An investigation into the product attachment ~~relationship~~ between athletes and their sports equipment

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Biography

Bryce Dyer is Deputy Head in the Department of Design & Engineering at Bournemouth University in the UK. He holds a PhD in Sports Technology Ergogenics, a PhD in High Performance Product Development, a Master of Science Degree in Engineering Project Management and a Bachelor of Arts Degree in Product Design. His current research interest is with the philosophy, design or performance analysis of technology used in either sport or biomedical applications.

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This study investigated the product/user relationship between a sample of 186 athletes and their racing bicycles. These participants completed a product relationship questionnaire that utilised a five-point Likert scale that investigated five pre-validated determinants of a product/athlete ~~relationship~~attachment. The questionnaire obtained an internal consistency using Cronbach's Alpha with a range of 0.73-0.89 of the sub sections. The results of this study achieved generally supportive responses for all five determinants of the product/user attachment~~relationship~~. The data therefore supported that a positive product ~~relationship~~ attachment can exist between athletes and this particular form of sporting equipment. By acknowledging that a product ~~relationship~~ attachment can exist – even in the performance orientated biases of a competitive sport, offers the possibility of a new potential form of design-based ergogenics that warrants further exploration in the future.

Keywords: product; sport; emotional bonding; sports equipment; athletes.

Introduction

Product attachment & emotional bonding

Product attachment is the acknowledgement and strength of an emotional bond between a consumer and a product (Schifferstein & Zwartkruis-Pelgrim 2008). Mugge et al. (2009) proposed that product attachment has been demonstrated to exist. Furthermore, they offered four distinguishing determinants for doing so. These were *self-expression*, *group affiliation*, *memories* and *pleasure*. These determinants are not dissimilar to those also offered by Schifferstein & Zwartkruis-Pelgrim (2008) of *product enjoyment*, *individual autonomy*, *group affiliation* and *life vision* and summarised more fully in a summative sense in the review by Kleine & Baker (2004). ~~.~~ By acknowledging that product emotional attachment exists, provides manufacturers and designers the means to

tailor products to their intended user groups, to help differentiate them from each other (Mugge et al. 2009), or to defer replacement (Mugge et al., 2005). Crucially though, the benefits of attachment is that if a person establishes an emotional bond with a product, the product in question acquires meaning and can become extraordinary (Mugge et al. 2009). Additionally, a successful product ~~relationship~~ attachment shares the determinants of both utility and appearance (Mugge et al. 2010) and contributes to the overall enjoyment (Richins 1994) . However, such product/user ~~relationships~~ attachments have been demonstrated to be impacted by time (Mugge et al. 2006; Schifferstein & Zwartkruis-Pelgrim 2008) . The impact that time can have on such relationships means the complication and potential creation of confounding effects. In addition, the type of products investigated have been limited in number to date and the product-user groups were ~~typically~~ merely ~~have often been~~ those of convenience samples or notably students of the author's home institution (Mugge et al. 2010; Mugge et al. 2009; Richins 1994). This is not to say these are entirely invalid but that it makes such study's findings extremely limited in both their conclusions and in their ability to be applied in other contexts. This is particularly pertinent with unique product end-users such as athletes within the realm of competitive sport whereby the reasons for sporting competition are both diverse yet unique (Bell & Stephenson 2014). It cannot be assumed that a proposed product attachment with a piece of sports equipment (Richins 1994) will translate to those who participate in sport of a competitive nature because some of the participants motivations such as competition, affiliation, goal achievement and health orientation (Bell & Stephenson 2014; Heazlewood et al. 2015) are not criteria that were noted in the studies that formally proposed that a product attachment exists (Mugge et al. 2010; Mugge et al. 2009; Richins 1994). Furthermore, competitive athletes and non-athletes have been shown to differ in terms of moral reasoning

(Bredemeier & Shields 1986), differing incidence of health and problematic behaviours (Geisner et al. 2012) and self-conceptualisation (Marsh 1998). This suggests that whilst it cannot be assumed to be definitive or universal for all athletes ages, genders or chosen sports, athletes have been shown to be a fundamentally different demographic from that of non-athletes. With previous studies providing the basis for product attachment but not aware of the nuances of performance sport, these limitations warrant~~rather encourages~~ further investigation of such effects ~~when using other sampling methods and different product categories.~~ with competitive athletes that perform sports that require some level of product-based technology.

