study of audiences who witnessed this production of *Phèdre*. Surveys were carried out both in the theatre itself and in a sample of cinemas in the UK on the night the live performance was screened. Detailed accounts of the survey methodology, results and analysis for this study can be found in Bakhshi and Throsby (2010). In the present paper, we

¹ Previous studies of the cannibalisation phenomenon have examined: the effects of increased TV and radio penetration on film and music sales (Liebowitz 2004); the effects of film rentals on film sales (Knox and Eliashberg 2009); the effects of PDF copies of books on demand for print copies (Kannan et al. 2009); and the effects of digital piracy on music and film sales (Smith and Telang 2012).

² Strictly satellite transmission is not a 'broadcast', as only designated cinemas are able to receive it. However, the term 'broadcast' is widely used to describe this type of transmission.

investigate the question: Did the live broadcast cannibalise the potential audience for the production at the NT itself, or did it in fact induce a greater number of such visits? We can answer these questions because the NT's broadcast of *Phèdre* can be interpreted as a quasi-field experiment (Harrison and List 2004; List and Reiley 2008; List 2011) for the following reasons. A significant proportion of the 70 cinemas participating in NT Live were located in the commuter belt of London, the catchment area for live performances at the National Theatre; individuals residing in these localities who wished to see this play were effectively presented with a choice: to see it at their local cinema on the night it was transmitted, or to attend a performance at the NT itself on a night of their choosing.³ We can test whether audiences from the catchment areas of participating cinemas were over- or under-represented in attendances at the NT itself compared with what otherwise might have been expected. We can do this by comparing the locational distribution of bookers for *Phèdre* at the NT over the length of its run with that of similar NT productions that were not broadcast.⁴

The logic of this experiment is as follows. If audiences for *Phèdre* from cinema catchment areas were *under*-represented at the NT's box office for this play, this would suggest that live broadcasts and live theatre had acted as *substitutes*; in other words, it would suggest that the former had cannibalised the latter. On the other hand, if the reverse were true, such that audiences from cinema catchment areas were *over*-represented at the *Phèdre* box office, we could conclude that the broadcasts had acted as a *complement* to the live theatre production. This might have been the case if, say, the publicity surrounding the live screenings had acted as a marketing channel for the theatre.⁵ Whether live broadcasts in fact complement or cannibalise theatre audiences has significant implications for the digital strategies of theatres contemplating the adoption of this technology.

3 Data, method and results

We were able to conduct this quasi-experiment because, with the agreement of the NT management, we were able to access the postcodes for all individuals who

³ What is considered 'local' will of course vary from consumer to consumer. In an in-depth study of the geography of cinema-going in Leicester, for example, the share of the audience claiming they visited a cinema because it was their nearest varied from 74 per cent to 4 per cent depending on the screen (Hubbard 2002). In this study, we make the plausible assumption that, on average, individuals are far more likely to go to a cinema that is in their postcode district than if it is not.

⁴ We have described this methodology as a quasi-experiment because the 70 cinemas were not randomly selected. However, the participating cinemas, once their distance to the NT's base at London's South Bank is allowed for, were not selected on the grounds that local audiences were more or less likely to opt for cinema screenings relative to seeing the production at the NT itself. In fact, the list of participating cinemas was agreed with the authors precisely to introduce a valid experimental design (Bakhshi and Throsby 2010). In other words, from the viewpoint of the cannibalisation hypothesis, which audiences were de facto given a choice of distribution outlet and which were not was an exogenous matter.

⁵ In principle, this could also reflect the possibility that individuals who had seen the NT Live screenings were then persuaded to go to the NT to see the play. However, in the audience surveys we found that only a very small number of NT audience members had in fact done so (Bakhshi and Throsby 2010).

booked for a performance of *Phèdre* over the play's three-month run, obtainable from the NT's Tessitura booking system. After cleaning the data set,⁶ we ended up with 20,542 unique bookings. We sorted these bookings into unique postcode districts; in the UK, in 2009, there were 2,981 unique residential postcode districts.⁷ So we effectively compiled a $2,981 \times 1$ column vector with each cell containing the number of unique bookings for *Phèdre* at the NT from each postcode district. We normalised the vector by expressing all cells as a percentage of the overall number of bookings. The task is to test whether this postcode distribution of bookings for *Phèdre* at the NT—that is, conditional on the NT Live broadcasts—is statistically different from the unconditional distribution, that is what it would have been had the production not been broadcast to cinemas.