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Product attachment relationships in sport

The ~~emotional or psychological~~type ~~relationship~~of relationship that an athlete or active participant may have with their sporting goods or equipment has seen little investigation to date. The reasons for this lack of interest could be that the focus on sporting equipment is often seen as one of primarily maximising its utility or performance - particularly when it is inferred that sports product development is a mainly engineering or physics led theme (Dyer, 2015). Nonetheless, with this perceived gap in knowledge, a question could be whether product attachment relationships exist and could then be of value in competitive sport. In such an environment, any legal ergogenic effects could be seen of value. Ergogenic aids are substances, techniques or equipment that are performance enhancing (Holowchak, 2002). Whilst the use of technological placebo's are well cited in sport (Beedie, 2007), the classification of emotional or psychological ergogenic effects, through the use of technology is either not disclosed or acknowledged (Holowchak, 2002). With this in mind, it has still been proposed that the player's perceptions of a footballs hardness and weight could be more complex than that of its

physical properties alone (Thompsett et al. 2016). Likewise, the aesthetic properties of tennis balls have been shown to influence tennis player's psychological perceptions of their functional abilities (Steele et al. 2008). Both of these studies demonstrate that an emotional response to sports products can be created and that this in turn could affect an athlete's state of mind and subsequent performance. Rhetorically speaking, if such an effect could ever be harnessed and positively applied, could a performance enhancing effect be created for athletes ?

More recently, the identification of a product attachment~~relationship~~ between athlete and sports technology has been formally attempted (Dyer, 2019). This study sought to identify whether a product attachment relationship existed between athletes possessing limb absence and the prosthetic limbs they would be wearing when competing. The study failed to comprehensively provide firm evidence to support the concept of a non-physical attachment~~relationship~~ with their prosthetic device. However, this outcome was openly conceded to have been affected by the comparatively small sample group of five that was used ~~(5)~~. This small group was stated as being typical of studies recruiting athletes with limb absence. Either way, some of the respondents did support some level and type of an emotional connection with their sports technology. In these cases they had (or wished) to incorporate some form of prosthetic personalisation or customisation, provided this did not impact on the prostheses functional performance. This studies outcome was recommended to be investigated further by recruiting a larger sample size and investigating athletes from other sports.

This study shall aim to extend the prior work by Mugge et al. (2009) by recruiting a non-convenience sample population to successfully replicate and identify a user/product ~~relationship~~attachment. Secondly, it will extend the prior investigation by Dyer (2019) to ascertain if a product ~~relationship~~ attachment can exist within the

performance-biased environment of competitive sport. If such an effect could be identified, this could provide a novel and beneficial approach to performance orientated product development in the future for athletes.

Methods

Participants

A questionnaire was created to ask a group of respondents about their thoughts and experiences as a result of owning and competing on a racing bicycle. The diverse nature of competitive cycling can comprise many different forms of terrain, formats, equipment and physiological demands (Jeukendrup et al. 2000). As a result, for the purposes of this study, a single cycling discipline, *time-trialling*, was selected.

Time-trialling is a competitive cycling discipline that requires a participant to independently get from point to point as quickly as possible and is typically undertaken by a single athlete or a team of athletes (Dyer et al. 2016). The riders can compete over fixed distances or over a range of fixed durations. Such athletes utilise specialist equipment to achieve this. Athletes will typically use bicycles that require use of a unique riding position and equipment including solid disc wheels, aerodynamic frame forms and uniquely shaped helmets. An example of a time-triallist is shown in figure 1

[INSERT FIGURE 1 HERE]

Participants were invited to complete a questionnaire via their membership of an internet-based cycle time trialling forum (www.timetriallingforum.co.uk). The eligibility criteria would be that the respondents would be cyclists who were time-triallists who competed in such competitions. Any participant who wished to complete

the questionnaire would follow an online link housed within a forum message thread. The questionnaire was constructed using the 'Google Docs' application (Google, Mountain View, US). When the data collection period ended, it was then downloaded from Google Docs to Microsoft Excel (Microsoft, Washington, US) for subsequent analysis.

Online-based questionnaires have been investigated for their value (Evans & Mathur 2018). They offer notable clear advantages over other formats such as their global reach, speed, convenience, controlled methods of sampling and their technological innovation (Evans & Mathur 2018). However, they do possess several shortcomings which could apply to this study. These include sample selection issues, impersonality, privacy concerns and potentially a low response rate – possibly due to the perception of them as spam (Evans & Mathur 2018). In the case of this study, these shortcomings were minimised by inviting participation through a membership-based specialist forum. This would make it more likely that the participants were of the appropriate background. Furthermore, a series of initial questions would allow the author to identify the respondents' identity and legitimacy – by requesting previous performances and the details surrounding them. These details could then be checked against an online results service (www.cyclingtimetrials.org.uk/find-results). Secondly, the impersonality issue was reduced by including several questions requesting the respondents own experiences using an open-ended format. The privacy concerns were minimised by maintaining the anonymity of all participants' responses from each other at all times. The response rate issue was addressed by utilising the use of a membership-based discipline specific online forum to then direct to the study itself.

Questionnaire Design

The questionnaire structure comprised three sections of questions. The first section served to define the background of each respondent. As a result, respondents were asked to indicate their age, gender, years of participation in time trialling, personal best for a commonly used fixed racing distance (10 miles/16km), when this personal best was achieved and on what course it was obtained. Knowing both the time and the course of the record would serve to indicate the ability of the rider and the date would provide the means to check the participant's authenticity.

The second section acted as the main source of identifying the ~~relationship~~ attachment the respondent would have with their racing bicycle. The questions for this were adapted from the ~~19 point~~ multi-item scale created by Mugge et al. (2005) and later employed again successfully to a bicycle (Mugge et al., 2009). The multi-item scales were adapted from the first study (Mugge et al. 2005) by changing the word 'backpack' to 'time-trial bicycle'. Two questions were also slightly altered in their phrasing as it felt that the grammar of these needed to be tailored to that of participants that would have English as their first spoken language. The 19 questions were made up of five sub categories that were the 'determinants of product attachment' (Mugge et al. 2006). These determinants comprised five question items relating to *self-expression*, four items relating to *product attachment*, four items related to *memories*, three items relating to *group affiliation* and three items relating to *pleasure*. The order of these questions was then randomised so that these sub sections were not obvious to the respondents. A list of these 19 core questions (in the order they were presented) are listed in table 1.

[INSERT TABLE 1 HERE]

Finally, a final series of questions was included that asked whether they had customised their time trial bicycle or not and to what form this entailed. This last question was intended to detect a theme regarding the value of customisation in terms of consumer products (Mugge et al. 2009) or sports technology (Dyer 2019) that had been observed in such prior research.

Statistical Analysis of Section 2

All 19 questions came in the form of statements that respondents would then score against a five-point Likert scale as per a previous study (Mugge et al. 2006). A five-point scale was opted as this has been suggested as a 'normal' level of Likert choices (Croasmun & Ostrom, 2011). This scale spread from 'strongly agree', 'agree' 'neither agree nor disagree', 'disagree' and 'strongly disagree'. It was felt that use of this particular scale meant that each option had a clearly defined level of intensity for all five options. For data analysis purposes, the Likert scale results were then converted to numerical values to provide the basis for statistical analysis. These were: strongly agree=1, agree=2 neither agree nor disagree=3, disagree=4 and strongly disagree=5.