We cannot of course directly observe this unconditional distribution, but we can proxy it with the postcode distributions for productions that could be regarded as very similar to *Phèdre* in terms of the likely socio-demographic they would attract. In consultation with the theatre, two productions were chosen for these purposes: *Never So Good*, starring Jeremy Irons, which played at the NT between 17th March and 14th August 2008, and Michael Frayn's *After Life*, which played at the NT from 3rd June to 30th August 2008. Like *Phèdre*, both productions were performed on the NT's Lyttelton stage and at similar times of the year (*Phèdre* having run from 4th June to 27th August 2009). Quite aside from these similarities, NT staff believed that all three productions would have by their nature attracted essentially the same audience socio-demographic.⁸

We propose two models to investigate the questions raised in this paper. Our baseline model (Model 1) assumes that any complementarity or substitution effects between NT bookings and cinema availability are independent of bookers' residential distance from the NT (or that they attenuate at exactly the same rate). However, it is also reasonable to hypothesise that such effects might attenuate at different rates as this distance increases. In Model 2, the independence restriction is relaxed. In both models, the dependent variable is the postcode distribution for *Phèdre* audiences at the NT as described above.

3.1 Model 1

The independent variables in Model 1 are the postcode distributions for bookings for *Never So Good* and *Afterlife*, and a dummy variable, *Cinema*, taking the value 1 in postcode districts where there was a cinema broadcasting NT Live *Phèdre* and

⁶ In a small number of cases individuals made multiple bookings for the play. Where these bookings were made on the same date for the same performance, we treated the booking as a single booking. In cases where multiple bookings were made on different dates for the same performance, we removed all bookings other than the first from the data set. In cases where multiple bookings were made on different dates for different performances we treated these multiple bookings as different unique bookings. We then removed all non-UK bookings from the data set.

⁷ This excludes the Channel Isles and some non-residential postcodes in England and Wales.

⁸ To allow for any seasonal differences in the postcode distribution, and to ensure consistency with the data for *Phèdre* and *After Life*, the results reported here are for models where we included only bookings for performances for *Never So Good* from June 4th. However, the results were not sensitive to doing this.

Table 1 Estimated equations for Models 1 and 2

	Model 1	Model 2
Cinema	0.00019 (4.37)	0.00033 (4.91)
Cinema x Dist		−0.0000008 (−2.72)
Never so good	0.48712 (35.66)	0.48290 (35.32)
Afterlife	0.48424 (45.37)	0.48478 (45.51)
Constant	−0.00016 (−19.19)	−0.00016 (−18.56)
Observations	2981	2931
LR χ^2	5355.88	5337.6
Prob > χ^2	0.0000	0.0000

t statistics in parentheses

LR χ^2 statistic computed with three degrees of freedom in case of Model 1 and 4 degrees of freedom in case of Model 2

0 otherwise. The model was estimated using the Tobit procedure in STATA.⁹ Results are shown in Table 1.

The positive coefficient on the *Cinema* dummy is statistically significant and suggests that there were greater numbers of *Phèdre* bookers than might have been expected in the absence of the NT Live broadcasts. Specifically, the 0.00019 coefficient on the *Cinema* dummy variable means that the audience share at the NT of postcode districts with a cinema broadcasting NT Live *Phèdre* was on average 0.00019 percentage points higher than in postcode districts which did not have a participating cinema. In absolute terms, this turns out to mean that there were on average 11 bookings from postcode districts with a participating cinema compared with 7 bookings from those without. The coefficients on the two control variables sum close to 1 (0.97), although the restriction that they equal one is comfortably rejected, suggesting that these two productions are not unreasonable candidates for control variables.

3.2 Model 2

Model 2 relaxes the restriction that any attenuation in complementarity and substitution effects at the postcode level between NT Live and NT bookers occurs at the same rate. This is done by including in the model an additional independent variable, which interacts the *Cinema* dummy with a variable, *Dist*, which measures the geographical distance between the postcode district of the participating cinema

⁹ Estimations using OLS yielded qualitatively similar results.

and the NT's location on London's South Bank. Results are again estimated using the Tobit procedure and are shown in Table 1.

The coefficient on the new variable is significantly negative, suggesting that on average any complementarity effects attenuate more quickly than substitution effects. The 0.00033 coefficient on the *Cinema* dummy variable in Model 2 (over two-thirds higher than in Model 1) suggests that a cinema broadcasting NT Live *Phèdre* right next door to the NT would have generated roughly seven more bookings for the NT's performance of *Phèdre* than if there had been no participating cinema (as compared with four more in Model 1 when the complementarity effects and substitution effects were assumed to attenuate at the same rate). However, a postcode district containing a cinema participating in NT Live and located 100 km away from the NT would have had only five more bookings on average than if there had been no cinema.