Cronbach's Alpha would be used to assess the internal validity for the five sub-sections of section two. It has been suggested as imperative to assess sub-scales and not individual items for their validity (Gliem & Gliem, 2003) so this study adopted this approach. The level of acceptability of α was set as 0.7 based upon previous guidance (Tavakol & Dennick, 2011; Gliem & Gliem, 2003). All scores below 0.7 would be investigated further.

The voting percentages would be provided for each of the 19 items. In addition, the means and standard deviation (SD) would also be calculated for the individual items

and the five sub-sections. However the use of such statistics has been questioned when analysing Likert scale data (Allen & Seaman, 2007). It is conceded that the perceived gap between the five Likert options cannot be assumed to be equal from the viewpoint of the respondent. However, including the means as a valid method of Likert scale analysis has been demonstrated to still be robust (Norman 2010) and without potentially coming to the wrong conclusion" (Murray, 2013). In addition, inclusion of both means and SD maintain continuity with previous seminal works that also ~~used them~~adopted their use (Mugge et al. 2009; Mugge et al. 2006). Nonetheless, acknowledging such concerns, t~~T~~he use of the meanss~~e~~ was ~~reinforced~~ supplemented in this study by also calculating the mode as well. Use of the mode provided a complementary comparative metric that counters some of the criticism levelled at use of the mean in such studies by using a rounded number format the respondent would have used when actually completing the questionnaire. The means of the five sub-sections ~~would also be~~were checked for statistical significance from each other. This would be achieved by calculating the ANOVA of each sections responses with a level of significance set as p=<0.05. Post-hoc significance tests ~~would be~~were then conducted using paired student *t*-tests to ascertain any specific differences between each different pairing of the five items. Furthermore, r-egression analyses were also conducted to ascertain the level of a relationship between two sub-sections taken from the questionnaire. In each regression analysis, product attachment was used as the dependent variable with self-expression, group affiliation, memories, or pleasure acting in turn as the independent variables. Finally, Pearson's *r* ~~would also be~~was calculated to determine the level of correlation between any of the five sub-sections. Use of ANOVA and Pearson's r, whilst contentious with ordinal data such as Likert scales, has both been proposed to be robust enough in this context (Murray, 2013; Norman 2010). Ultimately, the inclusion in this

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study of modes, means, SD's, Pearson's *r*, ANOVA and *t*-tests follows the guidance for Likert scale analysis as suggested by Boone and Boone (2012).

Institutional ethics approval was obtained prior to this study commencing.

Results

187 responses were received. One participant was identified for accidentally completing the questionnaire twice so had one of their submissions subsequently removed from the analysis. This provided a total sample of 186 respondents.

Section 1

The gender splits were male (97%), female (2.7%) and 'prefer not to say' (0%). The small number of female responses made any analysis on a gender basis unsuitable. The age demographic was 0-20 years (1%), 21-30 (6%), 31-40 (21%), 41-50 (35%), 51-60 (23%) and 61+ (14%). The number of years the respondent had been competing were 0-2 years (8.1%), 3-9 years (38.2%), 10-19 years (22.6%) and 20+ years (31.2%). The personal best of the 10 mile/16km race distance was a mean of 21 minutes and 19 seconds and a range of 17:52-27:25. 86.7% of riders had achieved this in the last ten years, 76.1% in the last five, 28.9% in the last twelve years and 13.3% achieved this over ten years ago. Finally, 55.9% of riders had purchased their racing bicycle new, 38.2% second-hand, 4.3% saw their donated as part of a sponsorship arrangement and 1.6% said it had been obtained via other means.

Section 2

The following measures of internal consistency were initially obtained for the product relationship sub-sections. These were: pleasure (α=0.81),self-expression (α=0.42),

memories (α=0.89), group affiliation (α=0.73) and product attachment (α=0.46). Further investigation revealed two questions that were heavily influencing the poor results for both the self-expression and product attachment sub-sections. These were questions 13 and 19 (see table 1). When these were removed from the analysis, the corrected scores were self-expression (α=0.76), and product attachment (α=0.89). Therefore, once these were discounted, all scores achieved the pre-determined α =>0.7 threshold.

The ~~modes and~~ percentages of the question responses are shown in table 2.

[INSERT TABLE 2 HERE]

The means and modes of the questions and subsection ~~responses~~ are shown in table 3.

[INSERT TABLE 3 HERE]

~~The means of the questions are amalgamated as an overarching mean for each of the five sub-sections and are shown in figure 2.~~

~~[INSERT FIGURE 2 HERE]~~

~~Figure 2~~Table 3 shows ~~illustrates~~ that all five sub-sections themes achieved means below the neutral 'neither agree nor disagree'. ~~choice (3). In addition, when noting that the +/- SD's of all five sub-sections were still below the numerical neutral option, the results supported that the outcome was not negative.~~

A calculated ANOVA ~~of~~ between the five sub-sections responses achieved statistical significance (p=<0.001) demonstrating that the sub-sections yielded a significantly scored response from each other. Post-hoc *t*-tests and results of Pearson's *r* pairings of the five sub-sections are shown in table 4.

[INSERT TABLE 4]

From the pairings in table 4, it is shown that all ten possible pairings have not achieved a high level of correlation. The exception to this was that the *self-expression* and *product attachment* sub-sections achieved a good level of positive correlation. Four other pairings achieved a moderate level of positive correlation but three of those barely met a 0.50 threshold. Nine of the possible pairings achieved statistical significance (*t*=<0.05). The pairing of *self-expression* and p*roduct attachment* ~~were~~was not statistically significant from each other. Furthermore, linear regression obtained a low level of relationship when denoting product attachment as the dependant variable with the other sub-sections acting as independent variables. Those with a low level of relationship of <0.3 included pleasure (r^2=0.27), memories (r^2=0.25) and group affiliation (r^2=0.23). However, as per the correlation results, the pairing of *self-expression* and *product attachment* did produce a slightly higher relationship (r^2=0.43).

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Section 3

Table 5 shows the results of the responses with respect to equipment customisation.

[INSERT TABLE 5]

Discussion

The evidence provided in this study achieves its aims by extending the previous work by Mugge et al. (2006) and proposing that some level of product ~~relationship~~ attachment could be identified when using a non-convenience sample group. Secondly, it managed to resolve the shortcomings of the Dyer (2019) study by being able to more robustly identify a product ~~relationship~~ attachment with athletes. The five product attachment determinants of *pleasure*, *group affiliation*, *product attachment*, *self-expression* and *memories* all achieved mean scores that were ~~generally~~ generally positive in nature~~ly supported~~. However, this paper is sensitive to previous published concerns over how Likert data should be analysed. With this in mind, when noting the mode responses alone, only *pleasure*, *group affiliation* and *product attachment* comprised responses that were mainly positive and non-neutral. Noting this disparity when comparing the mean and mode suggests a mainly polarised or diverse opinion of the sample group of the two other determinants. In other words, athletes either fully support the determinant or they do not. It is certainly notable that *memories* proved to obtain the weakest determinant score of a product ~~relationship~~ attachment in this study even though it was also noted as a key factor in Dyer (2019) when utilising the responses from a different type of athlete demographic. Again, the relevance of memories (and the contribution of sporting equipment to them) seems to have generated a polarised view from the respondents and must certainly be relative depending on their background and prior sporting experience. This may suggest that the type of athlete and type of sport may well be crucial in the prioritisation, ranking and

acknowledgement of these determinants. It also reinforces that the use of convenience samples in some prior studies such as Mugge (2009) is not sufficient to provide universal conclusions about product/user relationships.