4 Discussion

The results reported above suggest that, far from cannibalising audiences for the live performance in the theatre, the availability of the NT Live satellite transmission was actually associated with an increase in bookings for live performances of the play during its run. This is consistent with the complementarity having been generated by the publicity surrounding this production arising from its involvement with the NT Live project. This proposition can be investigated as follows.

The NT first announced its plans for launching the NT Live season with *Phèdre* at a press conference in January 2009. At that stage, it revealed only that it would be working with the Picturehouse cinema chain and a number of (unnamed) other venues. The theatre began taking bookings for live performances of *Phèdre* on 24th February. However, it was not until 3rd March that the NT issued a press release listing all the Picturehouse cinemas that would be participating in the NT Live transmission of *Phèdre* scheduled for 28th June; the identities of the other cinemas were made known to the public as tickets went on sale at later dates (these dates varied from cinema to cinema). If the hypothesis concerning the effects of publicity is to be confirmed as reasonable, we would expect to observe an increase in *Phèdre* bookings after 3rd March.

We examine this question by estimating Model 2 using bookings over steadily increasing booking periods from 24th February till the end of the *Phèdre* run. This enables us to plot recursive estimates of the implied impact on bookings for *Phèdre* at the NT from a cinema broadcasting NT Live *Phèdre* right next door to the NT. The results are shown in Fig. 1.

It is clear from Fig. 1 that the greater-than-expected numbers of *Phèdre* bookers at the NT from postcode districts including broadcasting cinemas were in fact evident for all periods since the NT began taking bookings for *Phèdre* on 24th February 2009. Specifically, however, these results indicate that NT bookings—and hence complementarity—were much weaker prior to 3rd March when the individual identity of the participating cinemas was unknown. Bookings increased noticeably after this date, with the release of publicity surrounding the NT Live screening.

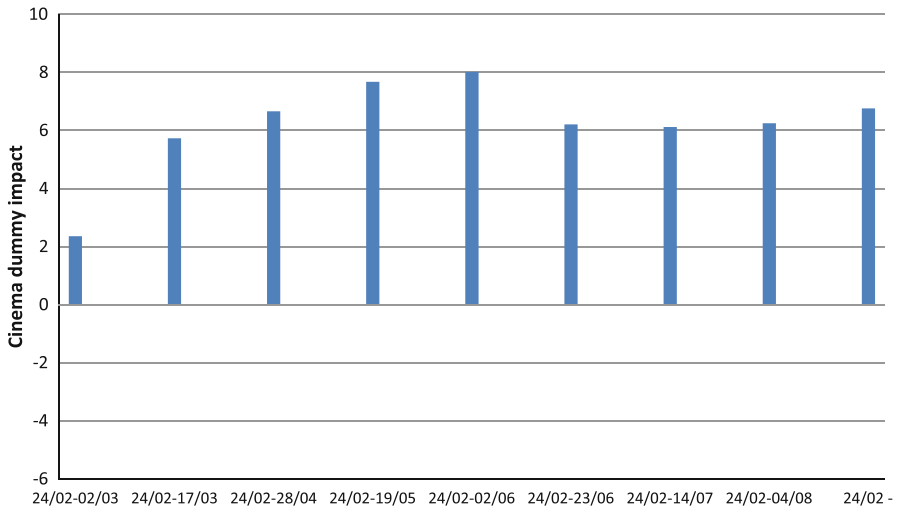


Fig. 1 Estimated impact of NT Live on NT bookings, recursive booking periods

5 Conclusions

It is well known that digital technologies such as online downloads, streaming and digital cinema have opened up significant new opportunities for content industries like music and film, but that they have also have challenged established business models. It is perhaps less widely appreciated that they have impacted on the live performing arts too. This paper has explored whether live broadcasts of theatre to digital cinemas substitute for or complement audiences for traditional theatre, exploiting the quasi-experimental design of the Royal National Theatre's NT Live broadcast of the production *Phèdre* in June 2009. Our analysis finds no evidence for substitution. Although the quasi-experimental nature of the study means we cannot categorically rule out that proportionately greater numbers of audiences from areas with participating cinemas would have gone to the NT for this particular production regardless of the live screenings, our results are also consistent with there having been complementarities. If this result is representative of live broadcasts more generally, it implies that theatre companies can significantly expand their audience reach through digital broadcasts to cinemas without cannibalising their audiences at the theatre.

As increasing numbers of performing arts organisations explore live broadcasts and streaming, we would urge them to structure their pilots as formal experiments, enabling them to test for cannibalisation in a more rigorous way than is possible using the alternative survey-based approaches that have been used in the music and film industries (Smith and Telang 2012).

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