OOne of the reasons that *self-expression* was not so conclusively supported in this study may be when considering that the latter questions surrounding product customisation as a practise were also not overwhelmingly well-supported. Only 23.5% of the respondents modified the components for aesthetic reasons and only 23% added custom decals. There was much wider support for product customisation made for functional and performance reasons but these would not be considered as pure forms of self-expression – moreso to support the athlete's pursuit of performance. This said, virtually a quarter of the sample still supported this concept so it should still be valued. Product customisation has been proposed as a key factor of establishing a product ~~relationship~~attachment, its relevance to the user (Mugge et al. 2009) and has been shown to be attractive to some athletes (Dyer 2019). It is notable that in a sport like cycling, many athletes such as team leaders or those that have achieved certain achievements like world championship wins have seen them utilise a bicycle frame that is customised and is aesthetically different to other members of their own team (https://www.cyclingweekly.com/news/latest-news/11-of-the-best-custom-pro-bikes-196178; https://road.cc/content/tech-news/237751-pro-bike-tom-dumoulins-world-champs-giant-trinity-time-trial-bike). In such cases, these could be judged to affirm to both the athlete themselves or others their status or identity. With this in mind, athletic identity is a relevant psychological construct to be sensitive to because of the potentially important psychological, social, and behavioural ramifications which could then affect their sporting performance

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(Martin et al. 1997). Therefore, product customisation could well be seen as a means of either performance reinforcement or enhancement to any level, status or ability. This is prudent when considering the placebo effect has been evidenced when athletes have used performance sports footwear (Mohr et al. 2016).

Curiously, *self-expression* and *product attachment* were the only determinants that yielded a good level of correlation to each other (r=0.66), a moderate strength of relationship when conducting linear regression (r^2=0.43) and were the only pairing that were not statistically significant from each other (t=0.56). This suggests that for those who are aware of their racing bicycle and its contribution to their overarching image, then choose to have it form an essential part of their product attachment.

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It was noted in the results that that two questions were removed due to them negatively affecting the statistical internal consistency. Further analysis revealed that these were also the only questions in the questionnaire that were reversed items in terms of their phrasing. The approach of including reversed items was identical to that employed by Mugge et al. (2006). In that study, no issues surrounding internal consistency seemed to occur. However, it is conceivable that the reversed nature of these two questions in this study potentially confused the respondents. This is supported by the large increase in Cronbach's Alpha scores when these were removed from the analysis. The resulting α range of 0.73-0.89 of the five determinants is broadly in line with those reported in similar studies before (Mugge et al.,2006; Mugge et al. 2009). It could therefore be argued that future studies should either exclude the reversed questions entirely or to contain more reversed phrasing to make such practise visually more common and therefore more obvious.

An interesting follow-on question from this study is that once a product ~~relationship~~ attachment has been identified, could it be harnessed as a performance enhancing or ergogenic effect ? For example, due to reasons of placebo or a positive relationship with vital sporting equipment, could an athlete achieve a better standard of sporting performance than another who has not ? The key limitation to this study was that most athletes were amateur or 'non-professional' and had financed the purchase of the bicycle themselves. Therefore their product ~~relationship~~ attachment may well be different to professional athletes who could be sponsored or endorsed and therefore not have the same level of personal investment. It would be prudent to next pursue such differences in athletic status before any ergogenic effects could be investigated. When acknowledging that a proportion of the sample supported the determinants of *self-expression* and *memories*, plus given the positive level of correlation of *self-expression* to *product attachment*, a benefit to some athletes may exist. For example, if professional athletes were shown to possess the same product ~~relationship~~ attachment as amateur athletes, offering racing cyclists the ability to strengthen their relationship with their equipment could well be a low cost contribution to a positive sporting performance. If nothing else, customisation of sporting goods could be undertaken as a form of design co-creation with brands and there are advantages to this approach which includes both increased user productivity and increased brand strength, (Sanders & Stappers 2008). In summary, it is acknowledged that if the emotional state of an athlete is integral to sporting performance, any intervention to positively affect this emotional state through product design should be investigated.

It should be noted that there were several other limitations to this study that warrant acknowledgement. Most respondents were male so it is not known if differences in a product ~~relationship~~ attachment are dependent on gender. Likewise, this study did not consider the length of time a racing bicycle was owned even though it has been shown that ~~the~~ product attachment ~~relationship~~ can change positively or negatively over time (Mugge et al. 2009; Mugge et al. 2006). Therefore, it is entirely possible that the results could be altered by categorising such purchases based on their time of ownership. Secondly, the timing of the data collection itself could be crucial. For example, if the study is conducted in the middle of the athletes racing season, their performances (good or bad) may then positively or negatively affect their feelings towards their bicycle. To avoid this issue, this study was conducted during the winter season as this was judged to be all athletes 'off-season' and when racing would be at its lowest level. This approach was also adopted by Dyer (2019). However, this too may not be completely free from seasonally-based biases. Finally, the generalisability of the findings are limited at this time as it only investigated one form of sports equipment. In this case, the bicycle was a fundamental part of competitive cycling. It would also be interesting to see how the relationship differs when the product is more or less actively involved as part of an athlete's performance. Furthermore, some more in-depth and exploratory qualitative research methods should now be pursued as they may offer further insight and rationale into why such considerations offer value to athletes.

Ultimately, this study offers the exciting possibility of a direct product ~~relationship~~ attachment between athletes and their competitive equipment – even when

in a performance driven culture. If this effect can be harnessed and optimised, it offers new avenues in sports technology design that are not typically considered.

Conclusion

This study further contributes to the understanding of user-based emotional product attachment by investigating the relationship between a sample of amateur competitive cyclists and their racing bicycle. A product ~~relationship~~ attachment questionnaire was undertaken by 186 participants that covered five pre-validated determinants of a product ~~relationship~~attachment. The results of this study achieved general support for all five determinants of an emotional product/user ~~relationship~~attachment. The data therefore supported that a positive product ~~relationship~~ attachment can exist between athletes and their performance equipment ~~with~~ despite the potential restrictions and biases of a competitive sport. However, further analysis revealed that a polarisation of responses existed in two determinants so that it was more likely that a relationship was only comfortably achieved by the full sample with three of the determinants. However, b~~B~~y acknowledging that a product ~~relationship~~ attachment can exist – even in the constricted domain of a competitive sport, offers the possibility of new potential avenues in sports technology design not typically considered.

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References

~~Allen, I, and Seaman, C. 2007. Likert Scales and Data Analyses. *Quality Progress* 40 (7): 64-65.~~

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~~Beedie, C. 2007. Placebo Effects in Competitive Sport: Qualitative Data. *Journal of Sports Science & Medicine* 6 (1): 21.~~

~~Boone, H.N. and Boone, D.A., 2012. Analyzing Likert Data. *Journal of Extension* 50 (2): 1-5.~~

~~Croasmun, J, and Ostrom, L. 2011. Using Likert-Type Scales in the Social Sciences. *Journal of Adult Education* 40 (1): 19-22.~~

~~Dyer, B. 2019. An Investigation into the Relationship Between Paracycling Athletes and their Prosthetics Technology: A Proposed Design Framework. *Disability and Rehabilitation: Assistive Technology*: 1-7.~~

~~D~~Allen, I, and Seaman, C. 2007. Likert Scales and Data Analyses. Quality Progress 40 (7): 64-65.

Beedie, C. 2007. Placebo Effects in Competitive Sport: Qualitative Data. Journal of Sports Science & Medicine 6 (1): 21.

Bell, N., & Stephenson, A. L. 2014. Variation in motivations by running ability: Using the theory of reasoned action to predict attitudes about running 5K races. Journal of Policy Research in Tourism, Leisure and Events, 6(3), 231-247.

Boone, H.N. and Boone, D.A., 2012. Analyzing Likert Data. Journal of Extension 50 (2): 1-5.

Bredemeier, Brenda Jo, David L. Shields, and David L. Shields. 1986. Moral growth among athletes and nonathletes: A comparative analysis. *The Journal of Genetic Psychology* 147, 1: 7-18.

Croasmun, J, and Ostrom, L. 2011. Using Likert-Type Scales in the Social Sciences. *Journal of Adult Education* 40 (1): 19-22.

Dyer, B. 2019. An Investigation into the Relationship Between Paracycling Athletes and their Prosthetics Technology: A Proposed Design Framework. *Disability and Rehabilitation: Assistive Technology*: 1-7.

Dyer, B. 2015. The Controversy of Sports Technology: A Systematic Review. *SpringerPlus* 4 (1): 524.

Dyer, B, Hassani, H, and Shadi, M. 2016. The Analysis and Forecasting of Male Cycling Time Trial Records Established Within England and Wales. *Journal of Sports Sciences* 34 (13): 1222-1230.

Evans, J, and Mathur, A. 2018. The Value of Online Surveys: A Look Back and a Look Ahead. *Internet Research* 28 (4): 854-887.

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Geisner IM, Grossbard J, Tollison S, Larimer ME. 2012. Differences between athletes and non-athletes in risk and health behaviors in graduating high school seniors. *Journal of Child & Adolescent Substance Abuse*. (2):156-66.

Gliem, J, and Gliem, R. 2003. Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-type Scales. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education.

Heazlewood, I., J Walsh, J., Climstein, M., Adams, K., Sevene, T., DeBeliso, M., & J Kettunen, J. 2016. Participant motivation: A comparison of male and female athletes competing at the 2009 World Masters Games. In *Applied Psychology: Proceedings of the 2015 Asian Congress of Applied Psychology (ACAP 2015)* (pp. 291-297).

Holowchak, M. 2002. Ergogenic Aids and the Limits of Human Performance in Sport: Ethical issues, Aesthetic Considerations. *Journal of the Philosophy of Sport* 29 (1): 75-86.

Jeukendrup, A, Craig, N, and Hawley, J. 2000. The Bioenergetics of World Class Cycling. *Journal of Science and Medicine in Sport* 3 (4): 414-433.

Kleine, S. & Baker, S. 2004. An integrative review of material possession attachment. *Academy of Marketing Science Review* 1(1), 1-39.

Marsh, H.W. 1998. Age and gender effects in physical self-concepts for adolescent elite athletes and nonathletes: A multicohort-multioccasion design. *Journal of Sport & Exercise Psychology* 17 (1): 70-83.

Martin, J, Eklund, R, and Mushett, C. 1997. Factor Structure of the Athletic Identity Measurement Scale with Athletes with Disabilities. *Adapted Physical Activity Quarterly* 14 (1): 74-82.

Mohr, M, Trudeau, M, Nigg, S, and Nigg, B. 2016. Increased Athletic Performance in Lighter Basketball Shoes: Shoe or Psychology Effect?. *International Journal of Sports Physiology and Performance* 11 (1): 74-79.

Mugge, R, Schoormans, J, and Schifferstein, H. 2009. Emotional Bonding with Personalised Products. *Journal of Engineering Design* 20 (5): 467-476.

Mugge, R, Schifferstein, H, and Schoormans, J. 2010. Product Attachment and Satisfaction: Understanding Consumers' Post-purchase Behavior. *Journal of Consumer Marketing* 27 (3): 271-282.

Mugge, R., Schifferstein, H, and Schoormans, J. 2005. A Longitudinal Study of Product Attachment and its Determinants. *ACR European Advances*.

Murray, J, 2013. Likert Data: What To Use, Parametric or Non-parametric?. *International Journal of Business and Social Science* 4 (11).

Norman, G. 2010. Likert Scales, Levels of Measurement and the "Laws" Of Statistics. *Advances in Health Sciences Education* 15 (5): 625-632.

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Richins, M. L. 1994. Valuing things: The public and private meanings of possessions. *Journal of Consumer Research, 21*(3), 504-521.

Sanders, E, and Stappers, P. 2008. Co-creation and the New Landscapes of Design. *Co-design* 4 (1): 5-18.

Schifferstein, H, and Zwartkruis-Pelgrim, E. 2008. Consumer-product Attachment: Measurement and Design Implications. *International Journal of Design* 2 (3): 1-13.

Tavakol, M, and Dennick, R. 2011. Making Sense of Cronbach's Alpha. *International Journal of Medical Education* 2: 53.